

1928.

WESTERN AUSTRALIA.

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# FORESTRY AND FOREST RESOURCES WESTERN AUSTRALIA.

A Statement prepared for the  
BRITISH EMPIRE FORESTRY CONFERENCE  
(Australia and New Zealand).

1928

by

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LIST OF BOTANICAL NAMES OF THE PRINCIPAL LOCAL SPECIES REFERRED  
TO IN THIS REPORT.

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*Eucalypts* :—

- Jarrah (*Eucalyptus marginata*).
- Karri (*Eucalyptus diversicolor*).
- Tuart (*Eucalyptus gomphocephala*).
- Wandoo (*Eucalyptus redunca* var. *elata*).
- Powder Bark Wandoo (*Eucalyptus accedens*).
- Salmon Gum (*Eucalyptus salmonophloia*).
- Marri (*Eucalyptus calophylla*).
- Blackbutt (*Eucalyptus patens*).
- Yate (*Eucalyptus cornuta*).
- York Gum (*Eucalyptus foecunda* var. *loxophleba*).
- Red Morrell (*Eucalyptus longicornis*).
- Gimlet (*Eucalyptus salubris*).
- Red Tingle Tingle (*Eucalyptus Jacksoni*).
- Yellow Tingle Tingle (*Eucalyptus Guilfoylei*).
- Brown Mallet (*Eucalyptus astringens*).
- Bullich (*Eucalyptus megacarpa*).

*Non-Eucalypts* :—

- Sandalwood (*Santalum spicatum*).
  - North-West Sandalwood (*Santalum lanceolatum*).
  - Sheoak (*Casuarina Fraseriana*).
  - River Banksia (*Banksia verticillata*).
  - Raspberry Jam (*Acacia acuminata*).
  - Peppermint (*Agonis flexuosa*).
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## SECTION I.

### General Description of the Country from the Forestry Point of View.

Although the State of Western Australia extends from the 14th parallel of latitude in the north to the 35th parallel in the south, the absence of high mountains and the general predominance of the genus *Eucalyptus* in the tree flora, results in less divergence between vegetation types than might be expected. Rainfall plays a very important part in determining the distribution of flora, and the comparatively low rainfall of the northern regions explains the absence of the tropical rain forests which are found on the eastern side of the continent.

A vegetation map of the state on which isohyets are shown is appended (Map No. 1) and more precise information concerning the boundaries of types referred to hereunder may be obtained by reference to this map.

Owing to the wide distribution of the genus *Eucalyptus*, the distinction between vegetation types is based on the class of undergrowth, in many instances. Difficulty has also been experienced in the nomenclature of types, owing to the lack of well defined and generally accepted terms.

#### A. *Sclerophyllous Types.*

Under this heading have been grouped those types in which the undergrowth is composed of harsh-leaved shrubs.

i. *Low rainfall tropical woodlands* are found in a restricted area in the extreme north of the State. The annual average rainfall is approximately 30 inches, most of which falls in the summer months. The main tree species, which grow in open formation and have little economic value, are *Eucalyptus tetrodonta*, *E. Houseana*, *E. terminalis*, *E. clavigera*, *E. miniata*, the first-named being by far the most prevalent. An interesting feature is the deciduous nature of certain of the eucalypts. *Eucalyptus brachyandra* has been observed as a deciduous tree, and *E. alba* is to a certain extent deciduous, but never completely so. The shrubs, mainly *Acacia* species, are almost thorny in character. This area is undeveloped.

ii. *Low rainfall temperate forests and woodlands with belts of mallee and heath.* This region, characteristic of the southern interior, includes the best of the agricultural land, and the forests of salmon gum (*Eucalyptus salmonophloia*) and other associated eucalypts are rapidly being cleared for the growing of wheat, where the rainfall is between 12 and 20 inches. This is a winter rainfall region in which the annual rainfall is remarkably consistent both in quantity and season. The sand heath formation gen-

erally denotes poorer soils, although certain of these together with mallee areas, are proving suitable for cereal culture with improved methods of farming.

The wheat production for the State last year was 30,021,616 bushels, valued at £8,318,489, and the estimate for the coming season is 36,000,000 bushels, indicating the rapid advances in area being brought under crop.

In a country so richly endowed with hardwoods, little value is placed on the timbers of this region, except in the Eastern goldfields, where the eucalypt forests have proved of very great value to the mining industry. The main timber trees are again referred to in Section II. of this statement.

iii. *Sclerophyllous Forest.* This region of higher winter rainfall, in the South-West corner of the State, includes the principal merchantable forest, Jarrah (*E. marginata*). It is dealt with at some length in Section II.

#### B. *Temperate Eucalypt Rain Forest.*

In the extreme South-West, where the average annual rainfall exceeds 40 inches, Karri (*E. diversicolor*) replaces Jarrah as the principal tree species. The undergrowth becomes more luxuriant and softer in foliage, and the general character of the forest assumes more the rain forest type. Tree ferns and lianes are absent, however, and the only epiphytes are a small fern (*Asplenium furcatum*) and an orchid (*Corysanthes fimbriata*), both of which occur on the corky bark of the sheoak. Lichens show only a limited development. This type is dealt with at greater length in Section II.

#### C. *Savannah Types.*

Under this heading are grouped those types in which the undergrowth is herbaceous, being composed principally of grasses.

i. *Savannah Forests and Woodlands.* This type occurs in two widely distributed regions which should be considered separately. On the fringe of the sclerophyllous forest of the South-West are found belts of open park-like forest, where grasses replace the harsh-leaved woody shrubs. The tree species of this type along the coast is Tuart (*E. gomphocephala*) while further north, and on the eastern fringes of the sclerophyllous type, Wandoo (*E. redunca* var. *clata*), York Gum (*E. loxophleba*) and Jam (*Acacia acuminata*) replace the Tuart.

The type occurs again in the extreme north-west and is valuable cattle country. The principal tree species are *Eucalyptus Spenceriana*, *E. terminalis*, *E. tetrodonta*, *E. miniata*, *E. clavigera* and *E. alba*.



The bark of the Ridge gum (*E. alba*) has a high tannin content, and, if found in more accessible country, would rival Mallet in popularity as a tanning agent. Grasses of a tussocky type are common, and, on the northern fringe, *i.e.* the black soil of lower Kimberley rivers, tall grasses develop. Here they attain a height of up to 10 feet during the months November to March, and, toward the end of the season, carry fierce fires which are gradually killing out the belts of *Callitris intratropica*. The timber of this species, which grows to 2ft. 6in. in diameter, and 70 feet in height, is highly valued for building in the termite infested areas, and it may prove possible to exploit the small areas of forest remaining when closer settlement of the northern portion of the State results in local demand for the timber at special rates.

Throughout this region there are a number of permanent rivers, along the banks of which tropical rain forests occur in narrow belts varying from 20 to 250 yards in width. The combined soil moisture and extra humidity on the river flats are apparently sufficient to give the flora the character usually associated with humid tropical conditions.

ii. *Savannah.* The savannah region in the north is characterised by wide, open plains, with occasional belts and clumps of trees of the genus *Eucalyptus*. This country is used for pastoral purposes, and with improved transport conditions sheep are replacing cattle.

iii. *Mulga* is an Australian term used to describe a mixture of *Acacia* species which grow in close formation to a height of 10 to 15 feet. Where a break occurs, the grasses of the adjoining savannah type are found. Most of the acacias are useful stock feed, and this region is the principal sheep country of the State. The value of wool produced last year was £3,225,540.

#### D. Treeless Regions.

In a State whose area is 975,920 square miles, and in which the merchantable forest region is only 5916 square miles, the treeless country is limited to an area of limestone plains in the south-eastern corner, of value for pastoral purposes, and an area of uninhabited desert-like formation in the interior. This latter region is not without vegetation and is crossed by at least one important stock route. Sandy ridges, having a general bearing of 75deg. 255deg., are

more or less covered with spinifex, *Triodia pungens*, *T. invitans* and *T. Mitchellii*, and in the valleys belts of low shrubs are not infrequent.

#### TOPOGRAPHY AND GEOLOGY.

Western Australia is generally regarded as a very ancient land mass, which has undergone little change through geological ages. In the North it is broken by rivers and mountain ranges of very moderate elevation. The whole of the central and southern portion is an elevated plateau with a narrow fringe of coastal plain. This continental plateau is gently undulating, rising gradually towards the interior with an average elevation of about 1,400 feet, although isolated portions reach altitudes of nearly 4,000 feet. In the interior drainage is chiefly into shallow depressions or basins known as salt lakes, which are frequently dry for many years on end. The plateau ends abruptly along the South-West edge in a scarp-like face known as the Darling Range, which has an average elevation of 900 feet. Numerous short rivers take their source near the edge of the plateau and, after working their way through deeply eroded valleys, meander sluggishly across the coastal plain. Between Perth and Albany the coastal plain is 20 to 30 miles wide. Low limestone hills fringing the coast line frequently obstruct the flow of streams to the ocean, causing large areas of winter swamps.

The geological formation of the Southern portion of the continental plateau, where the forests are situated, is igneous, being mainly composed of granite and gneiss. Dykes of diorite occur through the Darling Ranges and give rise to the more fertile soil conditions found along certain valleys and river flats. A distinctive feature of the granitic formation of the Darling Ranges is the capping of laterite, consisting of hydrated oxides of iron and aluminium.

The coastal plain is a Cainozoic formation, consisting of tertiary and post-tertiary limestones, silicious sand and more fertile alluvium where traversed by streams from the plateau.

#### CLIMATE.

In the Northern or tropical portion of the State the rainy season occurs from October to April, *i.e.*, during the hot months of the year. The following are the meteorological statistics of certain Northern stations:—

	Mean Shade Temperatures.			Rainfall.	
	Mean.	Maximum.	Minimum.	For 1927.	Mean.
Wyndham ... ..	84.2	92.8	75.5	inches. 28.61	inches. 27.10
Hall's Creek ... ..	77.0	91.5	62.4	23.95	21.08
Derby ... ..	81.3	92.2	70.4	20.50	26.26
Broome ... ..	78.8	88.3	69.3	26.09	23.50

In the Southern portion of the State, the rain falls during the cool months of the year. Between the tropical North and the temperate South there is a belt of country extending into the interior, where

it widens out considerably, over which the rainfall is low and irregular. Where underground water is obtainable much of this country is being opened up for pastoral purposes.



The agricultural and timber industries are confined to the South-Western portion of the State, where the rain falls with unfailing regularity between April and September, during the cooler months of the year, which, owing to the mildness of the climate, scarcely deserve the name of winter. The average annual rainfall rapidly decreases from the coast to the interior. In the Karri country in the extreme South-West, it varies from 40 to 60 inches, in the

Jarrah country from 30 to 50 inches, and, in the adjoining pastoral country on the Eastern fringe of the Jarrah, from 18 to 30 inches, and in the main wheat belt still further inland from 12 to 20 inches.

The following meteorological particulars refer to stations situated in proximity to the principal forest region in the extreme South-West only. In this region severe frosts are very infrequent.

	Mean Shade Temperatures.			Rainfall.	
	Mean.	Maximum.	Minimum.	1927.	Mean.
				inches.	inches.
Perth ... ..	64.2	73.1	55.3	36.59	34.37
Bridgetown ... ..	59.4	72.6	46.1	33.12	34.12
Busselton ... ..	60.7	71.1	50.3	34.91	31.89
Karridale ... ..	59.4	68.4	50.5	50.54	47.67
Albany ... ..	59.9	66.8	52.6	45.06	37.01

## SECTION II.

### Description of Main Types of Forest Growth.

In the more detailed map (Map No. II.) showing the main forest regions of the South-West division, a departure has been made from the vegetation types indicated in Map No. I., with the object of indicating more clearly the habitat of the principal timber trees. The zones have been given the name of the principal timber tree occurring therein, although in nearly all cases there is an overlapping of species.

#### Jarrah Forests.

Jarrah (*Eucalyptus marginata*) is the principal tree species, growing on an area of some 13,000,000 acres, but the prime jarrah forest having a high merchantable value is limited to about 2,500,000 acres. This forest, which forms a compact belt some 20 miles wide and 200 miles long, stretching along the Darling Range from Perth in the North to Manjimup in the South, is probably the most valuable hardwood forest in Australia. The two important factors limiting the habitat of the better class forest are rainfall and soil conditions. A rainfall of over 30 inches per annum is necessary for optimum development. A capping of laterite boulders or lateritic gravel is characteristic of the Jarrah forest, giving soil conditions which render any form of agricultural development a hopeless undertaking. Practically the whole of prime jarrah forest remains the property of the Crown and is now being dedicated State Forest. Jarrah is found in practically pure stand, and throughout the prime region referred to above shows uniform development, reaching to a height of 150 feet, with a diameter of three to five feet. In virgin forest the volume of mature timber suitable for sawmilling, measured in the round, may reach 5,000 to 6,000 cubic feet per acre over extensive areas, but the average is nearer to 1,000 cubic feet per acre.

Associated with it are marri (*E. calophylla*), blackbutt (*E. patens*), and bullich (*E. megacarpa*), while, in some of the poorest situations, South of the Preston River, mountain marri (*E. haematoxylon*) becomes a component of the forest.

It is only in the better class laterite and alluvial soil that marri and blackbutt are predominant. Elsewhere jarrah forms the bulk of the growing stock.

Both marri and blackbutt attain the same size as jarrah, but blackbutt establishes itself on the richest soil pockets and is at its best in diorite valleys and gullies.

Bullich grows in the laterite gullies and forms pure stands, but it is occasionally found on poor laterite plateau-like ridges in mixture with jarrah. Along the banks of the larger perennial streams and rivers grow flooded gum (*E. rudis*), of little timber value, and river banksia (*Banksia verticillata*), a tree attaining a height of 50 feet, and providing one of the few softwood cabinet timbers found in the State.

