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J. H. MAIDEN, I.S.O., F.R.S., F.L.S.,

GOVERNMENT BOTANIST

AND DIRECTOR OF THE BOTANIC GARDENS,

SYDNEY.

VOL. VI.

PARTS 51 — 60.

136663
4:9:15
212341
19:5:27

Sydney:
WILLIAM APPLEGATE GULLICK, GOVERNMENT PRINTER.

1917.

97647 A

VI

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Sydney : William Applegate Gullick, Government Printer.—1917.

No. 185.

Hakea Ivoryi Bailey.

Ivory's Hakea.

(Family PROTEACEÆ.)

Botanical description.—Genus, *Hakea*. (See Part XLVI, p. 105.)

Botanical description.—Species, *H. Ivoryi* Bailey in the *Queensland Flora*, p. 1346, with a Plate.

A tree attaining a height of 30 to 40 feet, with a thick corky bark, branchlets often dark and more or less clothed with short appressed hairs.

Leaves terete, pungent pointed, smooth, very slender, usually under 6 inches long, simple or once or twice forked, often crowded on the branchlets.

Inflorescence silky-hairy, in simple racemes or paniculate with irregular raceme-like branches, some 3 inches long, dense, peduncles short, on which the hairs sometimes form strigose tufts.

Pedicels hairy, 3 lines long.

Perianth-tube hairy outside, 3 lines long, greenish white (perhaps when fresh yellowish white), slightly enlarging towards the pedicel, revolute under the globular limb.

Gland purple, prominent, narrow horseshoe-shaped.

Ovary stipitate, glabrous or slightly hoary.

Style glabrous; stigmatic disk conical in the centre.

Fruit nearly straight, 1¼ inch long, ½ inch broad, shortly tapering to the stipes and from above the middle upwards; dorsal protuberances small. Seed wing not decurrent along the nucleus. (*Op. cit.*)

Contrasted with allied species it has terete, smooth, pungent-pointed leaves, usually under 6 inches long, and once or twice forked. Flowers racemose, or in racemose-panicles. The perianth-tube is hairy outside.

Botanical Name.—*Hakea*, already explained (see Part XLVI, p. 106); *Ivoryi*, in honour of William Alexander Laurie Ivory, who collected it and sent it to the describer.

Vernacular Name.—A "Cork-wood," because of its thick corky bark. It could be called "Ivory's Hakea," of course, but if any man were to adopt that vernacular, a reasonable question would be to ask him what objection he has to *Hakea Ivoryi*.

Timber.—Mr. R. J. Dalton, of Wanaaring, N.S.W., informed me some years ago, "The best timber for bullock-yokes, and is far superior to the Oak (*Casuarina*) which comes from inside districts; no use for anything else." If it be the "best" timber for a specific use like bullock-yokes, it must be a timber of some merit, and it is well worthy of further inquiry.

Size.—A medium-sized tree, but it is little known in New South Wales.

Habitat.—Confined to the drier parts of Queensland and New South Wales, so far as we know at present. We want very much more information as to its distribution.

The Queensland localities quoted by Mr. F. M. Bailey are both in the Cunnamulla district, and are:—

Bingara, a little west of Eulo, which is still further west of Cunnamulla (J. F. Bailey); and Charlotte Plains, a few miles north-east of Cunnamulla (W. A. L. Ivory).

It has since been found in New South Wales, viz.:—

Tuncoona, near Bourke (R. Ridge, recorded by Mr. R. T. Baker, *Proc. Linn. Soc. N.S.W.* xxxi, 716).

Wanaaring on the Paroo River (R. J. Dalton).

EXPLANATION OF PLATE 190.

A. Flowering twig.

B. Bud.

C. Unopened flower.

D. Opened flower, showing—
- (*a*) Four-lobed corolla, with sessile anthers in the concave laminæ.
- (*b*) Ovary.
- (*c*) Style.
- (*d*) Stigma.

E. Portion of flower (corolla removed), showing—
- (*a*) Hypogynous gland, or oblique torus.
- (*b*) Stipitate ovary.
- (*c*) Style.
- (*d*) Stigma.

F. Anther.

G. Stigma.

H. Twig with fruits.

I. Half of capsule, with (*a*) seed, and (*b*) persistent horse-shoe shaped gland. (See *Ea.*)



A HAKEA.

(*Hakea Ivoryi*, BAILEY.)

No. 186.

Eucalyptus gigantea Hook. f.

A Mountain Ash or Gum-topped Stringybark.

(Family MYRTACEÆ.)

Botanical description.—Genus, *Eucalyptus*. (See Part II, p. 33.)

Botanical description.—Species, *E. gigantea* Hook. f. in *Lond. Journ. Bot.* vi, 479 (1847).

This is a species which has been the cause of much synonymy and uncertainty, because it was confused (and most pardonably so) by its original describer and subsequent botanists with *E. obliqua* L'Hérit.—a species whose identity had not been made clear at the time.

The original description may be translated as follows:—

Branches and Branchlets smooth, elongated, slender.

Leaves alternate, petiolate, ovate-lanceolate, obliquely curved and acuminate, very unequal at the base, and with a distinct midrib and spreading lateral veins.

Pedicels many-flowered, elongated.

Buds linear-clavate, obtuse.

Calyx-tube pedicellate, obconical when in flower, with a short hemispherical, obtuse or nearly acute operculum, as broad as the calyx-tube.

Fruits rather large, pedicellate, from obconical-hemispherical to turbinate, somewhat contracted at the mouth or nearly globular and hardly contracted. "Stringybark" of the colonists.

Tall tree 150 to 250 feet high and about 20 to 26 feet in diameter at the base. Branches and branchlets slender, elongated. Leaves 4 to 6 inches long and 1 to 1½ inches broad. Bud narrow, elongated, twice or thrice longer than the cup.

Hooker afterwards redescribed his species in the following words:—

(The first paragraph following is a translation of the Latin.)

A gigantic tree with slender pendulous branches and large slender petiolate leaves, ovate lanceolate at the base and gradually acuminate, opaque, much unequal at the base, and with a distinct midrib and spreading veins, with elongated many-flowered pedicels (peduncles) with nearly clavate pedicellate calyces, with a short, hemispherical, obtuse or rather acute operculum, with a pedicellate rather large capsule, turbinate, obconical, hemispherical or subglobose, woody, somewhat contracted at the mouth, flat or abruptly depressed inside, with included valves. (*Gunn*, 1095, 1104, 1106, 1965, 1966.) (Tab. XXVIII.)

This forms a gigantic tree, specimens having been felled in the valleys at the base of Mount Wellington, 300 feet high and 100 feet in girth, of which a full account is given in the "Proceedings of the Royal Society of Tasmania." It is also a most abundant species, and forms the bulk of the forests of the elevated tableland of the interior and flanks of the southern mountains. It is difficult so to define its

characters that it shall be recognised by them, but it is a well-known and readily distinguished species in the forest. At all periods of growth it has a tall, straight trunk, and few terminal branches, never very leafy or umbrageous. In some varieties the young branches have a fine glaucous-purple bloom on them, especially in alpine localities; such is the case with Mr. Gunn's No. 1095, from the banks of Lake St. Clair, where it forms a forest on one side of the lake only, to the exclusion of all other timber. *Bark* flaking off in stringy masses, used formerly by the natives for huts, canoes, etc. *Branchlets* slender, pendulous. *Leaves* broader than in most other species of this section, 4–7 inches long, ovate at the broad oblique base, then lanceolate and tapering to an acuminate point, surface not polished; nerves diverging. *Peduncles, flower* and *fruit* so variable, that it is difficult to characterise them; usually the peduncles are stout, woody, as long as the petioles; the flowers very numerous, and forming a capitate head; the pedicels stout; calyx turbinate; operculum hemispherical. *Capsule* woody, gradually or suddenly contracted at the pedicel, spherical or oblong, obconic, with a contracted, not thickened, mouth, and sunk valves.—As in the other species, I have found very great differences in the flowers and fruits from upper and lower, older and younger, slender and stout branches. *Flora of Tasmania*, vol. I, p. 136.

The plate (XXVIII) accompanying this description, and which has been reproduced in its essential details in Plate 191 of the present work, is, in the light of later knowledge, quite clear.

As has already been said, Hooker mixed two closely allied trees, and it is better to disentangle the confusion, making it clear what refers to *E. obliqua*, what to *E. gigantea*, than to perpetuate the confusion by permitting botanists to continue to assume that one is a synonym of the other, and to ignore Fitch's beautiful plate in Hooker's work.

Neither Hooker's original description nor his amended one in *Flora Tasmaniæ* applies exclusively to *E. obliqua* or *E. gigantea*. There is more to go upon in the *Flora Tasmaniæ*.

First, we have Gunn's specimens Nos. 1095, 1104, 1106, 1965, 1966, which are as follow:—

1095 is *E. obliqua*. Some of the material under this number may be *E. gigantea*.
1104 is *E. obliqua*.
1104 (second specimen) is *E. gigantea*.
1106 is *E. obliqua*.
1965 is *E. gigantea*.
1966 is *E. gigantea*.

I have re-examined the above specimens, with some additional material; I had previously examined them for my *Critical Revision Eucal.*, i, 178.

The glaucousness is by far the commoner in *E. gigantea*, but it occurs also in *E. obliqua*.

Then as to the use of the terms "Stringybark" and "Stringybark Gum," as applied by Hooker, *E. gigantea* is often known as "Stringybark," although it is more frequently applied to *E. obliqua*. Indeed, perhaps the commonest name for the former is "Gum-topped Stringybark," the branches being more or less smooth. The two trees often carry the same vernaculars, especially when not fully grown.

Undoubtedly the two species are closely allied. Some years ago I made *E. gigantea E. obliqua* var. *alpina*, and there is much to be said in favour of that view. According to the opinions of various people as to what amount of difference constitutes a species as distinct from a variety, so one may look upon it as a variety of *E. obliqua*, and another as a distinct species. I think it is better to look upon this tree as a distinct species, but I came to that conclusion very gradually. I have specimens which most closely connect the two species, whose affinities are not so obvious from typical forms.

E. gigantea generally succeeds *E. obliqua* in alpine situations. Its bark is whiter, more matted (box-like)—that is to say, less fibrous; while the branches are smoother and more glaucous, the opercula less pointed, the fruits more pear-shaped, and the foliage more succulent and more pleasantly aromatic.

E. gigantea was subsequently described by Mueller in *Fragm.* ii, 44, and at p. 45 its supposed differences from *E. obliqua* L'Hérit. were stated. *E. obliqua* was then not known to him, and he followed Hooker in confusing the two species.

Botanical Name.—*Eucalyptus*, already explained (see Part II, p. 34); *gigantea* (Latin), pertaining to the giants—hence gigantic or very large, in reference to the size of the tree.

Vernacular Names.—"Stringybark," or "Stringybark Gum," and "Gum-topped Stringybark," the two latter names in reference to the comparative smoothness ("gum"-like) of the upper part of the trunk. "Woolly Butt" of Gippsland, for obvious reasons. It is called "Mountain Ash" in New South Wales, but not to be confused with *E. Sieberiana* F.v.M. (see Part XXXIV of the present work). The name is given because of its resemblance to Ash timber.

Synonyms.—It has long been confused with *E. obliqua* L'Hérit., as already explained, and also to a lesser extent with *E. hæmastoma* Sm., *E. delegatensis* R. T. Baker, and *E. obliqua* L'Hérit. var. *alpina* Maiden, are synonyms.

Leaves.—They are often glaucous, and exhale a delicious and dainty aroma.

Bark.—This tree has tall, clean, tapering trunks, the bark on the lower half of stem very thick and woolly, like stringybark; this ceases abruptly at about half the height of the stem or barrel, no matter what height the tree or length of stem may be. Above this the bark is quite clean, very thin, only about half an inch thick, of a pale bluish grey or whitish colour, the old bark peeling off in long thin strips which do not generally hang loosely about the stem and branches, as is the case with *E. regnans*. (H. Hopkins, in letter.)

Timber.—Remarkably sound at heart, few trees being less liable to show any signs of pipe or heart decay. Remarkably light in weight and colour, easy to work, and very suitable for joiners' work. It splits freely, but is not durable in the ground.

In Tasmania it is used for fencing, palings, and railway sleepers.

In New South Wales it is used in the districts in which it is found, for snow-shoes, whilst its paleness and pleasing grain has commended it for use as bedroom furniture, and Mr. W. Kopsen, of Sydney, has extensively employed it in the manufacture of boat oars and implement handles, which have displaced much of the American trade (the product of American Ash) in these articles.

The timber of *Eucalyptus gigantea* is one of the most valuable of the Eucalypts, and its utilisation is capable of enormous development. Australians who desire to see the products of their country utilised, should take the trouble to ascertain the merits of this timber, and encourage those firms which are enterprising enough to utilise it.

Mr. T. H. Williams, District Forester, Tumbarumba, speaks thus enthusiastically of this timber :—

Although I have seen our best forests, and had years of experience as a sawmiller before coming to this district, I shared the common prejudice that Mountain Ash was an inferior, soft, spongy timber, its use only justified where other timbers could not be got.

My experience was confined to the Coast Mountain Ash (*E. obliqua*), which, although a good timber for inside use, will not last in the ground or when exposed to the weather. *E. Sieberiana*, although better than *obliqua*, is still much inferior to *gigantea*.

E. obliqua and *Sieberiana* will grow in various kinds of soil and climate, but *gigantea* is *never* found below winter snowline nor a mile away from volcanic soil. It is a rapid grower, and fully 95 per cent. of seedlings grow perfectly straight; it produces more trees to the acre than any hardwood, reaches a good height—frequently 150 feet to the first limb—and is an ideal timber for the sawmiller, being seldom more than 6 feet in diameter, is round, straight as a gun-barrel, with very little taper. I recently measured a log 84 feet long, 5 ft. 10 in. in diameter at the butt-end, and 3 ft. 1 in. at small end—a taper of only 2 ft. 6 in.

This quality makes it especially valuable as a girder, either round or square.

It is absolutely the best reafforester in the State. On an area at Pilot Hill (Bago Forest), which I saw ringbarked in June, 1910, there is now (June, 1912) a dense jungle of seedlings, many of them 20 feet high.

The timber is pale, hard, close-grained, not unlike English oak, for which it is frequently substituted in cabinet work, coffins, and picture frames. For heavy work, such as girders and the top structure of bridges, I believe it to have few equals, and only one superior, viz., grey ironbark. I know of beams and girders which have been in position over fifty years, and are still as sound as when first put in.

A girder and ground plate at Mr. Hides' abandoned sawmill, erected twenty-nine years ago, are still quite sound. The girder is 15 inches in diameter at butt and 11 inches at small end. With a 32-foot span it carries the weight of the flat roof, which every winter is covered with feet of snow many tons in weight, and there is no sign of bend or sag. The ground plate held the bench in position and stood the strain of a twelve horse-power engine for seventeen years, and for the past eleven years has been in the open, exposed to all weathers; the piles and posts of the old building are still quite sound. Culverts put up twenty-five years ago, and decked with Mountain Ash, still carry a traction engine and loads of logs.

Mr. Hides' house was built of ash weatherboards and shingles thirty-four years ago; the roof is still perfectly watertight, and the boards, which never had a coat of paint or a verandah to protect them, show absolutely no sign of decay. It has been used by Messrs. Davies and Kershaw, at Adelong, for several years in making wood pipes in connection with their hydraulic dredging and sluicing operations, and pronounced by them superior to iron, standing a much greater pressure. I could go on quoting instances of its durability.

As an ex-sawmiller, contractor, and bridge builder, I do not hesitate to recommend its use as girders, corbels, wales, braces, and decking on all top work requiring durability and tensile strength. Builders like it because it is easily worked, and, without boring, it will not split when large nails or spikes are driven into it. I have seen many instances of its durability in the ground, and believe it would make a good pile or sleeper; but I do not recommend its use for those purposes, because we have growing in the same locality the Messmate (*E. amygdalina*), which has no superior as a pile (not even ironbark). I have samples of Messmate now in my office, which are known to have been in and on the ground forty-five years, and have not even started to decay. For another reason, I believe Mountain Ash to be too valuable to be used for squaring into sleepers and cut under-sized for piles, because I believe it will in the near future be recognised as one of the very best timbers, only inferior to American hickory for one or two special purposes, and superior to that timber in every other respect, as it is lighter, more elastic, and for bending purposes has few equals, and no superior.

It will bend to any shape, and no matter how thoroughly dried will retain all its elasticity, and its fibre is practically non-perishable. It makes the best snow-shoes, and timber for that purpose is annually sent to Sweden and Norway. Boat oars made at Laurel, up to 28 feet long, have a world-wide reputation, and are pronounced by experts in all the principal seaports to have no equal.

Window-frames, sashes, and doors, hand-made over fifty years ago, are still in buildings here. Tool handles of all descriptions are made at Laurel Hill factory, sent all over the world, and the demand cannot be met. Wine casks made of it over forty years ago are still in use at Albury. When thoroughly dry it is tasteless and stainless, and would be suitable for butter boxes or any kind of box requiring lightness, durability, and strength.

For backs of brushes, furniture, cabinet-making, and all kinds of turnery it is unsurpassed, takes a high polish, and shows good figure. Heavy waggons, light sulkies, and buggies are made of it. A waggon made nine years ago is now hauling sleepers to the Tumbarumba Railway. A sulky now at Laurel Hill, made entirely of Mountain Ash, and in constant use for fourteen years, is still as good as new. I have noticed that in a few instances where it has not given satisfaction in the ground the timber has been from very young trees felled in the spring, and put on the market right away. This is a test that no timber will stand. From experiments I have made I find that timber from trees felled in the winter and autumn, and allowed to season in the log for a few months, will not shrink.

Size.—It is one of the largest of our trees, and trees up to 150 feet in height are not uncommon.

Habitat.—Found in Tasmania, north-eastern Victoria, and south-eastern New South Wales. In the two latter States it is confined to high elevations, and in Tasmania it is usually found high up, but it descends to 1,500 feet at Mount Wellington, and to 500 feet at Russell Falls River, and perhaps even lower. As a rule, it is found at higher elevations than is *E. obliqua*. In Victoria, it is found in the Australian Alps, and as far south as Mount Donna Buang.

In New South Wales it occurs in the Snowy Mountains and the Australian Alps, also at elevations not much below 4,000 feet over a fairly wide area. Specific localities are Delegate Mountain, Tumberumba district generally, while it is found as far north as Brindabella-road, Queanbeyan.

"Found in volcanic soil in the winter snow-clad tableland commencing at Laurel Hill, extending in huge belts many miles in extent, *viâ* Tumbarumba, Neurenmerrenmong, Lobb's Hole, and Kiandra, almost to the foot of Kosciusko, a piece of practically unoccupied Crown lands from 6 to 30 miles wide and 90 miles long. It is found all over the southern tableland on an area of about half a million acres, with, of course, breaks of Snow and Mountain Gum. I am sure, however,

there is at least an area of 300,000 acres densely timbered with Ash. There is a belt of Ash on the falls towards Queanbeyan and the head of the Cotter River, but it is not nearly so good as that grown on the tableland; in fact, high altitude seems essential to produce the best Mountain Ash."—(T. H. Williams.)

It being accustomed to heavy falls of snow, is a useful species for acclimatisation in other parts of the world presenting severe, but not extreme conditions.

EXPLANATION OF PLATE 191.

A. Flowering twig, reproduced from Plate 28, Vol. I, of Hooker's *Flora of Tasmania*, depicting his *E. gigantea*.

B. Leaf and fruit, reproduced from the same plate.

C. Fruit from Parattah, Tasmania.

D. Anthers.

E. Juvenile leaf from Laurel Hill, Tumbarumba, N.S.W.

PHOTOGRAPHIC ILLUSTRATIONS.

Eucalyptus gigantea (2 views), St. Bernard's Hospice, Victoria. (R. H. Cambage, photo.)

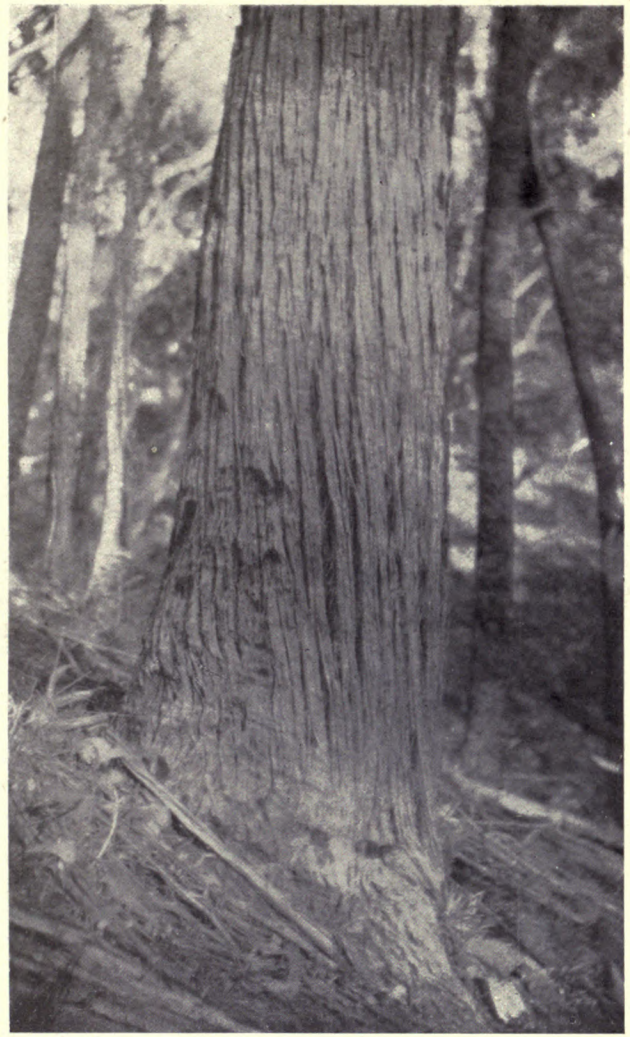
Eucalyptus gigantea. Guildford Junction, Tasmania. Locally called "Stringybark." Trees 150 feet high. (R. H. Cambage, photo.)

4 Views of Mountain Ash in the Tumbarumba district. (T. H. Williams, photo.)



A MOUNTAIN ASH.

(*Eucalyptus gigantea*, HOOK.,*f.*)





R. H. Cambage, photo.

Eucalyptus gigantea, ST. BERNARD'S HOSPICE, VICTORIA.



R. H. Cambage, photo.

Eucalyptus gigantea ("STRINGYBARK"), GUILDFORD JUNCTION, TASMANIA.
TREES 150 FEET HIGH.





T. H. Williams, photo.

MOUNTAIN ASH IN THE TUMBARUMBA DISTRICT.





T. H. Williams, photo.

MOUNTAIN ASH IN THE TUMBARUMBA DISTRICT.

No. 187.

Acacia hakeoides A. Cunn.

Western Black Wattle.

(Family LEGUMINOSÆ: MIMOSEÆ.)

Botanical description.—Genus, *Acacia*. (See Part XV, p. 103.)

Botanical description.—Species, *Acacia hakeoides* A. Cunn.

It was described by Bentham from Cunningham's MSS. (the descriptions of which were usually prepared by Cunningham with the utmost care) in the *London Journal of Botany*, i, 354 (1842).

Following is a translation of the original description :—

Glabrous, with somewhat angular branches and linear-spathulate, obtuse and often truncate phyllodia, much narrowed at the base, rather thick, with hardly a prominent margin and a gland about the middle, one-nerved and indistinctly reticulate-veined, with racemes shorter than the phyllodia and about 20 flowers in the head, with spathulate nearly free sepals and a glabrous ovarium.

Phyllodia 2–5 inches long and 2–6 lines broad, more obtuse than in *A. crassiuscula*, thinner, more narrow at the base and less marginate than in *A. obtusata*, less incurved than in *A. gladiiformis* and the gland always solitary, thicker than in *A. penninervis* and always obtuse. Young sepals connate, easily separating during flowering time.

Lachlan and Dumaresq Rivers, N.S.W., *Cunningham*.

Bentham subsequently published the following description in English :—

A tall shrub, glabrous or nearly so, the branches scarcely angular. Phyllodia linear-spathulate or narrow oblong-lanceolate, obtuse, much narrowed at the base, 2–5 inches long, rather thick, 1-nerved, obscurely marked with longitudinal reticulations, the margins scarcely prominent, usually with a gland towards the middle. Racemes shorter than the phyllodia, with a few globular heads of about 20 flowers, mostly 5-merous. Sepals spathulate, cohering at first but readily separating, half as long as the corolla. Petals smooth, glabrous or minutely pubescent. Pod flat, usually curved, 2–3 lines broad, much contracted between the seeds. Seeds oblong, longitudinal ; funicle half as long as the seed, the last fold thickened into a clavate, keeled, fleshy aril, almost from the base, with 2 or 3 very minute folds below it. (B.Fl. ii, 367.)

Affinities.—Bentham (B.Fl. ii, 367) says, "Allied in flowers to *A. obtusata* and *A. crassiuscula* and in foliage to *A. salicina*, but differing in several points from each of these species." This is based on the words of the original description which has just been translated.

Taking these comparisons in detail, we have :—

(a) *A. crassiuscula*. There would appear to be no advantage in pursuing this comparison. See p. 113 (Part XLVI) and p. 153 (Part XLVIII) of the present work showing the uncertainty which has gathered around *A. crassiuscula*.

(b) *A. obtusata* Sieb. Compare Plate 177. The pods as well as the phyllodes are very different.

(c) *A. gladiiformis* A. Cunn. This species will be figured at Plate 196, next Part (LII).

(d) *A. penninervis* Sieb. See Plates 91 and 92 (Part XXIV). *A. penninervis* is a coast and mountain species with cream coloured (not bright yellow) flowers, curved, pointed phyllodes and broad pods.

Botanical Name.—*Acacia*, already explained (see Part XV, p. 104); *hakeoides*, from two words, *Hakea*, and the Greek *oidos*, like, the shrub having reminded the describer of a *Hakea*, one of those with leaves of medium width. My readers may refer to the plates of such species as *Hakea saligna*, *dactyloides*, &c. It would not appear that the similarity is very striking.

Vernacular Name.—It is oftenest called "Black Wattle," but it is a very different plant to *A. decurrens*, which bears that name in the coastal districts. It is so called because of the darkish cast of the young buds and branchlets. It is sometimes known as "Silver Wattle," a not very appropriate name in comparison with other Australian Wattles to which this name is more or less applied.

Aboriginal Name.—I am in some doubt as to what aboriginal name to append to this species, for it is scarcely possible to assume that they have not given it a name.

Leaves (Phyllodes).—Pituri (*Duboisia Hopwoodii* F.v.M.) is the best known masticatory of the Australian aborigines, and they chew it with the ashes of certain green leaves. Dr. T. L. Bancroft has made certain investigations, and finds that the leaves (phyllodia) of the present species are amongst the species that are so used.

Timber.—It being a small-sized tree, with rarely a trunk of much length, it is not important as a timber for ordinary industrial purposes; at the same time, it is a good fuel, as all Wattles are, more or less.

The drawback to this species, from the point of view of the landowner, is its capacity for suckering. In Australia many landowners clear their land, dealing with the trees indiscriminately, and working according to the calendar. The most fatal time for dealing with tree-growth is when it is in full flower; and if this be borne in mind as regards this particular Wattle, fewer complaints would be heard of its suckering.

Size.—A tall shrub or small tree, rarely exceeding 20 feet in height.

Habitat.—The localities quoted in the original description are "Lachlan and Dumaresq Rivers, New South Wales, Cunningham." The Lachlan River was visited by Cunningham on Oxley's Expedition in 1815. The Dumaresq is in the northern part of the State, approaching Queensland.

The specimen I have depicted is from the Lachlan district, and the species is fairly uniform over a considerable part of its range. I have not an actual specimen of the type, but I believe that what I have figured is practically typical.



