

Some Characteristics of Queensland Rain Forests and Rain-Forest Trees.

By W. D. FRANCIS, Assistant Government Botanist.

VERY few field observations of our rain-forest or so-called "scrub" trees appear to have been made and recorded by botanists, although the open or hardwood forest trees, especially the Eucalypts, have received a considerable amount of attention. Perhaps the difficulties of determining the rain-forest species in the field may account for part of the botanists' neglect of them, as the recognition of the various species in their wild state presents several obstacles, such as the inaccessibility of the leaves, flowers, and fruit, the apparent similarity of so many of the trees, and the very large number of species crowded into a limited area.

In the latter part of this paper the writer has endeavoured to facilitate the recognition of some of the rain-forest trees by placing on record some of their peculiarities. It is not claimed that these peculiarities are exhibited in all cases, but experience has shown that a large number of them is serviceable in the field in the specific, generic, or ordinal determinations in which they are stated to be applicable. Most of the observations were made by the writer during a residence of several years in the rain forest at Kin Kin, North Coast line, or whilst on short official visits to rain forests in various parts of the State.

It is well known that the Eastern Australian rain-forest flora, in contrast with the true or old Australian type of vegetation as exemplified by the Eucalyptus forests, is allied to the Papuan and Malayan floras, and is often referred to as chiefly constituting the Austro-Malayan type. Although allied to Papuan and Malayan ones, the great majority of the Australian rain-forest species is endemic.

THE RELATION OF RAIN FORESTS TO RAINFALL.

The dependence of our luxuriant rain forests upon heavy rainfall is unquestionable. The heavy or luxuriant

rain-forest areas of the State appear to have an average annual rainfall approximating or exceeding 60 inches. The areas in which this condition of rainfall prevails generally, if not always, contain relatively large areas of rain forest of the luxuriant type. A meteorological map showing the distribution of rainfall in Queensland indicates roughly the following areas with rainfalls approximating or exceeding 60 inches annually:—

- (1) The extreme south-eastern portion of the State, including the MacPherson Range and Tambourine Mountain;
- (2) The North Coast line district, between Landsborough and Cooran;
- (3) The small area round Yeppoon;
- (4) The area between Mackay and Proserpine;
- (5) The fairly large area to the north, south, and west of Cairns; and
- (6) The northern part of Cape York Peninsula.

All of these areas, with the possible exception of Cape York Peninsula, whose flora is not very well known, contain tracts of heavy rain forest. Following are the average annual rainfall registrations, in inches, of meteorological stations situated in or near the rain forests of the areas enumerated:—

- (1) Tweed Heads 70, Tambourine Mountain 64;
- (2) Landsborough 67, Montville 70, Nambour 60, Cooran 56, Kin Kin 57;
- (3) Yeppoon 65;
- (4) Eungella 72 for 1913, Mackay 69; and
- (5) Cairns 90, Atherton 53, Harvey's Creek 165.

It is evident that the luxuriant rain forests are indicative of a heavy rainfall.

On the other hand, certain types of vegetation—for example, brigalow (*Acacia harpophylla*) “scrub”—indicate a relatively low rainfall. Extensive areas of brigalow forest occur between Dalby and Roma on the Western, between Warwick and Goondiwindi on the South-Western line (C. T. White), and between Westwood and Emerald on the Central line. These three areas have an average annual rainfall of

from 20 to 30 inches. The prevalence of brigalow in coastal areas, as at Marmor, south of Rockhampton, with an average rainfall of 34 inches at Raglan (the nearest meteorological station), and at Rosewood, with 32 inches, appears to signify coastal localities with low rainfalls.

Rain forests of a type less luxuriant than those of the fertile areas of MacPherson Range and the North Coast line occur in many parts of the State, especially in the coastal area. Following are some of the locations of these less heavy rain forests, with the annual rainfall of the locality in parentheses:—Myer's Ferry, near Southport (55), Rosewood (32), Goodna (37), Imbil (45), Theebine (40), Marmor (Raglan, nearest station, 34). This type, which is not so aptly described by the term "rain forest," occurs in areas of great or less extent from the Tweed River in the south to Rockhampton, and probably, from what the writer has heard, as far as Cooktown in the north.