The prime jarrah forests contain a number of small trees, of which sheoak (*Casuarina Fraseriana*) is the tallest, attaining a height of 45 feet. In the same storey are found *Banksia grandis*, native pear (*Xylomelum occidentale*), *Dryandra floribunda*, Christmas tree (*Nuytsia floribunda*), while Emu bush (*Persoonia elliptica* and *P. longifolia*) form a still lower storey, attaining about 15 feet. Below these again are found a wealth of shrubs, prickly mimosa (*Asacia pulchella*), *Hibbertias*, *Hakeas*, and many other Proteaceous species, *Acacias*, *Mirbelia*, *Thomasia*, *Leocopogons*, and many other *Epaeridaceous* and *Myrtaceous* species, *Daviesia* spp., several unique *Liliaceous* plants, the blackboy (*Xanthorrhoea Preissii*), grass tree (*Kingia australis*), and *Dasyopogon Hookeri*, and *Zamia palm* (*Macrozamia Fraseri*).



The wealth of ground cover is very great, the chief families represented being Amaryllidaceae, Liliaceae, Iridaceae, Leguminosae, Rutaceae, Stylidiaceae, Goodeniaceae, and Epacridaceae. There is, however, a total absence of Gramineae, which, considering the rainfall and amount of light which reaches the forest floor, is a remarkable feature of the jarrah belt.

Although Jarrah grows in close stand, there is no intermingling of crowns and the canopy is comparatively open. There is a complete absence of humus; the leaf litter which escapes the frequent ground fires disappears rapidly into the mineral soil without any transitional layer of mould.

Jarrah, in common with many other Eucalypts, has remarkable recuperative powers, following burning. It is an open question how frequently fires were started in the Jarrah forest before the advent of the white man one hundred years ago, but it is evident that the undergrowth has developed considerably on areas which have since been cut over, rendering subsequent fires more intense. Until the Forests Department introduced fire control measures, within the past few years, fires did considerable damage throughout extensive areas of prime forest from which a small proportion of the crop had been cut. The rapidity with which the blackened forest renews its foliage after a fire has caused the extent of the damage to be largely under-estimated in the past.

Sample plots established ten years ago, to measure the rate of growth of Jarrah, have not given sufficient information on which to base a reliable estimate of increment at all ages, but it is evident that the species is comparatively slow-growing, when compared with such species as Karri or even Tuart.

#### *Karri Forests.*

Karri (*E. diversicolor*) is restricted in its habitat to the wettest portion of the State, where the average rainfall is 40 inches and over. The northern boundary is a line between Manjimup and Nannup, and from there south and south-east to Denmark. Except for an isolated area from the Leeuwin to the Margaret River, it does not extend westwards beyond a line drawn from Nannup to a point on the Warren River, 6 miles above the mouth. Another small and isolated area of karri occurs in the Porongorups hills. It is generally separated from the sea by a belt of sand-plain country, though at Nornalup it comes down to the edge of the estuary formed by the Deep and Frankland Rivers. The tree attains a great height. The average is 200 feet, and the highest tree measured 278 feet. It is improbable that trees of 300 feet or over exist to-day.

The karri forests, unlike the jarrah, do not extend in a pure state over the whole area of 240,000 acres described above, but are intersected by belts of jarrah and by belts of mixed karri and marri, pure marri and blackbutt (*E. patens*) and marri. The karri forest soil is of a deeper and more friable nature than the jarrah soil. Soils on which mixed karri and marri grow are considered better for agricultural purposes than pure karri soil.

Along the rivers and brooks grow such trees as peppermint (*Agonis flexuosa*), cedar (*Agonis juniperina*) and river banksia (*Banksia verticillata*), none of which reach a greater height than 70 feet. Karri

sheoak (*Casuarina decussata*) is a prominent member of the understorey, and occasionally *Banksia grandis*.

The cover afforded by the karri forest is denser than that of the jarrah, the trees growing more closely, though in proportion to its size karri has a less spreading crown than jarrah. The undergrowth is soft-leaved in distinction from that of the other forest formations. There is a great wealth of small trees up to 20 feet high, which form dense, almost impenetrable thickets, e.g., *Acacia pentadenia*, *Albizzia lophantha*, Hazel (*Chorilaena hirsuta* and *Trymalium spathulatum*).

Large shrubs are plentiful and form heavy thickets, e.g., waterbush or netic (*Bossiaea aquifolium*), *Acacia urophylla*, *Acacia nigricans*, *A. pulchella*, banjine (*Pimelia clavata*, and other *Pimelia* spp.), bluebush (*Hovea celsi*) and bracken fern (*Pteridium aquilinum*). Quite often, under pure karri forest, the undergrowth is almost confined to bracken fern, which grows up to 10 feet in height. *Zamia* palm (*Macrozamia*) and blackboy (*Xanthorrhoea*) are common to both jarrah and karri forests. Small shrubs and other plants are numerous in the forest proper, and along the brooks and rivers the undergrowth is wonderfully profuse. Rushes are prominent, while tea tree, paperbark and spearwood (*Melaleuca* spp.) form dense thickets. The dense undergrowth becomes sufficiently dry to burn at intervals of seven to eight years, as, even in summer, mists and falls of rain are common.

Around the base of the larger trees there is always a pile of fallen dry bark, which burns fiercely, and the high dense thickets burn so intensely that even the crowns may be scorched. The bark of karri offers less protection to the tree than that of jarrah, and after a fire cracks longitudinally, through which cracks fungoid diseases gain entry.

The density of the stocking in the virgin karri is very great; 20,000 cubic feet of merchantable timber have been removed from an acre, though the average is much lower than this. During the past three years, one of the larger sawmills cut over a total area of 3,650 acres, which included approximately 1,000 acres of other non-merchantable species, from which area they obtained 9,600,000 cubic feet in the round, i.e., from 2,650 acres actually carrying karri, the average yield was 3,600 cubic feet per acre. Many logs regarded as unprofitable on account of faults or comparative immaturity of timber were left behind.

Karri regenerates freely from seed and shows rapid growth. No information concerning frequency of seed years is yet available. Near Karridale, an area which was cut over for karri, from 27 to 40 years ago, splendid natural regeneration has occurred, which, although it has received no tending of any description, has maintained an average annual increment of 2.6 per cent., and is now carrying an average volume of 3,000 cubic feet per acre.

Around Nornalup on the south coast, a mixed forest of karri and the two tingle-tingles (*E. Jacksoni* and *E. Guilfoylei*) is found. The undergrowth is much the same type as in the karri forest elsewhere. Red tingle-tingle (*E. Jacksoni*) is a large tree and produces a good timber, which has, so far, not been marketed in any quantity. In any case, the area of



the tingle-tingle forests is small, the prime forest being confined to 8,660 acres near the mouths of the Deep and Frankland Rivers.

#### *Tuart Forests.*

First quality tuart forest is confined to an area of State Forest of less than six thousand acres, on the coastal limestone formation between Bunbury and Busselton. The species follows the coast in a northerly direction for some distance beyond Perth. Both first and second quality forest is open in character, with a second story of peppermint (*Agonis flexuosa*) and a floor of annual grasses of considerable grazing value. Graziers have been responsible for annual summer fires which have favoured the free suckering peppermint rather than the tuart, with the result that, in many places, dense thickets of peppermint render the problem of tuart regeneration both difficult and costly. In the prime forest it is probable that the only satisfactory method of securing a full stocking of tuart will be to introduce a rotation of a fast-growing softwood to suppress the peppermint. In the event of this procedure proving necessary, it will be possible to retain the poles and piles of tuart, whose open canopy should not seriously interfere with growth of the pines.

Natural regeneration following general seed years at 7 to 10 year intervals is plentiful, but survives only on the ash beds where debris such as tuart or peppermint tops has been burnt. A careful study under field conditions would appear to indicate that the two principal factors influencing the survival on ashbeds are the elimination of root competition with other undergrowth, the roots and seeds of which are burnt out by the fire, and the fertilising value of the ash which assists the development of the seedling before dry summer conditions commence.

#### *Wandoo Forests.*

The name Wandoo is applied to two species, *Eucalyptus redunca* var *elata* (the most abundant) and *E. accedens*, two very similar species growing in the same localities. Both species produce hard, strong, and heavy timbers, very similar in appearance and qualities, and timber of both species is accepted under the specification "Wandoo." They are often distinguished as white gum and powder bark respectively.

The better quality wandoo forests, of the species *E. redunca* var *elata*, are limited to areas a few thousand acres in extent to the north and east of the prime jarrah forest. Within the wandoo zone, where the laterite gives way to heavier loams and clays, are belts of savannah forest and wood land where the place of harsh leaved undergrowth is taken by native grasses. This herbaceous type of undergrowth is more usually associated with York Gum (*E. foecunda* var. *loxophleba*) and Jam (*Acacia acuminata*). In the pure wandoo type many of the commoner shrubs are toxic to stock, and this has retarded the development of this country for pastoral purposes. Much of the wandoo country has been alienated and the timber destroyed, but, during recent years, a considerable demand for wandoo railway sleepers has arisen. These sleepers, which are considered far more durable than jarrah even, have been obtained by hewing with the broadaxe at rates 25 per cent. to 50 per cent. in advance of that paid for hewn jarrah. Wandoo timber on Crown lands has been reserved

until such time as private property supplies are exhausted, before which time Working Plans will be prepared limiting the output, so that the supply of this timber may be used to help the position during such time as the output of jarrah is being brought back on to a sustained yield basis.

Other timbers occurring in the Wandoo zone, such as York Gum, which is used for wheelwright work, and jam, which is exceedingly durable as a fence post, have specialised local uses, but the preservation of supplies will be secured through the recognition by farmers of the value and importance of the farm woodlot rather than by departmental action.

Two species which have found a ready sale overseas occur within this zone. Sandalwood (*Santalum spicatum*) and mallet (*E. astringens*) have been exploited without restriction until even an odd specimen of sandalwood is rarely seen in the settled country, although the species still supports a valuable industry in the undeveloped country to the east.

The first mallet to be exploited was *Eucalyptus astringens*, the bark of which has a 45 per cent. tannin content. As supplies became scarce, other associated thin-barked *Eucalypts* were found to be only slightly inferior, and these have since been stripped to maintain supplies. *E. astringens* occurs on rocky hilltops in wandoo country. It has not been determined to what extent these colonies have been forced to retreat to the barren hill tops by competition with the more fire-resistant wandoo. Recent investigations have shown that the mallet country is associated with peculiar soil conditions, which, under certain meteorological conditions, result in unsatisfactory growth of cereals unless treated with manganese dioxide. *E. astringens* does not coppice freely, but regenerates easily from seed, and recent reconnaissance work has located considerable areas of regrowth on Crown lands, which are now being protected from fire and extended by spot sowing of seed on cleared land. The area reserved for mallet growing is 45,716 acres at present, and this is being extended as other suitable areas are located.

#### *Salmon Gum Forests.*

The forests of the southern interior consist of a large number of species which may vary from a mallee form with a large number of shoots arising from a flattened root stock to large trees reaching 60 to 80 feet in height. Salmon gum (*Eucalyptus salmonophloia*) is the commonest species, extending throughout the entire formation from 20 in. rainfall on the west to 8 in. on the east. Other common tree species are:—

- Red Morrell—*Eucalyptus longicornis*.
- Yorrell—*Eucalyptus gracilis*
- Gimlet—*Eucalyptus salubris*.
- York gum—*Eucalyptus foecunda* var. *loxophleba*.
- Brown Mallet—*Eucalyptus astringens*.
- Blue Mallet—*Eucalyptus Gardneri*.
- Merrit—*Eucalyptus Flocktoniae*.
- Redwood—*Eucalyptus transcontinentalis*.
- Goldfields Red Flowering Gum—*Eucalyptus torquata*.
- Goldfields Blackbutts — { *Eucalyptus Clelandi*.
- } *Eucalyptus le Souefii*.
- Goldfields Yellow Flowering Gum—*Eucalyptus Stricklandi*.



The abundance of high grade hardwood timbers in forests of greater volume per acre and trees of large size has resulted in little value being placed on forests of the salmon gum zone for purposes other than local farming, firewood and mining requirements. The manner in which these forests develop to a height of eighty feet, with a yield of 4,000 tons of firewood to the square mile in the Eastern Goldfields, where the annual average rainfall is eight inches and the sub-soil moisture highly mineralised, is worthy of mention.

With research into dry farming methods and the breeding of drought-resistant wheats, the clearing of land for wheat growing is rapidly extending in an easterly direction, and large areas of salmon gum forest are being burnt annually. The most serious feature of this wholesale clearing is the failure to leave adequate timber belts to prevent wind erosion and desiccating winds. Even where, in the subdivision of the land, provision has been made for the retention of a small proportion of the forest crop, there is a constant agitation for it to be thrown open for selection, and any movement in this direction generally has the support of local authorities, who, if they are not directly interested in supporting the person seeking the land, are apt to regard the timber reserve

as a shelter and breeding place for vermin. The difficulty of replacing shelter belts by planting or sowing owing to low rainfall, excessively dry summer conditions, and wind, is not generally appreciated.

A species of considerable economic importance scattered through this region, and extending into the mulga country to the north and east, is sandalwood (*Santalum spicatum*). Sandalwood is a root parasite, which will attack the roots of a great variety of shrubs, and a few tree species, but rarely Eucalypts. Sandalwood getters and prospectors have blazed the way and opened tracks into the back country. As new railway lines have been constructed, the sandalwood getter has worked the country as far as 100 miles from the rail head, until, at the present time, the whole of the supplies are obtained many miles beyond the nearest settlement, rendering any estimate of the duration of supplies almost impossible, although men with long experience in the back country consider that, within economic hauling distance, at least 10 years' supplies are available. Extensive areas carrying regrowth and suitable for artificial regeneration have been located in the Eastern Goldfields, where there is no conflict with agriculture or pastoral interests, and 205,176 acres have been reserved for this purpose.