M. Flockton del et lith.

WESTERN BLACK WATTLE.

(*Acacia hakeoides*, A. CUNN.)

Its range may be stated as portion of the drier parts of New South Wales, Queensland, Victoria, and South Australia. For example, we know it from—

(*a*) South Australia, Lake Torrens to Barrier Range, Plain of the Lower Murray River, and Yorke Peninsula.

(*b*) The north-west or Wimmera district of Victoria.

(*c*) The Pituri country of Queensland, which is in the vicinity of the Mulligan River.

Specific localities should be looked for in the above States.

As regards New South Wales, it is represented in the National Herbarium from the following localities; it extends over enormous areas in the south-west, western and north-western districts :—

"Silver Wattle," Tocumwal (Forester Payten); Moama (N. Watson); Weddin Mountain, Young district (J.H.M.); "Black Wattle," Wyalong (A. Osborne); "Black Wattle," an upright shrub or small tree of 5 to 10 feet. Produces suckers from roots, especially when cut. Common all over the Lachlan and Murrumbidgee districts (J. Duff); "Silver Wattle," Bogan Gate to Condobolin, also on Euabalong Road (J.H.M.).

Bathurst; more precise locality not stated (C. Moore).

Bowan Park, near Cudal (W. F. Blakely).

Up to 10 feet; liable to sucker. Bidden Road, 7 miles northerly from Gilgandra (R. H. Cambage); Tomingley to Peak Hill and Narromine (J.H.M.); Black Wattle, Dubbo district (J. L. Boorman); small shrubs to small trees, loosely branched, with stems crooked and misshapen (Coolabah to Girilambone, C. J. McMaster, R. N. Peacock, J. L. Boorman, J.H.M.).

Cobar and Mount Boppy (L. Abrahams, J. L. Boorman).

Talooby (R. T. Baker), Mudgee (J. D. Cox), Gulgong (J. L. Boorman, J.H.M.).

Wattle, about 10 feet, with Box and scattered Pine, Cuttabri, Pilliga Scrub (E. H. F. Swain). Brigalow Creek, 8–10 miles from Cuttabri; also on all red sandy loams between Cubbo and Baradine, Pilliga Scrub; also 10–11 miles, W.S.W. of Narrabri (Dr. H. I. Jensen).

Warrah, on dry sandy soil, accompanied by Callitris (Jesse Gregson).

EXPLANATION OF PLATE 192.

A. Flowering twig.
B. Flower-head.
C. Individual bud.
D. Flower.
E. Flower opened out, showing—
  (*a*) Calyx.
  (*b*) Corolla.
  (*c*) Pistil. (Stamens removed.)
F. Bract.
G. Pods from Bogan Gate, N.S.W.
H. Seed.

No. 188.

Polyosma Cunninghamii J. J. Bennett

Feather-wood or Yeralla.

(Family SAXIFRAGACEÆ.)

Botanical description.—Genus, *Polyosma, Bijdr.*, Blume, p. 658 (1825).

Calyx-tube ovoid, adnate to the ovary, the limb small, 4-toothed, persistent.
Petals 4, valvate, linear, erect and frequently cohering in a tube, spreading at the end, deciduous.
Stamens 4, anthers linear, erect.
Ovary inferior, one-celled, with numerous ovules attached to two parietal placentas, protruding far into the cavity and almost dividing it into two cells.
Style filiform, with an entire terminal *stigma*.
Berry ovoid, inferior, with a single large erect seed; testa rather thick; embryo small, in the summit of a fleshy albumen.

Trees.
Leaves opposite or nearly so, usually turning black in drying.
Flowers white or greenish, in terminal simple racemes. (B.Fl. ii, 438.)

Botanical description.—Species, *P. Cunninghamii* J. J. Benn. *Pl. Jav. Rar.* 196 (1852).

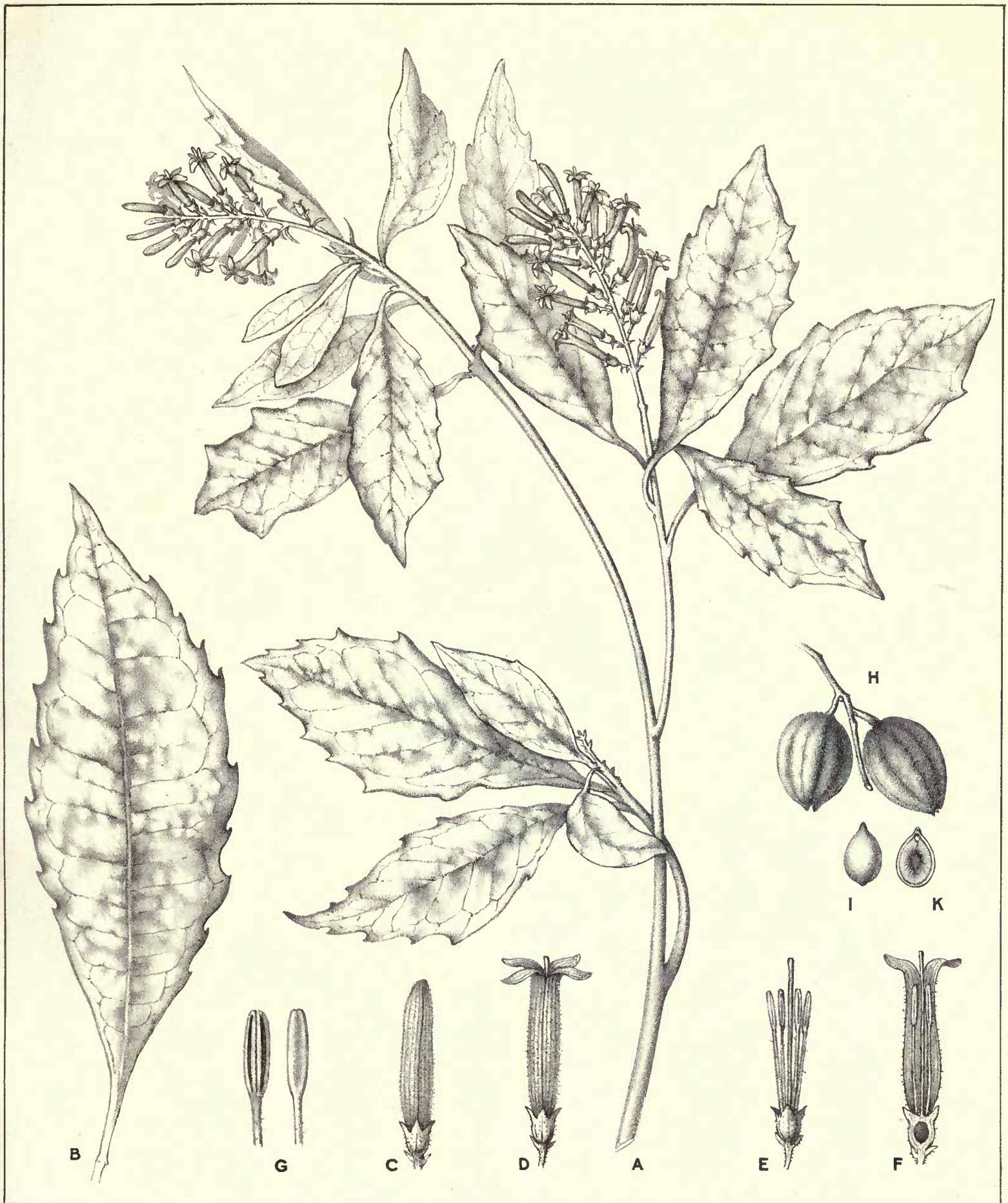
A tall shrub or small tree, quite glabrous except the inflorescence and flowers.
Leaves ovate elliptical, acuminate acute or rarely obtuse, 3 to 4 inches long, irregularly notched with callous teeth, much narrowed into a short petiole, somewhat coriaceous, penniveined.
Racemes usually shorter than the leaves.
Pedicels 1 to 2 lines long, with two minute bracteoles under the ovary.
Calyx-teeth small.
Corolla about 5 lines long, slightly pubescent outside with appressed hairs, the petals remaining long coherent in a narrow tube.
Fruit ovoid, above ½-inch long, crowned by the small persistent cup-shaped calyx-limb. (B.Fl. ii, 438).

Three other species have been described from Northern Queensland.

Botanical Name.—*Polyosma*, from two Greek words, *polu* (*poly*) and *osme*, signifying much and perfume, in reference to the flowers; *Cunninghamii*, in honour of Allan Cunningham, who appears to have been the first to collect it (1818).

Vernacular Name.—I have heard it called "Feather-wood" in southern New South Wales, also "Wineberry," but this name is not specially appropriate.

Aboriginal Name.—"Yeralla" of the aborigines of the Illawarra, New South Wales, according to the late Sir William Macarthur. "Yerrālla" is an earlier spelling by the same gentleman. Whether it is the same word as Yaralla (Concord), I do not know.



M. Flockton. del et lith.

FEATHER WOOD.

(*Polyosma Cunninghamii*, J. J. BENN.)

Flowers.—The flowers are very fragrant, yellowish-green and tubular—not very conspicuous.

Fruit.—The fruits are fluted, the fluting being the more conspicuous as drying proceeds.

Timber.—A pale coloured timber, with a neat, maple-like figure. It is fissile. If it were procurable in sufficient quantity, it would be worthy for test for bedroom furniture.

Size.—Sir William Macarthur gave the trunk diameter as 8 to 12 inches, and the height of the tree as 30 to 40 feet, which is perhaps a fair statement. Some specific sizes will be found quoted under "Habitat."

Habitat.—It is a native of coastal New South Wales chiefly. Mr. F. M. Bailey gives "Scrubs of the North Coast Railway" as a Queensland locality.

It was first collected by Allan Cunningham near "Five Islands" (Wollongong), "in sylvis umbrosis submontosis," in the year 1818, and this remains almost its most southerly recorded locality. I found it in a little park at Robertson, a few miles further south, and believe that search in the brushes will reveal it very much further south still.

The late Sir William Macarthur gave its locality in 1855 "from Illawarra, only upon the mountain side," and in 1862 "high up the mountain."

It is also not uncommon at Otford (J. H. Camfield, J. L. Boorman).

Following are some localities north of Sydney:—

Hogan's Brush, Narara (A. Murphy); Fernmount, Bellinger River, slim tree, 25 feet, 10-foot bole, 2–3 feet diameter (E. H. F. Swain); Dorrigo (W. Heron, J. L. Boorman); Ballina, 12–15 feet (W. Baeuerlen); Burringbar (W. Forsyth); Acacia Creek, Macpherson Range, 20 feet (W. Dunn).

Leichhardt collected it at "Brush of Piri, January, 1843." I do not know whether this is northern New South Wales or Queensland; a search in the record of his itinerary would show.

EXPLANATION OF PLATE 193.

A. Flowering twig.
B. Single leaf.
C. Flower-bud.
D. Flower with 4 linear, valvate petals.
E. Flower, the petals removed.
F. Vertical section of flower.
G. Anthers, front and back views.
H. Fruit, an ovoid berry.
I. Seed.
K. Vertical section of seed.

Drawn from specimens collected in the National Park, a few miles south of Sydney.

ABORIGINAL METHOD OF OBTAINING WATER.

We are indebted to the aborigines for a method of obtaining water, and that from a source in which we should perhaps least look for it. This simple method, which had best be given in the words of those who have had much intercourse with the blacks, is now given, and no adult in Australia should be ignorant of it. There is no doubt that a knowledge of this method of obtaining water would have been the means of saving the lives of many people who have suffered one of the most terrible of all deaths—death from thirst.

It frequently happens to the natives, when out in the mallee country, that the water-holes on which they had counted on obtaining a supply of water have dried up, but they are never at a loss. They select in the small broken plains some mallee trees, which are generally found surrounding them. The right kind of trees can always be recognised by a comparative density of their foliage. A circle, a few inches deep, is dug with a tomahawk around the base of the tree; the roots, which run horizontally, are soon discovered. They are divided from the tree and torn up, many of them being several feet in length. They are then cut into pieces, each about 9 inches long, and placed on end in a receiver, and good, clear, well-tasted water is obtained. The roots of several other trees yield water.—(Dr. Grummow.)

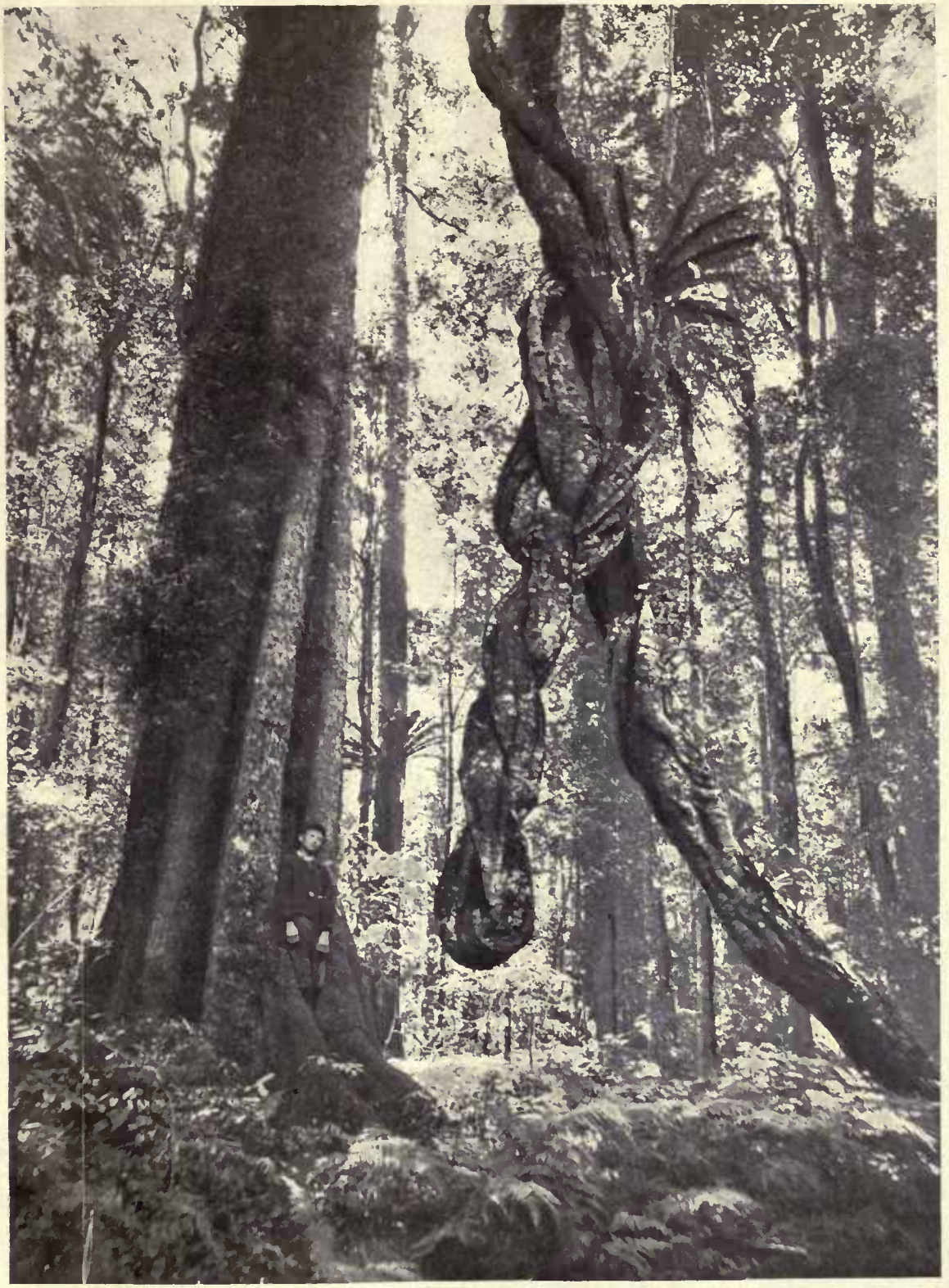
This method of obtaining water in arid regions has been described in almost similar language by many explorers.

How the natives existed in this parched country was the question! We saw that around many trees the roots had been taken up, and we found them without the bark, and cut into short clubs, or billets, but for what purpose we could not then discover. . . . . I expressed my thirst and want of water. Looking as if they understood me, they hastened to resume their work, and I discovered that they dug up the roots for the sake of drinking the sap. It appeared that they first cut these roots into billets and then stripped off the bark or rind, which they sometimes chew, after which, holding up the billet, and applying one end to the mouth, they let the juice drop into it.—*Three Expeditions* (Mitchell), pp. 196 and 199.

Then we have a short paper, entitled, "Notes on the Method of Obtaining Water from Eucalyptus Roots as practised by the Natives of the Country between the Lachlan and Darling Rivers," by the late K. H. Bennett, in *Proc. Linn. Soc. N.S.W.*, viii (1883–4), 213. He says :—

There are several kinds of trees from which water was obtained, including three species of Eucalyptus, a species of Hakea and Currajong. The Eucalypti consisted of a gum (the largest of the back country trees), a box, and mallee. The first named was the most preferred, as yielding the greatest quantity, and as the method was the same in all cases, this one will serve for a description of the *modus operandi*. This tree, which somewhat resembles the red gum in appearance—the leaves being narrow and of a silvery colour—grows chiefly on sandy or light loamy soil, and throws out numerous lateral roots at a depth of from 6 to 12 inches from the surface of the ground. The native, having ascertained the position of one or more of these roots by repeatedly jobbing the point of a spear or sharpened stick into the soft earth, and at a distance of some 6 or 8 feet from the trunk of the tree, quickly removes the superincumbent soil with his wooden shovel for 20 or 30 feet, and cutting the root off at each end, lifts it out of the trench, and cuts it up into lengths of about 18 inches to 2 feet, knocks off the bark, and stands the severed portions on end in some receptacle to contain the water (in former times a water-bag made of the entire skin of a male wallaby). As soon as these pieces are placed on end, the water commences to drip, and when the whole of the root or roots are cut up and placed on end, the native beginning at the first placed, puts the end in his mouth and by a vigorous puff expels the remaining water. The roots chosen are—with the bark on—about the size of a man's wrist; the larger ones being more woody and less porous contain little or no water. The water is beautifully clear, cool, and free from any unpleasant taste or smell.

I believe the trees referred to are *Eucalyptus rostrata* Schlecht., the Red Gum, *E. microtheca* F.v.M., the Coolabah, and *E. incrassata* Labill. var. *dumosa* F.v.M., one of the Mallees, and I would suggest to dwellers in the West that they should definitely ascertain what Eucalypts are so used before those blacks and whites who used the method pass away.



Sid. W. Jackson, photo.

HUGE WATER VINE *(Vitis)* GROWING UP INTO AND HANGING FROM A ROSEWOOD TREE *(Dysoxylon Fraserianum)*, DORRIGO SCRUBS, N.S.W.



Sid. W. Jackson, photo.

SID. W. JACKSON OBTAINING A DRINK FROM A CUT WATER VINE (*Vitis*) IN THE DORRIGO SCRUBS OF NEW SOUTH WALES.

Hakea leucoptera R.Br., one of the Needle-bushes, was similarly employed, the fleshy roots being stripped.

In an experiment on a water-yielding Hakea, the first root, about half an inch in diameter and 6 or 8 feet long, yielded quickly, and in large drops, about a wineglassful of really excellent water. (Lockhart Morton, *Proc. R. S. Vic.*, 1860, p. 132.)

The other plant mentioned by Mr. Bennett is the Kurrajong (*Brachychiton populneus* R.Br.).

Mr. A. T. Magarey, in a paper entitled "Aboriginal Water Quest," in *Proc. Roy. Geog. Soc. S.A.* (session 1894-5), quotes Eyre, Vol. I, 349–351, for an account of these water-bearing roots.

Speaking of the Desert Oak (*Casuarina Decaisneana*, F.v.M.), he quotes Mr. W. H. Tietkens ("Ooldea Water," region S.A.):—Travelling once with a small native boy of about 10 years of age, and towards the close of a dreadful day, the waterbag long since emptied and the boy gasping for water, and myself no better (the boy was riding a very unusually tall camel, we still had 15 miles more to travel), all at once a cry broke from him, and with one bound he was off that camel and running towards an oak-tree, well 4 chains distant at least. I stopped the camels and went up to him. He was clawing away at the hot sandy soil, and at last—snap. A root one and a half inches thick was broken, a hard pull, and about 8 feet of root was exposed, lifting the soil as it was raised. About 2 feet length was broken off and upended into the mouth, and a cold drink the result. But not sufficient; another and another length was broken off till we had sufficient. We did not take any more than one root, and I think there were eight or ten more such roots—enough in abundance for a dozen men. . . . . The water so obtained was cool, quite cool, colourless, and refreshing; but I have noticed that upon exposure to the air for a few hours it becomes a pale brown colour, such as would be noticed in water into which a piece of bark has been dropped.

Bloodwood (*Eucalyptus terminalis*), of Central Australia.—The bloodwood also is a "water-tree"; several Australian explorers refer to its qualities in this connection. Mr. W. H. Tietkens says of it: I have myself obtained nearly a bucket of water from the bloodwood tree at the Rawlinson Range. I was cutting this tree down for smoke-house purposes, and the water was not required.

Mr. G. A. Keartland ("Notes on the Zoology of the Great Desert of N.W. Australia," *Vict. Nat.* xxx, 43, says:—

Here I shot several chestnut-coloured wallabies—an adult male of which only weighed about 3 lb.—and two species of bandicoots. How they obtained water was at first a mystery, but on wandering near camp I found a quantity of the water-bearing mallee, and in many cases the animals had scratched the sand from the roots, and then, after gnawing through the wood, had sucked the precious fluid. I took up one of these roots (about 2 feet long), cut the ends with a sharp axe, and stood it in a pannikin. In ten minutes I had about an egg-cupful of water.

Now we come to the coastal districts, and *Vitis*, the native vine, has a number of species which have thick lianes or stems, which hang pendent from the trees. The earliest reference I can find is where the late Dr. George Bennett records that Mr. Bidwill's life (he was Director of the Botanic Gardens, Sydney, for a short period in 1847, and died in 1853) was saved when he was lost in the bush by the water he was able to procure by incising one of these vines (*V. hypoglauca* F.v.M.).

The two photos., taken by Mr. Sidney W. Jackson, show a huge vine of this sort growing up into and hanging from a Rosewood tree (*Dysoxylon Fraserianum*) in the Dorrigo brushes, New South Wales. He says this is the largest he has ever seen in his wanderings in this State and Queensland.

The second photograph shows him taking a drink from such a vine, and he informs me that he got many drinks daily in this way in the brushes. The vine is cut *almost* through, and again about 3 feet up (see X) from the drip to admit the air.

16

A Critical Revision of the genus Eucalyptus.*

THIS work is, like the present one, issued in Parts, and each Part also contains four plates (except Part IV, which contains twelve plates). It contains botanical details and critical observations which would be unsuitable for the present work, which is more of a popular character.

Of the New South Wales species of Eucalyptus, the following are dealt with in the "Critical Revision" (the number of the Part of which is given in brackets) :—

Eucalyptus acacioides, A. Cunn. (XI).
" *acmenioides*, Schauer (IX).
" *affinis*, Deane and Maiden (XIII).
" *amygdalina*, Labillardière (VI).
" *Andrewsi*, Maiden (VII).
" *apiculata*, Baker and Smith (IX).
" *Baueriana*, Schauer (XIII).
" *Behriana*, F.v.M. (X).
" *bicolor*, A. Cunn. (XI).
" *Boormani*, Deane and Maiden (X).
" *Bosistoana*, F.v.M. (XI).
" *Caleyi*, Maiden (X).
" *calycogona*, Turczaninow (III).
" *capitellata*, Smith (VIII).
" *Consideniana*, Maiden (X).
" *coriacea*, A. Cunn. (V).
" *crebra*, F.v.M. (XII).
" *dives*, Schauer (VII).
" *eugenioides*, Sieber (VIII).
" *fruticetorum*, F.v.M. (XI).
" *Gillii*, Maiden (XV).
" *globulus*, Labillardière (XVIII).
" *hæmastoma*, Smith (X).
" *hemiphloia*, F.v.M. (XI).
" *incrassata*, Labillardière (IV).
" *leucoxylon*, F.v.M. (XII).
" *Luehmanniana*, F.v.M. (IX).
" *macrorrhyncha*, F.v.M. (VIII).
" *Maideni*, F.v.M. (XVIII).
Eucalyptus melanophloia, F.v.M. (XII).
" *melliodora*, A. Cunn. (XIV).
" *microcorys*, F.v.M. (IX).
" *microtheca*, F.v.M. (XI).
" *Muelleriana*, Howitt (VIII).
" *obliqua*, L'Héritier (II).
" *ochrophloia*, F.v.M. (XI).
" *odorata*, Behr and Schlecht (XI).
" *oleosa*, F.v.M. (XV).
" *paniculata*, Sm. (XIII).
" *pilularis*, Sm. (I).
" *piperita*, Sm. (X).
" *Planchoniana*, F.v.M. (IX).
" *polyanthemos*, Schauer (XIII).
" *populifolia*, Hooker (X).
" *regnans*, F.v.M. (VII).
" *Rudderi*, Maiden (XIII).
" *siderophloia*, Bentham (X).
" *sideroxylon*, A. Cunn. (XII).
" *Sieberiana*, F.v.M. (X).
" *Smithii*, R. T. Baker (XII).
" *squamosa*, Deane and Maiden (XVII).
" *stellulata*, Sieber (V).
" *umbra*, R. T. Baker (IX).
" *uncinata*, Turcz. (XIV).
" *virgata*, Sieber (IX).
" *vitellina*, Naudin (VII).
" *vitrea*, R. T. Baker (VII).

* Quarto. Government Printer, Sydney. Two shillings and sixpence a part (Part IV, Six shillings). Part IV will be charged Two shillings and sixpence to subscribers only. For this work Mr. Maiden has received Eucalyptus specimens from the principal Herbaria throughout the world.

Sydney: William Applegate Gullick, Government Printer.—1913.

No. 190.

Hakea Macraeana F.v.M.

Macrae's Hakea.

(Family PROTEACEÆ.)

Botanical description.—Genus, *Hakea*. (See Part XLVI, p. 105.)

Botanical description.—Species, *H. Macraeana* F.v.M. in *Aust. Journ. Pharmacy* (Melbourne), November, 1886.

Following is the original description :—

Branchlets glabrous or scantily silky.

Leaves rather long, thinly filiform, glabrescent, underneath traversed by a slight longitudinal furrow, the apex gradually pointed.

Umbels usually only 3–6 flowered, almost glabrous.

Stalklets about as long as the small flowers.

Style glabrous.

Stigma lateral.

Fruit rather large, nearly ovate, very turgid, outside densely verrucular-rough, except at the much compressed slightly or not horned summit.

Seeds almost smooth, their membraneous appendage imperfectly decurrent on one side.

Leaves 3–5 inches long.

Petals $\frac{1}{4}$–$\frac{1}{3}$ inch long, pale coloured.

Ovary almost sessile, glabrous.

Hypogynous gland nearly square.

Fruit attaining a length of $1\frac{1}{2}$ inches, the margin of the valves slightly edged along the upper portion.

Seeds oblique-ovate, measuring about $\frac{1}{3}$ inch in length, shorter than the terminating membrane.

This species differs from *H. nodosa* in much longer and never compressed leaves, in somewhat larger flowers, fewer in each umbel, in evidently not yellow petals, in bigger and still rougher fruits, and in not tuberculated seeds; moreover, *H. nodosa* is always a low-lands species. The leaves of *H. Macreana* are much like those of *H. Persiehana*. The fruit is similar to that of *H. propinqua*, which species, however, has thicker, much shorter, and more rigid leaves, not unisulcate beneath, and also rougher seeds. (*Aust. Journ. Pharm.*, Nov., 1886.)