THE RELATION OF RAIN FORESTS TO SOIL.

Both the luxuriant and the less heavy types of rain forest abound on soils derived from various kinds of rock. Following is an enumeration of some of the heavy rain-forest areas, showing the kinds of rock from which the soils are derived:—The MacPherson Range areas, such as Roberts' Plateau, Tambourine Mountain (basalts and andesites)¹; Blackall Range (basalts) (H. I. Jensen); Kin Kin (phyllites and slates)²; the area between Beenham Range and Kin Kin (granodiorite)³; and the Eungella Range, westward of Netherdale, Mackay district (granodiorite).⁴

SOME EFFECTS OF SOIL, RAINFALL, AND CLIMATE ON RAIN FORESTS.

The character of the luxuriant rain forests of areas such as Tambourine Mountain, Kin Kin, and Eungella Range shows that in those localities the conditions of soil and rainfall approach the optimum. The heavy rain forests of the MacPherson Range, such as those of Roberts' Plateau,

¹ H. C. Richards, Proc. Roy. Soc. Q., Vol. xxvii, plate x (1916).

² L. C. Ball, Q'land Govt. Mining Journ., p. 58, Vol. xix., Feb. 1918.

³ L. C. Ball, loc. cit.

⁴ L. C. Ball, Q'land Geo. Survey Pubn. No. 224, p. 27 (1910).

are situated at an altitude of 3,000-4,000 feet, and the climate is therefore temperate. They only differ in general character from those at lower levels further north, where the climate is subtropical, in containing less undergrowth. The less luxuriant types of rain forest often grow in poor soils, especially where the rainfall is high. This fact is exemplified at places such as Myer's Ferry, south of Southport, where a rain forest of the lighter kind flourishes in the sandy soil adjacent to the ocean beach. The soil in this and similar localities is composed of grains of silica in very high proportions, and plant food must be present in low percentages. In cases of this kind it appears obvious that a heavy rainfall (55 inches in this instance) is a very decisive factor in determining the character of the forest. On the other hand, in localities where the soil is fertile a rain forest of the lighter type is generally the result of a light rainfall. These conditions are seen in the light rain forests in the neighbourhood of Theebine (Kilkivan Junction), where the average annual rainfall is 40 inches and where the fertility of the soil is exhibited by the good crops grown in the felled areas.

SIZE OF RAIN-FOREST TREES.

Queensland rain-forest trees do not often exceed 160 feet in height and 6 feet in barrel diameter when measured above the basal flanges or plank buttresses. The fig trees (*Ficus* spp.), Queensland kauri pines (*Agathis* spp.), scrub box (*Tristania conferta*), and some species of Eucalypts such as the messmate (*Eucalyptus Cloeziana*) and the flooded gum (*E. saligna*), when growing in the luxuriant rain forests sometimes exceed 6 feet in barrel diameter. The Eucalypts which sometimes grow in the rain forests or on their margins often exceed the true rain-forest trees in height, but they do not grow beyond 200 ft. in height, so far as the writer is aware. The common form of rain-forest tree has a long barrel bearing a shorter canopy of branches and foliage. In some cases the barrels attain 80 or 90 ft. in height before they branch. In the light rain forests the size of the trees is sometimes reduced so that the general height is brought down to about 40 or 50 feet, and the barrel diameter of the larger trees to 12 or 18 inches.

BUTTRESSED BARRELS.