### SECTION III.

## Area and Contents of Existing Forests.

Table I.

*Area (in square miles).*

	Forest.			Agricultural Land (Arable land only).	Other (includes sheep and cattle country).	Total Land.
	Merchantable.	Unprofitable or Inaccessible.	Total.			
	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)
Conifers ... ..	...	...	...	...	...	...
Broadleaved ... ..	4,329.6	1,587.5	5,917.1	93,750	876,253	975,920
Total ... ..	4,329.6	1,587.5	5,917.1	93,750	876,253	975,920
Forest Area as percentage of total Land Area ...	0.45	0.16	0.61	9.60	89.79	100

The figures in Column (1) referring to merchantable forest are for the jarrah, karri, tuart, wandoo, and tingle only.

The figures in Column (2) refer only to country which has a value for hewing at the present time and a possible future value for sawmilling. The greater proportion of the State is carrying trees of some description providing timber for development, but clearing for agricultural purposes is rapidly leading to the destruction of the bulk of this timber, and ultimately practically the whole State will have to rely on the forest regions of the South-West for timber supplies.

"Agricultural land" in Column (4) refers to areas in the South-West Division and Eucla Division within the safe rainfall belt.

"Other land" (Column (5)) comprises the area of the State exclusive of the South-West and portion of Eucla Division mentioned above. Of this area, approximately half a million square miles are leased for pastoral and mining purposes, and a large proportion of the balance will eventually be used for pastoral pursuits, while portions of the Kimberley Division will support tropical agriculture.



The following is a brief analysis showing how the above totals have been arrived at:—

	Good Quality Forest.						Low Quality Forest.		Total.	
	Virgin.		Cut over with considerable mature timber remaining.		Cut over with only odd merchantable trees remaining.					
	acres.	sq. mls.	acres.	sq. mls.	acres.	sq. mls.	acres.	sq. mls.	acres.	sq. mls.
State owned Forest.										
Jarrah ... ..	1,291,700	2,018.3	846,450	1,322.6	314,450	491.3	333,200	520.6	2,785,800	4,352.8
Karri ... ..	238,800	373.1	...	...	...	...	...	...	238,800	373.1
Tingle ... ..	8,600	13.4	...	...	...	...	...	...	8,600	13.4
Tuart ... ..	...	...	7,000	10.9	...	...	...	...	7,000	10.9
Mixed (Wandoo and Jarrah)	...	...	...	...	...	...	234,800	366.9	234,800	366.9
Privately owned Forest ... } Jarrah, Karri and Wandoo }	9,600	15	38,400	60	16,000	25	448,000	700	512,000	800
Total ... ..	1,548,700	2,419.8	891,850	1,393.5	330,450	516.3	1,016,000	1,587.5	3,787,000	5,917.1

Quality 1 and Quality 2 jarrah forest, which can be worked by sawmills under existing economic conditions, has been included in good quality forest.

Quality 3 and Quality 4 jarrah forest, which can only be worked at the present time by hewers or under exceptional circumstances, such as proximity to an existing mill or special local market, has been included under low quality forest.

Karri occurs only in comparatively small areas as pure forest and the figure shown for this species necessarily includes mixed jarrah, marri and karri. In such mixed forest the average volume of karri timber per acre is greater than that of all other species combined.

The figures relating to privately owned forests are estimates only.

TABLE IA.  
VOLUME OF STANDING TIMBER.

	Forests.				Total.
	Merchantable.		Unprofitable or inaccessible.		
	per sq. mile.	Total.	Per sq. mile.	Total.	
	(1.) cub. ft. in the round.	(2.) Million cub. ft. in round.	(3.) Cub. ft. in the round.	(4.) Million cub. ft. in round.	(5.) Million cub. ft. in round.
Conifers ... ..	...	...	...	...	...
Broadleaved ... ..	324,320	1,404.17	96,376	153.0	1,557.17
Total ... ..	324,320	1,404.17	96,376	153.0	1,557.17

The figures above refer to Jarrah, Karri, Tuart, Wandoo and Tingle forests, and represent quantities in the round, based on the full volume measure, compiled from detailed assessment survey carried out along regular strips spaced from 15 to 40 chains apart, depending on the density of the forest crop.

## SECTION IV.

### Notes on Most Important Timbers and Forest Products.

#### JARRAH (*Eucalyptus marginata*).

Jarrah is a hardwood originally known as Western Australian mahogany, which it resembles in appearance. It is a timber with an unusually wide range of uses, owing to its durability under all conditions and fine working qualities. A reputation built upon its world-wide use as a durable timber for fencing posts, sleepers, poles, piles for bridge and harbour work, and paving blocks has tended to re-

tard recognition of the value of jarrah as a cabinet timber suitable for high grade work. Of recent years, a very large export trade in flooring boards has been built up and locally it is used generally for all classes of joinery work, furniture, panelling and interior decoration. It takes an excellent high polish or wax finish. Seasoning difficulties have been shown to be associated with local climatic conditions rather than any inherent defect in the timber, and schedules for



kiln seasoning in various types of kilns are now available. Properly treated the timber is as reliable as any high grade furniture timber. Severe tests on experimental lines and under service conditions have shown both jarrah and karri to be remarkably fire-resistant timbers.

Weight per cubic foot (green)—68lbs.

Weight per cubic foot (at 12% moisture)—55lbs.

Transverse strength 15,000lbs. per square inch.

**KARRI** (*Eucalyptus diversicolor*).

A reddish timber similar to jarrah in appearance, of greater transverse strength, but not durable in the ground without preservative treatment. The trees are very distinctive in appearance, and occur in pure forest, so that there is little chance of confusion in supplies. Owing to the large size and length of clear bole, beams of great length, free from defect, are obtainable for superstructural purposes. The timber does not work to a smooth finish as readily as jarrah, and, in consequence, its uses, other than superstructural timber, are limited to railway wagon scantling, telegraph arms, agricultural implements, motor body building, and other uses where a fine finish is not required. Owing to its excellent bending properties, it is being used in large quantities for rims of wheels, particularly for agricultural machinery.

Large quantities of railway sleepers, treated by the Powellising process, have been supplied to all parts of the world. Local experience appears to indicate that, while the Powellising treatment for karri is an effective preventive of white ant attack, there are certain fungi which may attack the treated timber. A new process, of which the Forests Department hold the patent rights, is now in use, under the name of "Fluarising." The timber is treated by the open tank process with an aqueous solution of arsenic oxide, sodium fluoride and sodium dinitrophenate.

Weight per cubic foot (green)—72lbs.

Weight per cubic foot (at 12% moisture)—58lbs.

Transverse strength—17,300lbs. per square inch.

**MARRI** (*Eucalyptus calophylla*).

This tree occurs plentifully throughout the whole of the jarrah and karri forests, but, unfortunately, a large percentage of the trees are very seriously affected by gum veins and pockets. Sound trees yield a light-coloured strong timber suitable for purposes requiring strength and elasticity, e.g. shafts, timber whips, tool handles. The so-called gum, more correctly described as a kino, yielded by this species contains a high percentage of tannin, and, as tapping does not kill the tree, a valuable and inexhaustible product can be obtained from it. It imparts a red colour to leather, which has, so far, militated against its being used extensively, but it is hoped that chemical investigations will overcome this difficulty. Investigations are now proceeding with a view to manufacturing a blended tanning extract of marri kino and tanning matter from karri bark.

**BLACKBUTT** (*Eucalyptus patens*).

A tree like jarrah in appearance and size, occurring chiefly in gullies. It yields a good clean timber,

but supplies are limited and scattered. The timber has physical and mechanical properties resembling those of jarrah and is pale yellow in colour. Recent tests have shown that the timber can be kiln dried and worked up into a high grade furniture wood.

**TUART** (*Eucalyptus gomphocephala*).

Tuart attains a height of 120 feet, with a bole of 30 to 60 feet and a diameter of 7 to 8 feet. The timber is pale yellow in colour, strong and durable. Its mechanical properties are slightly superior to those of karri, the timber is harder and the grain even more interlocked than that of karri. The wood is used locally for railway wagon undercarriages, where it is used in place of steel.

Weight per cubic foot (green)—78lbs.

Weight per cubic foot (dry) at 12% moisture—68lbs.

Transverse strength—17,900lbs. per square inch.

**RED TINGLE TINGLE** (*Eucalyptus Jacksoni*).

The prime tingle-tingle forest is restricted to a small area some 8,660 acres in extent in the vicinity of Nornalup Inlet.

Red tingle is a tree not unlike jarrah in appearance, but it grows to a height of 180 feet, with a diameter 10ft.-13ft. The mechanical properties of this timber are similar to those of jarrah, but its density is considerably lower, timber from the prime forest averaging about 45lbs. per cubic foot. The timber is almost a rose colour, and is eminently suited for furniture and similar classes of work.

**YELLOW TINGLE TINGLE** (*Eucalyptus Guillefoylei*).

Yellow tingle tingle as a tree is very similar to red tingle in appearance, but attains a height of only 80 to 120 feet, with a diameter 3 to 4 feet. It occurs on the margins of, and sometimes penetrates into, the red tingle forest. The timber resembles tuart in physical and mechanical properties and has the same pale yellow colour.

**WANDOO** (*Eucalyptus redunca* var. *elata*).

A tree attaining a height of 100 feet, with a bole of 30 to 40 feet, and diameter up to 4 feet. The timber is strong, hard and durable, with a dense interlocked grain. It resembles tuart in its mechanical and physical properties, and is used for the same purposes in railway wagon construction. In addition, its great durability makes it valuable for railway sleepers, bridge timber, piles and poles.

Weight per cubic foot (green)—79lbs.

At 12 per cent. moisture—71lbs.

Transverse strength—16,100lbs. per square inch.

**OTHER HARDWOODS.**

The more important eucalypts of the low rainfall salmon gum forests—Wandoo, Morrell, Salmon gum, York gum, Yate—all produce timbers of great strength. The moisture contents of the green wood are all low, being between 30 and 44 per cent. of the dry weight, whereas in the merchantable forests (Jarrah, Karri, Marri, Blackbutt, Tuart and Tingle Tingle) the initial moisture content is in all cases above 60 per cent.



Owing to the scattered nature of the Salmon gum forest, milling is difficult, and this limits the extent of utilisation of the timber. Morrell, Yate and York gum are used in coach and wheelwright work, while Salmon gum has been extensively used for mining purposes on the goldfields.

#### MALLETS.

There are four Eucalypts from which the mallet bark of commerce is obtained, viz.:—

Brown Mallet, *Eucalyptus astringens*.

Blue Mallet, *Eucalyptus Gardneri*.

White Mallet, *Eucalyptus falcata*.

Swamp Mallet, *Eucalyptus spathulata*.

The most valuable of these is Brown Mallet, which grows to a tree of 50 to 70 feet with a diameter of one to two feet. The bark is thin and may carry as much as 50 per cent. of tannin. Uncontrolled exploitation has resulted in the destruction of practically the whole of the original crop, but numerous small areas of regrowth are now being protected from fire, and extended by sowing of seed in situ. It will be many years before mallet can be again regarded as a possible source of any large quantities of tanning material. The timber of brown mallet is exceptionally strong and has somewhat the characteristics of ash.

#### NON-EUCALYPTS.

Among the non-eucalypts, River Banksia (*B. verticillata*), and Sheoak (*Casuarina Fraseriana*) are milled for local use to the extent which the restricted supplies allow.

*River Banksia*, which is to be found along rivers and streams in the jarrah and karri forests, yields a prettily figured wood with pronounced medullary rays. It is used for panelling, furniture, and similar purposes. The timber is soft and easy to work.

*Sheoak* is a harder timber, sometimes possessing a very bold oak grain. It is used for furniture, shingles, and cooperage stock.

*Native Pear* is a softwood with pronounced medullary rays and deep red colour, but the trees are small, scattered, irregular and invariably fire-damaged, which restricts supplies of this beautiful wood.

*Cedar* (*Agonis juniperina*), which is found along the streams in the karri forest, yields a light brown or yellow wood, which is very strong and suitable for uses similar to those of hickory and ash.

*Raspberry Jam* (*Acacia acuminata*), a small tree with a short bole, yields a heavy wood smelling strongly like raspberry jam. This wood is very durable and is much used as a fence post in the wheat belt. It has a beautiful grain which makes it prized for cabinet and turnery work. Supplies are rapidly being depleted.

*Sandalwood*.—There are two true sandalwoods found in Western Australia. In the North, *Santalum lanceolatum* grows as a scattered tree in small quantities over a very wide habitat. Its use has

been restricted by regulation for oil distillation purposes within the State only. The oil has been used for blending with that of the Southern sandalwood, in order to bring the optical rotation of the blended oil to British Pharmacopoeia standard. The difficulty which has been experienced in securing a few hundred tons annually is an indication of the comparative scarcity of the species in country accessible to the coast.

The principal sandalwood (*Santalum spicatum*), which has provided a valuable export commodity for very many years, is found through the Southern portion of the State from the 25-inch rainfall belt within 50 miles of Perth to the eight-inch rainfall region of the dry interior. There is some confusion among botanists as to its proper classification, but evidence in favour of its acceptance as a true *Santalum*, with the specific name of *S. spicatum*, is accumulating.