Mr. J. L. Boorman says its general habit of growth is like that of *H. propinqua*, but that its foliage has a silvery cast.

Botanical Name.—*Hakea*, already explained (see Part XLVI, p. 106); *Macraeana*, in honour of Mr. George Macrae, of near Braidwood, who assisted Mr. William Baeuerlen, the original collector of this species, in his botanical travels.

Vernacular Name.—This is one of our rather numerous "Needle bushes," or "Pin bushes," but it has no special name in the bush.

Timber.—This timber appears to be good. It is very soft, easy to work, of a bright pink to flesh colour when fresh, and has a pretty figure. But it is not likely that it will ever be commercially important, as its range is very restricted. I have no doubt whatever that further search will extend its range, but it is not likely that abundant forests of it will be found.

Size.—Sometimes a small tree, with a maximum trunk diameter of 14 inches, but it is usually a moderately tall shrub of 6 to 10 feet in height.

Habitat.—In the original description the localities given are "near the sources of the Shoalhaven River, and near the eastern tributaries of the Snowy River, at elevations of 4,000 feet."

These are localities in south-eastern New South Wales. A specific locality for the original specimens (collected by Mr. W. Baeuerlen) is Monga, or Sugar Loaf Mountain, about 15 miles east of Braidwood. It occurs on the top of Sugar Loaf Mountain, in common with *Eriostemon Coxii* F.v.M.

EXPLANATION OF PLATE 194.

A. Flowering twig.
B. Bud.
C. Unopened flower.
D. Opened flower, showing—
  (*a*) Four-lobed corolla, with sessile anthers in the concave laminæ.
  (*b*) Style.
  (*c*) Stigma.
E. Portion of flower (corolla removed), showing—
  (*a*) Hypogynous gland.
  (*b*) Ovary.
  (*c*) Style.
  (*d*) Stigma.
F. Anther.
G. Stigmatic disc.
H. Rugose fruit.
I. Seed.

Drawn from the type specimen, Sugar Loaf Mountain, near Braidwood. (W. Baeuerlen.)



M. Flockton. del. et lith.

MACRAE'S HAKEA.

(*Hakea Macraeana*, F.v.M.)

No. 191.

Eucalyptus microtheca F.v.M.

The Coolabah.

(Family MYRTACEÆ.)

Botanical description.—Genus, *Eucalyptus*. (See Part II, p. 33.)

Botanical description.—Species, *E. microtheca* F.v.M. in *Journ. Linn. Soc.* iii, 87 (1858).

Following is a translation of the original description, which is in Latin :—

A tree with slender nearly terete branches.

Leaves alternate, shortly petiolate, linear-lanceolate subfalcate, somewhat acute, dark, and without visible oil-glands, very thinly veined, the marginal vein close to the edge.

Umbels axillary, solitary or paniculate, few-flowered, the peduncles angular.

Fruits small, semi-ovate, not ribbed, shortly pedicellate, 3-to 4-celled, the valves inserted below the margin, and hardly exserted.

Fertile seeds blackish, smooth, not winged.

Hab.—Not rare in the fertile plains of Tropical Australia. Tree of middle size, with a dirty brownish-white bark full of wrinkles and cracks, persistent on the trunk, deciduous on the upper branches, leaving them ashy-white.

Leaves rather thin, 2–5 inches long, 4–8 inches broad.

Panicle shorter than the leaves, the peduncles variable in length.

Fruits 1½ to 2 lines long.

Seeds nearly ⅔ line long, peltate or truncate-ovate.

It was afterwards described in English by Bentham in *B.Fl.* iii, 223, as *E. brachypoda* Turcz., though with some confusion with *E. rudis* Endl.

Bentham's description is as follows :—

A tall shrub or small or moderate-sized tree, the bark varying from smooth and whitish to dark and rugged, persistent or shed in large patches (*Oldfield*), dark and rough on the trunk, smooth, whitish and deciduous on the branches (*F. Mueller*).

Leaves from ovate obtuse and under 2 inches to long-lanceolate obtuse acute or acuminate, and attaining 6 to 8 inches, more or less pale or glaucous, with numerous very fine parallel almost transverse veins, scarcely conspicuous when the leaf is thick, the marginal one near or close to the edge.

Peduncles short, terete or nearly so, each with about three to six or sometimes more small flowers; umbels usually three or four together in short panicles either terminal or in the upper axils, or rarely the lower ones solitary and axillary.

Calyx short, broad and open, 1 to 1¼ lines diameter.

Operculum conical or obtuse, not longer than the calyx-tube.

Stamens 1 to 2 lines long, inflected in the bud; anthers very small, globular, with distinct parallel cells.

Ovary convex in the centre.

Fruit almost hemispherical, rarely 2 lines diameter, the orifice open or almost dilated, the rim narrow, the capsule slightly sunk but very convex in the centre, the valves protruding when open. (*B.Fl.* iii, 223.)

With regard to the varying descriptions of the bark of this species, see "Bark."

Botanical Name.—*Eucalyptus*, already explained (see Part II, p. 34); *microtheca*, from two Greek words, *micros*, small, and *theke* something to put anything else in—hence, in botany (amongst other technical meanings) a capsule—hence a small fruit, for this species has one of the smallest of all Eucalyptus fruits.

Vernacular Name.—This is the true Coolabah of the aborigines, variously spelt Coolybah, Coolibar, Coolybar. The name has been persistently though erroneously attached to at least two other trees—*Eucalyptus bicolor* A. Cunn., the Black or Flooded Box, and one at least of the so-called Apples (*Angophora*).

"Flooded Box," Gulf of Carpentaria. "White Gum" in Western Australia, where its bark sometimes looks as if it had been whitewashed.

Aboriginal Name.—"Coolabah" is the aboriginal name, and has been adopted by the white man; "Tangoon" of those of the Riverina, N.S.W. (K. H. Bennett); "Jinbul" and "Kurleah" of those of southern Carpentaria (E. Palmer).

Synonym.—*E. brachypoda* Benth. non Turcz.; see B.Fl. iii, 223. I have reinvestigated the matter from the original material in my "Critical Revision of the genus Eucalyptus," Part xi, p. 51, and have arrived at the same conclusion as Mueller in his "Eucalyptographia."

Leaves.—The leaves of this tree are commonly glaucous, or at least pale-coloured, and the venation well marked.

Fruits.—The very small fruits with exserted valves are usually quite sufficient to distinguish this species.

Bark.—The bark of this tree, as we in New South Wales know it, is rough and persistent, more or less fibrous and even scaly on the trunk, with usually smooth bark on the limbs.

Mueller, however, described the tree (type from the Northern Territory) as . . . . "with a dirty brownish-white bark, full of wrinkles and cracks, persistent on the trunk, deciduous on the upper branches, leaving them ashy white."

Bentham (B.Fl. iii, 223) quotes Oldfield, as regards the Murchison River, W.A., ... "who remarks on the variability of the bark, but there appears to be some confusion in his notes." There may be no confusion.

Western Australian trees are so different, as regards the bark, to New South Wales and Queensland (not far north) trees that, familiar as I am with the latter, I did not recognise *E. microtheca* (a White Gum) in the Murchison district, W.A., when I first saw it, and had to examine the twigs. Here is an instance in which

there is great variation in the bark in the same species (over an interval of, say, 2,000 miles), and we are reminded that examination of the bark, a most useful character, must be conducted with caution. The amount of rough bark on the trunk varies within wide limits; sometimes it is almost absent. It is a matter of degree.

Roth refers to the bark as used by the Queensland aborigines in the following terms, but it contains nothing of a poisonous nature, and the results are obtained through the astringent principle. There is no active principle which is contained in this bark which is not contained in the bark of very many other Eucalypts; its use is simply a matter of local convenience by the blacks.

In the North-west Central districts, especially in large water-holes, I have often watched the process (of fish-poisoning, or rather stupefying.—J.H.M.).

The whole camp may co-operate, and will start throwing the leafy boughs and branches in first thing of a morning. During the day the water becomes darker and darker and strongly smelling, until by the following morning at sunrise, when it is almost black, the fish all lie panting at the surface, and are easily caught. (*N. Q. Ethnography*, Bull. No. 3, Roth.)

The inside bark is beaten up and used as a poultice for snake-bites, heated. Cloncurry, &c. (E. Palmer.)

Timber.—This wood is reddish-brown or reddish, and hard, heavy, and elastic. Mons. Thozet speaks of it with figure not unlike walnut, but darker, heavier, and closer grained. It is useful in building and for fencing purposes, being a generally useful timber, durable, though not of outstanding merit. It is almost impossible to split. "Piles made of the young trees have been used with advantage for the construction of the Great Northern Railway of Queensland." (Thozet.)

A Water-yielding Tree.—The late K. H. Bennett, who used to live in the Hay district, was particularly interested in this tree as a water yielder, and, at my request, wrote out the following account of it:—

It is a species of Gum, and its native name is "Tangoon." It is our largest tree, often attaining a height of 70 or 80 feet, with a diameter in the trunk of 4 feet. It is peculiar—[It has a wider range.—J.H.M.]—to the arid and waterless country lying between the Lachlan and Darling Rivers, and is distributed in clumps and patches, and in greatest quantities on, and in the vicinity of, the low stony hills which intersect this country. In appearance it is somewhat like the Red Gum (*E. rostrata*); the leaves are, however, much smaller and lighter coloured, and unlike the Red Gum. It is no indication of water, as it only grows on the driest soil, and never in the neighbourhood of wet or swampy ground.

Although, as I have said, these trees are no indication of water, either above or below the surface, still they themselves possess stores of this necessary element, and from the roots of this, and two or three other varieties of trees, the natives in bygone dry summers obtained their supply of water. The occupation of the country by whites, and the consequent construction of tanks and dams, has in a great measure done away with the necessity of their obtaining water by this means, but even now they are sometimes compelled to resort to it. The other trees from which water is procured are the glossy-leaved Box, Mallee, Currajong, and a species of Hakea; but the natives prefer this Gum, as it yields the most of the precious fluid. In all cases the *modus operandi* is the same, which is as follows:—The operator or operators commence by thrusting a sharp-pointed stick (generally the tops of their spears) into the earth at a distance of 15 or 20 feet from the tree; this is to find the roots, which generally are found at a depth varying from a few inches to a foot beneath the surface, and the reason for commencing at that distance from the trunk is that the root near the tree is too woody, and not sufficiently porous to contain water. Having struck the root, they quickly remove the soft superincumbent earth for a distance of 20 or 30 feet with their wooden shovels, and cutting the root off at each end remove it, and then cut it up into lengths of about 18 inches, knock the bark off, and putting one end into some vessel, and the other into the

mouth, blow vigorously for a few seconds, and the water runs out in a small stream. Shortly after rain, and when the earth is moist, the water will drip from the root when held up, and the supply is greater, showing that the yield is affected by rain. Roots which are (with the bark on) about the size of a man's wrist are the best, as when larger they become woody, and contain less water. It is astonishing how soon water can be got by this means. I have myself, and quite unassisted, obtained a quart pot full in less than half an hour, and I feel sure, were the fact more generally known, that it would be the means of saving many valuable lives, as anyone provided only with a tomahawk need never perish from thirst in country where this or any of the other trees I have mentioned are to be found. The water is beautifully clear and cool, and free from any unpleasant taste. The wood of this tree is very hard and almost impossible to split.

See also a brief article on the subject in Part LI.

Size.—It is a spreading and medium-sized tree. Mueller ("Forest Resources of Western Australia") says it exceptionally attains a height of 150 feet. I have never seen nor have heard of properly authenticated trees of this height. It is usually about 50 or 60 feet, or even less, in height, with a diameter of 3 feet, and exceptionally up to 80 feet, with a diameter of 4 feet.

Habitat.—It is found in the drier parts of Australia in all the mainland States except Victoria. It usually occurs on the banks of rivers, or in depressions liable to flooding.

NEW SOUTH WALES.

This is the "Dwarf Box" of Forest Department (N.S.W.) Exhibition Catalogues of a few years back, where it is labelled: "*E. brachypoda*; timber not much used or valued. Open plains, Lachlan, Darling, and towards the Barrier Range."

The late K. H. Bennett sent this species from Ivanhoe, *viâ* Hay, under the native name of "Tangoon," with the note that "this is our largest tree, often attaining a height of 70 to 80 feet, with a diameter of 4 feet."

We have it from the banks of the Bogan, near Coolabah (J.H.M. and J. L. Boorman), and on flats near the Darling River, *e.g.*, Bourke, &c. The leaves vary in width, *i.e.* (with same length), varying on the same tree from $\frac{3}{8}$ inch to $\frac{3}{4}$ inch broad.

Angledool, north of Walgett, near the Queensland border (Newcomen); Burren Junction (J. L. Boorman); Boggabilla (H. M. R. Rupp); Tibooburra, in the extreme north-west of the State (O. E. Couch).

While usually a small gnarled tree on the flats near the Namoi, it sometimes occurs as a tree of considerable size. Bark rough and persistent, scaly; a pretty tree, with rather dense and drooping foliage. Banks of Namoi at Narrabri (H. Deane and others). "Coolibah or Swamp Box," Narrabri. Leaves 7 inches long and up to 1 inch broad, and glaucous. (Forester McGee.)

"Coolibah, about 30 feet, nearly always leaning and crooked, resembling Box, but bark shaggier; grows in black-soil flooded country." (Forest Guard J. Hay, Boolcarrol, through E. H. F. Swain, District Forester.)

"Coolibah, tree of 20 feet, crooked, low branching; foliage glaucous, limbs clean, rough bark on butt." Mungindi (E. H. F. Swain).

This is the Coolabah whose suckers are, under the provisions of the Crown Lands Act of 1889, declared to be "scrub" in a *Gazette* notice of November, 1904. (District Surveyor Arch. Lockhard, Moree.)

Howell, near Inverell (E. C. Andrews).

QUEENSLAND.

Goondiwindi, near New South Wales border (Glasson, R. B. McIntyre); Roxborough (through F. M. Bailey); Thargomindah; "Coolabah," Mulligan River. The seed is a favourite article of food of the blacks (H. Clarke). Butt and right up the main branches dark persistent bark, large spreading head, Rockhampton (W. N. Jaggard and J.H.M.).

Dawson River, Coolibar, grows on flooded country only (A. Beck).

Reid River, near Townsville (N. Daley).

"Coolabah" or "Flooded Box" is found on all Gulf (of Carpentaria) waters, often in flooded ground, of a crooked growth, about 30 feet high (E. W. Palmer, *Proc. Roy. Soc. N.S.W.*, 1883, p. 106). Mr. Palmer's specimens came from the Flinders.

On 10th August, 1892, the late Rev. Dr. Woolls wrote to me as follows:—

I have just received a letter from Mr. E. Palmer in which the following passage occurs:—

"The specimens of Coolibah sent from the Flinders were designated by Baron Mueller as *E. microtheca*. The tree generally is of a crooked growth, but now and again in favoured localities of deep soil it is straight enough to make stockyard posts of, about 10 to 12 inches in diameter and 8 or 10 feet long. The wood is excessively hard and inlocked, impossible to split, and hard to bore through. It requires especially good augers to bore it. The bark is rough and scaly, and the branches are not smooth and white. The colour of the wood is very dark brown."

SOUTH AUSTRALIA.

Lake Eyre (W. Baldwin Spencer).

NORTH AUSTRALIA.

Port Darwin. Not in fruit (M. Holtze); Victoria River, type (Mueller).

WEST AUSTRALIA.

Murchison River (Oldfield).

"Flooded Gum," Mount Narryer, Murchison (Isaac Tyson, per R. Helms); Milly's Soak, near Cue (W. V. Fitzgerald, J.H.M.).

I wrote the following on the spot at Milly's Soak:—"Large numbers of White Gums; they are white with a powdery surface, and a very little flaky bark at butt." So that *E. microtheca* is a White Gum in Western Australia!

"It is a pretty, shady, medium-sized tree, in the grass land all round the Soak. This grassy plain is of a few hundred acres, dotted over with *microtheca* to the exclusion of almost every other form of arboreal and tall shrubby vegetation; quite park like. Called White Gum here."

"Tree 4 to 10 metres high, with pendulous branches, smooth white bark, subglaucous foliage. Creek near Roeburne, in clayey soil, with Acacias. No. 2,758." (L. Diels.)

Dr. J. B. Cleland (who collected it at Strelley River and other north-west localities, where it is known as "Black-heart Gum") tells me that the trunk of this species in Western Australia is often as white as if whitewashed, and the whiteness rubs off readily if touched.

May River and other places, North-west Australia (W. V. Fitzgerald); Noonkaubak, West Kimberley (E. Mjöberg).

EXPLANATION OF PLATE 195.

A. Juvenile leaf, Bourke.

B. Flowering twig, narrow leaf, from Boolcarrol.

C. Fruits, from Coolabah, Bogan River.

D. Broad mature leaf, from Moree District. (All from New South Wales.)

PHOTOGRAPHIC ILLUSTRATIONS.

Coolabah (*Eucalyptus microtheca*). Cooper's Creek, South Australia.

This is the tree under which Robert O'Hara Burke (of Burke and Wills Exploring Expedition) was buried. The initials on the tree, R.O.H.B., and date 21/9/61, were cut by the party who collected his remains.

Coolabah. Bourke District. (Kerry, photo.)

E. microtheca and *Acacia stenophylla* (Native Willow or Eumong) lining the banks of Tallacallana Creek, 20 miles from Hergott (and 5 miles from Lake Harry Bore). Permanent water, save in specially dry times; desert country for a very great extent around in all directions. Northern South Australia. (W. Gill, photo.)



M. Flockton. del et lith.

COOLABAH.

(*Eucalyptus microtheca*, F.v.M.)



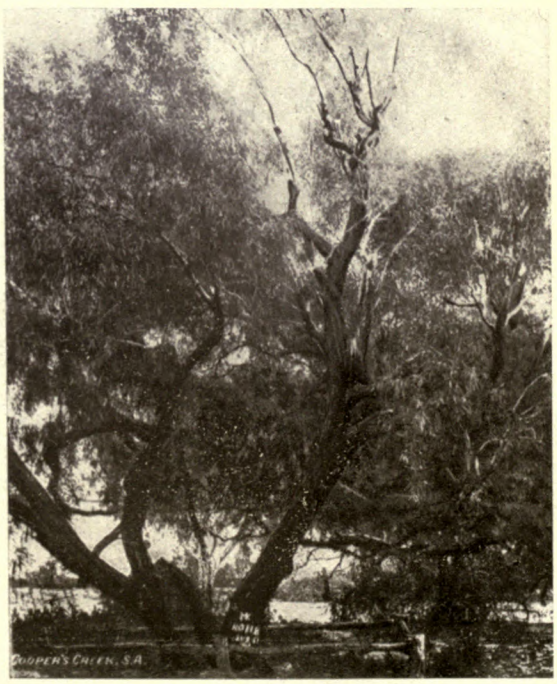
Kerry & Co., photo.

E. microtheca, BOURKE DISTRICT N.S.W.



W. Gill, photo.

E. microtheca AND *Acacia stenophylla*, S.A.



E. microtheca, COOPER'S CREEK, S.A.

No. 192.

Acacia gladiiformis Benth.

The Sword Wattle.

(Family LEGUMINOSÆ : MIMOSEÆ.)

Botanical description.—Genus, *Acacia*. (See Part XV, p. 103.)

Botanical description.—Species, *A. gladiiformis* Bentham in Hooker's *London Journal of Botany* i, 354 (1842).

Following is the original description :—

A. gladiiformis (Cunn. MSS.), glaberrima, ramulis angulatis phyllodiis longe lineari-lanceolatis spathulatisve incurvo-arcuatis obtusis mucronulatis basi longe angustatis crassis marginatis nitidis uninerviis, venis obscuris, glandulis 2–5, racemis phyllodio brevioribus, capitulis multifloris dense imbricatis, sepalis spathulatis ciliatis, ovario glabro.—Species rigida, laevis, siccitate rubescens. Phyllodia 3–5 pollicaria. Racemi rhachis rigida, flexuosa. Legumen lineare, planum, flexuosum, marginatum, valvulis coriaceis.—Rocky hills, interior of N.S.W., *Cunningham*. (Bentham in Hooker's *London Journal of Botany*, Vol. 1, p. 354.)

It was then described in English by Bentham in the following words :—

A tall shrub, quite glabrous ; branchlets angular.

Phyllodia linear-lanceolate or almost spathulate, curved, very obtuse or with a small hooked point, 3 to 6 inches long, much narrowed towards the base, thickly coriaceous, 1-nerved, smooth and shining, the margins thickened, and usually two or more marginal glands.

Racemes short, the rhachis rigid and flexuose, with several dense globular heads of above 30 flowers, mostly 5-merous.

Sepals narrow-linear, spathulate, with dark concave tips more than half the length of the corolla.

Petals smooth.

Pod elongated, flat but flexuose, about three lines broad, coriaceous.

Seeds longitudinal ; funicle long, slightly dilated, encircling the seed in a double fold, but not returning the third time as in *A. amœna*. (*B.Fl.* Vol. ii, 365.)

Affinities.—The species with which it is most likely to be confused are *A. hakeoides* A. Cunn., and *A. obtusata* Sieb.

As regards *A. hakeoides*, it certainly resembles it a good deal in the bush and some field notes will be found under "Habitat."

In *A. gladiiformis* the phyllodes are usually rather longer and more incurved, with 2 to 5 glands prominent on the upper edge. It has two folds of the funicle encircling the seed, while in *A. hakeoides* (see Plate 192) the funicle is clavate and does not encircle the seed. The shapes and hairiness of the flowers of the two species are sufficiently distinct.

That there is some resemblance to *A. obtusata* Sieb. is proved by the fact that they are sometimes confused in herbaria. Comparison of Plates 196 and 177 will be useful. *A. obtusata* is a smaller plant, while the phyllodes are smaller, and of a different shape. The number of flowers and the shape of the sepals are different, while the pod and aril are very different.

Botanical Name.—*Acacia*, already explained (see Part XV, p. 104); *gladiiformis*, from two Latin words, *gladius*, a sword, and a derivative of *forma*, a shape.

Vernacular Name.—I do not know any vernacular name actually in use, and have suggested "Sword-shaped Wattle," on which the specific name was based, though it is not specially appropriate. The sword is somewhat of the shape of the scimitar.

Timber.—This shrub has no importance as a timber producer; I have never seen the trunk more than a few inches in diameter.

Size.—A shrub, which is usually dwarf; I have never seen it larger than 12 feet high.

Habitat.—It is peculiar to New South Wales. The type specimen came from "Rocky hills, interior of New South Wales, *Cunningham.*" I have not certainly seen the type, although a specimen labelled "Acacia gladiiformis Cunn. MSS. Benth. in Hook. Lond. Journ. i, 354, No. 108, fide C. J. Meisner" is probably one. The drawing closely resembles this specimen. In absence of further particulars, I may say that "interior of New South Wales" was, in Cunningham's time, a term used (although not exclusively) for any locality west of the Blue Mountains. Bentham (B.Fl. ii, 366) quotes *A. and R. Cunningham*, Blue Mountains and rocky hills to the westward." A. Cunningham probably (but not certainly) collected his specimens on Oxley's Expedition, while R. Cunningham was killed near Dandaloo, his furthest west.

It is essentially a western New South Wales form, although Mr. R. T. Baker records it from only a few miles from the coast (George's River, near Campbelltown, *C. W. Darley*). He also records it from Rylstone, and also from near Bathurst (*W. J. Clunies Ross*).

Following are some notes and some specific localities:—

Dubbo to Tomingley (J.H.M., J. L. Boorman).

About 5 feet high, on sandy soil east of Bidden-road, 7 miles N.E. from Gilgandra (R. H. Cambage, No. 1,098).

A small shrub or tree of 8–10 feet, solitary plants growing in Box country, *Eucalyptus hemiphloia* var. *albens*, and also in company with *Calythrix tetragona*, *Lissanthe strigosa*, &c. Has much the appearance of *A. hakeoides*, but larger in all its parts, and less branching in habit. Goonoo, Talbragar River, Dubbo district (J. L. Boorman).



M. Flockton. del et lith.

THE SWORD WATTLE.

(*Acacia gladiiformis*, A. CUNN.)

10-15 miles from Coonabarabran, towards Rocky Glen (Dr. H. I. Jensen, No. 133).

A plant, when growing in the bush, showing great similarity to *A. hakeoides* A. Cunn., but it is less densely leaved and comparatively unbranched. It grows to about 9 feet high in solitary plants with such plants as *Leptospermum* and *Calythrix* alongside. Coonabarabran (J. L. Boorman). Parish of Wondoba, County Pottinger (M. H. Simon).

Narrabri (J. L. Boorman).

3–5 feet high, stooling in habit, throwing up but a few stems; usually in moist land, and attaining the summits of the hills with such plants as *Acacia spectabilis* and *Leucopogon biflorus*. Warialda (J.H.M., J. L. Boorman).

Attention is invited to this species as the localities quoted are doubtless very imperfect, the probable explanation being that it has been frequently passed over for the much more abundant *A. hakeoides* A. Cunn.

EXPLANATION OF PLATE 196.

A. Flowering twig.
B. Flower-head.
C. Individual bud.
D. Flower.
E. Bract found at the base of each flower.
F. Flower opened out, showing—
  (*a*) Calyx.
  (*b*) Corolla.
  (*c*) Pistil. (Stamens removed.)

The above from Warialda, N.S.W. (J. L. Boorman).

G. Pods.
H. Seed.

From Gilgandra, N.S.W. (R. H. Cambage).

No. 193.

Quintinia Sieberi A.DC.

The Opossum Wood.

(Family SAXIFRAGACEÆ.)

Botanical description.—Genus, *Quintinia* A.DC.

Calyx-tube obconical, adnate to the ovary, with 5 persistent teeth.

Petals 5, imbricate, deciduous.

Stamens 5 ; anthers ovate.

Ovary inferior, 3- to 5-celled, with several ovules in each cell, the free summit broadly conical, tapering into a persistent 3- to 5-furrowed style, with a capitate 3- to 5-lobed stigma.

Capsule inferior, opening at the summit in teeth or valves continuous with the styles, which separate up to the stigma.

Seeds ascending, long, spindle-shaped, with a loose testa; embryo (very minute) in a fleshy albumen.

Glabrous trees or shrubs.

Leaves alternate, coriaceous, without stipules.

Flowers small, white, in racemes, either simple in the axils, or several forming a terminal panicle. (B.Fl. ii, 437.)

Botanical description.—Species, *Quintinia Sieberi* A.DC. *Monogr. Camp.* 90 (1830) and in DC. *Prod.* iv, 5 (a translation of which will be found in Don's "History of Dichlamydeous Plants," iii, 195).

A spreading tree of 30 to 40 feet, and more.

Leaves oval-elliptical, shortly acuminate, mostly 3 to 4 inches long, entire, narrowed into a petiole of about $\frac{1}{2}$ inch, coriaceous, reticulate.

Racemes numerous, in a terminal panicle, scarcely longer than the last leaves.

Pedicels very short, rarely 1 line long.

Calyx-lobes very short and broad.

Petals oval-oblong, spreading, about 2 lines long.

Styles separating in the ripe capsule up to the stigmas, which remain united.

Seeds obovate or oblong, with a loose reticulate testa, but not winged. (Endl. in *Flora*, 1832, ii, 389, t. 3, and *Atakta*, 10, t. 10.) (B.Fl. ii, 438.)

Botanical Name.—*Quintinia*, in honour of "La Quintinie, qui olim de hortis scripsit." In Pritzel the name is given as Jean De la Quintinye, who wrote a work entitled "Instruction pour les jardins fruitiers et potagers, avec un traité des

Orangers." This was published in Paris in 1690, and passed through several editions. An English translation was published by the celebrated John Evelyn in 1693. *Sieberi*, in honour of Franz Wilhelm Sieber. See Part XXXIV, p. 47. His *Pls. Exs. Nov. Holl.* No. 261 is the type of this species.