Many rain-forest trees are deeply flanged or buttressed (plank-buttressed) at the base of the barrel, a peculiarity which appears to be exhibited by certain species of trees in dense rain forests in tropical and subtropical parts of the world. J. H. Maiden⁵ has recorded the buttressed character of several common Australian rain-forest trees. A. F. W. Schimper⁶ remarks that the plank-buttress is a peculiarity of trees in a tropical climate with abundant rainfall, that the amount of rainfall necessary for its appearance is not yet ascertained, and that the physiological causes of the phenomenon and its significance to the life of the tree are still obscure. As plank-buttresses are common in all of the luxuriant rain forests mentioned previously in this paper, even in those at an altitude of 3,500 feet in latitude 28.2 degrees south, on the MacPherson Range, it can be definitely stated that in Queensland the phenomenon is not confined to tropical forests, but occurs in relatively temperate climates, and that it appears when the annual rainfall approximates or exceeds 60 inches.

A large number of species of Queensland rain-forest trees have plank-buttresses. Following are the most conspicuous trees which exhibit this peculiarity:—Fig trees (*Ficus* spp.), the carribin (*Sloanea Woollsii*), blueberry ash (*Elaeocarpus obovatus*), quandong (*Elaeocarpus grandis*), mountain beech (*Elaeocarpus Kirtonii*), *Dysoxylum* spp., booyong (*Tarrietia argyrodendron*) and its varieties, black jack (*Tarrietia actinophylla*), water gum (*Eugenia Francisii*), *Eugenia Luchmanni*, *Eugenia* spp., red cedar (*Cedrela toona*, var. *australis*), marara (*Weinmannia lachnocarpa*), pink marara (*Geissois Benthami*), and the giant ironwood (*Syncarpia subargentea*). The buttresses of some species often assume characteristic shapes. For example, the carribin (*Sloanea Woollsii*), which is one of the most conspicuously buttressed trees, frequently has flanges whose edges curve outwards.

⁵ J. H. Maiden, "Australian Vegetation," Federal Handbook on Australia, issued in connection with visit of British Assn., 1914, p. 172.

⁶ A. F. W. Schimper, "Plant Geography," trans. W. R. Fisher, revised and edited, Groom and Balfour, p. 305 (1903).

CHARACTERISTICS OF SOME RAIN-FOREST TREES.

Trees with Channeled or Fluted Barrels.—Some species are characterised by channeled or fluted barrels which are angular or sub-angular in cross-section. Unlike the buttressed trees, the channeled or fluted character is not always confined to the basal portion of the barrel, but often extends upwards towards the lowermost limbs. Examples are the churnwood or soap box (*Villaresia Moorei*), lignum-vitæ (*Vitex lignum-vitæ*), black apple or black plum (*Sideroxylon australe*), koda (*Ehretia acuminata*), she pine or brown pine (*Podocarpus elata*), giant stinging tree (*Laportea gigas*), scrub turpentine (*Rhodamnia trinervia*), and white myrtle (*Rhodamnia argentea*). Occasionally the churnwood, lignum-vitæ, and koda resemble each other in general appearance. The churnwood is one of the largest trees of the rain forests, and attains a barrel diameter of nearly 5 feet. It has a pale or whitish cork-like fissured bark. Its timber is pale or nearly white, and is remarkable for its broad medullary rays, which in tangential section measure 2-4 mm. or more in height. The lignum-vitæ has a bright yellow bark when cut. The rays of the timber are fine and inconspicuous, measuring from .2-7 mm. in height in tangential section. The koda (which is an Indian name for the species) is generally not so tall as the churnwood and lignum-vitæ, and it is frequently almost leafless in the spring. The rays of its timber appear to the unaided eye as minute specks which measure .5-1.5 mm. in tangential section.

Trees with Conspicuously Fissured Barks.—The following rain-forest trees have prominently fissured barks comparable to that of ironbark:—Scrub ironbark (*Bridelia exaltata*), white cedar (*Melia Azedarach*), and red ash (*Alphitonia excelsa*).