In higher rainfall regions the tree may reach a height of 25 feet, with a diameter of 18 inches, but logs of this size are now unobtainable, although a few specimens have been preserved on farms in the York and Toodyay districts. The species is practically extinct in the wheat belt, and supplies are now obtained from lower rainfall regions to the East of the settled country, where the tree grows to a height of 15 feet, with a diameter of 6 to 12 inches. The tree is pulled with the larger roots attached. Before being forwarded the sapwood is adzed from the log. The roots are sent forward and form the bulk of supplies from which the oil is distilled. Western Australian sandalwood oil is now gaining a place on the world's market as a high grade product equal to Indian oil.

The stick wood, which is of yellow colour and fragrant, is sent to China, where it is burnt for ceremonial purposes. The output from Crown lands is restricted according to market requirements and the royalty fixed at £9 per ton. The puller receives £16 per ton on trucks at port of shipment for wood of fair average quality.

*Blackboy* (*Xanthorrhoea Preissii*), which is so common throughout the jarrah forests, grows to a height of up to 15 feet, and yields a variety of products, which have not been exploited to any extent. "Blackboy" gum—a dark reddish-coloured resin, which has been used in the manufacture of picric acid, is the chief of these. Destructive distillation of stem and leaf bases has been carried out on a commercial scale in Western Australia, yielding the usual products, but the industry has failed to compete at current prices, particularly in the absence of any considerable market for charcoal.

*Grass Tree* (*Kingia australis*) provides a fibre suitable for coarse and heavy brooms, as well as finer grade material for high grade brushes. It is a widespread species, and grows abundantly on the poorer classes of soil. Its height ranges from 6 to 25 feet.

*Zamia Palm* (*Macrozamia Fraseri*) is a cycad growing to a height of 3 feet, and in one particular locality to 15 feet. The core contains a large amount of starch, which was utilised by early settlers as a substitute for tapioca, but has not been exploited on a commercial scale.



## SECTION V.

## Ownership of Forests.

TABLE II.

*Forest Area by Ownership (in square miles).*

Type of Forest.	The State.				Corporate Bodies.	Private Individuals.	Total.
	Dedicated to timber production.	Permanent dedication pending.	Other Forest.	Total.			
Merchantable ... ..	(1.) 1,581	(2.) 2,410	(3.) 238	(4.) 4,229	(5.) ...	(6.) 100	(7.) 4,329
Unprofitable and Inaccessible ... ..	344	...	544	888	...	700	1,588
Total ... ..	1,925	2,410	782	5,117	...	800	5,917
Percentage of Total Forest Area ... ..	32.6	40.7	13.2	86.5	...	13.5	100

"Other forest" includes Timber Reserves, which, while not permanently dedicated, are held as reserves pending the removal of the present crop, before which time it may be decided to add a considerable portion to the area permanently dedicated.

The progress of dedication is indicated by the following figures:—

	Area Dedicated.			
At 30th June, 1923 .. ..	82	sq.	miles.	
30th June, 1924 .. ..	85	"	"	
30th June, 1925 .. ..	210	"	"	
30th June, 1926 .. ..	1,432	"	"	
30th June, 1927 .. ..	1,483	"	"	
31st Decr., 1927 .. ..	1,925	"	"	

Reserves for Mallet and Sandalwood not included in the table are as follows:—

Mallet .. ..	71.4	sq.	miles.
Sandalwood .. ..	320.5	"	"

## SECTION VI.

## The Relationship of the State to the Forests.

*A. Brief Summary of Existing Legislation.*

By "The Constitution Act, 1889" the management and control of waste Crown Lands were vested in the legislature of the Colony.

Under "The Land Act, 1898" timber leases were granted of areas not exceeding 75,000 acres, for a term of 25 years at an annual rent of £20 per square mile.

"The Land Act Amendment Act, 1904," prohibited any further timber leases, substituting a system of sawmill permits providing for 10 years' cutting.

In 1918, an Act to provide for the better management and protection of forests ("Forests Act, 1918") was placed on the statute books.

The main provisions of the Act are:—

Section 3. Repeal of old Acts and preservation of existing timber rights.

Section 6. Extension of Sawmill permits, concessions and timber leases for a time equal to the temporary cessation caused through the war.

Section 7. The control and management of matters of forest policy to be vested in a Department of Forests.

Section 8. The Conservator is permanent head, is appointed for 7 years and is directly responsible to the Minister of Forests.



- Section 9. The Conservator is a body corporate.
- Section 14. No person shall be appointed to the professional division unless he has obtained the degree or diploma of a recognised forest school.
- Section 20. State Forests to be dedicated by Governor in Council.
- Section 21. And once dedicated can only be revoked in whole or in part by both Houses of Parliament.
- Section 25. Timber reserves to be made by the Governor in Council, and these may be revoked. No revocation to be made without a report from Conservator being obtained.
- Section 27. The deposit of maps certified by the Surveyor General, of State Forests and Timber reserves.
- Section 28. The exclusion of agricultural land within State Forests prior to dedication. Such land to be surveyed and alienated later if necessary.
- Section 29. The surrender of existing pastoral leases within State Forests, the lessee to have the option within six months to take up a forest lease at the same rental.
- Section 31. The Conservator to draw up Working Plans. Such plans to be approved by the Governor and when approved, have effect, and shall not be altered except on the recommendation of the Conservator.
- Section 41. Three-fifths of the net revenue of the Department to be paid into a special fund at the Treasury to be used solely for forestry work.
- Section 43. The making of regulations and prescribing a penalty.
- Sections 45-54 deal with major and minor forest offences and penalties.
- Section 66. The branding of timber before export.
- Section 67. The transfer of the control of timber on catchment areas from the Minister of Water Supply to the Conservator.

Regulations have been gazetted from time to time under the powers conferred by the above Act and were last consolidated and reprinted in 1925.

#### *B. Brief Summary of the Development of Forest Practice and Management, 1920-1928.*

The statement prepared for the 1920 Conference followed the passing of the Forests Act, 1918 so closely that it was only possible to indicate that a modest start had been made in the practice of forestry. Prior to 1919 no efforts were made towards the protection or regeneration of indigenous forests and for the following two or three years lack of trained staff together with limited knowledge of the silvicultural requirements of the species to be dealt with hampered rapid expansion. Work has now definitely emerged from the experimental stage and rapid progress is being made in reforestation operations in connection with Jarrah, Karri, Tuart, Mallet and Sandalwood in the habitats of the respective species.

Although there are necessarily certain field officers who specialise in definite branches, the protection of existing forests, the control of reforestation and pine planting form part of the work and responsibilities of the whole field staff which now numbers 118.

The scheme of organisation provides for a Working Plan branch who are to be responsible for the preparation and revision of Working Plans, but shortage of trained staff has made it necessary for the professional division of the field staff, to undertake the work of preparing Working Plans in addition to their responsibilities in supervising field operations. The principle of requiring a simple form of Working Plan to be prepared and approved before work has been started in any centre has, however, been adhered to, with the result that 31 Working Plans covering 551,589 acres have received the approval of the Governor in Council and 5 Working Plans dealing with 212,060 acres are now in course of preparation or held pending approval, making a total of 36 working plans covering 763,649 acres.

The working unit in all classes of reforestation and afforestation work with the exception of sandalwood regeneration, is a "Block," which is under the charge of a resident working Overseer. This Overseer may be responsible for carrying out practically all necessary work with the aid of one or two casuals, or may look after a large gang of men at certain seasons of the year.

The oversight of a number of Blocks, together with the other responsibilities such as timber and land inspections referred to in Section 7, is the responsibility of the District Forester (non-professional division), and his assistants, who are as far as possible relieved of clerical work.

As professional officers of sufficient experience become available, Districts are grouped together into Divisions. It is anticipated that the organisation of Divisional offices within the next few years will make it possible to decentralise and relieve Head Office of much of the detailed work which tends to overload central administration at the present time.

The Block in the Jarrah forest is an area of 10,000 to 15,000 acres which is bounded as far as practicable by natural features. It is divided into compartments of approximately 500 acres following either well defined creeks, ridges, or, preferably, railway formations or tracks left by sawmilling companies who have operated over the area.

It is decided at the time the Working Plan is prepared, whether regeneration and improvement work shall be associated with further trade cutting. The silvicultural system adopted is a type of Group Selection and the sequence of operations is as follows:—

- (a) *Preliminary burn*—a controlled fire to prevent a serious fire destroying regrowth following trade cutting.
- (b) *Trade cutting* of marked trees by either sawmilling or hewing. The marking of trees according to the Group Selection system is usually the responsibility of the District Forester and his assistants. The exploitation is carried out by permit holders under Departmental supervision.



The yield is fixed by either volume or area: frequently by the latter as the cutting is generally in the nature of improvement felling immediately prior to treatment for regeneration.

(c) *Regeneration Cleaning*.—The second part of the regeneration operations following the removal of the merchantable timber is carried out by Departmental labour and is referred to as Regeneration cleaning. Trees of the understorey and faulty advance growth on blanks existing in the forest, or resulting from recent felling operations, are clear-felled and larger trees of useless species or overmature and containing no merchantable timber are destroyed by ring barking. There is usually sufficient advance growth already on the ground to provide a full stocking although it is at times necessary to hold seed trees.

(d) *Final Burn*.—A controlled fire following regeneration cleaning. If there is sufficient advance seedling growth on the ground the area is burnt in the summer following treatment. In exceptional cases it is necessary to hold the final burn pending a satisfactory seed year.

Improvement work and thinning in existing groups is not usually associated with regeneration cleaning in blanks, owing to difficulties experienced by untrained staff in differentiating between the requirements of the two classes of work.

In some centres, where heavy cutting has taken place with little or no control in the past, a satisfactory stocking of regrowth has become established, despite repeated fires. Occasionally, on whole blocks, but more frequently on odd Compartments, by far the most urgent work is the removal of useless members of the original crop, which are beginning to suppress regrowth.

Much of this regrowth has already reached the sapling or pole stage and needs crown thinning itself. Such work is referred to as Improvement Work and special overseers are employed on it.

The number of resident overseers established on blocks in the Jarrah forest where reforestation work is in progress is 34, and the area treated for regeneration to date is 24,000 acres.

For fire control purposes blocks are grouped together, connected by telephone with the district office, and lookout stations, manned constantly during the summer months, are established on prominent hills at intervals of 15 to 20 miles. Each compartment of 500 acres is surrounded by a strip of five chains in width, on which no improvement work is carried out, and this is divided from the treated country by a scraper track formed by a horse-drawn implement.

The five-chain strips around treated compartments are burnt at intervals of two years by controlled fires, so that hazards are reduced to a minimum, and danger from large fires sweeping in from outside eliminated. During the past seven years no treated country has suffered damage from uncontrolled fires.

The area of Karri country treated under a clear felling system, with regeneration from seed trees retained until after the final burn, is 5,000 acres.

The area of Tuart country treated under the Group Selection system is 2,000 acres. Satisfactory regeneration has been secured on ash beds scattered through the forest, but it may prove necessary to introduce a rotation of fast growing soft woods to suppress the peppermint and restore the factors of the locality as suggested in Section II.

A flying reconnaissance of Mallet country has been followed by the reservation of 45,716 acres.

Very satisfactory results have been obtained by spot sowing of Mallet seed on *Euc. accedens* country on certain of these reserves West of Cuballing, and a more intensive classification of the reserved areas is now in progress. Provided this classification indicates that there is a sufficient area of existing Mallet regrowth and country suitable for sowing within five miles radius, an overseer is established. The first work undertaken is the thinning and fire protection of existing regrowth and later the extension of Mallet (*Euc. astringens*) by sowing of seed in prepared spots 6ft. x 6ft. on country carrying *Euc. accedens*, which is felled and burnt prior to sowing. To date approximately 500 acres have been spot sown with mallet. The following are the results of the classification of the two first groups of reserves:—

Vegetation.	Lol Gray Block.	Montague Block.
	acres.	acres.
Dense regrowth ... ..	345	317
Scattered regrowth ... ..	1,052	1,049
Suitable for sowing Mallet ... ..	2,831	2,847
Wandoo Flats and other country ... ..	7,576	4,629
Totals ... ..	11,804	8,842

Sandalwood reforestation work, for reasons already referred to, has been confined to the Kalgoorlie district, where the annual rainfall is 10 inches and the fall unevenly distributed in heavy storms. The removal of the Eucalypts for mining timber and fuel has given the undergrowth of shrubs forms of *Acacia*, *Eremophila*, *Dodonaea*, and various *Myrtaceous* species, opportunity to develop as dense thickets providing ideal conditions for sandalwood sowing. The root parasitism favours artificial regeneration under low rainfall conditions, in that a heavy storm may supply sufficient moisture to germinate the seed, and support the seedling for a few weeks, until it can find other support by attaching itself to the root system of a vigorously growing host plant. The technique of sowing is still subject to amendment, following results on a series of experimental plots which have been established. Present practice is to sow two or three "nuts" an inch or two beneath the surface, well under the shade of the host plant, as apparently the young Sandalwood has no difficulty in pushing up through the branches and foliage of the host plant.



Factors taken into account in selecting reserves have been—

- (a) Stocking of vigorously growing host plants.
- (b) Soil conditions and topography providing maximum catchment and retention following rain storms.
- (c) The stocking of young Sandalwood existing on the area at time of classification.

The stocking of existing regrowth was found to be surprisingly high on many areas, and an average of six trees to the acre was arrived at on all areas reserved.

The total area reserved to date is 205,176 acres. Sowing has been carried out on 1,850 acres.

The absence of any local supplies of softwood timber render necessary the planting of conifers, apart from proposals for the utilisation of waste areas. Large scale planting operations have been confined to areas reasonably accessible to the capital city, Perth, as the only important industrial centre in the State. Two classes of country are being used—

- (a) Coastal sand plain which is considered valueless for other purposes.
- (b) Fertile valleys in the Darling Ranges which are closed to settlement as water catchment areas.