Vernacular Name.—Opossum Wood, but there seems no special appropriateness in the appellation, and I cannot learn how the tree first got its name.

Flowers.—It is very floriferous, and bears masses of pure white flowers, reminding one of such species of *Ligustrum* (Tree Privet) as *L. lucidum*.

Bark.—Has a corky bark, transversely corky.

Timber.—Three pieces of this timber were reported on as follows:—

(1) Light in weight, of a pale brown colour, no figure, easy to work; much rent in drying.

(2) It is very hard and heavy, but very short in the grain. It would be good for flooring boards; while of a third it was said,—the timber is heavy, and close-grained; of a yellowish shade, and it seems to be of good quality. (*General Report, Sydney International Exhibition*, 1879.)

Size.—It is a small and even moderately large tree. I have often seen it 50–60 feet high (estimated), and with a trunk diameter of 2–3 feet (measured).

Habitat.—In the Flora Australiensis it is recorded only from New South Wales, Blue Mountains, *Sieber*, n. 261. *A. Cunningham* and others; southward to Illawarra, *A. Cunningham*; and the dividing range towards the Yowaka, *Leichhardt*.

Mr. Cambage informs me that the Yowaka River flows into the Pambula River. There is a range of mountains between Twofold Bay (in a flourishing condition in Leichhardt's time, because of the whaling station) and the Yowaka River. There is nothing improbable in this species being found in such a locality; this is near the Victorian border, and search may even prove that it occurs in that State.

Mueller in *Fragm.* iii, 166, has "Illawarra in altis montibus. *Leichhardt*." for this species.

It occurs in coastal New South Wales from near the Victorian border (the southern limit is unknown) to Southern Queensland. Its westerly range is unknown, but it occurs (in gullies) in the highest parts of the Blue Mountains.

It is represented from the following localities in the National Herbarium, Sydney:—

Conjola, near Milton (W. Heron); Cambewarra Mountain (W. Forsyth); Barrengarry Mountain (R. H. Cambage and J.H.M.); Belmore Falls, Moss Vale (W. Forsyth); Robertson (J.H.M.); top of Bulli Pass (L. Stephenson); Mount

Werong (R. H. Cambage); Jenolan Caves (W. F. Blakely); Mount Wilson (Jesse Gregson), Mount Tomah and Kurrajong Heights; Wolgan River (H. Deane); Mount Victoria (E. Checl); Blackheath (A. A. Hamilton); near Mountain top, 3,000 feet, Kempsey district (W. McDonald); Dorrigo (W. Heron), Beilsdown Falls (Spigott's old camp); Dorrigo Forest Reserve (J.H.M.); Acacia Creek, Macpherson Range (W. Dunn).

Propagation.—Speaking of the Botany of Berrima at Mittagong, the late Rev. Dr. Woolls speaks of—

> *Quintinia Sieberi*, a curious tree, which, although sometimes standing alone in the forest, and attaining a height of 40 or 50 feet, is frequently to be seen growing from the Tree Fern (*Dicksonia antarctica*), each having its separate stem in the ground, but so blended together as at first sight to appear one and the same tree. Allan Cunningham was the first to notice this botanical curiosity, on Mount Tomah, but subsequent observers are of opinion that this extraordinary tree, although sometimes apparently growing by itself, is nevertheless always propagated in the first instance from the stem of the Tree Fern. The same opinion is also expressed respecting Eucryphia Moorei, of which I have already spoken.—(*The Flora of Australia*, p. 113.)

I have mislaid the reference to Cunningham's statement, so cannot quote it at length.

It is now well known that these trees begin life on the side of the trunk of a tree fern (*Dicksonia* at Robertson), penetrating the trunk, and even splitting it up. Eventually the roots reach the ground, and the tree destroys the tree fern.

In 1905 there was a fine example, in the hotel yard at Robertson, of an *Acacia melanoxylon*, a fairly large tree, growing out of a tree fern, and I shall be glad if my readers will favour me with the names of trees known to them which start life on a tree fern.

EXPLANATION OF PLATE 197.

A. Flowering twig.
B. Flowers enlarged.
C. Bud.
D. Flower, showing—
  (*a*) Calyx.
  (*b*) Petals.
  (*c*) Stamens.
E. Part of flower, showing—
  Calyx-lobes.
  5-celled ovary.
  5 styles uniting in one.
  Stigma.
F. Ripe capsule.
G. Fruit after dehiscence.



M. Flockton. del et lith.

OPOSSUM WOOD.

(*Quintinia Sieberi*, A.DC.)

FISH-POISONS OF THE AUSTRALIAN ABORIGINES.

THE practice of throwing leaves, bark, &c., into streams and pools for the purpose of killing fish, or stupefying them sufficiently to enable them to be caught, is by no means confined to the aborigines of this continent, but appears to be practised by the natives of many tropical and subtropical countries. Attention has been drawn to the subject through the researches of the late Dr. Greshoff, attached to the famous botanic garden at Buitenzorg, Java, who subjected to chemical analysis the plants used for fish capture by the natives of that country.* So far as I know, no systematic attempt has yet been made to investigate the properties of the fish-poisons employed by our aborigines. As a very general rule, the plants employed by them are astringents or tanning agents, the tannin contained in which may be the cause of a temporary helplessness of the fish, which renders them an easy prey. I do not speak positively in regard to this, for I am inclined to think that usually the real active agent is a saponin, to which some of our Acacia and other barks owe the persistent bitter taste they possess, and which is, of course, very different to astringency. The subject is one which might well be worked up by one who desires to do original work in connection with the properties of our indigenous plants. I should be glad to receive additions to the list of plants I submit as having been used by the blacks for catching fish.

Following is (or used to be) the method employed by New South Wales blacks for catching fish by throwing wattle bark into streams or waterholes. In the case of streams, stakes were placed across, and a few wisps of wattle bark thrown into the water. In a little while the fish seemed to be intoxicated, knocked against the stakes, appeared bewildered, and the blacks, posting themselves near the stakes, took them out of the water.

This stupidity or intoxication only lasted for about an hour. The fish caught by this method are in no way impaired as an article of food.

Radlkofer† some years ago published a long list of plants which are used to poison fish, and added a history of the earlier literature. He lists some 154 species which have been used in various parts of the world for this purpose, and these plants belong to the following orders and genera. The species are listed under the poisonous species in another part of this work:—

Dilleniaceæ (*Tetracera*), Menispermaceæ (*Anamirta, Abuta, Pachygone*), Cruciferæ (*Lepidium*), Capparideæ (*Cleome*), Bixaceæ (*Pangium, Hydnocarpus*), Ternstroemiaceæ (*Caryocar*), Tiliaceæ (*Grewia*), Meliaceæ (*Walsura*), Chailletiaceæ (*Chailletia Tapura*), Rhamneæ (*Gouania*), Sapindaceæ (*Serjania, Paullinia, Sapindus, Dodonæa, Harpullia, Magonia*), Hippocastaneæ (*Pavia*); Leguminosæ (*Tephrosia, Milletia, Orobus, Abrus, Centrosema, Clitoria, Camptosema, Phaseolus, Lonchocarpus, Derris, Piscidia, Bowdichia, Cassia, Bauhinia,*

* See, for example, his "Fish Poisons" (G. Kolf, Batavia); "Mededeelingen uit 'S Lands Plantentuin" (Batavia), vii, and subsequent Parts.

† Sitz. Math-Phys. Classe k. b. Akad. d. Wiss. München., 1886, 379.

Leucæna, Albizzia); Myrtaceæ (*Barringtonia, Gustavia*); Compositæ (*Clibadium, Ichthyothere*); Campanulaceæ (*Tupa*); Ericaceæ (*Rhododendron*); Primulaceæ (*Cyclamen*); Myrsineæ (*Aegiceras, Jacquinia*); Sapotaceæ (*Bassia*); Ebenaceæ (*Diospyros*); Apocyneæ (*Melodinus, Thevetia, Cerbera, Aspidosperma*); Loganiaceæ (*Buddleia, Strychnos*); Solanaceæ (*Hyoscyamus, Nicotiana*); Scrophularineæ (*Verbascum, Digitalis*); Bignoniaceæ (*Bignonia, Tecoma, Jacaranda*); Labiatæ (*Eremostachys*); Chenopodiaceæ (*Chenopodium*); Polygoneæ (*Polygonum*); Aristolochiaceæ (*Aristolochia*); Piperaceæ (*Piper*); Thymelæaceæ (*Daphne, Wilkstrœmia*); Euphorbiaceæ (*Euphorbia, Phyllanthus, Securinega, Piranhea, Croton, Joannesia, Manihot, Jatropha, Excœcaria, Hura*); Coniferæ (*Taxus*); Liliaceæ (*Veratrum*).

Ernst* lists only sixty species that are used as fish poison. There must, however, be considerably more, as indicated by Radlkofer.

W. M. I. Brost Pauwels† in his contribution on the Surinamic fish poisoning‡ plants contributes an interesting article on the subject.

Pauwels, who made an investigation of Nekoe (*Lonchocarpus violaceus*), states that it is a powerfully toxic substance. He found that Nekoeid will poison fish in proportion of 1-5,000,000, and that a second substance, B. Nekoeid, will poison fish in proportion of 1–10,000,000. The poison will take effect in one hour. The water poisoned with the substance will cause the fish to make an effort to get away from the poison—they are in a horizontal position, breathe heavily, come to the surface of the water and try to jump out, and finally breathing becomes increasingly difficult, and at last they turn on their backs and die.

(Manual of Poisonous Plants, Pammel, pp. 52–3.)

Menispermaceæ.

The aborigines near Nerang in Southern Queensland use the Tape Vine for catching fish. They term it "Nyannum," and it was identified as *Stephania hernandiœfolia*. In a paper communicated to the Linnean Society of New South Wales by Dr. T. L. Bancroft, in 1889, it was pointed out that an extract from the root of this plant is extremely poisonous to frogs, and that the poison causes loss of co-ordination of muscular movement in the creature. He also states that the action of the poison is similar to that of *Picrotoxin*, and that like that substance, it is an alkaloid. In a paper to the Royal Society of South Australia, in 1894, Dr. Rennie showed that *Picrotoxin*, as well as a second poisonous alkaloid, could be found in an extract from this plant. The part employed by the blacks is the stem, which is cut in lengths of about 2 feet, and frayed out by beating, just in the same manner as that by which the native cloth of the South Sea Islanders is made. The structure of the stem is abnormal in menisperms, the medullary rays being in excess, and possibly this aids in the fraying out of the plant. A well-known waterhole or rock-pool, noted as a good haunt for fish, is selected, and the bruised stem is scattered about in the water of the pool. The alkaloid is extracted from the bruised plant by the water, and its action upon the fish is said to be very rapid. Probably it also causes "a loss of co-ordination of muscular movement," as stated by Dr. Bancroft; but whatever the way in which it acts, the fish float on the surface of the water, and soon find their way into the dilly-bags of the operators. It is asserted by the farmers living in the neighbourhood that the fish recover after a time, if left in the poisoned water, but of that I

* Memorio. Bot. el Embarbascar o sea la Pesca por media de Plantis venenosas.

† Bijdrage tot de Kennis der Surinaamsche Vischvergiften. M. Greshoff has likewise published a number of works on fish poisoning plants.

‡ Hart and Swatters found in the *Piscidia Erythrina* piscidin, $C_{15}H_{12}O_4$, and Greshoff found in *Pachyrhizus angulatus*, pachyrhizid, $C_{23}H_{18}O_3(OCH_3)_2$.

have no proof to offer. *Stephania* is a genus of an order from which is obtained the so-called *Cocculus indicus*, a drug well known to be employed in various countries in fortifying beer, and making it more intoxicant. Bentley states that it has been extensively used for a long period as a poison in taking fish and game. Further inquiry will probably prove that other plants of this family, as *Cocculus Moorei*, are also used by our aborigines in like manner. (J. Shirley in *Proc. Roy. Soc. Qld.* xi, 89.)

As will be seen at p. 31, other plants belonging to this Family are used as fish poisons in the East Indies.

Sapindaceæ.

In the General Report of the Sydney International Exhibition of 1879, it is stated that the aborigines used the pounded bark of *Cupania pseudorhus* A. Rich., to stupefy fish in waterholes. It is a native of the north coast district of our State, and is also found in Queensland.

Leguminosæ (Mimosæ).

The late Sir William Macarthur stated that the bark of *Acacia falcata*, Willd., a small tree found on the coast districts, and sometimes known as "Sally," or "Hickory," used to be used by the aborigines of the counties of Cumberland and Camden, in this State, for poisoning fish. The native name for it was "Wee-tjellan." They also employed the bark to make embrocations for the cure of cutaneous diseases.

Another "Hickory" or "Blackwood" (*Acacia penninervis* Sieb.) was used by the natives of Southern New South Wales for catching fish. I have heard that both the bark and the leaves were employed.

It is mentioned by Sir Thomas Mitchell that the blacks of the interior made use of the bark of the "Goobang" (*Acacia salicina* Lindl. var. *varians*), usually known as "Cooba," or "Native Willow," for poisoning the fish in small lagoons, and Mr. W. Hill stated that the natives of the Fitzroy River (Queensland) put it to a like purpose. See Part XXXIV, p. 149.

Leguminosæ (Papilionaceæ).

A leguminous shrub known to botanists as *Derris uliginosa*, Benth. is found in Queensland and Northern Australia, and the pounded leaves are thrown into water for the purpose of stupefying fish by the natives of many tropical countries. No doubt this property was found out accidentally in the first place; a broken bough fell into the water and it was noticed that the fish came to the surface.

Dr. Roth gives the following account of the operations of certain North Queensland blacks :—

The stems are hammered on a stone or log (during which operation there emanates a peculiar smell), put up into bundles and roasted, and finally thrown into the water, which it renders more or less soupy. It is thus used at Cooktown :—On the (Lower) Tully River the leaves are rather employed, especially for eels. Cooktown, "Mokorja"; (Lower) Tully River scrubs, "Mara." (*North Queensland Ethnography*, Bull. No. 3, Roth.)

E. J. Banfield, writing in *Proc. Roy. Geog. Soc. Qld.*, 1909, speaks of the use of both *D. uliginosa* and *D. scandens*, and gives "Bag-garra" as an aboriginal name. He says:—

> The blacks tear up the plant—branches, leaves, flowers and all—coarsely bundle them together, and, wading into an enclosed pool where fish are observed, beat the mass (after dipping it into the water, and while held in the left hand) with a nulla nulla. The action is repeated until the bark and leaves are macerated, and then the bundle is thrown into the pool. In a few minutes the fish rise to the surface, gasping and making extraordinary efforts to get out of the infected water. Death ensues rapidly, but the fish are quite wholesome as food.

Following are exhaustive botanical and chemical researches on this plant:—

"No. 33. The anatomy of the stem of *Derris uliginosa* Benth., an eastern fish-poison," by Pierre Elie Felix Perredes.

"No. 34. The Chemistry of the stem of *Derris uliginosa* Benth. Frederick B. Power (Wellcome Chemical Research Laboratories, London. Extr. from *Scient. Sec. Amer. Pharm. Assocn.*, Philadelphia, September, 1902).

Derris elliptica Benth., is largely used in Java in fishing, and appears to be also a constituent of the Borneo arrow-poison.

Dr. Greshoff, of the Buitenzorg Botanic Gardens, has examined the plant. He finds that it has an exceedingly poisonous action on fish, a decoction of the roots being fatal, even when diluted with 300,000 parts of water. The only active constituent isolated is a resinous substance termed derrid, which does not contain nitrogen and is not a glucoside; it readily dissolves in alcohol, ether, chloroform, and amyl alcohol, but is very sparingly soluble in water and potash solution. On fusion with potash it yields salicylic and protocatechuic acids. It occurs almost entirely in the cortex of the root, but has not yet been obtained pure. Its alcoholic solution has a slightly acid reaction and a sharp aromatic taste, causing a partial insensibility of the tongue, which remains for hours. A solution of one part in 5,000,000 is almost instantly fatal to fish. (Ber. xxiii, 3, 537; *Journ. Chem. Soc.* lx, 335.)

Tephrosia purpurea Pers., is used in many tropical countries for the purpose of stupefying fish for the sake of capturing them. Speaking of a *Tephrosia*, whose native name on the Cloncurry is "Jerril-jerry," Mr. Palmer says the aborigines use it to poison fish or stupefy them. The whole plant is broken up and placed in small lagoons.

Myrtaceæ.

There are but very few allusions to the use by the blacks of the all-pervading Eucalyptus vegetation for fish catching. The earliest I can find is by Sir Thomas Mitchell (*Three Expeditions*, ii, 24), who says, in speaking of the Lachlan:—"There the river contained some deep pools, and we expected to catch fish; but Piper (Sir Thomas' black interpreter) told us that the holes had been recently poisoned, a process adopted by the natives in dry seasons . . . All these holes were full of recently-cut boughs of the eucalyptus, so that the water was tinged black"

Speaking of the blacks of the interior of Queensland, Mr. E. Palmer says the small branches of *Eucalyptus microtheca* F.v.M. (the "Coolibah" or "Flooded Box"), are cut up, and, with the leaves, are laid in water for several days to sicken the fish; it is universally used for the purpose.

It is very likely that this is the tree referred to by Sir Thomas Mitchell. See also p. 21.

As regards the use of Mahogany leaves (*E. resinifera* Sm.), see Part III, p. 190.

It is not likely that these species of Eucalyptus act other than through their astringent properties, and it is very probable that, given a favourite fishing ground, the aborigines choose what they consider the most suitable of the Eucalypts in the immediate neighbourhood.

The bark of the so-called Fresh Water Mangrove (*Barringtonia racemosa* Gaud.) is a fish poison of the natives of the Mitchell River, Northern Queensland. Mr. E. Palmer says the native name for the tree is "Yakooro," and that the blacks cut up the bark into small pieces, hammer it fine on a stone, and then place it in water.

Dr. Roth's version is—

> The bark is hammered between stones till it gets quite spongy, and then taken into the water, where it is rubbed with the hands. Fish are stupefied in about a quarter of an hour. Bloomfield (R. Hislop), Cooktown. (E. Palmer speaks of its use on the Mitchell, Laura, and Lynd Rivers.) (*North Queensland Ethnography*, Bull. No. 3, Roth.)

Barringtonia speciosa Linn. f., which is also a native of Queensland, does not appear to be used by Australian aborigines as a fish poison; but the Fijians so employ it, according to Seemann, and they use the outer portion of the fruit, and not the bark. This observation has been confirmed by many other observers, the fruit being so employed in many South Sea Islands. See *Wikstræmia*, below.

Careya australis F.v.M., is a myrtaceous tree, and is closely allied to the two preceding plants. The bark was used by the aborigines of Cleveland Bay, Queensland, for stupefying fish, in fresh or salt water. I believe Murrell, a shipwrecked sailor, is the authority for this statement. Mr. E. Palmer, however, gives a little additional information, when he states that the blacks on the Burdekin use the bark of the stem to poison fish in fresh water, and the bark of the root for salt water. There is, perhaps, a sufficient reason for this discrimination, and it would be well if some local resident would explain the matter.

Mr. E. J. Banfield calls it the "Karoo," and says the bark at the base of the trunk and roots is the part used. He says the *modus operandi* is somewhat similar to that employed in the case of *Derris*.

Cucurbitaceæ.

A kind of towel-gourd (*Luffa ægyptiaca* Miller), whose native name on the Mitchell is "Bun-Bun," is used to poison fish when green, according to Mr. E. Palmer.

Polygonaceæ.

Mr. C. Hedley has a note in *Proc. Royal Soc. of Queensland*, vol. v, in which he states that a species of *Polygonum*, probably *P. orientale*, was pointed out to him as being one of the plants which the Port Curtis (Queensland) blacks use in obtaining fish, and that when a quantity of it is pounded up and thrown into a waterhole, it rapidly brings all the fish to the surface in a dying condition, without impairing their wholesomeness as food.

Verbenaceæ.

Faradaya splendida F.v.M. Mr. E. J. Banfield (*loc. cit.*) says this plant is known in Northern Queensland as "Koie-yan," and the blacks employ it as follows:—

> Portions of the vine are cut into foot lengths; the outer layer of bark is removed and rejected, the middle layer alone being preserved. This is carefully scraped off, and piled up in shapely little heaps on fresh green leaves. When a sufficiency is obtained it is rubbed on to stones, previously heated in the fire. The stones being then thrown into a creek or a little lagoon left by the receding tide, the poison becomes disseminated with fatal effect to all fish and other marine animals.

Thymelaceæ.

Wikstræmia indica. Solander, the companion of Cook and Banks, says that the branches and leaves of the Tahitian variety bruised and mixed with the rasped seeds of *Barringtonia speciosa*, are used in the Society Islands to stupefy fish for the purpose of catching them when they come to the surface of the water.

Such is a brief list of the principal plants used by the aborigines of New South Wales and Queensland for the purpose of poisoning fish. It must not for a moment be supposed that it includes even a small percentage of our indigenous poisonous plants, scores of which could be at once quoted as being undoubtedly deleterious to fish. Nevertheless, it would be interesting to take even the few I have quoted, subject them to chemical analysis, and thus decide to what substance the effect first noticed by the aborigines on fish is due.

Euphorbiaceæ.

Dr. Kyle, of St. Andrews', has studied the effects of *Euphorbia hiberna*, used as a fish poison by the natives of some parts of Ireland. He says that tannic acid appears to be the active ingredient. It produces fatal effects by causing inflammation of the gills, and consequent suffocation (*Gard. Chron.*, 24th May, 1902, p. 341).

There is an article in *The Indian Forester*, for June, 1896, on "The bark of *Cleistanthus collinus* Benth. as a fish poison." This plant is used in many parts of India for the purpose, and the presence of tannin is suggested to be the active principle. The paper also gives a short list of trees used as fish-poisons.

In Eastern Australia we have four species of *Cleistanthus*, but I have not seen it recorded that their bark has been used in the manner above indicated.

No. 194.

Hakea leucoptera R.Br.

Needlewood.

(Family PROTEACEÆ.)

Botanical description.—Genus, *Hakea*. (See Part XLVI, p. 105.)

Botanical description.—Species, *H. leucoptera* R.Br., in *Trans. Linn. Soc.*, x, 180; *Prod.* 382 (1810).

A shrub or small tree, with rather slender virgate branches, minutely hoary-pubescent.

Leaves terete, smooth, mucronate with fine straight rigid points, more or less attenuate at the base, 1½ to 3 inches long.

Flowers small, in short racemes or clusters pedunculate in the axils or rarely terminating short leafy branches, the peduncle and rhachis minutely silky pubescent, ½ to ¾ inch long.

Pedicels glabrous, 2 to 2½ lines long.

Perianth glabrous, the tube about 2½ lines long, slightly dilated below the middle, revolute under the limb.

Torus slightly oblique.

Gland semiannular.

Ovary stipitate; style not long, with a very oblique almost lateral stigmatic disk.

Fruit about 1 inch long, ½ to ¾ inch broad, often somewhat verrucose, with a short conical beak, the valves without any or with scarcely prominent dorsal protuberances at the end.

Seed-wing usually more or less decurrent along the upper margin only of the nucleus. (B.Fl. v, 515.)

Botanical Name.—*Hakea*, already explained (see Part XLVI, p. 106); *leucoptera*, from two Greek words, *leucos* white, *pteron* a wing (white winged). The explanation is afforded by the words in the original description "seminibus albo-cinereis" (seeds ashy white).

Vernacular Names.—Needle Bush and Pin Bush, because of their terete pointed leaves; Needle Wood for the same reason. It is also called "Water-tree," because the roots are used to give a limited water-supply to the aborigines in dry regions.

Aboriginal Names.—It would appear to have several aboriginal names, *e.g.*, "Booldoobah," Ivanhoe, *viâ* Hay, N.S.W. (K. H. Bennett); "Uri," Gunbar, Darling River, N.S.W. (Robert E. Horton); "Kuluva," Mount Lyndhurst, S.A., practically a type locality (Max Koch); "Kuloa," at Cooper's Creek, near Lake Eyre, S.A. (A. W. Howitt).

Synonyms.—*H. leucocephala*, Dietr. Syn. Pl. i, 531 (by a misprint); *H. virgata* R.Br. Prot. Nov. 26 (specimen collected 1817, towards the Lachlan River, A. Cunningham); Meissn. in DC. *Prod.* xiv, 395; *H. tephrosperma* R.Br. l.c.; Meissn. l.c. 402; *H. longicuspis*, Hook. in Mitch. Trop. Austr., 397; Meissn. l.c. 395; *H. stricta* F. Muell.; Meissn. in *Linnæa* xxvi, 360, and l.c. 400.

Leaves.—They are used for fodder, but form only a famine food.

Cattle are fond of its leaves. (K. H. Bennett, Ivanhoe, *viâ* Hay.)

The pin-like leaves are eaten by stock, but slight nourishment could be expected from them. This is one of the many plants which sheep will eat when hard pushed, and nothing better is available. (R. W. Peacock, Coolabah.)

Of little value as a fodder plant in Bourke district. (A. W. Mullen.)

Mr. F. B. Guthrie, in *Agric. Gazette N.S.W.*, October, 1899, gives an analysis with the following result:—

	Water.	Ash.	Fibre.	Ether Extract (oil, &c.).	Albumin-oids.	Carbo-hydrates.	Nutrient Value.	Albumin-oid ratio.	Tannin (oak bark).
16. Needlebush ...	12·59	4·79	39·09	0·74	6·44	36·35	44½	1 : 6	1·5

Timber.—The timber is coarse grained and soft, but hard and brittle when dry. It is reddish and very ornamental, with the peculiar showy grain of so many Proteaceous timbers.

The root-stock is carved for tobacco pipes, just as the briar-root (*Erica arborea*) of South Europe is. An enthusiast wrote to me: "The roots make the best wooden pipes in the world." This may be true, but it is safer to say that they make good pipes, and I have been assured on this point for the last twenty-five years.

In the year 1895 the "Australian Needlewood Pipe Company" was formed in Sydney.

A Water-yielding Tree.—This has been referred to at Part LI, p. 15. Good drinking water is got from the fleshy roots of this bush in the dry districts in which it grows. The same method of obtaining it is employed as already described.

In an experiment on a water-yielding Hakea, the first root, about half an inch in diameter and 6 or 8 feet long, yielded quickly, and in large drops, about a wine-glassful of really excellent water." (Lockhart Morton, *Proc. Roy. Soc. Vict.*, 1860, p. 132.)

Mr. Max Koch calls this tree "Kuluva," and says that in the Mount Lyndhurst district of South Australia, when hard up for water, the blacks get it from the root of this tree in the following way:—First they burn the tree down in order to drive the moisture into the roots. Then they dig up the roots called "Nappa Kopari"—that is, water root—put an end into a slow fire, and the other into a vessel to receive the water which drips slowly from the roots.

Mr. A. W. Mullen, of Bourke, says the blacks extract water from the roots by burning the branches back from the outside tips of the leaves, gradually forcing the moisture or sap back to the roots.

Mr. Dawes, of Yandama, informed Mr. Mullen that the blacks forced the moisture back to the roots by burning the branches, starting at the outside tips of the leaves.

Size.—A small, rather straggly tree, but often erect and shapely.

6–12 feet high, 3–4 inches diameter, and occasionally of the size of small trees (Paroo River, N.S.W., J. L. Boorman).

Up to 20 inches thick and 30 feet high ; near Collarendabri (S. W. Jackson).

"A straggling, ill-grown tree, from 15–20 feet high, with nothing to recommend it except that its timber is rather pretty." (K. H. Bennett, Ivanhoe, *viâ* Hay, N.S.W.)