Trees with Scaly Barks.—The scaly-barked trees are numerous. Some of the common species are bolly gum (*Litsea reticulata*), crow's ash (*Flindersia australis*), yellow-wood (*Flindersia Oxleyana*), crow's apple (*Owenia venosa*), red cedar (*Cedrela toona*, var. *australis*), white beech (*Gmelina Leichhardtii*), rosewood (*Dysoxylon Fraserianum*), scentless rosewood (*Synoum glandulosum*), deep yellow-wood (*Rhodosphæra rhodanthema*), and southern penda (*Xanthostemon oppositifolius*).

Trees with Very Smooth, Thin Barks.—The ironwood (*Myrtus Hillii*) and the giant ironwood (*Syncarpia subargentea*) have very smooth, thin barks. The bark of an ironwood 10 inches in barrel diameter measured $\frac{1}{16}$ -inch thick; and that of a giant ironwood 3 feet in diameter $\frac{1}{8}$ -inch thick. In both trees the surface of the bark is often bright-green or bright-brown. The ironwood rarely exceeds 10 inches in barrel diameter. The marara (*Weinmannia lachnocarpa*) has a thin but not very smooth bark, which measures $\frac{3}{16}$ -inch on a tree with a barrel diameter of 2 feet 3 inches, and which is generally deep-red when cut.

Trees with Yellow Inner Barks.—The following trees have yellow inner barks:—Black bean or Moreton Bay chestnut (*Castanospermum australe*), lignum-vitæ (*Vitex lignum-vitæ*), blueberry ash (*Elæocarpus obovatus*), mountain beech (*Elæocarpus Kirtonii*), quandong or blue fig (*Elæocarpus grandis*), *Elæocarpus foveolatus*, *Elæocarpus ruminatus*, and *Elæocarpus sericopetalus*. The species of *Elæocarpus* generally have a yellow surface on the sapwood, which is seen when the bark is removed. This peculiarity is often a well-marked one, and proved serviceable to the writer recently in locating species of *Elæocarpus* in the Eungella Range. The inner surface of the bark in these trees is generally similarly tinted. It was noticed in the case of the blueberry ash that after some hours' exposure the yellow colouration turned to a bluish tint.

Trees with Ochre-Coloured Inner Barks.—At least two species of trees of the natural order *Celastrineæ*—namely, the ivorywood (*Siphonodon australe*) and the orange bark (*Celastrus dispermus*)—have very distinctive inner barks. When the outermost layer of bark is removed an inner layer of an ochre-yellow or brown colour is exposed in the ivorywood and an orange-coloured layer in the orange bark. This peculiarity of these two trees was pointed out to me by bushmen and others. Somewhat similarly coloured inner barks may be found in other species of this natural order.

Trees with a Wrinkled Surface on the Sapwood.—A large number of trees of the natural order *Sapindaceæ* and a few of the natural order *Laurineæ* have a peculiar wrinkled surface on the sapwood which is seen when the bark is removed. The wrinkles are disposed longitudinally and suggest the appearance of corduroy cloth, or in coarser

examples, such as that provided by a species of *Cryptocarya*, they simulate the corrugations of a washing-board. This wrinkled surface has so far been observed in the following species of *Sapindaceæ*:—Native tamarind (*Diploglottis Cunninghamii*), *Cupania xylocarpa*, *Ratonia pyriformis*, *R. tenax*, corduroy (*R. stipitata*, wrinkles prominent), small tamarind (*Nephelium Lautererianum*, wrinkles prominent), *Nephelium semiglaucum*, *Heterodendron oleæfolium*, and *H. diversifolium*. The Lauraceous trees which exhibit this peculiarity are few in number. One of them is an undetermined species of *Cryptocarya* (referred to above) from Eungella Range, which is the only locality in which the wrinkled surface has so far been observed in *Laurineæ*.