It is found that a Working Overseer can most efficiently handle the planting of 100 to 150 acres per annum, and planting areas are in consequence divided into blocks of 3,000 to 5,000 acres of planting country. The principal species used for planting on coastal sand plain is *Pinus pinaster*, and on the heavier loams in the hills, *Pinus insignis*. Numerous other species are being tested for special soil conditions, and two experimental areas of 100 acres have been planted where large areas of waste land are available for future planting operations.

While rapid expansion is taking place in reforestation of indigenous forests and information is being gained concerning suitability of species and planting methods, the present planting programme aims at 1,000 acres per annum. Research work in connection with difficulties in the establishment of new nurseries has shown the dependence of all pine species in the early stages on a soil organism, probably a mycorrhizal fungus which is not present in local soils in sufficient quantity to enable seedlings to be raised in new ground. Infection of soil of a proposed nursery site can be secured by applying a dressing of soil from an old established pine nursery or plantation, but the use of the first crop of seedlings is not recommended. These should be ploughed in, and in the second season a more even crop secured giving seedlings which will stand up to much more severe conditions without checking after planting out. It is possible that the conditions

referred to above are only found in a country practically devoid of natural coniferae, and having a low soil fungus population owing to the drying out of the surface layers of soil during summer months, but the need for adequate root infection of seedlings before planting is a practical consideration of prime importance in pine planting operations in West Australia.

The indigenous forest is cleared, felled and burnt before planting. Pit planting with soil cultivation on land carrying a heavy stocking of woody undergrowth is standard practice. Compartments average 25 acres in area, and secondary breaks 15 feet in width are maintained round each compartment only until such time as canopy is formed and the danger of grass fire eliminated. After about the seventh year a one-chain break around each 100 acres and a two-chain break around 400 acres approximately will be maintained by ploughing single and double strip 15 feet in width respectively.

A property of 7,000 acres has recently been repurchased in the Mount Barker district, where it is proposed to plant from 100 to 200 acres annually by use of prison labour. As part of the scheme a prison farm is being established, which will be managed in conjunction with plantation operations.

The area of effective plantations at the close of the 1927 planting season was 2,658 acres.

#### C. Brief Summary of Assistance given to Forestry.

For many years a State Nursery has been in existence. Up to 1917 trees were distributed free to settlers and public bodies and since that date the trees have been issued at cost price to persons residing outside the Metropolitan Area. Last year 65,000 trees were distributed in this way.

In conjunction with the Education Department a scheme of school endowment plantations has been inaugurated. In centres where Local Committees together with the Head Teacher of the school are prepared to find land and undertake certain obligations as trustees, trees are supplied to enable a few acres to be planted annually by the school children. In addition to the educational value of the planting and caring for these areas it is hoped that ultimately the plantations will form a valuable source of income for school funds.

The advice of officers of the Forest Department is at the disposal of private individuals, corporations, and societies.

Private plantations are exempt from local rates and taxes.

Section 73 of the Forests Act, 1918, is designed to encourage the planting of a "woodlot" on every holding, or the improvement of indigenous timber thereon.



## SECTION VII.

## The Forest Authority.

The Forests Act, 1918, provides for the establishment of a Forests Department, which has control of—

- (a) all matters of forest policy;
- (b) all State forests and timber reserves, and the forest produce of other Crown lands;
- (c) the planting or thinning of forests, and the making, laying out, and maintaining of plantations and nurseries, and the distribution of trees therefrom;
- (d) the granting of all permits, licenses, and forest leases under this Act.
- (e) the enforcement of the conditions of timber concessions, leases, permits, licenses, and authorities granted under this Act, or any Act hereby repealed, or otherwise;
- (f) the collection and recovery of all rents, fees, royalties, charges and revenues of the department; and
- (g) the administration of this Act generally.

The Conservator of Forests is permanent head of the Department. His appointment is for a term of seven years, and may be renewed; he is a body corporate with perpetual succession and common seal. The Conservator is responsible to the Minister for Forests for management and control of the forests, and the administration of the department. The staff of the department consists at the present time of a professional division numbering 9, which is limited to men holding the degree or diploma of a recognised School of Forestry; a research branch of 3 trained men; a general division composed of men with long experience in the timber industry or trainees from the local school for forest apprentices, numbering 110, who are all field officers; and a clerical division numbering 39, practically the whole of which are attached to the Head Office in Perth, pending decentralisation as the services of senior professional officers become available. In the clerical division as set out above are included 8 draftsmen.

Work at Head Office is distributed among the following branches under the direction of a Chief Clerk:—

*Registration and Statistics*, dealing with all permits, leases, licenses, timber inspection returns, prosecutions, and summarising of statistics with sub-branches dealing with sandalwood business and Working Plan registration and control.

*Records*, handling, filing, and recording of correspondence only.

*Accounts*, dealing with all royalty accounts, fees and payments and costing of field operations.

*Drafting*, responsible for the plotting of classification, assessment and survey work and the preparation of plans and lithographs.

*Library and Museum*.—Books, periodicals, and articles of special interest are recorded by a card index system. The museum consists of specimens which are loaned for exhibition purposes from time to time.

*Research and Investigation*, divided into botanical, utilisation, including timber physics and seasoning, and chemical, including wood preservation (see Section X.)

*Working Plans*, the duties of which, owing to shortage of experienced professional officers, are principally carried out by senior field officers.

*Seed Store and Herbarium*.—The herbarium contains 2,000 species properly labelled and indexed, mostly woody trees and shrubs. The seed store supplies outside demands for indigenous seeds and orders, tests and distributes seed required for plantation purposes in various districts.

The main field work of the Department lies in the South-West division of the State, which is divided into two portions, each under the control of an Assistant Conservator. The Senior Assistant Conservator, who is also Working Plans Officer, is in charge of the Northern end with headquarters at Perth. The second Assistant Conservator is stationed at Donnybrook and is in charge of all work South of Collie.

The main forest region is divided into 19 Districts, each under the control of a Forester, who may have one or more Assistants. The Forester in charge is responsible for all work in his District, which may include general patrol of timber getting, enforcement of regulations, timber inspection, inspection of land for which application to select has been made, reforestation work, afforestation work, and granting of minor permits and licenses. The issue of long term permits over large areas is arranged by Head Office, the royalty being fixed by auction or tender. The grouping of districts into divisions is still in the early stages. Assistant Divisional Officers are employed at present principally on assessment, control of forest survey, preparation of Working Plan reports, and inauguration of reforestation and afforestation work, under direct control of an Assistant Conservator.

The control of operations outside the South-West timber areas, which are principally associated with sandalwood, fencing and mining timber, are under the general direction of a Divisional Forest Officer stationed at Kalgoorlie.

Timber inspection work, which is undertaken on behalf of practically every overseas buyer, is an important function of the Department. There is a Chief Timber Inspector stationed at Bunbury, the principal timber shipping port, who is responsible for general oversight of inspection work and the training of new officers in this part of their work.

## REVENUE AND EXPENDITURE.

Under Section 41 of the Forests Act, money is provided for forest work:—

41. (1) All revenue of the Department shall be paid into the Treasury.

(2) Three-fifths of the net revenue of the Department, to be certified by the Under Treasurer, shall in every financial year be placed to the credit of a special account at the Treasury, and shall form a fund for the improvement and reforestation of State forests and the development of forestry, and such fund may be expended by the Conservator with the approval of the Minister without any other authority than this Act.

Provided that a scheme for such expenditure shall be submitted annually to and shall be subject to the approval of Parliament.

(3) The balance of the revenue of the Department shall be paid into the Consolidated Revenue Fund.



(4) All moneys appropriated annually by Parliament for the purposes of this Act shall be expended under the control and management of the Conservator, with the approval of the Minister.

(5) The revenue of the Department shall include all royalties and proceeds of the sale of forest produce, license fees, rents, and damages awarded for offences against this Act, and all rents and royalties payable under leases, licenses, and permits granted under any Act hereby repealed, or payable under any other existing timber leases or concessions.

The cost of general administration covering such items as general ranging, revenue collecting, timber inspection, etc., are a direct charge against the consolidated revenue estimates. In addition, funds for the repurchase of land and pine planting are provided annually on the loan estimates.

The gross revenue of the Department and gross expenditure from all funds since the 1920 report was prepared are shown in the following statement:—

Year.	Revenue.	Expenditure.	Balance of Revenue over Expenditure.
	£	£	£
1912-13 ...	48,237	11,463	36,774
1919-20 ...	59,220	27,632	31,588
1920-21 ...	75,469	62,892	12,577
1921-22 ...	88,530	47,886	40,644
1922-23 ...	87,658	38,827	48,831
1923-24 ...	127,253	48,333	78,920
1924-25 ...	177,764	77,423	100,341
1925-26 ...	227,061	101,321	125,740
1926-27 ...	222,507	103,319	119,188
Total ...	1,065,462	507,633	557,829

The revenue and expenditure in greater detail for the year 1926-27 are set out hereunder, and, as an interesting commentary on the growth of the Department during the past eight years, the figures quoted in the 1920 report are reprinted:—

#### Revenue.

Particulars.	1918-19.	1926-27.
Royalties:—	£	£
Jarrah, Karri and Wandoo Logs	24,895	125,365
Hewn Sleepers ...	1,242	20,672
Piles and Poles ...	1,023	631
Miscellaneous ...	320	2,332
Sandalwood ...	1,606	46,074
Licenses (for removal of minor forest produce) ...	631	405
Inspection Fees:—		
Timber from Crown Land ...	876	8,437
Timber from Private Property Sales, following direct conversion, etc. ...	609	13,165
Registration fees (bush workers, brands, etc.) ...	597	2,589
Rents, Leases, Concessions, etc. ...	57	477
	10,194	2,358
Total ...	£42,050	222,505

#### Expenditure.

Particulars.	1918-19.	1926-27.
	£	£
Salaries and Allowances ... (General Administration, Timber and Land Inspection, Patrol, Revenue Collection, etc.)	9,629	31,494
General Equipment and Incidental Expenses ...	866	8,914
Forest Assessment ...	1,874	...
Topographical Surveys and Preparation of Working Plans ...	...	4,778
Purchase and Resumption of Land	9,081	15
Regeneration and Improvement of Indigenous Forests in South-West	...	32,622
Regeneration and Improvement of Sandalwood and Mallet ...	...	3,471
Establishment of Softwood Plantations ...	1,344	13,651
Popular Education, Publicity and Advertising ...	429	715
Research ...	...	1,937
Training of Field Staff ...	...	3,298
Accommodation for District Administrative Staffs (offices and houses) ...	...	1,546
Encouragement of Aborigiculture (including Maintenance of State Nursery) ...	241	878
Total ...	23,464	103,319

#### FORESTRY TRAINING.

In common with other States, Western Australia now sends its nominees for higher training to the Canberra School of Forestry, and the diploma of this School is the only qualification (obtainable in Australia) accepted under the Forests Act for appointment of professional officers.

A school for the training of subordinate staff on the apprentice system has been established at Ludlow, but the principal source from which the officers of the general division are obtained is from the ranks of the timber workers. In a country with a high standard of primary education, it is possible to obtain men of long experience as axemen and bush workers, who, with a certain amount of training, make very efficient overseers, assistant foresters and foresters, having the goodwill and confidence of other bush workers.

#### PUBLICATIONS AND REPORTS.

In addition to the annual report, a considerable number of publications have been issued during the past five years. From a perusal of the list set out in Appendix C, it will be seen that certain of these are of general propaganda or educational value, while others are the results of definite research work. Both the metropolitan and country press have assisted the work of the Department by the publication of information concerning forestry matters and the activities of the Department in their columns from time to time.



## SECTION VIII.

### Forestry Activities—Municipal, Corporate and Private.

The University Endowment Lands at Applecross, only a few miles from Perth, are being used for the planting of *Pinus pinaster*. The Forests Department has entered into an agreement with the University regarding the apportioning of revenue from the crop, and the cost and control of operations is being undertaken by the Department.

One private forestry company recently formed is operating in the State, viz., Esperance Pine Forests Limited. Its activities are directed toward the plant-

ing of waste land near the port of Esperance with softwoods. *P. pinaster* is the species being used for initial operations. The operations are under the control of a technically trained forester employed by the company.

Planting of ornamental trees and wind breaks has been carried out extensively by private individuals in the assured rainfall area. These trees have been obtained principally from the State Nursery.

## SECTION IX.

### Forestry Societies.

There is a local branch of the Australian Forest League, which periodically revives and indicates its interest in a national forest policy. A number of

other societies list among their objects the creation of a forest conscience and the preservation of forests and timber supplies.

## SECTION X.

### Educational, Research and Experimental Work.

#### A.—Educational.

There is no School of Forestry offering professional training in Western Australia. Boys have been trained for the general division of the field staff at the Apprentices' School, Ludlow. The course of training is essentially practical. Boys about 15 years of age are apprenticed for three or four years, during which period they spend three or four months each year at the School, and the remainder on various classes of practical work, during the first year under direct supervision of the Instructor, and subsequently attached to an Overseer or Forester. On the completion of the term of apprenticeship, the youths are promoted, subject to examination, to Forest Guards, and as such are employed on all classes of forest work, being still regarded as trainees. After reaching the age of 21 years, Forest Guards may, subject to a further examination, be promoted to vacancies which may occur for Assistant Foresters.

During the rapid extension of operations in the past few years, the general division of the field staff has been recruited from among timber workers of

long experience. These men have been trained in their duties by close association with senior professional officers, and recently a manual for their instruction and guidance has been published, in two volumes, dealing with practically all aspects of forest work in the main forest region from the point of view of the District Forester, Assistant Forester and Overseer.