Habitat.—Following are the records given in the *Flora Australiensis* :—

Queensland.—Armadilla (*Barton*).

New South Wales.—Field's and Harrington's Plains, Lachlan River (*A. Cunningham, Fraser*); Plains near the Gwydir (*Mitchell*); Lachlan and Darling Rivers to the Barrier Range (*Victorian and other Expeditions*); Mount Murchison (*Bonney*).

Victoria.—Murray Desert (*F. Mueller*); N.W. Districts (*L. Morton*).

South Australia.—Head of Spencer's Gulf (*R. Brown*); Cooper's Creek (*Murray*).

It is found in every State of the Commonwealth except Tasmania, and is a dry country species. Following are some specimens in the National Herbarium, Sydney :—

SOUTH AUSTRALIA.

The type came from the "South Coast of New Holland, Flinders Land, in the margins of woods at the bases of mountains," which refers to what was later known as South Australia, probably the Flinders Range, Spencer's Gulf.

Mount Lyndhurst (Max Koch), a locality very near the type; Killalpanina, Cooper's Creek, near Lake Eyre (correspondent of late A. W. Howitt).

VICTORIA.

Jeparit, in the north-west (St. Eloy D'Alton).

NEW SOUTH WALES.

Tibooburra, in the north-west angle of the State (O. E. Couch, No. 64).

Fairly common, found almost exclusively on dry gravelly ridges, Nulty to Toorale, Paroo River (J. L. Boorman); Paldrumatta Bore, *viâ* Wilcannia (P. Corbett); Dunambral, *viâ* Collarendabri (C. J. McMaster); 40–50 miles north-west of Collarendabri (S. W. Jackson); Bourke (R. W. Peacock); Coolabah

(R. W. Peacock, J. L. Boorman, J.H.M.); Girilambone (E. Betche); Minore, near Dubbo (J. L. Boorman); Parkes (Forester A. Osborne); Currygundi District, about 60 miles west from Moree (Forest Guard W. M. Brennan).

QUEENSLAND.

Stanthorpe (correspondent of F. M. Bailey). It is common in the western districts.

EXPLANATION OF PLATE 198.

A. Flowering twig.

B. Bud.

C. Unopened flower.

D. Opened flower, showing—

(*a*) Four-lobed corolla, with sessile anthers in the concave lam næ.

(*b*) Style.

(*c*) Stigma.

E. Portion of flower (corolla removed) showing—

(*a*) Hypogynous gland.

(*b*) Stipitate ovary.

(*c*) Style.

(*d*) Stigma.

F. Anther.

G. Stigmatic disc.

H. Twig with fruits.

I. Seed.



NEEDLE WOOD.

(*Hakea leucoptera*, R. Br.)

No. 195.

Eucalyptus crebra F.v.M.

Narrow-leaved Red Ironbark.

(Family MYRTACEÆ.)

Botanical description.—Genus, *Eucalyptus*. (See Part II, p. 33.)

Botanical description.—Species, *E. crebra* F.v.M. in *Journ. Linn. Soc.* iii, 87 (1859).

It has been described by Bentham in the following words :—

A small, middle-sized, or sometimes a large tree, with a hard, blackish, rough, persistent bark (*F. Mueller* and others).

Leaves oblong-lanceolate or linear, straight or more frequently falcate, obtuse, mucronate-acute or acuminate, attaining 4 to 6 inches long, rather thick and glaucous or yellowish when dry in the northern specimens, thinner in the subtropical ones, with numerous very diverging fine parallel veins, the intramarginal one very near or close to the edge.

Peduncles short, terete or nearly so, each with about 3 to 6 small flowers on short but distinct pedicels, umbels usually 3 or 4 together in short panicles either terminal or axillary, or rarely the lower ones solitary in the axils.

Calyx-tube turbinate, about one line diameter.

Operculum conical or hemispherical, about as long as the calyx-tube.

Stamens 1 to 2 lines long, all perfect, inflected in the bud : anthers very small and globular, like those of the *Porantheræ*, but the cells distinct and opening longitudinally to the base.

Ovary flat-topped or slightly convex in the centre.

Fruit obovoid-truncate, not 2 lines in diameter, somewhat contracted at the orifice, and often shortly attenuate at the base, the rim narrow, the capsule more or less sunk but the tips of the valves often protruding when open. (B.Fl. iii, 221.)

Botanical Name.—*Eucalyptus*, already explained (see Part II, p. 34); *crebra*, Latin, thickly grown, in other words, "plenty of them."

Vernacular Names.—I propose the name "Narrow-leaved Red Ironbark" as sufficiently distinctive. *E. paniculata* may also be narrow leaved, but its timber cannot be called red. At the same time Ironbark has sometimes an adjectival prefix which has nothing to do with the colour of the timber, but refers to the general appearance of the bark. Thus on that ground at Dubbo *E. crebra* is often known as Grey Ironbark as well as Red Ironbark. Incidentally, it may be mentioned that no *E. paniculata* occurs within hundreds of miles of Dubbo, so that no local confusion arises with that tree.

The following records the attempts made by me twenty years ago to ascertain if there was any difference between the Grey and Red Ironbark at Dubbo.

The Grey and Red Ironbark of Dubbo are both *E. crebra*. The former has a paler bark and timber than the latter, but there is no botanical difference between the trees, and users report that there is no difference in the quality of the two timbers. Bark rough on the ultimate branchlets.

Mr. de Coque wrote: "The Red and Grey Ironbark I believe to be *E. crebra* (I could find no difference in the leaves, branchlets or fruits); the kinds are distinguished as they grow by the difference in the colour of the bark, which appears to correspond in shade to the colour of the timber. I found several shades in colour of timber to the deep red."

Aboriginal Names.—George Caley, who was in New South Wales from 1800–1810 (see *Agric. Gazette* for October, 1903, p. 990), called this Ironbark "Mogargro," which seems the same word as that quoted by Sir William Macarthur later as "Mokaarago" by the aborigines of the county of Camden.

"Boobyinba" of those of the Namoi, N.S.W.

Fruits.—As a rule the fruits of *E. crebra* are not only small, but the valves are non-exsert, as shown in the Plate. Sometimes, as northern Queensland is approached, they are neither the one nor the other.

For example, in the Rockhampton district, Queensland, and also Roper River, Northern Territory, they may have small fruits with exserted valves.

At Stannary Hills, North Queensland (Dr. T. L. Bancroft) we have larger fruits and exsert valves.

At Chillagoe (E. Doran) and Almaden (R. H. Cambage) we have fruits large, almost hemispherical, with a pronounced rim.

In the Townsville district, viz., Reid River (Nicholas Daley) we have in the young buds the operculum of slightly less diameter than the calyx-tube, and the fruits, while a little less smaller than those from Chillagoe and Almaden, and possibly a little less hemispherical, still larger than the normal, and with a distinct rim, never seen in New South Wales forms.

Timber.—This and the timber of *E. siderophloia* (Broad-leaved Ironbark) may very well go together, as the timbers have much in common. They are of a deep red colour, of about equal hardness, and are really valuable timbers, although inferior to the best White or Grey Ironbark (*paniculata*).

That of *E. crebra* is an excellent timber, hard, tough, of inlocked fibre, durable and useful for many building purposes. It is much in use for fence-posts, railway cross-ties, bridge material, piles, waggon-building, &c., including spokes of wheels.

Mr. Allen Ransome examined samples of this timber sent from New South Wales to the Colonial and Indian Exhibition, 1886, and reported: "spokes were turned from the sample, and boards planed, the finish of both being excellent."

This is the species called in the Sydney Mint experiments (1860) "Narrow-leaved Ironbark." It is described as of excellent quality, and very durable. It came from Singleton, N.S.W. The trees were from 20 to 70 feet to the fork, and had an average diameter of 10 to 12 inches (maximum 3 feet) exclusive of the bark. Specific gravity, 1·119. Timber called "Ironbark" was also examined in the Sydney Mint experiments of 1858. This was probably the same species, as both samples were collected at the same place by the same gentleman (Mr. Collett). Captain Ward gives the specific gravity at 1·211.

A slab of "Narrow-leaved Ironbark" from Appin, shown at the London Exhibition of 1862, as No. 8 (and previously at the Paris Exhibition of 1855, as 123b), is exceedingly like the timber of *E. crebra* above referred to. Diameter, 24 to 48 inches; height, 60 to 100 feet. It is of a dark purplish colour, cross-grained, tough and hard, tearing much under the plane. It is very heavy.

Mr. Byerley experimented upon some Rockhampton (Queensland) timber of this species, and found a rod of 1 inch section and 12 inches long, to bear 970 lb. before breaking. Diameter, 20 to 36 inches; height, 70 to 90 feet.

In 1894 the late Mr. J. V. de Coque wrote me as follows *re* this timber:—

The bridge over the Macquarie River at Wellington was built nearly twenty-five years ago of Dubbo Ironbark. The Ironbark on the bridge is wonderfully sound and hard. I am now redecking this structure. The old deck is composed of Northern timbers only laid a few years. I found Blue Gum, Blackbutt and Tallow-wood. All these timbers have white ants in them. I even found the white ants crawling on the Ironbark girders, but they had not attempted to touch the timber. I examined the sheathing in the abutment piers, but found no ants anywhere except in the deck. In the spike-holes in girders, made through spiking the deck down, the ants were walking in and out, but the timber was untouched. The residents tell me the ants will rarely touch the Ironbark of their district when it is dry.

Size.—A medium to a large tree. Trees 100 feet high and 6 feet through are by no means uncommon. One of the photographs shows a tree 15 feet in diameter, but it had passed its prime.

Habitat.—It is confined to New South Wales, Queensland, and the Northern Territory. As regards the former State, it occurs principally on the eastern side of the Dividing Range, and nearly as far south as Nowra. Coast-wise it goes north to the Gulf of Carpentaria.

Northwards it is to be found all along the eastern slopes of the Coast Range as far as Newton Boyd. Westerly it occurs from Dubbo to the North-west Railway Line and for a considerable distance northwards and eastwards, though not ascending to a great elevation.

In Queensland it is very extensively distributed, but not occurring to the farthest west of the State.

Following are some localities represented in the National Herbarium, Sydney:—

NEW SOUTH WALES.

South.—Many localities in the counties of Cumberland and Camden.

West.—County of Cumberland; Capertee (J.H.M. and J. L. Boorman); Goulburn River; Murrumbo (R. T. Baker); Murrumbidgerie (A. Murphy); Dubbo (H. Deane, J. V. de Coque, J.H.M. and others); Minore (J. L. Boorman); Midway, near Dubbo (J. L. Boorman); Coonamble (Forest Ranger E. Taylor); Pilliga Scrub, many localities (J. L. Boorman, Dr. H. I. Jensen); Wee Waa (T. W. Taylor).

Habitat, open forests. Plentiful in places where soil is sandy (Forest Ranger McGee, Narrabri).

The largest forest of *crebra* in New South Wales (back country) is between Narrabri and Coonabarabran. There are fully two million acres of it. The forest commences at Gunnedah and goes to 25 miles from Coonamble. Received from various localities from M. H. Simon and E. H. F. Swain.

North.—Paterson River (J. L. Boorman); "Black Ironbark," Clarence Town (A. Rudder); Booral (A. Rudder; who says of it, "it is a much smaller tree than either *paniculata* or *siderophloia*, and, as far as I have seen, is of spreading and somewhat drooping habit. Leaves very narrow, fruit and flowers very small. Timber in colour, when fresh, either red or dark brown. Suitable for railway sleepers and girders, &c., and for use in bridges and culverts generally, where long lengths are not required. It does not, as a rule, approach so near the coast as the above two species. I have seen a little of it near Clarence Town, and it is fairly plentiful on the tributaries of the Upper Hunter." Cooloongoolook (A. Rudder).

Branxton (J. L. Boorman); Wybong Creek (A. Rudder); Denman (W. Heron); Merriwa, with broadish leaves like the Rockhampton specimens (J.H.M. and J. L. Boorman); Gungal (J. L. Boorman); Murrurundi (J.H.M. and J. L. Boorman); Timor (L. A. Macqueen); Page River and Gundy (J.H.M.). Tips of valves exserted; Scone (J.H.M. and J. L. Boorman).

"Red Ironbark," Glen Innes (Forest Guard N. Stewart); western slopes of Dividing Range, County Clive, Tenterfield (A. S. O. Reid); hills about Warialda (J.H.M., J. L. Boorman, Forest Guard Edward Julius); Acacia Creek, Macpherson Range (W. Dunn).

QUEENSLAND.

South Killarney (E. S. Taylor); Beech Mountain, Canungera (Dr. J. Shirley); Leyburn (A. E. A. McCahon); Gowrie Little Plain (W. F. Gray); Toowoomba North (F. E. Yardley); Gatton (Major Fowles); Brisbane River generally; Newtown, Ipswich (J. Spencely); Calliope (C. Curtis); Cullabunia (E. G. Davies); Kilcoy (J. E. McMinn); Engelsburg (W. H. Martin); Maryborough West (P. J. McGrath); Mount Perry (J. L. Boorman); Eidsvold, Upper Burnett River (Dr. T. L. Bancroft); Rockhampton (Thozet, R. Simmons, J.H.M.); Crescent Lagoon,



Kerry, photo.

Eucalyptus crebra, LITTLE RIVER, CLARENCE, N.S.W.

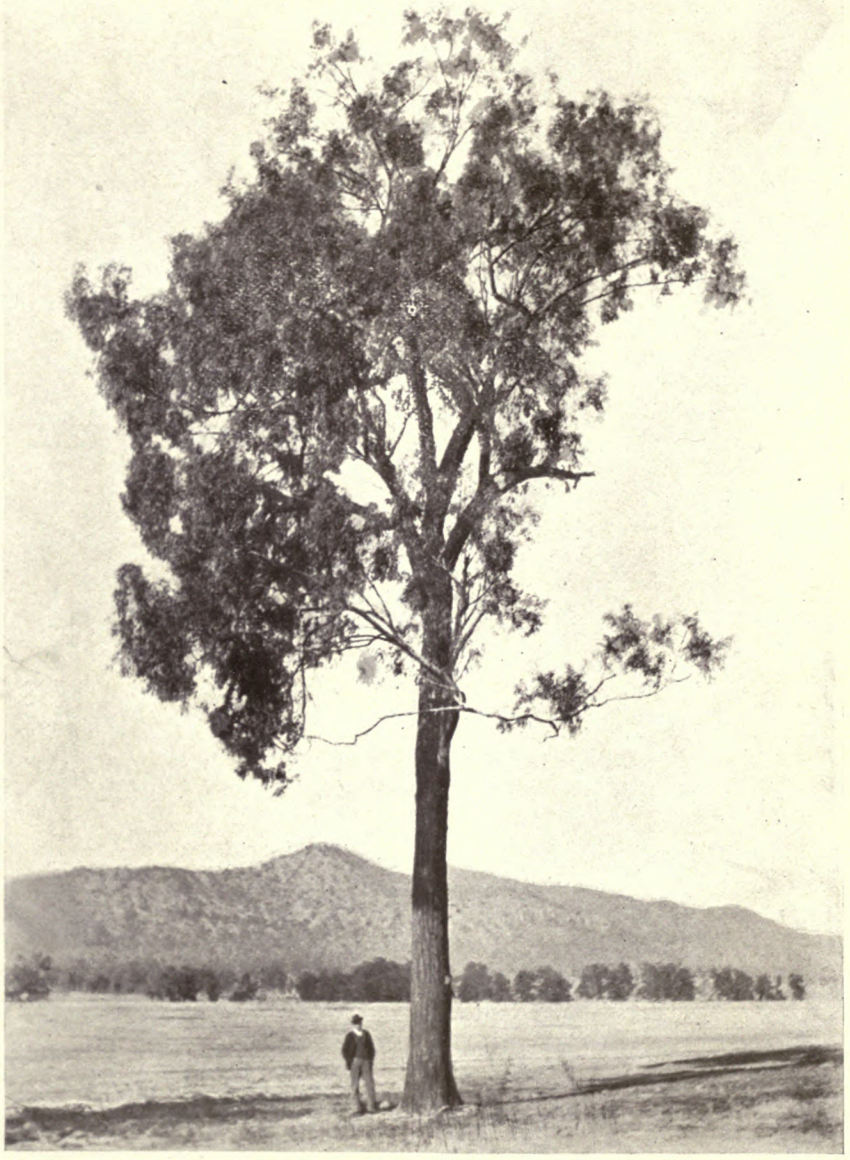


Eucalyptus crebra, MULGOA, SOUTH CREEK, N.S.W.



N. Stewart, photo.

RED IRONBARK *(E. crebra)*, GLEN INNES, N.S.W.



R. H. Cambage, photo.

Eucalyptus crebra, SINGLETON, N.S.W.



ON THE UPPER BELLINGER, N.S.W., DORRIGO TABLELAND IN BACKGROUND.

F. A. Kirton, photo.



NARROW-LEAVED RED IRONBARK.

(*Eucalyptus crebra*, F.v.M.)

West Rockhampton (W. N. Jaggard); Bouldercombe, Rockhampton (F. W. Smith); Gum-top Ironbark, Blackdown (R. N. Jolly); Duaringa (J.H.M.); St. Lawrence (T. Tate); Chillagoe (E. Doran); Stannary Hills (Dr. T. L. Bancroft); Narrow-leaved Ironbark, Reid River, *viâ* Townsville (N. Daley).

NORTHERN TERRITORY.

Roper Crossing and Providence Knoll (Baldwin Spencer).

EXPLANATION OF PLATE 199.

A. Sucker leaf from Pilliga, N.S.W.
B. Twig with buds and fruits.
C. Mature buds.
D. Anthers.
E. Mature leaf, broader form.

PHOTOGRAPHIC ILLUSTRATIONS.

E. crebra. Little River, Clarence District, Northern N.S.W. (Kerry, photo.)
E. crebra. Mulgoa, about 40 miles west of Sydney, 46 feet in girth. (Kerry, photo.)
"Red Ironbark" (*E. crebra*). Photo, N. Stewart, Forest Guard, Glen Innes)
E. crebra. Singleton. (Photo, R. H. Cambage.)

On the Upper Bellinger, Dorrigo Tableland in background. (F. A. Kirton, photo.)

No. 196.

Acacia brachybotrya Benth.

A Blue Bush.

(Family LEGUMINOSÆ : MIMOSEÆ.)

Botanical description.—Genus, *Acacia*. (See Part XV, p. 103.)

Botanical description.—Species, *A. brachybotrya* Bentham in Hooker's *London Journal of Botany*, i, 347 (1842).

The original is as follows :—

Pubescens, ramulis subangulatis, phyllodiis oblique obovatis obtusissimis rarius mucronulatis marginulatis eglandulosis uninerviis, racemis *tomentosis* 3–5-cephalis phyllodio brevioribus, capitulis multifloris *tomentosis*. Phyllodia 6–9 lin. longa. Racemi in specimine brevissimi, sed flores nondum evoluti. Peel's Range, N. S. Wales, Cunningham. [The italics are mine.]

Bentham himself later on described it in English, as follows :—

A handsome shrub of several feet, glabrous, glaucous or silvery-white with a close silky-pubescence, branchlets slightly angular, soon terete.

Phyllodia obliquely obovate or oblong, obtuse or rarely mucronulate, ½ to 1 inch, or in very luxuriant specimens twice as long, narrowed at the base, coriaceous, 1-nerved, penniveined, the marginal gland near the middle, small or often wanting.

Peduncles rather short, solitary, or more frequently 2 to 5 on a very short common peduncle, often growing out into a leafy branch, each bearing a globular head of numerous (20 to 50) flowers, mostly 5-merous.

Sepals linear-spathulate, free or connected by a thin membrane.

Petals smooth, distinct or readily separating.

Pod linear, straight or undulate, 3 to 5 lines broad, flat, but the valves often alternately convex and concave over the seeds and sometimes much warted.

Seeds longitudinal, funicle thickened at the end into a club-shaped lateral aril and once folded below it. (B.Fl. ii, 373.)

Varieties or Reputed Varieties.

(1.) Var. *glaucophylla* Benth. Glaucous and more or less pubescent. Phyllodia mostly ½ to ¾ inch long. Flower-heads mostly 2 to 5, shortly racemose, with about twenty to thirty flowers. (B.Fl. ii, 374.)

Bentham gives his own *A. dictyocarpa* as a synonym. Following is the original description :—

Acacia dictyocarpa, sp. n., glabra, pubescens, junior glaucescens, ramis subteretibus, phyllodiis oblique obovato-oblongis obtusis v. vix mucronulatis tenuiter marginatis uninerviis basi angustatis infra medium plerumque glanduliferis, pedunculis solitariis v. brevissime racemosis phyllodia non superantibus, sepalis late spathulatis demum subliberis, legumine lineari reticulato-venoso. Phyllodia iis *A. brachybotryæ*

et *A. buxifoliæ* subsimilia, inflorescentia et flores diversi. Ramuli nunc glaberrimi nunc pilis brevibus mollibus pubescentes. Phyllodia 6–9 lin. v. raro pollicem longa, 3–4 lin. lata mucrone brevissime obliquo v. saepius obsoleto. Pedunculi 4–5 lin. longi. Capitula parva floribus fere 20 glabris. Bracteolae peltatae. Sepala diu cohaerentia, demum saepe soluta, semper multo latiora quam in *A. argyrophylla.* Corolla calyce duplo longior. Legumen glaucum et glabrum v. pubescens, breviter stipitatum, 1–2 poll. longum, 3–3½ lin. latum, undulatum marginatum.

In Murray Scrub et Mallee-Scrub. (*A. glaucophylla* F. Müll. non Steud. Pl. Abyss.) (Bentham in *Linnæa*, xxvi, 616.)

This locality is doubtless within the South Australian boundary. I have seen a specimen marked *dictyocarpa* by Bentham. It is pubescent, and I cannot see in what way it can be separated from normal *brachybotrya*, which is pubescent or tomentose (see original description), and does not essentially differ in other respects.

The whole of the specimens from the far west of New South Wales, from north-west Victoria, and from South Australia (excepting varieties *argyrophylla* and *Spilleriana*), belong to this form.

(2.) Var. *glabra* Benth.

Quite glabrous, phyllodia small and narrow; flower-heads small. Murray desert. (B.Fl. ii, 374.)

This locality is doubtless within the South Australian boundary. No specimen is in the Melbourne Herbarium, nor can I certainly refer any specimen in the Sydney Herbarium to it. The species is, however, so variable within the limits mentioned, that I doubt if this is a useful variety.

(3.) Var. *argyrophylla* Bentham.

Silvery silky, turning sometimes to a golden yellow. Phyllodia mostly ¾ to 1½ inch long. Flower-heads often solitary, usually with more than 30 flowers. (B.Fl. ii, 374.)

Synonyms.—

(*a*) *Acacia argyrophylla* Hook. in *Bot. Mag.* t. 4384 (1848).

Following is the original description :—

Acacia argyrophylla, ramis angulatis, foliis obovato-oblongis obtusis obscure pennincrviis pulcherrime argenteo-sericeis hinc margine medium versus uniglandulosis, capitulis multifloris solitariis v. racemosis, calycis laciniis clavatis corollisque ciliatis.

This species is one of the many novelties sent by Mr. Drummond from the Swan River Settlement, and is no less beautiful in the foliage (phyllodia) than in its copious large heads of deep yellow flowers. The phyllodia are like the leaves of *Podalyria sericea*, everywhere clothed with a glossy silky cobweb in the young leaves partaking of a yellow tint. Already our shrub is 5 feet high, very much branched, of graceful and compact growth, with phyllodia more like leaves than those of almost any other species. It flowers in April.

Descr.—A tall shrub, with numerous erecto-patent branches. The latter are angled, the young ones silky, yellow-green. Phyllodia from 1½–2½ inches or more long, obovato-oblong, very obtuse, pointless, and opening below into a very short footstalk, clothed on both sides with a compact, glossy, silky, and silvery down, the younger leaves richly tinged with yellow, the margin is a little thickened, and, about the middle of the upper edge, is a gland. *Stipules* obsolete. *Heads* of flowers rather large, globose, deep

yellow, solitary or racemed, the racemes usually shorter than the leaves. *Calyx* of five clavate, ciliated segments. *Corolla*, with the petals, oblong, ciliated. *Stamens* numerous. *Style* about the length of the filaments.

Hooker says this species "is one of the many novelties sent by Mr. Drummond from the Swan River Settlement" (Western Australia). If this be true, then it is singular that no one has since recorded it from that State, and there has been much collecting over Drummond's limited areas. Bentham is probably correct when he says "Chiefly in South Australia." Bentham, of course, had access to Hooker's type, and besides his remarkable knowledge of Australian plants, he was an eminent authority on the genus.

(*b*) *A. bombycina* Bentham. This is described by him in Lindley and Paxton's "Flower Garden," ii, 101, figure 186 (1853).

It is (B.Fl. ii, 374) stated by Bentham himself to be synonymous with *A. argyrophylla*, and, like that species, was believed to have been "raised from seeds from Mr. Drummond . . . a fine silky leaved New Holland shrub from Swan River." He had, however, unfortunately mislaid his flowering specimens, and the description was apparently drawn up from a figure which had been prepared from them.

The phyllodes vary a good deal in regard to their shape, being bluntly lanceolate and 1 cm. wide, to obovate 3 cm. wide. In this form the silvery and golden down of the young foliage is most highly developed.

4. Var. *Spilleriana* F.v.M. (herb.), *A. Spilleriana* J. E. Brown.

This is figured in J. E. Brown's "Forest Flora of South Australia" (t. 31), and described by him in the following words:—

An evergreen shrub of from 7 to 10 feet in height.

Branchlets glabrous.

Phyllodia smooth, angular, ovate, obovate, sessile or almost so, obtuse at apex, and acuminate at base, coriaceous, scattered, alternate and opposite, ½ to 1 inch in length, and ¼ to over 1 inch in breadth, occasionally oblique, one-nerved, and with prominent irregular veins.

Peduncle ¾ to 1½ inches long, slender and solitary as a rule.

Flower heads globular, fragrant, golden-yellow in colour, ⅜ inch in diameter, and containing from 20 to 30 or more flowers.

Sepals connected.

Petals smooth and distinct.

Pod 1¾ to 2¼ inches long and ½ an inch broad, coriaceous, stiff, generally linear, though sometimes undulating.

Seeds more than semi-lateral.

Funicle short, white, longitudinal and once folded.

Aril thin and clavate.

The differences between *A. brachybotrya* and *A. Spilleriana* are stated by J. E. Brown to be as follows:—

The leaves (phyllodia) of *A. brachybotrya* and those of the form under review are much alike, although the latter are perhaps more ovate-shaped than those of the former: while again the pods of *A. Spilleriana* are double the breadth of *A. brachybotrya*. In the latter species the flower-stalk (peduncle) is described as being rather short, and more frequently than otherwise "two to five together on a very

short common peduncle." In contrast to this we find the flower-stalks of *A. Spilleriana* very long, and generally solitary. Still more marked is the position of the seeds in the pods of the respective species named. In *A. brachybotrya* they lie longitudinally in the pod, while those of our subject take a somewhat more than half lateral position, as shown in fig. 7 of the Plate.

I have figured the types of *A. brachybotrya* and *A. Spilleriana* and indubitable *A. argyrophylla*. As depicted on the same plate these typical forms look at first sight different enough to be distinct species, but let us examine the differences in detail.

1. *Phyllodes.*—Those of the type are "obliquely obovate or oblong," and about 2 cm. long. See fig. A, Plate 200. All the forms come under this category except those of var. *argyrophylla*, which are bluntly lanceolate to obovate, and nearly twice as long, with a width of 1–3 cm.

The silvery or golden appearance of the young foliage is not peculiar to *argyrophylla*, though it is seen in its best development in that form. I have observed it in all the forms.

2. *Pedicels.*—They are exceptionally long in *A. Spilleriana*, but sometimes nearly as long in that form sometimes called var. *glaucophylla*.