Occurrence of Black Wood (Ebony) in Queensland Ebenaceæ.—The species of the natural order *Ebenaceæ*, of which there is a considerable number in our rain forests, very frequently contain patches, streaks, or specks of black wood similar in appearance to the ebony of commerce (species of *Diospyros* and *Maba*). These black patches, streaks, or specks have been observed in the following species of the order in Queensland:—*Maba humilis*, *M. geminata*, *M. fasciculosa*, *M. reticulata*, black myrtle (*M. sericocarpa*), *Diospyros pentamera*, and *D. hebecarpa*. In *Maba humilis*, which is known as native ebony, the black wood is developed in fairly large quantities. Solereder⁷ states that the black colour of ebony is due to black or brown contents present in the wood vessels and in the lumina of the wood prosenchyma; that Belohoubek has shown that part of the black contents is soluble in caustic potash, and is due to humic acid whilst the part insoluble in alkalies consists essentially of carbon; and that Molisch had shown earlier that the black contents arise by a process of humification from a gum present in the cell lumen.

Trees with Very Soft Woods.—The giant stinging tree (*Laportea gigas*), glossy-leaved stinging tree (*Laportea photiniphylla*), flame tree (*Brachychiton acerifolium*), scrub bottle (*Brachychiton discolor*) and the Queensland bottle tree (*Brachychiton rupestre*), which is sometimes found in the light rain forests, have very soft, porous woods. The woods of *Panax elegans* and *P. Murrayi* are also soft, but not to the same degree as those of the stinging trees.

⁷ Solereder, "Systematic Anatomy of the Dicotyledons," trans. Boodle and Fritsch, revised D. H. Scott, Vol. I, p. 518 (1908).

Trees with Woods Depositing Brightly-coloured Ashes.

—A limited number of rain-forest trees, when burnt, deposit coloured ashes which are noticeable in newly burnt felled “scrub.” Among the most conspicuous examples are the bonewood, pink-heart or native orange (*Medicosma Cunninghamii*), which deposits a bright blue ash, and the ironwood (*Myrtus Hillii*), which deposits a bright yellow ash. The bonewood, which rarely exceeds a barrel diameter of 9 inches, owes its common name to the brittleness of the wood which is brought under the notice of axemen by the circumstance that the first blow with the blade of the axe often detaches a large flake of the bark and wood. The name pink-heart originates from the bright pink central heart-wood which often traverses the barrel.

Trees with Coloured Woods.—A very large number of trees have coloured woods, but only a few of the more distinctive ones can be mentioned here. The deep yellow-wood (*Rhodosphaera rhodanthema*) has a bright yellow heartwood. The wood of yellow sassafras (*Doryphora sassafras*) is also bright yellow. The black bean (*Castanospermum australe*), lignum-vitæ (*Vitex lignum-vitæ*), and hauer (*Dissiliaria baloghioides*) have dark-coloured heartwoods which generally fade to a lighter colour after a few weeks' exposure. The tulip wood (*Harpullia pendula*) has dark streaks in its heartwood. Trees with red woods are numerous; among the more common are red cedar (*Cedrela toona* var. *australis*), rosewood (*Dysoxylon Fraserianum*), scentless rosewood (*Synoum glandulosum*), maiden's blush (*Sloanea australis*), red ash (*Alphitonia excelsa*), onion-wood (*Dysoxylon* sp.), red bean (*Dysoxylon* sp.) and crow's apple (*Owenia venosa*).

The Large Medullary Rays of Proteaceæ.—It is well known to wood technologists and others that large and conspicuous medullary rays are very often characteristic of the woods of many species of the natural order *Proteaceæ*, such as the silky oaks and beefwoods (*Grevillea* spp., *Macadamia* spp., *Orites excelsa*, *Cardwellia sublimis*, *Stenocarpus* spp.). The ends of these large rays are visible as small more or less elliptical spots on the surface of the sapwood when the bark is removed. The “soft tissue” or wood parenchyma of Proteaceous timbers is very frequently arranged in short lines transverse to the medullary rays.