#### B.—Research.

Pending the establishment of an Australian Forest Products Laboratory, certain problems have received attention, but the amount of research work of a fundamental nature possible in a Department charged with large administrative responsibilities is limited. Considerable assistance has been received from the University of Western Australia and Professor H. E. Whitfield and Professor T. N. Wilsmore, as members of the Research and Investigation Committee controlling the research activities of the Department have given much valuable assistance in an honorary capacity.



### *Timber Seasoning.*

The first work undertaken was an investigation of the seasoning properties of Jarrah and Karri. A small Tiemann kiln was erected in the University grounds, Crawley, and a drying schedule was worked out, and some excellent kiln-dried timber produced, with the result, that one firm installed a set of four kilns. This work was followed up for several years and particular attention given to the problem of more economical and rapid methods of seasoning jarrah flooring. It was decided that a combined air kiln seasoning system offered the best possibilities. Despite the millions of feet of boards cut annually, no data concerning air seasoning were available. To secure this information, test boards were included in stacks at a large number of mills and monthly moisture contents taken over a period of two years. Interim results were published at the end of the first year (Bulletin No. 28) and a final report is now in course of preparation. Simultaneously investigations were carried on in the design of a simple type of kiln and finally patent rights were taken out for the "Clarke Kiln."

The results of this work extending over 10 years have recently been published in Bulletin No. 40, "The Seasoning of West Australian Hardwoods, by S. A. Clarke, B.E."

### *Timber Physics and Structure.*

By collaboration with the University School of Engineering, the Timber Tests carried out by G. A. Julius in 1906 have been added to from time to time. Certain work on the microscopic structure of local timbers has also been carried out.

### *Chemical Investigations.*

(a) *Wood Preservation.*—The method of preservative treatment previously used for Karri, known as "Powellising" has been investigated on behalf of the State Saw Mills, and a new process developed, known as Fluarising, of which the Department hold the patent rights. Fluarising is essentially an open tank process by which the timber is treated by immersion in a liquor heated to boiling point, in which the principal ingredients are arsenic and sodium fluoride.

Transparent weatherproof coatings for Jarrah have also been investigated.

(b) *Tannin Investigation.*—A comprehensive survey of tannin-bearing plants throughout the State has been carried out, and the results published by the Council for Scientific and Industrial Research, *vide* Forests Department Bulletin No. 3.

This survey which extended over the whole of Australia, indicated that there were reasonable prospects of a tannin extract industry being established in Western Australia. As a result, arrangements have been made for the erection of a Tannin Extract Plant on a semi-commercial scale at the University Engineering School, Crawley. The initial cost has been borne by the Council of Scientific and Industrial Research and the Forests Department of Western Australia. The two materials first receiving attention are Karri bark and Marri kino. It is understood that

this plant will ultimately be transferred and form part of the Commonwealth Forest Products Laboratory when established.

(c) *Botanical Investigations.*—The Department now possesses a properly catalogued herbarium of over 2,000 species of indigenous plants, mostly trees and shrubs.

A series of botanical problems including the artificial stimulation of the production of marri kino and the taxonomy and anatomy of our sandalwoods have received attention.

(d) *Entomological Investigations.*—By arrangement with the Government Entomologist attached to the Department of Agriculture, problems relating to forest entomology are investigated by his staff. The life history of a number of insects attacking forest trees have been published in the Journal of Agriculture.

### *C.—Experimental Work.*

In the first decade of forest work in a new country considerable time is necessarily devoted to silvicultural experiments, and all the more important have been recorded in special ledgers kept in District offices.

Twenty sample plots for the measurement of the rate of growth of Jarrah, Karri and Tuart were established in 1917 and these have been measured at intervals of three to five years. A number of other plots have been established in areas where regeneration and improvement work has been carried out both in the species listed above and also in Sandalwood and Mallet areas. It is proposed to bring all this work on to a uniform basis conforming with standards laid down for India, and the appointment of a special officer to take charge of this work is pending.

The principal problems investigated in connection with afforestation work, are difficulties experienced in the establishment of new nurseries. This has been traced to the absence from local soils of an essential mycorrhizal fungus. The obligatory relationship between soil organism and pine seedling has been definitely established in numerous large scale experiments, the results of which were published in the Empire Forestry Journal, Vol. 6, No. 1, 1927.

Another extended investigation is at present in progress, to determine the effect of ploughing before planting, in conserving and regulating the soil moisture at various depths on sandplain country. The planting of *P. pinaster* on coastal sandplain plays an important part in the afforestation programme, and the mortality among young pines during the first and second summer after planting has been found to have a direct relation to the latitude. This is undoubtedly due to the longer and more severe summer in the vicinity of Perth, compared with conditions on the south coast. It would appear that, subject to the elimination of root competition by woody shrubs, the pines can adapt themselves to dry summer conditions, and it is anticipated that a bulletin setting out the results of these investigations will be in the printers' hands before the Conference meets.

Fourteen species of softwood have been introduced on an experimental scale during the past five years, and four arboreta established.



## SECTION XI.

## Annual Increment and Utilisation of Home Grown Timber and Minor Forest Produce.

## A.—Increment.

The total area of merchantable forest is given under Table I. as 4,330 square miles. Of this 1,168,900 acres, or 1,825 square miles, is cut over forest on Crown lands, from which the best mature logs have been taken under minimum girth restrictions. Owing to the uncontrolled fires and the presence of faulty over-mature trees and useless species, the increment on this cut over forest is low and has, for the purpose of Table III., been estimated at 5 cubic feet per acre per annum. The remaining stand of virgin forest can be regarded as maintaining itself at a constant volume of merchantable timber.

Table III.  
Annual Increment.

Ownership.	Conifers.	Broadleaved Species.				Net Increment.	
		Area.	Estimated Gross Increment.		Loss by fire, water, decay, etc.		
			Per sq. mile	Total.			
		(1.)	(2.)	(3.)	(4.)	(5.)	(6.)
		sq. ml.	sq. ml.	cub. ft.	million cub. ft.	million cub. ft.	million cub. ft.
State :							
Merchantable—							
(a) Virgin ...	Nil	2,405	...	...	...	...	...
(b) Cut over	Nil	1,825	3,200	5,840	...	...	5,840
Other :							
Merchantable...	Nil	100	...	...	...	...	...
Totals ...	...	4,330	...	...	...	...	5,840

## B.—Utilisation.

Table IV.  
Annual Utilisation of Home-grown Timber.

Ownership.	Conifers.	Broadleaved.			
		Converted. (All types of Product)		Equivalent in Standing Timber.	
		Quantity.	Value.	Quantity.	Value.
		Million cub. ft.	£	Million cub. ft.	£
		(1.)	(2.)	(3.)	(4.)
State ...	Nil	14,768	1,845,972	46,888	146,973
Other ...	Nil	6,609	826,192	31,356	98,641
Total ...	Nil	21,377	2,672,164	78,244	245,614

These figures represent the timber converted during the year ending 30/6/1927.

The equivalent value of standing timber represents for State owned timber the actual royalty received. All mills, with one exception, operated on a royalty basis.

The value of State owned timber has been used as the basis for calculating the value of other timber.

Table IVA.

## Annual Utilisation of Home-grown Timber and Minor Forest Produce.

## (1.)—TIMBER.

Type of Product.	Broadleaved.	
	Quantity.	Value.
	Million cub. ft. in the square.	£
Jarrah ... ..	19,179	2,397,400
Karri ... ..	1,234	154,270
Wandoo ... ..	944	118,050
Tuart ... ..	016	1,990
Other Timbers ... ..	004	450
	tons	
Firewood and Mining Timber (various timbers) ...	503,956 lineal ft.	455,000
Piles and Poles (Jarrah and Wandoo) ... ..	37,245	Not known
Total ... ..	...	£3,127,160

## (2.)—MINOR FOREST PRODUCE.

Type of Product.	Broadleaved.	
	Quantity.	Value.
	tons.	£
Sandalwood ... ..	6,659	199,770
Tanning Bark ... ..	1,454	15,820
Essential Oils ... ..	...	26,300
Total ... ..	...	£241,890

The quantities stated for the first five items in Part 1 of this table represent sawn and hewn timber which in terms of standing timber total 78,243,700 cubic feet in the round. The figures given for piles and poles represent only the quantity cut on State owned forests. The majority of the piles and poles used are being obtained from private property, but no particulars regarding quantities or values are available.



## SECTION XII.

## Primary Forest Industries.

Table V.

Industry.	Quantity of Timber and minor Forest Produce consumed (Home grown and imported).	Value of Product.*	Number of persons employed.
Sawmilling ... ..	40,628,000 cub. ft. in the round	£ 1,731,782	4,060
Hewing ... ..	37,615,000 cub. ft. in the round	940,382	1,500
Mining Timber and Firewood ...	503,956 tons	377,970	1,100
Tanning Bark Stripping ...	1,454 tons	15,820	Not available.
Sandalwood ... ..	6,659 tons	199,770	620
Total ... ..	...	3,265,724	7,280

\* These values are based on the value of the product delivered on rails in an undressed condition at port of shipment or local market.

The stripping of mallet bark is done chiefly by farmers during a short, slack period and is more or less spasmodic. It is not possible to determine the number engaged on such work.

Sandalwood getters are not engaged continuously in supplying sandalwood and find it necessary to seek other employment for portion of each year.

This table does not include town sawmills and associated secondary industries.

## SECTION XIII.

## Exports and Imports.

## 1. Timber.

There has been a gradual increase in the quantity and value of timber exported annually during the last five years.

The following table giving particulars of the export and import trade over a number of years illustrates the present state of the trade as compared with the years prior to the war. With restriction of output from Crown lands there has been a big increase in cutting of timber on private property during the past five years.

Year.	Exports (Jarrah and Karri.)		Imports.
	Quantity.	Value.	Value.
	cub. ft in the square.	£	£
1911 ...	12,449,500	986,341	152,133
1912 ...	11,297,100	903,396	167,244
1913 ...	13,619,850	1,089,481	202,640
1923 ...	7,911,310	1,009,831	109,428
1924 ...	11,126,861	1,379,022	133,893
1925 ...	11,844,308	1,491,925	161,898
1926 ...	12,001,384	1,533,030	144,989
1927 ...	12,580,262	1,659,876	162,193

The average value of timber exported during the year 1927 was £6 12s. per load of 50 cubic feet.

## 2. Minor Forest Produce.

Over the period shown in the following table the exports of Sandalwood and Essential Oils fluctuated considerably. There has been a decided increase in the import of Tanning Materials and a corresponding decrease in the exports.

There is a marked increase in the value of the sandalwood exported during the last five years, due to amending regulations gazetted in 1923, by which the royalty payable to the Crown was increased from £2 to £9 per ton, and the price to be paid to the getters was fixed at £16 per ton f.o.r. Fremantle.

Year.	Exports.				Imports.	
	Sandalwood.		Tanning Materials Value.	Essential Oils Value.	Tanning Materials Value.	Essential Oils Value.
	Quantity.	Value.				
	tons.	£	£	£	£	£
1911 ...	6,907	65,506	83,470	...	2,912	4,938
1912 ...	3,154	27,533	49,094	...	3,089	4,598
1913 ...	6,260	47,589	47,377	...	2,651	5,392
1923 ...	7,705	103,958	21,161	20,075	6,991	4,033
1924 ...	14,081	348,713	29,807	39,877	2,790	3,301
1925 ...	6,243	186,775	40,136	42,057	2,670	4,429
1926 ...	7,771	238,203	15,056	47,819	5,826	4,449
1927 ...	6,821	199,746	15,818	26,307	8,971	4,254



Exports and Imports of Timber, showing destination and country of origin respectively, for year 1927.

Country.	Exports.		Imports.	
	Quantity.	Value.	Quantity.	Value.
	c. ft. in sq.	£	c. ft. in sq.	£
Commonwealth of Australia ...	4,539,489	568,026	*111,544	28,095
South African Union ...	3,594,850	531,509	75	51
New Zealand ...	1,096,708	134,375	27,576	7,740
India ...	1,080,883	130,772	...	...
Ceylon ...	728,766	98,950	...	...
United Kingdom ...	648,958	78,097	8	3
British Malaya... ..	559,517	69,173	808	170
Egypt ...	1,600	192	...	...
Mauritius ...	24,392	2,927	...	...
Sweden ...	2,483	367	85,309	11,473
Belgium ...	17,225	2,259	...	...
Germany ...	15,333	1,876	592	86
Holland... ..	88,475	10,839	325	156
China ...	181,283	21,787	...	...
Norway ...	...	...	19,588	2,728
Canada ...	...	...	85	18
Dutch Borneo ...	...	...	64	26
Latvia ...	...	...	13,142	1,489
Russia ...	...	...	3,881	740
New Caledonia ...	...	...	590	318
Japan ...	...	...	2,716	1,037
Phillipine Islands ..	...	...	7,033	2,059
United States of America ...	...	...	363,053	50,812

This table refers to Timber only, and not to small wood manufactures and minor forest produce.

It is worthy of note that 97½ per cent. of the timber exported goes to countries within the British Empire.

\* The Imports from the Eastern States of the Commonwealth represent chiefly American softwoods transhipped to this State.

TABLE VI.

## AVERAGE ANNUAL EXPORTS AND IMPORTS.

## (1.) TIMBER, WOOD MANUFACTURES.

	Exports.			Imports.			Balance (plus or minus).		
	Value.	Quantity.		Value.	Quantity.		Value (Col. 1— Col. 4).	Quantity.	
		Convert- ed.	Equiva- lent in standing timber.		Convert- ed.	Equiva- lent in standing timber.		(Col. 2— Col. 5).	Equiva- lent in standing timber. (Col. 3— Col. 6).
(1.)	(2.) Million cub. ft.	(3.) Million cub. ft.	(4.) £	(5.) Million cub. ft.	(6.) Million cub. ft.	(7.)	(8.) Million cub. ft.	(9.) Million cub. ft.	
Conifers ... ..	<i>Nil</i>	<i>Nil</i>	<i>Nil</i>	162,193	.660	1.320	—£162,193	— .660	— 1.320
Broadleaved ...	1,659,876	12.580	41.935	<i>Nil</i>	<i>Nil</i>	<i>Nil</i>	+£1,659,876	+12.580	+41.935
Total ... ..	£1,659,876	12.580	41.935	£162,193	.660	1.320	+£1,497,683	+11.920	+40.615

Note.—The figures for 1927 have been taken as representing an average year.