3. *Pods.*—The obliquity of the arrangement of the seeds in the pods is not constant, sometimes it is longitudinal. J. E. Brown thought this arrangement separated *A. Spilleriana* from *A. brachybotrya*. Tate, "Forest Flora of South Australia," followed him in this view, which is founded on imperfect information.

Acacia dictyocarpa means an Acacia with a netted pod (Greek *dictyon*, a net). This form, in my view, is hardly to be distinguished from normal *brachybotrya*, and is in allusion to the netted appearance of the external veins of the valves; similar veins are seen in the confluent state where the seed-impression is. See O, Plate 200. This roughness is seen in all forms of *brachybotrya*, so it is not a peculiarity of *argyrophylla* as might be supposed from the plate.

4. *Flowers.*—The greatest difference amongst the forms appears to be in the flowers. There are, of course, local differences in all the flowers, such as width of calyx, amount of hairiness of parts, &c. The flowers of *A. brachybotrya* and *A. argyrophylla* very closely resemble each other. The sepals of the latter (fig. P) would appear to be narrower than that of the normal form (fig. T), but perhaps this difference is not constant. Those of *A. Spilleriana* are less hairy than those of other forms, so far as the material at my experience shows. At the same time the main species (*brachybotrya*) varies in the amount of hairiness in all its parts, and I have tried to state the case fairly while following Bentham and Mueller in looking upon *argyrophylla* as a form of *brachybotrya*, and the latter in looking upon *Spilleriana* as a form also.

Affinity.—Perhaps the species most likely to be confused with the present one is *A. buxifolia* A. Cunn. Plate 165 of this work can be studied in this connection. It will there be seen that *A. brachybotrya* is separated from *A. buxifolia* by the slender axillary pedunculate flower heads, sometimes in pairs, which are all in racemes in the former species, young branches and peduncles distinctly pubescent in the former species almost invariably. The calyces of the two species sharply separate them.

Botanical Name.—*Acacia*, already explained (see Part XV, p. 104); *brachybotrya*, from two Greek words *brach(u)ys* short, and *botrys*, Latin, *racemus* (raceme) presumably because the pedicels do not exceed (are not longer than) the phyllodes. It is not especially descriptive.

Vernacular Name.—Called "Blue Bush" from the bluish cast of the foliage owing to its glaucousness or pubescence. Often the tips of the young leaves are quite silvery (bluish) in appearance.

Aboriginal Name.—Dr. C. Sutton quotes "Bûrupga" as that of the Hindmarsh (Victoria) natives. I have heard a similar name quoted for the variety *argyrophylla*, which has not yet been recorded for Victoria, although I should not express surprise if it were found within the limits of that State.

Synonyms.—These are given under the heading of Varieties.

Leaves.—I would again draw attention to the golden (less frequently silvery) pubescence of the young foliage, which is most marked in the variety *argyrophylla*. Eaten by sheep.

Fruit.—The seeds are not always arranged in an oblique manner in the pod; sometimes they are longitudinal.

Bark.—Two samples of this bark from the variety *argyrophylla* were forwarded to the Technological Museum by Mr. A. L. Thrupp, Balhannah, S.A., with the intimation that it is used in the adulteration of Golden Wattle bark (*Acacia pycnantha*) in South Australia.

The bark had been chopped, and from its general appearance it certainly would be somewhat difficult to detect when mixed with some samples of *Acacia pycnantha* bark. With the better samples of *Acacia pycnantha* the detection of admixture should not be difficult.

The barks are thin, inclined to be scaly, are somewhat fibrous, and of a reddish colour. They were stripped and analysed August, 1890, one with the result of 21·1 per cent. tannic acid, and 47·3 per cent. extract; the other gave 18 per cent. tannic acid, and 46·15 per cent. extract.

The first specimen came from Hammond, S.A.; the exact locality of the other was unknown.

Timber.—This Wattle is always a shrub; I have never seen it large enough to yield timber.

Size.—A shrub of 4 to 8 feet.

Habitat.—It will be observed that the type was collected by Allan Cunningham at Peel's Range. This was on Oxley's Expedition in the year 1817. At p. 66 of "Journal of two Expeditions into the Interior of New South Wales," by John Oxley (1820), Oxley, under date 15th June, 1817, says:—"Mr. (Allan) Cunningham went upon Peel's Range in search of plants, and found a few new ones. . . . ."

As shown by Oxley, Peel's Range is almost due north and south, a little to the east of the 146th parallel of East longitude, and between 33 and 34 South latitude. It is the Cocopara Range, south of the Lachlan River, between Hillston and Lake Cudgellico. It must not be confused with Peel Range, east of the Liverpool Range, *e.g.*, at Currabubula.

The following specimen:—"Shrub 4–5 feet high, Roto and Coan Downs Stations, Hillston North, County of Blaxland, Lachlan District, N.S.W. (J. Duff)," is practically from the type locality.

The species is indigenous to somewhat dry regions in New South Wales (Lachlan and Darling districts), north-western Victoria, and the so-called Murray Desert area of South Australia. Its form *argyrophylla* has been found in the northern part of South Australia.

Variety *glaucophylla* Benth.—This form (which I do not look upon as a useful variety) has been also labelled *A. undulifolia* A. Cunn. var. *dysophila* Benth. by competent botanists, but I will explain the differences between the two species when I describe and figure *A. undulifolia* in Part LIV.

New South Wales.

Nyngan district, edible for sheep (E. F. Rogers); Shuttleton, Cobar district (W. Baeuerlen); height, 3–4 feet, grows in Mallee Scrub (P. E. Lewis; E. C. Andrews, F. E. Haviland); South Nymagee, 2 feet high, eaten by sheep (R. H. Cambage, No. 142); Bentham gives the locality "from the Darling to the Barrier Range."

Victoria.

Wimmera (Charles Walter); Dimboola, Wimmera, with silvery and golden tips to the young phyllodia (St. Eloy d'Alton); Nhill (J. Staer); Brentwood (S. P. Croom); Mallee (C. French, jun.).

South Australia.

Murray Country in the Hundred of Mantung, which is really the north-west continuation of the Pinnaroo Country, "never saw it anywhere else" (W. Gill,

Conservator of Forests). With slightly silvery and golden tips like *argyrophylla*. Also with the scaly appearance on the old valves similar to that observed in *A. argyrophylla*. This South Australian locality is typical for *A. dictyocarpa* (*brachybotrya* var. *glaucophylla*).

Var. **argyrophylla** Benth.

Appears to be peculiar to South Australia, and it has a range from the elevated country about Adelaide to the northern part of the State.

"Blue Bush," Balhannah, 19 miles east of Adelaide (A. L. Thrupp); near Hamilton (50 miles north of Adelaide) near Kapunda (J. M. Black); Hammond, 45 miles east of Port Augusta (A. L. Thrupp); Oodnadatta, northern South Australia (J. M. Black).

Var. **Spilleriana** F.v.M.

A. Spilleriana is confined to the northern country of South Australia—Wirrabara, Terowie, Yarcowie, &c. (Walter Gill).

Propagation.—This species (or rather its variety *argyrophylla*) is much sought after for horticultural purposes, because of the golden appearance of its young phyllodes. It, however, shows this character best in regions of low rainfall.

EXPLANATION OF PLATE 200.

A. Normal form, flowering twig of normal *brachybotrya*.
B. Larger phyllode, from near Dimboola, Wimmera, Victoria.
C. Pods.
D. Seed.
E. Twig of var. *glaucophylla*, from River Darling, N.S.W., which seems to me in no way different from the normal species. (The flower details are similar to those shown under var. *argyrophylla*.)
F. Flowering twig of var. *Spilleriana*.
G. Pods.
H. Seed.
I. Flower-head.
K. Individual bud.
L. Flower (glabrous).
M. Bract found at the base of each flower.
N. Pistil.

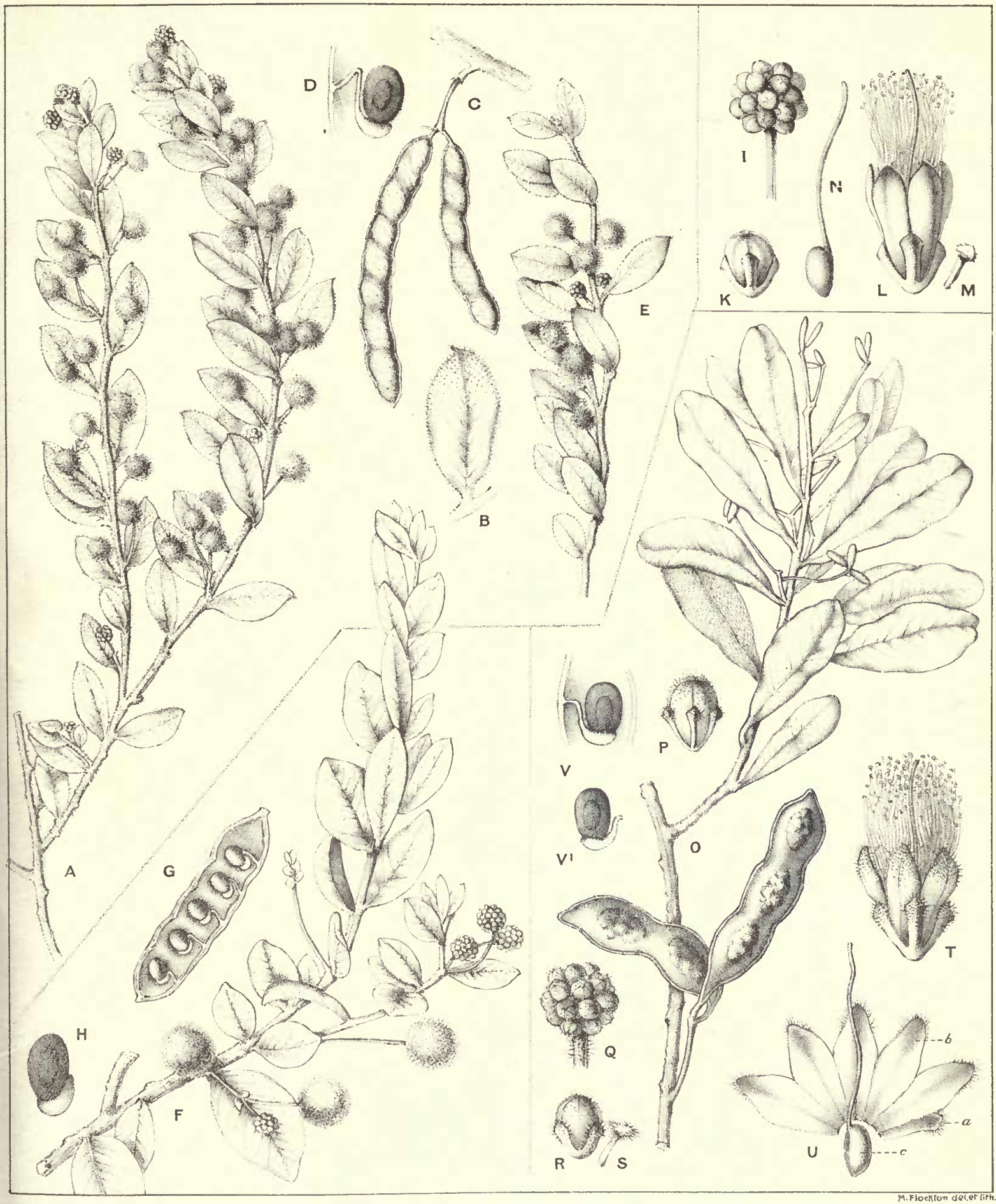
(F–N are all *Spilleriana*.)

O. Fruiting twig of var. *argyrophylla*.
P. Bud of the same, showing narrow calyx-lobes.
Q. Flower-head
R. Individual bud
S. Bract
T. Flower

(Q–T) The flowers are alike in *brachybotrya* and var. *argyrophylla*, except that the latter has a narrow calyx.

U. Flower opened out, showing—
  (*a*) Calyx.
  (*b*) Corolla.
  (*c*) Pistil (stamens removed).
V. Seeds.

(P–V are all *brachybotrya* and var. *argyrophylla*.)



A BLUE BUSH.

(Acacia brachybotrya Benth.: (A-E), and varieties.)

o. 197.

Quintinia Verdonii F.v.M.

(Family SAXIFRAGACEÆ.)

Botanical description.—Genus, *Quintinia*. (See Part LII, Vol. vi, p. 28.)

Botanical description.—Species, *Q. Verdonii* F. Muell. *Fragm.* ii, 125 (1861).

Very near *Q. Sieberi*, the leaves of the same shape and size, but much less reticulate.

Racemes in the specimens seen all simple and solitary in the upper axils, 3 to 4 inches long.

Flowers rather smaller than in *Q. Sieberi*, on pedicels about 2 lines long.

Calyx-lobes narrower, about half as long as the petals.

Capsule smaller than in *Q. Sieberi*.

Seeds small, ovoid-oblong, obtuse, not winged. (B.Fl. ii, 438.)

Botanical Name.—*Quintinia*, already explained (see Part LII, p. 28); *Verdonii*, in honour of the late Sir George Verdon, at one time Chairman of the Trustees of the Public Library, Museum, and Art Gallery, Melbourne, a member of the Victorian Legislature, and some time Agent-General for that State.

Vernacular Name.—I know of none.

Flowers.—Yellowish white or pale yellow.

Timber.—This is a small or medium sized tree, and I have not seen it sufficiently large or abundant for it to be looked upon as an important addition to our timber supply. It is pale coloured, and probably of no economic importance.

Size.—A large shrub or small tree. I do not call to mind that I have seen it higher than 15 feet, though it is highly probable that further search in brushes may show that it attains a far greater size.

Habitat.—This is a small brush tree, and, so far as we know at present, it is almost confined to coastal New South Wales. It extends to southern Queensland, but I know of no specific localities. It has been collected on the Tweed River.

It was originally collected on the Macleay and Hastings Rivers by Dr. Ludwig Beckler. Its farthest south locality recorded is the Ellenborough Falls,

but I am quite satisfied it will be found much more south. Following are some localities represented in the National Herbarium, Sydney:—

Ellenborough Falls, *viâ* Wingham, Manning River (J.H.M. and J. L. Boorman); found at high altitudes in rough, moist, stony localities, Coolpi Mountains, north of Ellenborough Falls (J. L. Boorman); Camden Haven (?Collector); Port Macquarie, Hastings River (J.H.M.); Upper Hastings River, ascent to Tableland (J.H.M.); Kempsey, Macleay River (W. MacDonald); Bellinger River (E. H. F. Swain); Dorrigo, *viâ* Bellinger River (W. Heron, J. L. Boorman); Murwillumbah, Tweed River (R. A. Campbell).

Propagation.—This plant is destined to be an agreeable addition to our gardens; it will succeed in practically the whole of the coast districts. It reminds one somewhat of a Portugal Laurel.

EXPLANATION OF PLATE 201.

A. Flowering twig.

B. Bud.

C. Young flower.

D. Mature flower, showing—

(*a*) Petals.

(*b*) Stamens.

(*c*) Pistil.

E. Part of flower showing—

(*a*) Calyx-lobes.

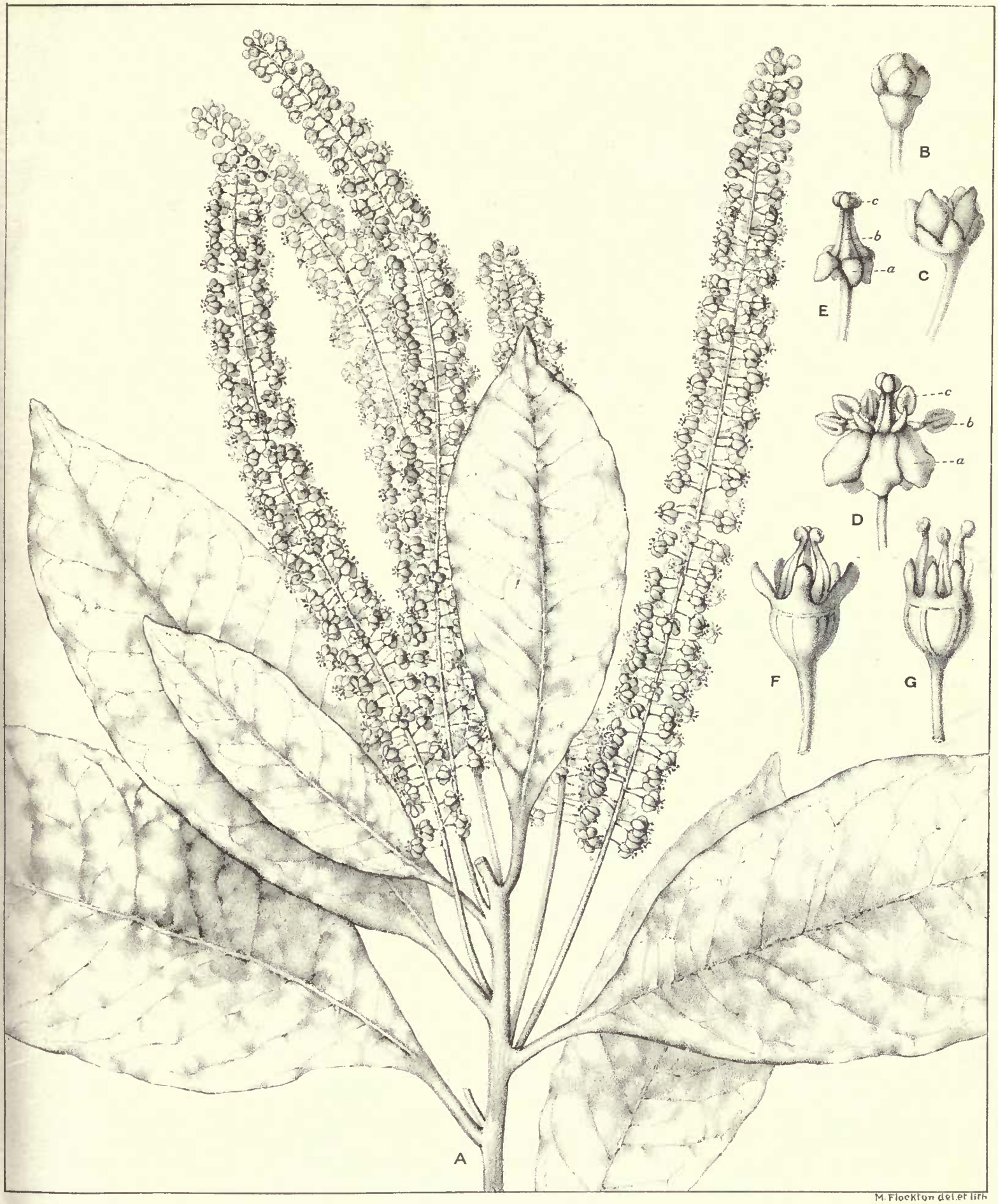
(*b*) The three styles united.

(*c*) Stigmas.

F. Ripe capsule, the styles separating to let the seeds escape.

G. Fruit after dehiscence.

[All drawings from a specimen (Port Macquarie, J.H.M.) which is practically a type locality.]



QUINTINIA VERDONII, F.v.M.

A FEW NOTES ON SAPONINS.

(Poisonous "Vegetable Soaps.")

A Saponin is a member of a group of glucosides which are characterised by the property of producing a soapy lather. Commercial Saponin is obtained as an amorphous powder principally from the Soap-bark of Chili (*Quillaja saponaria*), a flattish pale bark which is used for washing silk, and also by ladies for washing the hair, to which it imparts a glossy appearance.

M. Bernardin* published a pamphlet on Saponin-yielding substances in 1875.

Dr. Manuel Urbina published a short paper on "Los Amoles Mexicanos," in 1897, in which he listed 21 species of plants used as amole.

In the list which follows 30 species are recorded. So far as known I have given the Mexican name and the part of the plant used.

Soap Plants of Mexico.

Systematic Name.	Common Name.	Parts used.
RHAMNACEAE:		
Zizyphus mexicana Rose	Amole	Fruit.
SAPINDACEAE:		
Sapindus Galeotti Gray		Fruit.
Sapindus inequalis DC.		do.
Sapindus marginatus Willd.		do.
Sapindus saponaria L.		Fruit (?).
Sapindus sp.		Fruit.
LEGUMINOSAE:		
Entada polystachya DC.	Bejuco de amole	Wood.
Enterolobium cyclocarpum Griseb.	Huinecastle	Bark and pods.
CUCURBITACEAE:		
Cayaponia dubia (Hook. & Arn.) Rose		Fruit and vine.
Cucurbita foetidissima H.B.K.		do.
PHYTOLACCACEAE:		
Phytolacca octandra L.		
Phytolacca icosandra L.		
Stegnosperma halimifolia Benth.	Amole	Roots.
DIOSCOREACEAE:		
Dioscorea convolvulacea Cham. & Schlecht.		
Dioscorea sp		
PIPERACEAE:		
Piper Polmeri C.DC.		
LILIACEAE:		
Yucca rupicola rigida Engelm.		
Yucca baccata Nutt.	Amole	Roots and rootstocks.
Yucca angustifolia Pursh.		
AMARYLLIDACEAE:		
(§ Agave proper.)		
Agave filifera Salm Dyck		
Agave heteracantha (?) Zucc.		Rootstock.
Agave lechuguilla Torr.		Leaves.
Agave mexicana Lam.		
Agave Parryi Engelm.		
(§ Manfreda.)		
Agave brachystachys Cav.	Amole, lechuguilla	Rootstock.
Agave guttata Jacobi & Bouché	do	do.
Agava variegata Jacobi	do	do.
Bravoa geminiflora Llav. & Lex		do.
Polianthes tuberosa L.	Amole	do.
Prochnyanthes viridescens Watson.	Amolilla, amole	do.
Zephyranthes carinata Herbert		Bulbs.

Contributions from the U.S. National Herbarium, Vol. 5, p. 236.

* "Classification de 40 Savons Végétaux," pp. 11, 8vo. Gand (Ghent).

If my readers will turn to Part LII, p. 31, of the present work, they will observe that I have given a brief account of the Fish poisons of the Aborigines. In many cases the active principle is, or is believed to be, a saponin, and, as a very general rule, a saponin possesses poisonous properties.

A saponin may be the active principle in certain trees and herbs which have been suspected of being poisonous to stock, though the bitterness of the plant containing it is usually a deterrent.

The late Dr. M. Greshoff made original researches in regard to the plants which contain saponins, and the following is taken from his posthumous work* :—

Of still greater pharmacological and toxicological importance than the occurrence of hydrocyanic acid in a given plant is the discovery in it of a poisonous glucoside of the saponin group. A number of medicinal, toxic and economic properties of the plant may thus suddenly become clear. Medicinally: its use as diuretic, antisyphilitic (*e.g.*, *Sarsaparilla*), expectorant (*e.g. Senega*), emetic, vermifuge, taenicide, &c. Toxicologically: various poisonous actions on man and on animals, ascribed to the plant by popular experience, and further, the important application of saponin-containing plants as fish poisons and as insecticides. Economically: The use in washing as a substitute for soap (*e.g.*, *Quillaja*). For further information I refer to the excellent work of Prof. R. Kobert, "Beiträge zur Kenntniss der Saponinsubstanzen," 1904. Unfortunately, in the case of saponins there are no well-defined chemical characteristics like those of hydrocyanic acid, but for practical purposes three properties suffice: in the first place, the marked frothing of a plant extract containing saponins, which persists at very great dilutions (sometimes to 1 in 3,000, occasionally even to 1 in 15,000); secondly, the hydrolysis of glucosidal saponins by boiling with dilute acids and the colour reactions of the sapogenin formed; thirdly, as an important indication of the general toxicity, the determination of the haemolytic power. In the following report the figures 1–300 mean, for instance, that an extract of the plant at a concentration of 1 part in 300 dissolves an equal volume of diluted (1 per cent.) fresh blood of the ox.

Dr. Greshoff also quotes his work.†

Following are the references I have taken from Greshoff's Kew work so far as they refer to Australian plants:—

Acacia (Leguminosæ-Mimoseæ).

At Kew, I found saponin in the leaves of *A. pulchella* R.Br.; according to notes made at Haarlem, saponin also occurs in the seeds of *A. verticillata* Willd.

Various other species (such as *A. anthelmintica* Baill., *A. Cunninghamii* Hook., *A. concinna* DC., *A. delibrata* A. Cunn.) were already known to contain saponin. Six species of *Acacia* are mentioned as fish poisons in my "Monographie der bedwelmende planten bij de vischvangst in gebruik," Vol. ii, p. 69; this is probably connected with the presence of saponins. (p. 402.)

Aphanopetalum (Saxifragaceæ).

The leaves of *A. resinosum* Endl., have a very bitter taste. The extract froths slightly and shows alkaloidal reaction. I was able to extract the alkaloid from a small quantity of leaves by shaking with ether. The plant deserves further examination. (p. 403.)

At p. 404 he records *Atriplex* as a saponin plant, and this may afford a hint to examine our Saltbushes, of which many belong to this genus.

Callicoma (Saxifragaceæ).

The leaves of *C. serratifolia* Andr. contain saponin, but not in large quantity. (p. 404.)

Castanospermum (Leguminosæ-Papilionaceæ).

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* "Phytochemical Investigations at Kew." *Kew Bulletin* No. 10 of 1909, p. 401.

†"Monographie der giftige en bedwelmende planten bij de vischvangst in gebruik" (Monograph on fish poisons), which is at the same time a survey of the most poisonous plants of the world, and their distribution in natural orders. Of this work, Vol. I was published in 1893, at Batavia, and Vol. II in 1900; Vol. III in 1910.

The leaves of *C. australe* A. Cunn. et Fraser contain saponin, readily recognised by the strong frothing of an extract; I could not detect any saponin in the seeds.

The seed is edible but rather indigestible. Observations in Australia had already shown that the leaves are harmful to cattle. The saw-dust from the wood of *Castanospermum* greatly irritates the mucous membranes (saponin!) (p. 405.)

Clematis should be examined. See p. 406.

Kochia (Chenopodiaceæ).

The leaf of *K. scoparia* Schrad. contains saponin, as do the seeds of this species and of *K. arenaria* Roth. The seeds of *K. trichophylla* Hort. yielded an extract which frothed up to a dilution of 1–700 and caused complete haemolysis at 1–250. *Kochia* is now a much esteemed ornamental plant known as "Summer Cypress." The species examined is used to some extent as a popular remedy in Southern Europe, *e.g.*, as a diuretic. (p. 412.)

Our esteemed cotton bushes belong to the genus *Kochia*.

Olearia (Compositæ).

The herb *O. macrodonta* Bak. was found to contain saponin. *Olearia* (= *Eurybia* Cass.) is closely related to *Aster* and to *Erigeron*. (p. 413.)

Australia is, of course, very rich in the genus *Olearia*.

Pittosporum (Pittosporaceæ).

At Kew I was able to examine various species of this genus. Saponin was found in the leaves of *P. cornifolium* A. Cunn., *P. crassifolium* Soland., *P. erioloma* C. Moore et F. Muell., *P. eugenioides* A. Cunn., *P. Huttonianum* Kirk, *P. rhombifolium* A. Cunn., *P. Tobira* Ait., *P. undulatum* Vent. Tannin is also present in these leaves. The cause of the persistent bitter taste, possessed especially by *P. Buchanani* Hook., *P. eugenioides* A. Cunn., *P. rhombifolium* A. Cunn., and *P. undulatum* Vent. has not yet been investigated; an alkaloid is only present in traces. *Billardiera longiflora* Labill. closely allied to *Pittosporum*, also contains saponin.

At Haarlem I found saponin a good many years ago in the leaves of *Pittosporum Tobira*, from the University Botanic Garden at Leiden.