Trees Exuding Latex.—A number of trees exude a milky juice or latex when the bark, sapwood, or succulent parts is cut or ruptured. This group includes the majority of the Queensland species of the natural order *Sapotaceæ*, comprising the genera *Sideroxylon*, *Chrysophyllum*, *Lucuma*, *Hormogyne* and *Mimusops*; many species of the natural order *Urticaceæ* such as the species of fig trees (*Ficus*) and the axe-handle-wood (*Pseudomorus Brunoni-ana*); several species of the natural order *Euphorbiaceæ* such as the scrub poison tree (*Excæcaria Dallachyana*) and the majority of the species of the natural order *Apocynaceæ* such as *Alstonia* spp. including the native quinine tree (*Alstonia constricta*) and the milky pine (*A. scholaris*), *Cerbera odollam* and *Ochrosia* spp. Among the species of figs, *Ficus stenocarpa* is exceptional, as its juice is not milky. The flow of latex from species of *Ficus* and *Excæcaria* is generally copious.

Trees Whose Sap or Woody Parts Change Colour on Exposure.—The scrub bloodwood (*Baloghia lucida*), a tree rarely exceeding 1 foot in barrel diameter, has a bark more or less stained by a reddish brown sap which is frequently transformed into scattered hardened spots or nodules giving the bark a rather rough appearance. When the bark is freshly cut the sap appears colourless and turns bright red after a few seconds' exposure to the air. The native olive (*Olea paniculata*) attains about 1 foot 8 inches in barrel diameter in South Queensland rain forests. The barrel is sometimes flanged at the base and the bark on large trees slightly fissured or wrinkled with small warts arranged in longitudinal lines or rows in the wrinkles or shallow fissures. The bark and sapwood when freshly cut are white or pale, but turn pink after being exposed to the air for ten or fifteen minutes.

Trees Whose Freshly Cut Bark and Sapwood have a Characteristic Odour.—The mango bark (*Bursera australasica*) possesses an odour of mangoes in its freshly cut bark and sapwood. The sassafras (*Cinnamomum Oliveri*, *Doryphora sassafras*, and *Daphnandra aromatica*) have a strong smell of sassafras. Native cascarilla (*Croton insularis*) has an odour like that of official cascarilla bark (*Croton Eleuteria*). Red cedar (*Cedrela toona* var. *australis*), rosewood (*Dysoxylon Fraseranum*) and incense

wood (*Amoora nitidula*) have an aroma like that of the cedar oil used for oil immersion lenses, the aroma being present in the timbers, too. Some species of *Dysoxylon* have a disagreeable odour like that of onions and are, accordingly, sometimes called "onionwood" by bushmen. The turnip-wood (*Akania Hillii*) has a strong odour of turnips. *Panax elegans*, sometimes known as celery-wood, has a faint smell of celery. Black bean (*Castanospermum australe*) has a pumpkin or cucumber-like smell. Species of the natural order *Laurineæ* generally possess more or less fragrant barks. The aroma of the bark and wood of red cedar is often noticeable in the crushed green leaves, and is sometimes a useful means of identifying them.

Trees with Deciduous Leaves.—The majority of Queensland rain-forest trees is evergreen. The following species, however, are deciduous:—red cedar, white cedar, (*Melia Azedarach*), and *Ficus Cunninghamii*. The koda (*Ehretia acuminata*), *Ficus gracilipes*, flame tree (*Brachychiton acerifolium*), scrub bottle tree (*Brachychiton discolor*), Burdekin plum (*Pleiogynium Solandri*), and the Mackay cedar (*Albizzia toona*) are partly, if not truly, deciduous, and are often seen with very young leaves in the spring or early summer months—September, October, or November.

Trees with Leaves which Turn a Brilliant Red Colour in Age.—The leaves of the quandong (*Elaeocarpus grandis*) and the mountain beech (*Elaeocarpus Kirtonii*) turn a brilliant red colour in age. They are often conspicuous on the trees and on the ground beneath. Another species, the so-called native "bleeding heart" (*Homalanthus populi-folius*), which rarely attains the size of a timber tree and is more commonly seen as a shrub, has leaves which turn a deep red colour when old.

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