TABLE VIA.  
 AVERAGE ANNUAL EXPORTS AND IMPORTS.  
 (2.) MINOR FOREST PRODUCE.

Type of Produce.	Exports.		Imports.	
	Value.	Quantity.	Value.	Quantity.
	£	tons.	£	tons.
Sandalwood ... ..	199,746	6,821	<i>Nil</i>	<i>Nil</i>
Tanning Barks ... ..	15,818	1,454	2,309	115
Tanning Extract ... ..	<i>Nil</i>	<i>Nil</i>	6,662	Not known
Essential Oils ... ..	26,307	Not known	4,254	Not known
Totals ... ..	241,871	...	13,225	...

The figures for 1927 have been taken as representing an average year.

## SECTION XIV.

### Summary and Outlook.

#### A.—Timber Consumption compared with Increment.

The summary of forestry position and outlook contained in Table VII. makes it the most important in the report, but it is difficult in a brief tabulation to make provision for all factors in striking a balance.

The statement as printed below discloses a very unsatisfactory position in that our present estimated increment is not sufficient to meet the needs of the local market, quite apart from the large export trade which is being maintained. For home requirements alone we are eating into our forest capital at the rate of 31.789 million cubic feet (635,780 loads) per annum.

Two factors which are not taken into account in the debit balance indicated are of considerable importance in arriving at a correct estimation of the position. The volume of timber on virgin forest, and the fully developed trees on cut-over country showing no increment is considerable, and it would appear sound to subtract the correct possibility of the total stand of mature timber from the total consumption before balancing the output and increment. The volume of timber remaining on virgin forest is esti-

ated to be 1,160,674,000 cubic feet (Jarrah, good quality, 780.4; low quality, 52.7; mixed Wandoo and Jarrah, 11.7; Karri, 301.6; Tingle, 14.2 million cubic feet.) The above totals include mature timber only, and the full rotation of 90 years may be reduced by at least 10 years on account of immature timber in virgin forest. When the total of 1,160.7 million cubic feet is divided by 80 to arrive at the possibility the result is an allowable cut of 14.5 million cubic feet. To this must be added the allowable cut of mature timber on cut-over country. The volume is estimated at 292.5 million cubic feet, and divided by 90 gives a possibility of 3.25 million cubic feet. These two figures give a total allowable cut of 17.75 million cubic feet per annum.

On this basis it will be seen that the consumption of home grown timber exceeds the allowable cut of mature timber by 18.55 million cubic feet, and subtracting the estimated increment of 5.84 million cubic feet we are left with a considerable debit balance of 12.71 million cubic feet.

The other factor which should be taken into account to obtain a correct idea of the actual position is the large export trade which has been maintained in our local hardwoods since the early days of the Colony.



If the volume of timber exported is added to the above deficit the rate at which we are over-cutting our forests amounts to the huge total of 54.64 million cubic feet (1,000,000 loads) per annum.

A great deal of this over-cutting is in the form of hewn sleepers from private property over which the Forests Department has no control, but even in State-owned forests the gross debit balance is 23.30 million cubic feet (466,000 loads) per annum.

Even with the introduction of these additional factors the above methods of calculation cannot be accepted as a basis for sustained yield calculations, but they have a definite value in showing that the present position is unsound, and only drastic restriction of output, coupled with rapid extension of reforestation operations, can prevent it developing into a serious calamity affecting the welfare and credit of the State.

TABLE VII.

## SUMMARY STATEMENT.

(The total Home Consumption of Home Grown and Imported Timber, compared with the total increment.)

(EXPRESSED AS STANDING TIMBER.)

	Utilisation. (Table IV., Col. 3.)	Exports. (Table VI., Col. 3.)	Consumption of Home Grown Timber. (Col. 1, minus Col. 2.)	Imports (Table VI., Col. 6.)	Total Consumption of Home and Imported Timber. (Col. 3, plus Col. 4.)	Net Increment. (Table III., Col. 6.)	Balance plus (+) or minus (—). (Col. 6 minus Col. 5.)
	(1.) Million cub. ft.	(2.) Million cub. ft.	(3.) Million cub. ft.	(4.) Million cub. ft.	(5.) Million cub. ft.	(6.) Million cub. ft.	(7.) Million cub. ft.
Conifers ... ..	...	...	...	1.320	1.320	...	—1.320
Broad-leaved ... ..	78.244	41.935	36.309	...	36.309	5.840	—30.469
Total ... ..	78.244	41.935	36.309	1.320	37.629	5.840	—31.789
Per head of population ... (Total population = 395,447).	198 cub. ft.	106 cub. ft.	88 cub. ft.	3.3 cub. ft.	95 cub. ft.		

## B.—Probable Duration of Merchantable Supplies.

*Jarrah.*

Compilations, based on detailed field assessment carried out on the strip survey principle, representing an actual ocular estimate of 5 per cent. to 10 per cent. of the total stand, indicate that, at the close of 1927, the volume of jarrah of merchantable size in Western Australian forests was 1,125.7 million cubic feet. Of this total it is estimated that 1,033.1 million cubic feet is suitable for sawmilling under present conditions. The volume of log timber required per annum to maintain existing mills on Crown lands is 37.4 million cubic feet, so that the existing mature stand is only sufficient to maintain the present sawmilling output for 28 years. When this fact is considered in relation to unrestricted cutting for sixty years without any attempt at reforestation, the outlook is serious. Natural regeneration in the jarrah forest is plentiful and vigorous, but removal of selected trees at irregular intervals from the same areas, and lack of protection from fire of the regrowth has, generally speaking, resulted in a poor stocking of immature trees deficient in age classes, which should come to maturity in 30 to 60 years' time. The only manner in which the position can be met is by restriction of output, and it is imperative that this be brought into force forthwith.

The expiration of long term leases during the next few years will render it possible to regulate the cut so that, within five years, the production of timber from Crown Lands in Western Australia should be

brought on to a basis of sustained yield. The possibility first decided upon may need adjustment from time to time as additional data concerning growing stock and increment is accumulated, but it is evident that a considerable reduction is necessary if the future welfare of the industry and timber supplies for future development of the State are to be safeguarded.

It will be possible to produce simultaneously a limited quantity of hewn timber in the form of railway sleepers, but there are no reserves of timber on Crown lands which will make it possible even for a restricted period to maintain the same output as is being secured to-day from private property and Group Settlement country. It is difficult to estimate how long supplies from these sources can last, but, with cheaper transport, higher prices and acceptance of a rougher looking sleeper, there are a number of years' supply in sight.

*Karri.*

The estimated total stand of karri is 301.650 million cubic feet in the round, while the volume worked up during 1927 was 4.571 million cubic feet. At this rate of cutting, the life of present merchantable stands is 66 years, but it is important to note that the milling of Karri forest amounts to clear felling, and there are not the intermediate age classes developing as in the Jarrah forest. There is considerable waste in present sawmill practice owing to the limited local market and with the cutting out of forests accessible to existing sawmills, the exploitation of this



timber can with considerable economic advantage be held until the local demand and rising value render less wasteful methods practicable.

*Wandoo, Tuart and Tingle.*—These timbers have a special local value, but scarcely affect the general position. Undoubtedly as values rise, they will be used to an increasing extent, and the total volume of wandoo in particular, both on Crown lands and private property, is considerable.

#### *Summary.*

The consistent development of forest management as a permanent rural industry will not only provide for rapidly increasing increment on cut over areas, but, by limitation and control of exploitation on more intensive and economic lines will greatly reduce the lean period which is inevitable. Any attempt to express these results in figures would be premature and in all probability misleading.

#### **C.—Short Summary of steps which should be taken to protect and develop the Forest Resources of the Country.**

##### 1. *Dedication of State Forests and Gazetted of Timber Reserves under the Forests Act, 1918.*

Following the procedure laid down in Section 19 of the Forests Act, 1918, a joint soil and timber classification of forest country was commenced in 1918 and completed over the main portion of the prime timber region in 1922. Despite repeated recommendations, it has remained for the present Government to make a serious attempt to establish this most essential foundation for a sound forest policy. During recent months satisfactory progress has been made, and it is hoped that, before the Conference meets in September, the whole work of dedicating for the production of a forest crop in perpetuity, those areas of prime forest which remain the property of the Crown, may be finalised.

##### 2. *Working Plans.*

Mention has already been made of the need for the reduction of output from Crown lands to a sustained yield basis. The position is by no means hopeless provided (a) immediate action is taken to limit the rate of cutting, so that the existing mature stand may provide supplies until the younger age classes reach maturity, and (b) reforestation and associated fire control measures are extended on lines already established to deal with all forest as cut over.

To secure these objectives, all State Forests and many Timber Reserves must be brought under Working Plans as rapidly as possible. Comparatively de-

tailed Plans will prove possible in centres where heavy cutting is taking place, but, geographically, first quality forests of each species (*i.e.* Jarrah, Karri, Tuart and Tingle) are reasonably compact units, and must be treated as such in sustained yield calculations.

##### 3. *Stimulation of Public Interest.*

Coupled with the development of a forestry programme on lines indicated in paragraph 2 is the need for a more general appreciation of forestry as a permanent rural industry providing as much employment per unit of area as other forms of agriculture. The greater concentration of men engaged in forest operations and industries in communities is apt to be overlooked by land settlement enthusiasts, and the holding of reserves of untapped forest in certain districts as an offset against overcutting, which may be taking place in more accessible areas, is seldom understood. The conception of a forest as a mine of timber to be worked out and then deserted has not entirely disappeared.

##### 4. *More Complete and Economic Utilisation.*

Improvements are being effected constantly in methods of sawing and handling timber, all tending to produce a more valuable product with less waste, but the rate of progress is unnecessarily slow. Improved sawmilling practice, grading by definite rules, and better seasoning methods are reforms long overdue, which can play an important part in conserving our rapidly diminishing timber resources. This aspect of the problems of utilisation should receive increasing attention as senior officers of the Forests Department are gradually freed from the detailed work involved in the inauguration of extensive reforestation and afforestation operations. The assistance of a research institution on the lines of the proposed Forest Products Laboratory is urgently needed. The failure of the arrangements for the establishment of a Commonwealth Laboratory in Perth in 1920 has proved a severe loss.

##### 5. *Silvicultural Research.*

There are many peculiar features involved in the study of silviculture and plant nutrition in areas of low summer rainfall in Southern Australia, and a research institution equipped to study problems of a fundamental nature is urgently required. Many useful investigations of an empirical nature have been undertaken, but men with special training, freed from administrative responsibilities and properly equipped, are needed if the practice of tree growing is to be placed on a sound scientific and business-like basis.



## APPENDICES.

(Note.—All the publications listed under A, B, and C were published by the Government Printer, Perth.

## A.

- Report of a Select Committee on the Protection of Sandalwood of Immature Growth, 1881.\*  
 Report of a Commission on the Relative Values of Karri and Jarrah timbers for construction works, particularly for submarine operations, 1887.\*  
 Report of Select Committee on the Export Timber Branding Bill, 1892.\*  
 Report of Royal Commission on Forestry, 1904.\*  
 Report of Board of Inquiry into Timber Industry, 1906.\*  
 Report of Select Committee of the Legislative Council on Kingia Grass Tree Concession Bill, 1917.\*  
 Report of Royal Commission on Forestry, 1922.\*

## B.

- Land Act, 1898, and Amendments.  
 The Forests Act, 1918.  
 Native Flora Protection Act, 1912.  
 Bush Fires Act, 1902, and Amendments.  
 Bush Fire Regulations, 1926.  
 Engine Sparks Fire Protection Act, 1895.  
 Parks and Reserves Act, 1895.  
 Timber Industry Regulation Act, 1926, and Regulations.