The fruits of *P. phillyraeoides* DC., yielded an extract frothing at 1–4,000 and haemolytic at 1–1,500. The dry leaf of *P. undulatum* even gives an extract frothing at 1–1,200, with haemolysis at 1–1,500.

The fairly common occurrence of saponin in this natural order has already been repeatedly remarked. Some species (*P. coriaceum* Ait., *P. viridiflorum* Sims) are even known as soap-substitutes in their native countries. The use of *P. javanicum* Bl. as a fish-poison doubtless also depends on the high saponin content of this plant. The saponin of *P. undulatum* Vent. was examined in London in 1904 by Miss Hooper, and the essential oil in 1906 by Power. (*Pharm. Journ.* 1904, 538; 1906, 755). (p. 414.)

Psoralea (Leguminosæ-Papilionaceæ).

I have examined the leaf of *P. macrostachya*, DC. at Kew and the seeds at Haarlem; both contained saponin, especially the leaf.

Many members of this suborder contain saponin. The root of *P. glandulosa* L. acts as an emetic, and the leaves, for instance, are used as an anthelmintic. *P. tenuiflora* Pursh. is regarded as poisonous, and is avoided by cattle. (p. 416.)

The genus is not uncommon in Australia.

Tetragonia (Ficoideæ).

The shoots of *T. expansa* Murr. contain much saponin, but not the seeds.

Saponin had previously been found in this order in *Trianthema*. Presumably the saponin of *Tetragonia* is but slightly poisonous, as it is used as a vegetable; in boiling the leaves the saponin would moreover in general be removed with the water. (p. 418.)

This is the so-called "New Zealand spinach," a native of our coasts and farther inland.

Xylomelum (Proteaceæ).

The leaf of *X. pyriforme* (Knight) contains saponin. (p. 418.)

This is our native pear.

Attention may be invited to an important paper by G. Masson,* in which he draws attention to the unsatisfactory state of the literature concerning Saponins, and he gives the name of "Saponoides" (Saponoids) to certain pseudo-saponins to which he refers. All these substances were hitherto classified as Saponins.

He gives his chemical results in regard to a number of substances yielding Saponin; he does not deal with many. None are of Australian plants, though *Lychnis Githago* L. has invaded our wheat-fields.

The only Australian writer on the Saponins, as far as I know, was the late Dr. Lauterer,† of Brisbane, who published a useful preliminary paper.

The following references from my "Useful Native Plants of Australia" (1889) may be taken for what they are worth. The active principle of some of the plants at least is a saponin.

(1.) *Avicennia officinalis* L. (Verbenaceæ). "Mangrove." The ashes of this tree are used in the manufacture of soap. This plant is not endemic in Australia. In salt-water estuaries entirely round the coast.

(2.) *Cassytha filiformis* L. (Lauraceæ). A "Dodder Laurel." Crushed with gingelly oil, this plant is used in India as a head wash for strengthening the hair. Queensland and Northern Australia.

(3.) *Colubrina asiatica* Brongn. (Rhamnaceæ). The natives of Fiji use the leaves of this shrub for washing their hair, to clean it, and to destroy the vermin (Seemann). Queensland and Northern Australia.

(4.) *Entada scandens* Benth. (Leguminosæ). "Queensland Bean," "Leichhardt Bean." The kernels are used by the Nepalese for washing their hair, and in Bengal by washermen for crimping linen. (Gamble, *Manual of Indian Timbers.*) Queensland.

(5.) *Vitis saponaria* Seem. (Ampelideæ). The natives of Fiji used this creeper for washing their hair to destroy the vermin. The stem, especially the thicker part, is cut in pieces from a foot to eighteen inches long, cooked on hot stones, and when thus rendered quite soft it produces, in water, a rich lather, almost equal to that of soap. (Seemann.) Queensland.

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* "Recherches sur quelques plantes à saponine." *Ecole Sup. de Pharm.* Paris, 1910.

† Occurrence of Saponin in Australian Acacias and Albizzias." (*Proc. Roy. Soc. Qld.*, xii, p. 103.)

A very important paper on Saponins, translated by Dr. Walter J. Dilling, is by Prof. Rudolph Kobert.*

It contains a definition of a Saponin, and gives a warning as to the ignorant use of the term. Prof. Kobert deals with methods of preparation, chemical properties, elementary composition, decomposition, and notes of some plants which contain Saponins (including some of which we have congeners in Australia, and, in the case of *Entada scandens* and *Ægiceras majus*, the actual species).

It will interest many Australians (although the subject does not come under the purview of a "Forest Flora") that the secretion of the poison glands of venomous snakes (Ophiotoxin of Faust) is a saponin.

Prof. Kobert also deals with the physical properties, pharmacological properties, therapeutical uses of saponins, and ends with a valuable list of references to literature.

An adequate chemical and physiological research on the saponin-bearing trees and other plants of Australia, particularly the indigenous species, is one of the desiderata which, if people realised its importance, scientific men would be at once commissioned to undertake.

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* "Saponins; their properties, composition and uses." *Pharm. Journ.*, vol. lxxxvi, 244 and 293 (25th February and 4th March, 1911).

60

A Critical Revision of the genus Eucalyptus.*

THIS work is, like the present one, issued in Parts, and each Part also contains four plates (except Part IV, which contains twelve plates). It contains botanical details and critical observations which would be unsuitable for the present work, which is more of a popular character.

Of the New South Wales species of Eucalyptus, the following are dealt with in the "Critical Revision" (the number of the Part of which is given in brackets) :—

Eucalyptus acacioides, A. Cunn. (XI).
" *acmenioides*, Schauer (IX).
" *affinis*, Deane and Maiden (XIII).
" *amygdalina*, Labillardière (VI).
" *Andrewsi*, Maiden (VII).
" *apiculata*, Baker and Smith (IX).
" *Baueriana*, Schauer (XIII).
" *Behriana*, F.v.M. (X).
" *bicolor*, A. Cunn. (XI).
" *Boormani*, Deane and Maiden (X).
" *Bosistoana*, F.v.M. (XI)
" *Caleyi*, Maiden (X).
" *calycogona*, Turczaninow (III).
" *capitellata*, Smith (VIII).
" *Consideniana*, Maiden (X).
" *coriacea*, A. Cunn. (V).
" *crebra*, F.v.M. (XII).
" *dives*, Schauer (VII).
" *elæophora*, F.v.M. (XIX).
" *eugenioides*, Sieber (VIII).
" *fruticetorum*, F.v.M. (XI).
" *gigantea*, Hook. f. (XX).
" *Gillii*, Maiden (XV).
" *globulus*, Labillardière (XVIII).
" *goniocalyx*, F.v.M. (XIX).
" *hæmastoma*, Smith (X).
" *hemiphloia*, F.v.M. (XI).
" *incrassata*, Labillardière (IV).
" *leucoxylon*, F.v.M. (XII).
" *longifolia*, Link & Otto (XX).
" *Luehmanniana*, F.v.M. (IX).
Eucalyptus macrorrhyncha, F.v.M. (VIII).
" *Maideni*, F.v.M. (XVIII).
" *melanophloia*, F.v.M. (XII).
" *melliodora*, A. Cunn. (XIV).
" *microcorys*, F.v.M. (IX).
" *microtheca*, F.v.M. (XI).
" *Muelleriana*, Howitt (VIII).
" *nitens*, Maiden (XIX).
" *obliqua*, L'Héritier (II).
" *ochrophloia*, F.v.M. (XI).
" *odorata*, Behr and Schlecht. (XI).
" *oleosa*, F.v.M. (XV).
" *paniculata*, Sm. (XIII).
" *pilularis*, Sm. (I).
" *piperita*, Sm. (X).
" *Planchoniana*, F.v.M. (IX).
" *polyanthemos*, Schauer (XIII).
" *populifolia*, Hooker (X).
" *regnans*, F.v.M. (VII).
" *Rudderi*, Maiden (XIII).
" *siderophloia*, Bentham (X)
" *sideroxylon*, A. Cunn. (XII).
" *Sieberiana*, F.v.M. (X).
" *Smithii*, R. T. Baker (XII).
" *squamosa*, Deane and Maiden (XVII).
" *stellulata*, Sieber (V).
" *umbra*, R. T. Baker (IX).
" *uncinata*, Turcz. (XIV).
" *virgata*, Sieber (IX).
" *vitellina*, Naudin (VII).
" *vitrea*, R. T. Baker (VII).

* Quarto. Government Printer, Sydney. Two shillings and sixpence a part (Part IV, Six shillings). Part IV will be charged Two shillings and sixpence to subscribers only. For this work Mr. Maiden has received Eucalyptus specimens from the principal Herbaria throughout the world.

Sydney : William Applegate Gullick, Government Printer.—1914.

No. 198.

Hakea Fraseri R.Br.

Fraser's Hakea.

(Family PROTEACEÆ.)

Botanical description.—Genus, *Hakea.* (See Part XLVI, p. 105.)

Botanical description.—Species, *H. Fraseri* R.Br., *Prot. Nov.** 26 (1830).

A tall shrub, the branches much more slender than in *H. lorea*, of which it may possibly be a variety.

Leaves much more slender, 4 to 8 inches long.

Racemes only 1 to 2 inches long.

Pedicels 2 to 3 lines.

Flowers of *H. lorea*, but smaller, the perianth-tube not above 3 lines long.

Fruit unknown. (B.Fl. v, 496.)

(Notes on the leaves and fruit will be found below.—J.H.M.)

Botanical Name.—*Hakea*, already explained (See Part XLVI, p. 106); *Fraseri*, in honour of Charles Fraser, first Superintendent of the Botanic Gardens, who originally collected this plant in the year 1818. He was on Oxley's First and Second Expeditions as detailed in Oxley's "Journal of two Expeditions," &c. (1820). He is termed Colonial Botanist in contradistinction to Allan Cunningham who is termed King's Botanist. In the second expedition, when this plant was found, Oxley went from Bathurst to the vicinity of the Warrumbungles (Arbuthnot's Range), Liverpool Plains, and New England, and discovered Mount Seaview and the Hastings River.

In page 212 of Oxley's work he spells Fraser's name "Frazier" ("Frazer" at p. 375), and says that "a short description of the most remarkable plants collected during the expedition by Mr. Charles Frazier, the Government Collector, is added to this Journal," but it apparently was never published.

Leaves.—In the *Flora Australiensis* the length of the leaves is given as from 4 to 8 inches long. Some specimens collected by Mr. S. W. Jackson from Collarenebri have the leaves as long as 15 inches.

* The full title of this small but very important work is "Supplementum Primum Prodromi Floræ Novæ Hollandiæ: exhibens Proteaceas Novas quas in Australasia legerunt DD. Baxter, Caley, Cunningham, Fraser et Sieber et quarum e siccis exemplaribus characteres elaboravit Robertus Brown."

Fruit.—Nearly straight, smooth, about 1¼ inches long and about 5 lines broad.

As the fruit of this apparently very local handsome shrub has not been hitherto known, we have given the above description from a few old capsules (without seeds) collected by Mr. Forsyth. (Maiden and Betche, in *Proc. Linn. Soc., N.S.W.*, xxvi, 88, 1901.) The fruits are figured on the plate.

Timber.—Of a reddish-brown colour, and with the usual character of *Hakea* timbers. At present it is so rare that it seems unnecessary to discuss its possible economic value.

Size.—A shrub or small tree. Mr. S. W. Jackson says that a few miles from Collarenebri it is a tree of 20 feet. The Tia Falls plants are about 10 feet high.

Habitat.—This species is confined to New South Wales.

The *Flora Australiensis* has—

"Hastings River, *Fraser*, and probably from the same neighbourhood, *Herb. F. Mueller*, apparently from Leichhardt."

The type is stated by Brown to have come from the Hastings River; it was collected by C. Fraser, doubtless on Oxley's Expedition to Mount Seaview and the coast in the year 1818 (see "Journal of Two Expeditions into the Interior of New South Wales," by John Oxley, 1820.)

The late Mr. W. Forsyth collected this species at the Tia Falls on the New England Table-land, between the Upper Hastings River and Walcha. This gives us a clue, I think, as to where Fraser got it originally. Oxley went near the Tia Falls country on his way to Mount Seaview (p. 309, *op. cit.*) and the coast, and it is very easy for a specimen, so collected, to be labelled "Hastings River." The Upper Hastings arises in exceedingly rough country, and it is quite possible *Hakea Fraseri* may occur literally on or near the Hastings, but I think it is unlikely that it occurs on the Lower Hastings, which debouches at Port Macquarie. If this surmise be correct, the species must be removed from the coastal to the table-land flora. At all events, it is a very rare species in collections, and this note will invite re-examination of its range.

The only other locality that I know of for this species is between 40 and 50 miles of Collarenebri in north-western New South Wales. The township is a (at present) terminal station on the Narrabri-Burren Junction railway line. It is at the junction of the Gwydir and the Barwon and about 450 miles north-west of Sydney.

These two localities are about 300 miles apart, and it is obvious that intermediate ones will be found.



FRASER'S HAKEA.

(*Hakea Fraseri* R. Br.)

EXPLANATION OF PLATE 202.

A. Flowering twig.

B. Bud.

C. Flower unopened.

D. Opened flower showing—

- (*a*) Four-lobed corolla with sessile anthers in the concave laminæ.
- (*b*) Pistil.

E. Portion of flower, corolla removed, showing—

- (*a*) Hypogynous gland.
- (*b*) Stipitate ovary.
- (*c*) Style.
- (*d*) Stigma.

F. Anther.

G. Conical stigmatic disk.

H. & I. Fruits.

K. Seed.

(From Tia Falls, New England, which I believe will prove to be practically the type locality.)

No. 199.

Eucalyptus melanophloia F.v.M.

Silver-leaved Ironbark.

(Family MYRTACEÆ.)

Botanical description.—*Eucalyptus.* (See Part II, p. 33).

Botanical description.—Species *E. melanophloia* F.v.M., in *Journ. Linn. Soc.* iii, 93 (1859).

A small tree with a blackish persistent deeply-furrowed bark (*F. Mueller*), the foliage more or less glaucous or mealy-white.

Leaves sessile, opposite, from cordate-ovate or orbicular to ovate-lanceolate, obtuse or acute.

Peduncles short, terete or nearly so, 3 to 6-flowered, axillary or several in a short terminal corymb.

Buds tapering into a pedicel shorter than the calyx-tube or almost sessile.

Calyx-tube slightly angular, about 2 lines long or rather more, and as much in diameter.

Operculum obtusely conical, shorter than the calyx-tube.

Stamens 2 to 3 lines long, inflected in the bud; anthers very small and globular, but the cells parallel and distinct.

Fruit pear-shaped or globular-truncate, 2 to nearly 3 lines diameter, more or less contracted at the orifice, the rim thin, the capsule nearly on a level with it, and the valves slightly protruding, or more sunk with the valves included. (*B.Fl.* iii, 220.)

Botanical Name.—*Eucalyptus*, already explained (See Part II, p. 34); *melanophloia*, from the Greek *melas*, *melanos*, black, and *phloia*, bark.

Vernacular Names.—This is an Ironbark, and in districts in which it is gregarious it is called Ironbark without any prefix.

It is sometimes called "Broad-leaved Ironbark" for obvious reasons, but it is not to be confused with *E. siderophloia*, which has even broader leaves of a different shape and texture. (See Part XXXIX of the present work.)

Because of the glaucous appearance of the foliage, this tree is perhaps even most frequently known as "Silver-leaved Ironbark."

For the reason detailed under "Bark," as northern Queensland is approached, the tree is sometimes, but exceptionally, known as "Box."

Aboriginal Names.—Mr. E. Maher, of Collaroy, gave me the name "Ginghi" as the native name for this tree on the Macquarie River, New South Wales. I have received the name "Ghinghit" from the Dubbo district, but cannot understand the difference between the two words. Perhaps the Dubbo word was misspelt.

Leaf.—Reference to the plate will show that the shapes of the leaves vary. As a very general rule they are rounded, nearly circular, sessile, and therefore stem-clasping, but there is a perfect gradation to a lanceolar form, and to those with a distinct petiole.

Usually the foliage is glaucous.

Bark.—The bark varies. Mueller, in the original description, says: "Persistent bark thick, deeply furrowed, rough and blackish." He then speaks of Leichhardt (*Overland Expedition, &c.*) having found a second form, about the Gulf of Carpentaria, with dirty-greyish, flaky bark.

Generally speaking it is Ironbark; this would appear to be always the case in New South Wales. As tropical regions are approached, the bark would appear to have the ridges flatter and to become more flaky, so that the "box-like" character is sometimes assumed.

Timber.—As a rule, this is not a very large tree, and it is often crooked and pipy, the prey of white ants. In consequence large logs are not easy to obtain over a large area of its range, and hence it is not often seen in saw-mills. In Queensland it is used for railway purposes—sleepers, posts (girders (?))—on its merits, and it is often very durable. It is reddish in colour, and moderately hard. It would appear to be the least esteemed of all the Ironbarks, but it is far from being a useless timber; indeed it is much appreciated over large areas.

Habitat.—It is very extensively distributed in the drier parts of New South Wales and Queensland. The most southerly locality known to me is the Wybong Hills near Denman, New South Wales, where it was first collected by Dr. Leichhardt. Westerly it goes as far as the Paroo River. Northerly we have it on the western plains and slopes, and thence over an enormous area in Queensland from south to north. It also occurs in the Northern Territory, and extends to the Kimberley district in the north-western portion of Western Australia.

It is accommodating as to soil, occurring on both ridges and flats, but it has been stated that it is partial to good wheat soils, and this aspect of an important question might be followed up.

A remarkable form akin to E. melanophloia.—The making of species is going on all around us, but in regard to large trees, which do not produce seed until after the lapse of years, it is very rarely that we have the opportunity of tracing the parents except by inference.

I would invite attention to some specimens of an Ironbark sent from Warialda, N.S.W., by Mr. W. A. de Benzeville. Its foliage is pale-coloured but not glaucous. Its juvenile foliage is of a paler green, with short petioles, broadly lanceolate, but very different to that of *E. melanophloia.*

We have been, of course, aware for many years how variable is the foliage of *E. melanophloia*, lanceolate-leaved forms being well known; but the present form is different to any that I have previously seen.

Although *E. melanophloia* is abundant in the district, Mr. de Benzeville reports that this form does not appear to grow in association with that species, but appears to be always associated with *E. crebra*. (See Part LIII of this work.) He also states that the timber is extremely brittle, and the bark is not furrowed as deeply as is usual with Ironbarks. The specimen forwarded to me shows a *crebra*-looking bark and timber apparently not abnormal, but Mr. de Benzeville doubtless speaks of its local reputation. This form, as far as general morphological characters go, is intermediate between *E. melanophloia* and *E. crebra*, and it may have arisen from cross-pollination, but that is surmise.

Owing to changes of environment, it is very often the case that we have "breaks," and in the present case, we may have a break from *E. melanophloia* in the direction of narrower, more petiolate leaves, with other minor differences.

Mr. de Benzeville's statement that "it does not appear to grow in association with *E. melanophloia*, but appears to be always associated with *E. crebra*," would seem to indicate that the plant is getting established as an independent entity, and being in unstable equilibrium itself, it may produce progeny still further departing from typical *E. melanophloia*.

I do not think the departure from type in the present case has proceeded far enough for me to indicate a new species, but we certainly have indications of a new species in the making, and these aberrant forms can only be usefully dealt with in a collective manner.

EXPLANATION OF PLATE 203.

A. Sucker-leaf from Narrabri, New South Wales.

B. Flowering twig from Bourke district, New South Wales.

C. Fruit from Warialda, New South Wales, showing slightly exserted valves.

D. Fruit from Stannary Hills, North Queensland. Valves not exserted.

E. Lanceolate-leaved form from Warialda, the leaves showing short petioles.

PHOTOGRAPHIC ILLUSTRATIONS.

Eucalyptus melanophloia.—Bogantungan (228 miles west of Rockhampton), Queensland. (2 views.) R. H. Cambage, photo.

E. melanophloia.—Barraba, N.S.W. Rev. H. M. R. Rupp, photo.

E. melanophloia.—Gravesend, on the Gwydir River, N.S.W. Rev. H. M. R. Rupp, photo.



SILVER-LEAVED IRONBARK.

(*Eucalyptus melanophloia* F.v.M.)



R. H. Cambage, photo.



F. H. Cambage, photo.

Eucalyptus melanophloia, BOGANTUNGAN, QUEENSLAND.



Rev. H. M. R. Rupp, photo.

Eucalyptus melanophloia, BARRABA, N.S.W.



Rev. H. M. R. Rupp, photo.

Eucalyptus melanophloia, GRAVESEND, N.S.W.

No. 200.

Acacia undulifolia A. Cunn.

The Wave-leaved Wattle.

(Family LEGUMINOSÆ: MIMOSÆ.)

Botanical description.—Genus Acacia. (See Part XV, p. 103).

Botanical description.—Species, *A. undulifolia* A. Cunn., described in G. Don. *Gen. Hist. Dichlamydeous Plants*, ii. 404 (1832) as follows:—

A. undulæfolia (Cunning. MSS. *Loud. hort. brit.* p. 407) stipulas almost wanting; phyllodia, obliquely ovate, undulated, and marginated, 1-nerved, glabrous, ending in a hooked or twisted point, bearing an obsolete gland on the upper margin at the base; branches terete, hairy; heads of flowers axillary, solitary; peduncles beset with adpressed pili, longer than the phyllodia. Native of New South Wales. Lodd. *Bot. Cab.* 1544. Phyllodia an inch long. The heads of flowers being so numerous, appear like a raceme at the tops of the branches.

Wave-leaved Acacia. Fl. Apr. Ju. Clt. 1824. Sh. 3 to 4 feet.

The reference "*Loud. hort. brit.* p. 407," is to Loudon's *Hortus Britannicus* (1830) a work which contains no descriptions.

The reference Lodd. *bot. cab.* 1544, is to Loddiges' *Botanical Cabinet*, vol. xvi, (1829) which contains a figure, but no description. The statement is made:—

"We received seeds of this in 1824 from Mr. Fraser, of New South Wales, with this name." (Mr. C. Fraser was then Superintendent of the Botanic Gardens, Sydney, and the sometime companion of Allan Cunningham, from whom he doubtless received the name, if not the seeds.)

Then we come to *Bot. Mag.* t. 3394 (1836) where it is stated that the name *Acacia undulæfolia* originally occurs in Allan's Cunningham's MS., under date 1822. Cunningham's MS. description is quoted in the following words:—

Stipulis minutis acuminatis deciduis, phyllodiis latè ellipticis ovatisve obliquis interdum subæquilateris undulatis planiusculisve acuminatis leviter parallelo-venosis glabris, mucrone attenuato incurvato terminatis, margine antico prope basin uni-glanduloso, capitulis solitariis geminisve axillaribus pedunculatis, pedunculis glabriusculis vel parce pilosis phyllodium superantibus, ramulis teretiusculis diffusè dependulis cano-pilosis, floribus quinquefidis, petalis erectis apice uncinatis, stylo staminibus ferè duplo longiore.

It will be observed that G. Don's description already given is a fairly close translation of this.

It was again described by Bentham, in Hooker's *London Journal of Botany*, i, 346 (1842) in Latin, and in English as follows:—

A shrub sometimes low and bushy, but often attaining a great size, and very handsome from its long pendulous garland-like flowering branches; branchlets slightly angular, but soon terete, pubescent, hirsute, or rarely glabrous.

Phyllodia numerous, ovate or almost orbicular, very obliquely truncate or narrowed at the base and often petiolate, usually about ½ inch, but varying from ¼ to nearly 1 inch long, coriaceous, undulate, 1-nerved and penniveined, the margins thickened, terminating in a short or fine point.

Peduncles slender, often exceeding the *phyllodia*, bearing each a globular head of 20 to 30 or more flowers, mostly 5-merous.

Calyx very short, toothed.

Petals smooth, united above the middle.

Pod shortly stipitate, 7 to 9 lines broad, very flat, with nerve-like margins.

Seeds flat, ovate, oblique; funicle with the last fold thickened and not half so long as the seed, and short folds below it. (*B.Fl.* ii, 355.)

Affinities.—

1. With *A. brachybotrya* Benth.

Specimens of Bentham's var. *glaucophylla* and this species have been labelled by careful botanists *A. undulifolia* vars. *pubescens* or *dasyphylla.*

The most obvious difference between the species lies in the phyllodes (compare Plates 200 and 204). Those of *A. undulifolia* are almost invariably oblique, with a twisted point, and usually a broadish base. Those of *A. brachybotrya* are usually more oval.

The inflorescence is usually racemose in *A. brachybotrya* and peduncles 1-headed in *A. undulifolia.*

Bentham mentions that the peduncles are rather short, solitary, or more frequently 2-5, in *A. brachybotrya.* In *A. undulifolia* the peduncles are always onger than those of the phyllodes.

The pods are very different.

2. With *A. vestita.*

I will discuss the affinities of this species when I figure *A. vestita.*

3. With *A. podalyriæfolia.*

The same remarks apply to this species.

4. With *A. obliqua.*

Some forms of this species may be superficially confused with *A. undulifolia* var. *humilis.* The relations of the two species will be explained when *A. obliqua* is reached.

Botanical Name.—*Acacia*, already explained (see Part XV, p. 104); *undulifolia* (the original spelling is *undulæfolia*), from two Latin words, *undulatus*, wavy, and *folium* a leaf, in reference to the wavy appearance of the phyllodes.

Synonyms.—These are given by Bentham as follows:—

(a) *A. uncinata* Lodd.; Lindl. *Bot. Reg* t. 1332.

(b) *A. piligera* A. Cunn., in *Bot. Mag.*, under t. 3394.

(c) *A. setigera* A. Cunn., Hook., *Ic. Pl.* t. 166.

(d) *A. sertiformis* A. Cunn., in *Bot. Mag.*, under t. 3394, Hook. *Ic. Pl.* t. 159.

(e) *A. dysophylla* Benth., in Hook., *Lond. Journ. Bot.* i, 346.

(f) *A. plagiophylla* F.v.M., "in *Journ. Linn. Soc.* iii, 131, not of Sieber; belongs probably to one of the varieties of *A. undulifolia*." (I have stated below that I believe *A. plagiophylla* F.v.M. to be a good species.—J.H.M.).

Let us take these seriatim.

(a) *A. uncinata* Lodd. In *Index Kewensis* this is given as Lodd. *Bot. Cab.* t. 909 = *undulæfolia*, but the figure in question is that of *A. calamifolia*. Perhaps there is no such species as *A. uncinata* Lodd.

There is an *A. uncinata*, Lindl. in *Bot. Reg.* t. 1332, called "Hook-leaved Acacia," and which is doubtless *A. undulifolia*, in spite of the faultiness of the colouring. The phyllodes should not have pale undersides, neither should the heads of flowers be of a cream colour; they should be of a much brighter yellow.

(b) *A. piligera* A. Cunn. This is described in the following words under *Bot. Mag.* t. 3394 :—

A. piligera hirta, pilis laxis patentibus, stipulis acuminatis persistantibus, phyllodiis suboblique ellipticis obovatisve planiusculis cuspidatis, obtusisve cum acumine, mucrone attenuato subulato sphacelato, margine antico prope basin uniglanduloso, capitulis pedunculatis solitariis subgeminisve, pedunculis phyllodia longioribus, ramulis teretibus virgatis strictis, floribus quinquefidis, petalis erectis, staminibus dimidium styli vix quantibus.

Hab. in Nova Cambria Australi: in cacuminibus apricis præruptis montium ad flumen Hunter. *All. Cunn.* 1825. Aprili, Maio floret.

The original came from the Upper Hunter, and was collected by Allan Cunningham in April–May, 1825. On this trip Cunningham was at Mount Dangar, Pandora's Pass (already discovered by him), and descended to the Liverpool Plains. (See my "Sir Joseph Banks: the Father of Australia," p. 149.)