## C.

- “The Forests of W.A. and their Development,” by J. Ednie Brown, Conservator of Forests for Western Australia, 1899.\*  
 “Western Australian Timber Tests, 1906.—The Physical Properties of Hardwoods of Western Australia,” by G. A. Julius, B.Sc., M.E., 1906.  
 “Notes on the Timbers of Western Australia, suitable for Railways, Engineering Works and Constructional Purposes Generally,” 1906.\*  
 “The Physical Properties of the Hardwoods of Australia,” by G. A. Julius, B.Sc., M.E., 1907.\*  
 “Reports on portions of Kimberleys,” W. V. Fitzgerald, 1907.\*  
 “Botany of Kimberleys,” W. V. Fitzgerald, 1918.  
 “The Plants around Shark’s Bay,” von Mueller, 1883.\*  
 “Plants of North-Western Australia,” von Mueller, 1881.\*  
 “Forests and Timber Trade of Western Australia,” von Mueller, 1882.\*  
 “A Discussion of Australian Forestry, with Special Reference to Forestry in Western Australia,” 1916, by D. E. Hutchins.\*  
 “A Primer of Forestry,” by C. E. Lane-Poole, Conservator of Forests, Western Australia 1921.\*
- Bulletins of the Forests Department :
- No. 1—“The Kiln Drying of Jarrah,” by C. E. Lane-Poole.  
 No. 2—“Notes of the Forests and Forests Products and Industries of Western Australia, by C. E. Lane-Poole, 1921.  
 No. 3—“Notes on the Tannin Resources of Western Australia,” by S. L. Kessell, B.Sc., Conservator of Forests, Western Australia, 1923.  
 No. 7—“West Australian Timber Tests, 1906 (and Supplement), Physical Characteristics of the Hardwoods of Western Australia and the Principal timbers of Eastern Australia,” by G. A. Julius. (abridged edition), 1918.  
 No. 9—“Short Descriptive Notes of the Principal Timbers of Western Australia,” 1925.  
 No. 10—“Some Notes about the Forest Resources of Western Australia, with Illustrations and Map of Main Forest Regions,” 1927.  
 No. 11—“Blackboy,” 1925.  
 No. 12—“Sandalwood,” 1924.  
 No. 16—Table of Contents, in Cubic Feet, of Logs, 1920.  
 No. 21—“Jarrah,” 1925.  
 No. 22—“Karri,” 1925.  
 No. 23—“Tuart and Wandoo,” 1925.  
 No. 25—“Grass Tree,” 1925.  
 No. 27—“A Glossary of Technical Terms used in Forestry Practice,” by S. L. Kessell, 1925.  
 No. 28—“Seasoning of Western Australian Hardwoods,” by S. A. Clarke, 1925.  
 No. 30—“The Hardwoods of Western Australia,” 1923.  
 No. 31—Descriptive Catalogue with Price List—Hamel Forest Nursery—issued annually.  
 No. 32—“Botanical Notes, Kimberley Division of Western Australia,” by C. A. Gardner, 1923.  
 No. 33—“Damage caused by Creeping Fires in the Forest,” by S. L. Kessell, 1924.  
 No. 34—“Key to the Eucalypts of Western Australia with Descriptive and Botanical Notes, etc.” (S. L. Kessell and C. A. Gardner), 1924.  
 No. 35—“Key to the Eucalypts of Western Australia—extracts from Bulletin No. 34, by S. L. Kessell and C. A. Gardner, 1924.  
 No. 36—The Forester’s Manual, Part I., 1926.  
 No. 37—“Working Plan No. 1, Mundaring Working Circle,” 1926.  
 No. 38—“Air Seasoning Study,” by S. A. Clarke, 1926.  
 No. 39—The Forester’s Manual, Parts II. to V., 1927.  
 No. 40—“Seasoning of Western Australian Hardwood,” by S. A. Clarke, 1927.

## D.

- “Pflanzenwelt von West-Australien,” Dr. L. Diels, 1906. (Wilhelm Engelmann, Leipzig.)  
 “Fragmenta Phytographiæ Australiæ occidentalis,” L. Diels and E. Pritzel, 1905. (Wilhelm Engelmann, Leipzig.)  
 “On the Rapid Seasoning of Jarrah,” by Alfred Tomlinson, M.Sc. (West Australian Institution of Engineers.\*

\*Out of print.



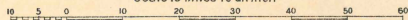
# MAP OF Part of the SOUTH WEST DIVISION OF WESTERN AUSTRALIA

## SHOWING FOREST ZONES

Red hatching indicates approximately the position of prime merchantable forest.

Isohyets shown thus:  $30^{\circ}$

Scale 15 Miles to an Inch

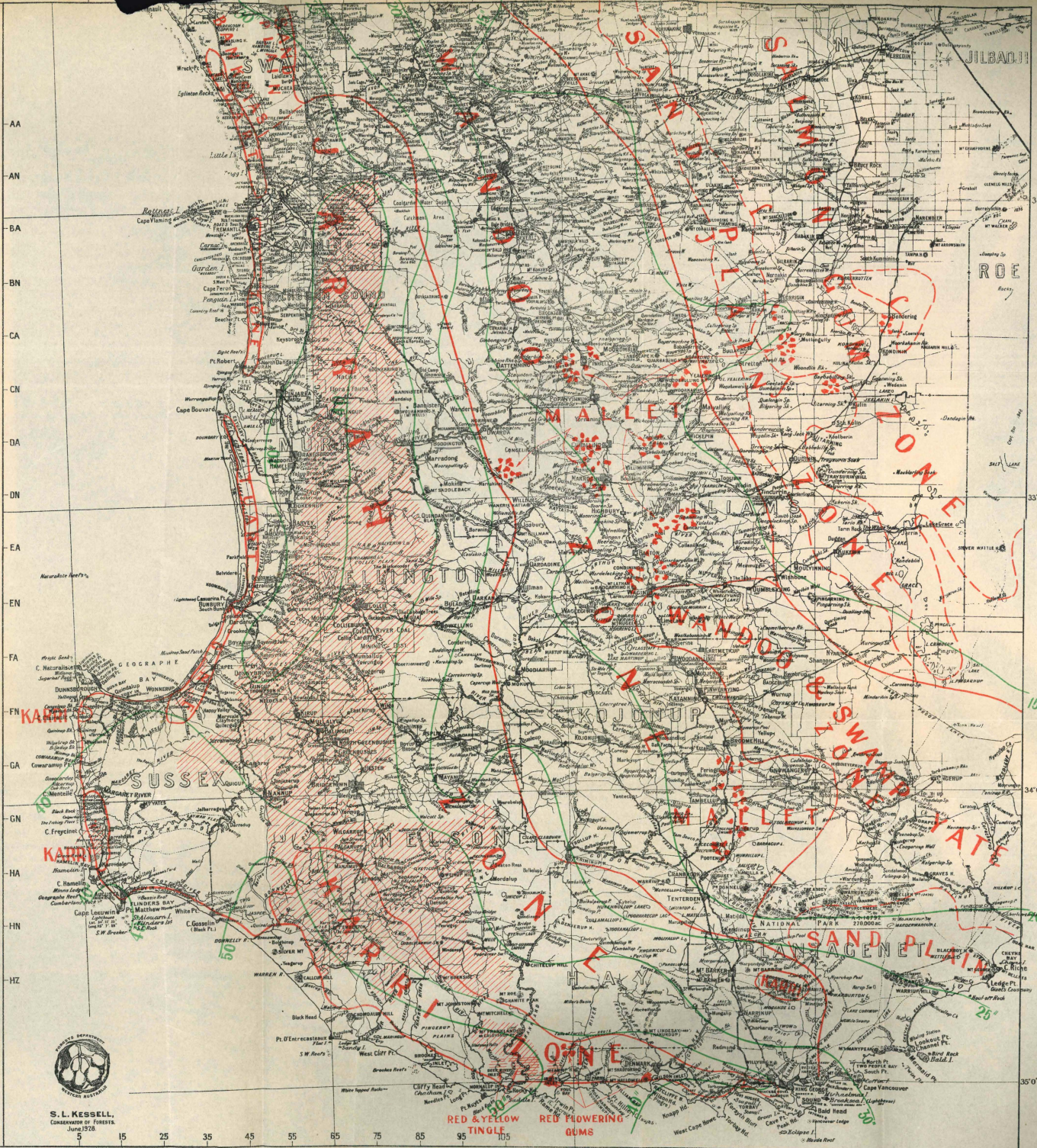


<b>JARRAH ZONE.</b>	
JARRAH	( <i>Eucalyptus marginata</i> )
MARRI	( <i>Eucalyptus calophylla</i> )
BLACKBUTT	( <i>Eucalyptus patens</i> )
FLOODED GUM	( <i>Eucalyptus rudis</i> )
WANDOO	( <i>Eucalyptus redunca</i> , var. <i>elata</i> )
POWDER-BARK WANDOO	( <i>Eucalyptus accedens</i> )
RIVER BANKSIA	( <i>Banksia verticillata</i> )
BULL BANKSIA	( <i>Banksia grandis</i> )
SHEOAK	( <i>Casuarina Fraseriana</i> )
BULLION	( <i>Eucalyptus megacarpa</i> )
<b>KARRI ZONE.</b>	
KARRI	( <i>Eucalyptus diversicolor</i> )
MARRI	( <i>Eucalyptus calophylla</i> )
RED TINGLE	( <i>Eucalyptus Jacksoni</i> )
YELLOW TINGLE	( <i>Eucalyptus Guilfoylei</i> )
JARRAH	( <i>Eucalyptus marginata</i> )
BULLION	( <i>Eucalyptus megacarpa</i> )
RED FLOWERING GUM	( <i>Eucalyptus ficifolia</i> )
KARRI SHEOAK	( <i>Casuarina decussata</i> )
CEDAR	( <i>Agonis juniperina</i> )
RIVER BANKSIA	( <i>Banksia verticillata</i> )
<b>TUART ZONE.</b>	
TUART	( <i>Eucalyptus gomphocephala</i> )
COASTAL WHITE GUM	( <i>Eucalyptus decipiens</i> )
PEPPERMINT	( <i>Agonis flexuosa</i> )
YATE	( <i>Eucalyptus cornuta</i> )
<b>WANDOO ZONE.</b>	
WANDOO	( <i>Eucalyptus redunca</i> , var. <i>elata</i> )
POWDER-BARK WANDOO	( <i>Eucalyptus accedens</i> )
JARRAH	( <i>Eucalyptus marginata</i> )
MARRI	( <i>Eucalyptus calophylla</i> )
SALMON GUM	( <i>Eucalyptus salmonophloia</i> )
RED MORREL	( <i>Eucalyptus longicornis</i> )
YORK GUM	( <i>Eucalyptus foecunda</i> , var. <i>loxophleba</i> )
JAN	( <i>Acacia acuminata</i> )
SHEOAK	( <i>Casuarina Huegeliana</i> )
SANDALWOOD	( <i>Santalum spicatum</i> )
<b>WANDOO &amp; SWAMP YATE ZONE.</b>	
WANDOO	( <i>Eucalyptus redunca</i> , var. <i>elata</i> )
SWAMP YATE	( <i>Eucalyptus occidentalis</i> )
YATE	( <i>Eucalyptus cornuta</i> )
SALMON GUM	( <i>Eucalyptus salmonophloia</i> )
RED MORREL	( <i>Eucalyptus longicornis</i> )
JAN	( <i>Acacia acuminata</i> )
SWAMP OAK	( <i>Casuarina glauca</i> )
SWAMP MALLET	( <i>Eucalyptus spathulata</i> )
SANDALWOOD	( <i>Santalum spicatum</i> )
<b>SALMON GUM ZONE.</b>	
SALMON GUM	( <i>Eucalyptus salmonophloia</i> )
RED MORREL	( <i>Eucalyptus longicornis</i> )
YORRELL	( <i>Eucalyptus gracilis</i> )
GIMLET	( <i>Eucalyptus salubris</i> )
YORK GUM	( <i>Eucalyptus foecunda</i> , var. <i>loxophleba</i> )
WANDOO	( <i>Eucalyptus redunca</i> , var. <i>elata</i> )
JAN	( <i>Acacia acuminata</i> )
BROWN MALLET	( <i>Eucalyptus astringens</i> )
BLUE MALLET	( <i>Eucalyptus Gardneri</i> )
MERRIT	( <i>Eucalyptus Flocktoniae</i> )
SANDALWOOD	( <i>Santalum spicatum</i> )
<b>SAND PLAIN BANKSIAS.</b>	
HOLLY-LEAVED BANKSIA	( <i>Banksia hickii</i> )
NARROW-LEAVED BANKSIA	( <i>Banksia attenuata</i> )
FIREWOOD BANKSIA	( <i>Banksia Menziesii</i> )
SWAMP BANKSIA	( <i>Banksia littoralis</i> )
COASTAL BLACKBUTT	( <i>Eucalyptus Toitiana</i> )
<b>SAND PLAIN ZONE.</b>	

Various small shrubs of several families. All of low stature.



S. L. KESSELL,  
Conservator of Forests.  
June 1928.





# VEGETATION MAP OF WESTERN AUSTRALIA

Scale of English statute miles.

## REFERENCE

- |   |  |                       |
|---|--|-----------------------|
| <p><b>Sclerophyllous types</b><br/>(undergrowth harsh leaved shrubs).</p> <p>*Low rainfall tropical woodlands.</p> <p>*Low rainfall temperate forests and woodlands with belts of sand heaths and mallee<br/>(Verenaculor: Salmon gum forest and sandplains).</p> <p>*Sclerophyllous forest<br/>(Verenaculor: Jarrah forest).</p> <p>*Temperate Eucalyptus rain forest<br/>(Verenaculor: Karri forest).</p> <p><b>Savannah types</b><br/>(undergrowth herbaceous, principally grasses).</p> <p>*Savannah forests and woodlands.</p> <p><b>Savannah.</b></p> <p><b>Mulga</b> (Acacia) bush.</p> <p>*Denote forests and woodland where Eucalyptus are the dominant species.</p> | <p><b>Treesless regions.</b></p> <p>Saltbush plains<br/>(Verenaculor: Nullabor plains).</p> <p>Desert with spinifex and belts of low shrubs.</p> <p><b>Fringing Forests.</b><br/>Throughout the savannah woodland region of the Kimberley Division tropical rain forests occur in narrow belts fringing the principal water courses.</p> <p><b>Mangrove formation.</b><br/>Mangroves occur from Carnarvon Northwards along the coast but only develop in distinct front formations in the estuaries Northwards from Derby.</p> <p><b>Isolyths shown thus</b></p> | <p>20°</p> <p>20°</p> |
|---|--|-----------------------|



- ### REFERENCE
- Towns ..... shown thus ● EUCLA
  - Railways ..... ————
  - Land District Boundaries ..... ————
  - Land Division ..... ————
  - Goldfields ..... ————
  - Telegraph Lines & Stations ..... ————
  - Lighthouses ..... ————
  - Stock Routes ..... ————
  - Heights in feet ..... ————
  - Steamer Routes ..... ————

Compiled by C. A. GARDNER.  
S. L. KESSELL,  
CONSERVATOR OF FORESTS,  
JANUARY, 1926.