(c) *A. setigera*, A. Cunn. This is described, *Hook. Ic.* t. 166, in the following terms :—

Pilosa, ramis diffusis teretibus, phyllodiis ellipticis obliquis undulato-tortuosis venosis marginatis marginis basi superiore uniglandulosis apice in mucronem elongatum subulato-setiformem acuminatis, pedunculis axillaribus monocephalis folio longioribus (foliis superioribus sub-flores saepe abortivis).

The *phyllodia* and *branches* of this shrub are black in drying (this can only refer to these particular specimens, which probably got wet.—J.H.M.); the latter are quite cylindrical, pilose—the former are scarcely an inch long (even the largest of them), elliptical, oblique, coriaceous, acute at the base, acuminated at the apex into a long slender curved subulate, or almost setaceous point; the margin is thickened and ciliated with long hairs; the surface has a few scattered hairs. Heads of *flowers* globose, copious, on *peduncles* twice as long as the phyllodia, from the axils of which they spring; these phyllodia, however, gradually become smaller and altogether disappear beneath the uppermost *peduncles*, which thus form a terminal *raceme*.

It came from sandstone ridges on the western branches of "Hunter's River, New Holland."

(d) *A sertiformis* A. Cunn., in *Bot. Mag.* under t. 3394, the following description is given :—

A. sertiformis: glaucescens glabra, stipulis acutis persistentibus, phyllodiis oblique subrotundis perlate ovatisve acuminatis manifeste parallelo-venosis, venulis anastomozantibus, acumine incurvato

innocuo, dimidio superiore minore ad basin uniglanduloso, capitulis solitariis axillaribus pedunculatis; pedunculo phyllodium aequante (nunc duplo longiore), ramis teretibus elongatis incurvatis deflexsive, floribus quinquefidis, petalis suberectis, stylo staminibus paulo longiore.

Hab. in Novae Cambriae Australis parte interiore: in desertis ad margines occidentales planitiei peramplae Liverpool. *All. Cunn.*, 1825. Florens lecta mense Maio.

In Hooker's *Icones Plantarum*, t. 159, a figure of the type is given with the following note:—

Mr. Cunningham notices this as a lovely *shrub*, forming beautiful garlands with its bending many-flowered *branches*. It is extremely difficult to describe the form of foliage in the numerous species of New Holland *Acaciae*, which have oblique or inæquilateral leaves. In the present species, were the two halves of the phyllodium equally large, the shape would be cordate; but, besides that, the one-half is much smaller than the other, this lesser one is suddenly contracted above the middle, and thence to the apex presents little more than the thickened margin running parallel with the costa. There is a small subulate stipule on each side the base of the phyllodium. The heads of flowers are numerous in the axils towards the extremity of the branches, handsome, and yellow.

(e) *A. dysophylla* Benth. in Hook, *Lond. Journ., Bot.* i, 346, is described in the following terms:—

Ramulis pedunculis phyllodiisque molliter villosis, phyllodiis ovali-oblongis falcatis undulatis marginatis saepius minute glanduliferis basi oblique cuneatis, nervo in mucronem brevem excurrente, pedunculis phyllodium aequantibus, capitulis multifloris.—Villositate et phyllodiis majoribus (8–12 lin. longis a præcedentibus differt. Pine Ridge, near Croker's Range, interior of New South Wales, *Cunningham.*

(f) *A. plagiophylla* F.v.M. in *Journ. Linn. Soc.*, iii, 131, is described as follows:—

Ramulis hirtellis angulatis, phyllodiis parvis glabris triangularibus sive ovato-deltoideis sessilibus mucronatis curvato-uninerviis subaveniis marginatis ad angulum superum obtusiusculum glanduligeris

. . . . .

Ad flumen Brisbane, No. 25, *Hill et Muell.*

Habitu ad *Acaciam pravissimam* accedens. *Phyllodia*, 2–4 lines longa, 1½–3 lines lata, satis obscure viridia, nitidula. *Flores et fructus* hactenus ignoti.

(Without further information, it will be impossible to judge of or identify this species. There are no specimens sent.—G.B.)

Mueller later described it as follows:—

Acacia plagiophylla (F.v.M. in the Journal of the Linnean Society, iii, 131. *A. undulifolia* var. *humilis*, Bentham, Fl. Austr. ii, 356).

Shrubby; branchlets slightly angular, scantily short-downy; stipules almost obliterated; phyllods small, glabrous, deltoid-semiorbicular, shining, one-nerved, the lower margin extended into a straight prickle, the nerve slightly curved, passing into the margin at some distance from the terminal point; a minute gland at the extremity of the blunt upper angle of the phyllode; veins obliterated; flowerstalks axillary, solitary, one-headed, glabrous, little or doubly longer than the phyllodes; flowers 10–20 in the heads; bracts bearded-fringed, linear towards the base, rhomboid towards the summit, about as long as the calyx; petals 5, neither hairy nor streaked, at least twice as long as the bluntly toothed short-bearded calyx; pods curved-oblong, flat, suddenly contracted into a stalk-like base, at both extremities rounded-blunt, smooth outside; seeds placed transversely.

Near Durval and Biroa, Dr. Leichhardt; vicinity of the Brisbane river, F.v.M. and W. Hill; Maroochie, Bailey. Belongs to the series of Triangulares. Ripe fruit unknown.—(Wing's *Southern Science Record* for July, 1882, p. 149.)

It is figured by Mueller in his "Iconography of Australian Species of Acacia," iv, 5, and Bailey ("Queensland Flora," 486), gives the locality in that

State as "along the North Coast Railway Line." He also states that *A. undulifolia* var. *humilis* is a synonym, perhaps following Bentham, a decision with which I do not agree. I believe it to be a distinct species. It is certainly not a form of *A. undulifolia.*

So far as I know, it is confined to Queensland, and therefore I cannot deal with it in this work. It reminds one of *A. vomeriformis* A. Cunn. It is, however, less prostrate in habit, as it forms small upright, slightly pendulous bushes about 3 or 4 feet, but sometimes up to 6 feet high, in moist, sandy low-lying places. It is found at Bundaberg, Noosa River, top of Glass-house Mountain, &c.

Varieties and reputed varieties.—This is a variable species, and a number of varieties (too many, I think) have been constituted.

First of all let us consider the type.

As regards the indument we have—

"Phyllodia glabrous, branches hairy." (Don.)

Phyllodia "smooth; branchlets . . . . " densely clothed with short cinereous hair." (Hooker, in *Bot. Mag.* under t. 3,394.)

Then we have—

A. piligera A. Cunn., (combined with normal species by Bentham), hirta, pilis laxis patentibus. (A. Cunn).

Var. *setigera* A. Cunn., (also combined with normal species by Bentham), ". . . . branches . . . . pilose." . . . . "Margin (of phyllodes) . . . . ciliated with long hairs; the surface has a few scattered hairs." (*Hook. Ic.* t. clxvi).

There is no doubt that, as regards the shape, size, and vestiture (or absence of it) the phyllodes vary a good deal.

The type comes from "rocky hills near Bathurst," and was subsequently found "to the north-west of that settlement." Although I have not a specimen of the type, the following specimens are not far removed from it—

Mullion Creek, near Orange, 3 or 4 feet high (R. H. Cambage). Molong (J. L. Boorman).

Phyllodia nearly oval, acuminate, ciliate, rhachises with weak hairs. Bulga-road, Singleton (R. H. Cambage).

A little more hirsute—2 to 2½ feet high, east of 10-mile peg, Inverell to Tingha-road (R. H. Cambage, No. 944).

A few weak hairs, all but glabrous on the rhachises; phyllodia entirely glabrous. Merriwa, also plentiful on the sandstone near Collaroy (J. L. Boorman and J.H.M.).

Yerranderie, in the Burragorang district, *viâ* Camden, also The Peaks. (R. H. Cambage, Nos. 1,263, 3,102.) Very similar to the preceding two specimens.

(1) Var. *sertiformis* Benth.

This is "glaberrima glauca" but, as Bentham puts it "*more* glabrous" (*i.e.*, not entirely glabrous) with larger phyllodia, not contracted at the base.

The following specimens approach very closely var. *sertiformis* Benth.

Phyllodia glaucous, rhachises very slightly besprinkled with short hairs. Murrurundi (J. L. Boorman and J.H.M). Mount Vincent, on the watershed between the Capertee and Turon Rivers, also Bylong Creek, and Taloobie (R. T. Baker).

Perfectly glabrous. Quirindi (W. MacDonald).

Some specimens perfectly glabrous, others a little hairy. Gungal, near Merriwa (J. L. Boorman).

Phyllodia glabrous and apparently typical, rhachis pale, slight tomentum. Warrumbungle Range (E. Betche, W. Forsyth).

Warrumbungle Range, on sandstone, 3 to 7 miles from the Coonabarabran-Bugaldi road (Dr. H. I. Jensen). Phyllodia glabrous and rhachises with thinnest sprinkling of hairs.

Small trees of 6-8 feet, usually found at the foot-hills of high mountains and accompanied by such plants as *Banksia marginata* and *Jacksonia scoparia*. Forked Mountain (Warrumbungle Range) Coonabarabran. (J. L. Boorman, Dr. H. I. Jensen.)

All these Warrumbungle Range specimens are very close to the type, if not absolutely identical with it.

It also occurs in the south, at Yass. (W. W. Froggatt.)

(2) Var. *dysophylla* Benth. "Softly villous, phyllodia large; pine ridge near Croker's Range." (B.Fl., ii, 356.)

I have a fragment of the type through the kindness of Kew.

Croker's Range was named by Oxley, and is situated in the Wellington district.

The following specimens, which almost precisely match it, are from the south-east of the State, where there is much winter cold.

Low-growing, loose-spreading plants of 3-5 feet, quite unlike the habit of growth of plants from Gungal and the Mudgee district, where the species is sometimes more pyramidal in habit. Velvety all over. Sides of Macnally's Range, Cooma district (J. L. Boorman).

Not quite so tomentose. Slate formation, Cowra Creek, 15-20 miles north east of Cooma (R. H. Cambage, No. 1,876).

The following two specimens form a connecting link between typical var. *dysophylla* and the normal form.

Tomentum of phyllodes hardly to be detected except by the feel; that of the rhachis the same. Terry-hie-hie, *viâ* Moree (E. Julius). Gravesend, near Warialda (W. de Benzeville).

(3) var. *humilis* Benth. "Diffuse and low, glabrous; phyllodia not above 3 or 4 lines long, very oblique and often recurved, nearly as broad as long. North-west interior of New South Wales; also Brisbane." (B.Fl. ii, 356).

There is no portion of the type in Australia. I have specimens which answer the above description very well from Cullenbone, near Mudgee, (J. D. Cox), and Dunedoo (S. P. Sheldon). The latter locality answers to the description "North West interior of New South Wales."

Doubtful variety. Var. *pubescens* Maiden and Baker, *Proc. Linn. Soc. N.S.W.* xix, 459. George's River, near Campbelltown (T. V. Alkin).

A softly pubescent variety with typical phyllodes, those on the young shoots at the base of the peduncles mostly deciduous in drying, giving the appearance of a raceme in inflorescence very much resembling *A. vestita*. The flower heads are smaller than those of the typical species. This variety is all the more interesting as it brings this species within the County of Cumberland, the type being previously recorded from the Blue Mountains.

It was sent to us by the Rev. T. V. Alkin, M.A., of Campbelltown, who collected it at George's River. We propose the name *pubescens* for this variety. It differs from the variety *dysophylla* in having smaller phyllodes." (*Proc. Linn. Soc. N.S.W.* xix, 459.)

This form is doubtful; it probably does not belong to this species, and I will discuss it when *A. vestita* is reached.

Having considered all the characters, and the reputed varieties, it may be convenient to maintain the following :—

(1) Var. *sertiformis* Benth. For the forms chiefly found near the Warrumbungles and broken country to the east, with large glaucous phyllodes.

(2) Var. *dysophylla* Benth. For the forms with velvety phyllodes.

(3) Var. *humilis* Benth. For the forms with very small phyllodes. (The "diffuse and low" character applies to most of the forms.)

At the same time, I repeat that the forms run into each other in a perplexing manner.

Phyllodes.—I desire to emphasise that in size, shape, and vestiture there is great variation.

Size.—A shrub often nearly prostrate and serambling over rocks, or taking on a more or less erect habit and attaining a height of 6–10 feet.

Habitat.—"It was discovered in 1822, clothing rocky hills near Bathurst; and was subsequently observed occupying arid spots in the country lying north-west from that settlement, at elevations exceeding 3,000 feet above the level of the sea." (*Bot. Mag. t.* 3391.)

It is exclusively a New South Wales species so far as we know at present, for I believe the statement of Bentham that var. *humilis* is found as far north as Brisbane is founded on a mistake.

In New South Wales it is found from south to north of the State, chiefly in the table-lands and mountain ranges, being found west as far as Orange and the Warrumbungles.

Individual localities have already been given, and need not be repeated.

EXPLANATION OF PLATE 204.

A. Flowering twig from Molong (near type).

B. Flower-head.

C. Individual bud.

D. Flower.

E. Bract found at the base of each flower.

F. Flower opened out, showing—

(*a*) Calyx.

(*b*) Corolla.

(*c*) Pistil. (Stamens removed.)

G. Twig with long curved points to phyllode, from Mullion Creek, near Orange (near type).

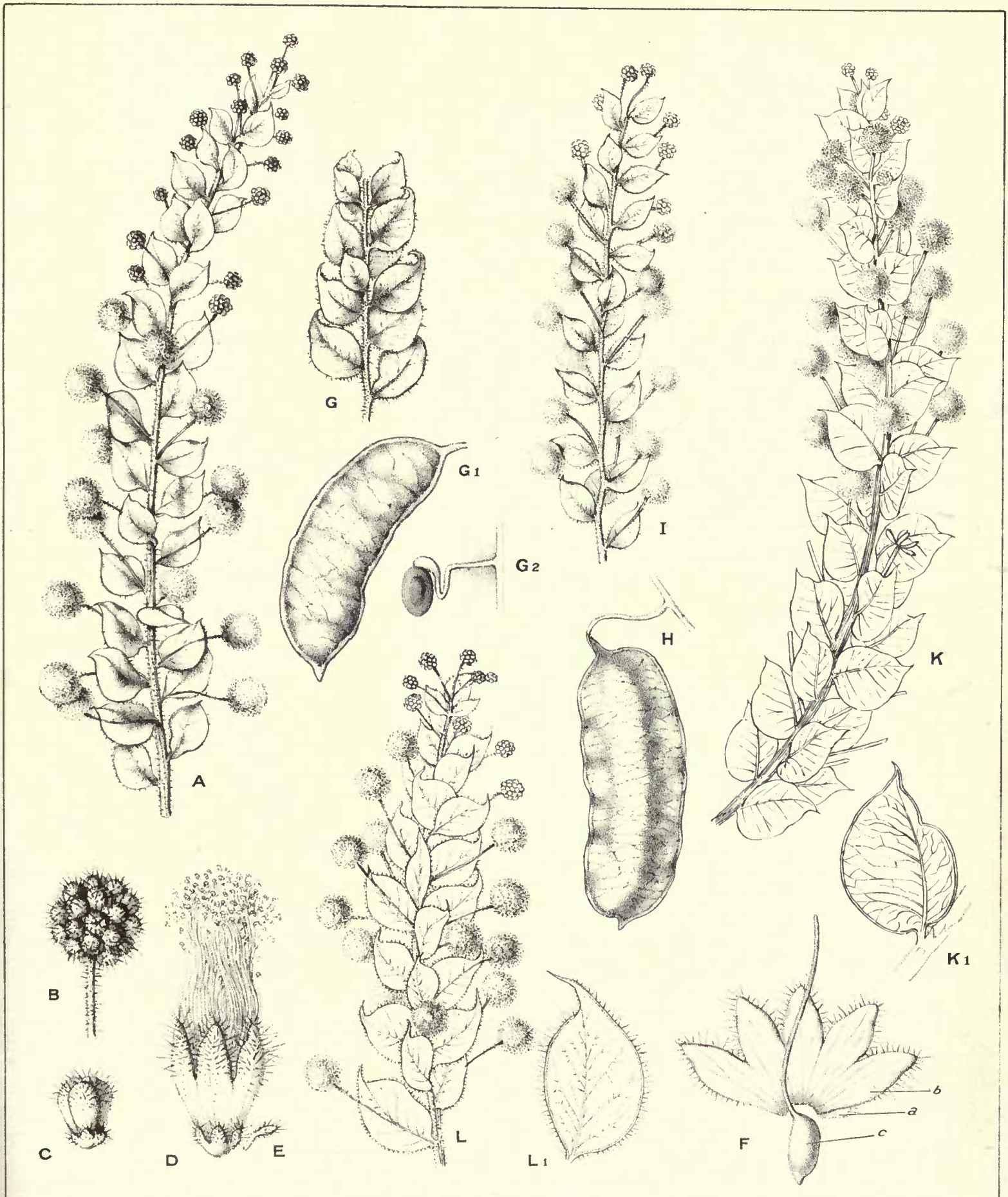
G1. Pod.

G2. Seed (immature).

H. Pod, from near Orange.

I. Flowering twig showing small phyllodia, var. *humilis* Benth. From Cullenbone, near Mudgee.

K & K1. Drawing of *A. sertiformis* A.Cunn. (the var. *sertiformis* Benth.). From Hooker's *Icones Plantarum* Vol. 1, pl. clxvi (combined with normal *undulifolia* by Bentham).



M. Flockton. del. et lith.

WAVE-LEAVED WATTLE.

(*Acacia undulifolia* A. CUNN.)

No. 201.

Schizomeria ovata D. Don.

The White Cherry.

(Family CUNONIACEÆ.)

Botanical description.—Genus, *Schizomeria* D. Don.

Calyx-tube short, adnate to the base of the ovary; lobes 5, valvate, not enlarged after flowering.
Petals small, toothed.
Stamens 10, inserted outside a lobed disc; anthers ovate, the connective produced into a short conical appendage.
Ovary short, free except the broad base, 2-celled, with 4 ovules in each cell attached to a pendulous placenta; styles distinct, short, recurved with terminal stigmas.
Fruit, a drupe, with the small calyx-lobes reflexed from its base; epicarp thick and fleshy; endocarp bony.
Seed solitary, somewhat curved; embryo green, rather large in a fleshy albumen.
Tree.
Leaves opposite, simple.
Stipules small.
Flowers small, in terminal trichotomous cymes. (B.Fl. ii, 442.)

Botanical description.—Species, *S. ovata* D. Don, *Cunon.* 12, in *Edinb. New Phil. Journ.* (April to June, 1830).

A tree attaining 50 feet (see below J.H.M.) with a dense foliage of a light green.
Leaves ovate or ovate-lanceolate, obtuse or acuminate, mostly 3 or 4 inches long, nearly entire or with irregular obtuse serratures, shortly narrowed at the base and continuous with the petiole, coriaceous, penniveined and reticulate.
Flowers rather smaller than those of *Ceratopetalum apetalum*, and the cymes usually looser, but otherwise much resembling them.
Calyx-lobes scarcely above 1 line long.
Petals shorter than the calyx, broad and toothed or lobed at the end.
Drupe ovoid or globular, under ½ in. diameter. (B.Fl. ii, 443.)

Botanical Name.—*Schizomeria* from two Greek words *schizo*, I cut, and *meria*, a part, in reference to the petals, which usually have the appearance of pieces being cut out of them; *ovata*, Latin, in reference to the shape of the leaves.

Vernacular Names.—Because of the white colour of its somewhat succulent fruits it is called "White Cherry," and because of the acidity, and usual astringency, it goes under the name of "Crab Apple." It usually bears this name in the Dorrigo, where it is especially abundant. Its smooth tight bark when young causes it, in common with many other brush trees, to be given the name of "Leather-jacket."

"White Ash" is the Gosford district name according to Mr. A. Murphy.

Aboriginal Name.—I know of none.

Leaves.—The margins are sometimes much more toothed than shown in the figure. I have also seen them, exceptionally, 9 inches long and 4 wide.

Flowers.—Particularly when in flower this tree may readily be confused with the Coachwood (*Ceratopetalum apetalum*); see Part VI of the present work. Comparison of the floral and fruit details will readily show the differences between the two trees, while the fresh bark of the *Ceratopetalum* has a pleasing odour faintly resembling that of Tonquin Bean. That of the present tree is less pleasant.

Fruit.—The fruit is translucent white and somewhat fleshy. Mr. E. H. F. Swain describes it as of agreeable acidity like loquats: useful for relieving thirst, but it is of inferior merit as an edible fruit. Because of the fruit it obtains its names "White Cherry" and "Crab Apple."

Bark.—The bark has an offensive odour resembling decayed pumpkins (N. Stewart). It is smooth in young or moderately young trees, but becomes rough and corky in old ones.

Buttress roots (so-called).—The present species is one of many trees in which the so-called "Buttress-roots" are well developed.

The buttresses proceed from the lower part of the trunk, are like planks, standing on end, and radiate from the trunk, forming partitions comparable to the stalls of a stable. This form is often seen in the rich brushes of our northern rivers, *e.g.*, in figs, and a photograph of one, by no means of abnormal size, may be seen at page 157, Part XL, of the present work. They are really lateral expansions of the stem, which they strengthen and maintain in an erect position. In the struggle for existence in a tropical or sub-tropical forest these buttresses are admirably designed to support the long-trunked tree with comparatively small canopy.

Wallace, in his "Tropical Nature and Other Essays," thus speaks of them:—

> Others, again, and these are very characteristic, send out towards the base flat and wing-like projections. These projections are thin slabs radiating from the main trunk, from which they stand out like buttresses of a Gothic cathedral. They rise to various heights on the tree, from 5 or 6 to 20 or 30 feet; they often divide as they approach the ground, and sometimes twist and curve along the ground for a considerable distance, forming elevated and greatly compressed roots. These buttresses are sometimes so large that the spaces between them if roofed over would form huts capable of containing several persons.

In coastal New South Wales and Queensland the list of species would be a very long one, and remains to be compiled. As further examples, may be mentioned Yellow Caribeen (*Sloanea Woollsii* F.v.M.), which displays enormous buttresses, extending in most fantastic shapes along the ground. It usually has buttresses of a thin and somewhat delicate nature, sometimes not more than 1 inch in thickness and very large. We have also Booyong (*Tarrietia argyrodendron* Benth.), Red Cedar (*Cedrela australis* F.v.M.), which may be taken as examples.

The following interesting account is by Schimper, and refers principally to Java :—

The most remarkable of these structures appear, as Haberlandt has already stated, on trees of the family of Sterculiaceæ. In my notes I find *Sterculia spectabilis*, Miq, *Firmiana colorata*, R.Br., and *Pterygota Roxburghii*, Schott and Endl., as specially remarkable. I have also recorded as worthy of note, *Dysoxylum mollissimum* and *D. Kadoya* (Meliaceæ); *Urostigma altissimum* and *Cecropia cyrtostachya* (Artocarpaceæ); *Spathodea campanulata* (Bignoniaceæ); *Vitex timorensis*, *V. Cofassus*, *V. leucoxylon* (Verbenaceæ); most species of *Terminalia* (Combretaceæ). No plank-buttresses are possessed by tall trees belonging to the families Sapindaceæ, Apocynaceæ, Sapotaceæ, or to species of *Myristica*. Many species of the latter genus have prop-roots. Brandis mentions plank-buttresses in connexion with *Bombax malabaricum* and species of *Vitex*, *Antiaris*, *Lagerstroemia*, *Hymenodictyon*, *Nauclea*, and others.

The plank-buttress is a peculiarity of trees in a tropical climate with abundant rainfall. It is not limited to the evergreen rain-forest, for it also occurs in the deciduous monsoon-forest, but is not found in less humid districts. The amount of rainfall necessary for its appearance is not yet ascertained. The physiological causes of the phenomenon and its significance to the life of the tree are still obscure. (Schimper's "Plant Geography," Eng. Edn., p. 304).

Timber.—This is closely allied to ordinary Coach-wood (*Ceratopetalum apetalum*), for which it is sometimes substituted. It is an inferior substitute, but a good timber, nevertheless.

Mr. Robert Kaleski, writing of the Dorrigo, says :—

Similar to Cedar (*Cedrela*) in size and trunk. Timber very sound though with very deep sapwood. Very little known; durable if protected from weather. Very bad burner if allowed to lie on the ground, as the sapwood absorbs much water. It should not be felled with other scrub but left standing and burnt down when logging up. Colour of timber light yellow.

"It resembles White Beech (*Gmelina*) in colour, but softer, and has a more open grain." (N. Stewart, Glen Innes.)

"Is cut up for boat planks and housebuilding timber. It cuts easily." (A. Murphy, Gosford.)

"A leading coachbuilder here thinks it would be suitable for some parts of coachbuilding." (N. Stewart, Glen Innes.)

"A Bellingen coachbuilder used a quantity of it for coachbuilding purposes and was much impressed with it at the time. He now informs me, however, that he finds it subject to dry-rot when unvarnished." (E. H. F. Swain.)

"For butter-boxes I would think it an excellent timber. Good colour, light, and apparently free from any unpleasant odour. Enormous quantities could be obtained at Dorrigo and elsewhere." (T. H. Wilshire, Grafton.)

"Good for fruit-cases; is exceedingly light and is a very good substitute for deal." (Late A. E. Stopford.)

Exudation.—The following report was made on a specimen collected by Mr. W. Baeuerlen at Evans' River, near the Richmond River :—

This exudation has the appearance of kino.* When treated with alcohol the greater portion of the tannic acid goes into solution. This tannin gives a brownish-green colour with ferric chloride, when a

*A number of our Eucalyptus and other astringent exudations of variable composition have been called "kinos," because of their resemblance, more or less strong, to the astringent exudation of *Pterocarpus marsupium*, known in medicine as "kino." The use of the term is convenient, and is used in these papers "without prejudice." It seems to us quite unnecessary, at present, to coin another term for astringent exudations whose composition is not precisely identical with that of the original kino; we also look upon it as undesirable, until very many more have been examined, and before those who lay stress upon nomenclature of this kind are in a position to select a suitable term or terms.

fairly strong solution of the kino is tested, but on sufficient dilution (in a very dilute aqueous solution), it gives a purple colour with the same reagent; an aqueous solution of the tannin was the material tested. The insoluble portion has the appearance of a gum, but is insoluble in water on heating until a small quantity of dilute soda has been added. When the original substance is treated with water the tannin dissolves, while the gum remains insoluble, but much swollen. This insoluble portion is soluble in dilute soda, and is precipitated on acidifying the solution, or on the addition of alcohol. It is thus found to be metarabin. The reactions and composition of this exudation show it to be identical with that yielded by the *Ceratopetalums** and the exudations thus confirm the affinities of these trees belonging to different genera of the Saxifrageæ.—(J. H. Maiden and H. G. Smith, in *Proc. Roy. Soc., N.S.W.*, 401, 1895.)

Size.—It is one of the largest of our brush trees. Specimens 70-80 feet in height and with a diameter of 2 or 3 feet are not uncommon, but on the Dorrigo it is one of the giants of the forest. Mr. E. H. F. Swain says :—

On the Bellinger the tree rarely attains more than 6 or 7 feet basal girth and 20-30 feet bole. At the Dorrigo, however, I have measured it up to 27 feet girth at chest height. This would, of course, be 9 feet in diameter.

Over 20 years ago, on the Dorrigo, I measured it 5 feet in diameter, and estimated the height of a tree as 90 feet to the first branch.

Settlement has greatly reduced the available amount of this timber in the Dorrigo, but, while not making extravagant claims for this timber, increased settlement and development of orchards will, in my opinion, render this timber valuable for fruit and other packing-cases.

Habitat.—Following is the statement in the *Flora Australiensis* :—

New South Wales.—Port Jackson (*R. Brown*); Blue Mountains (*Miss Atkinson*); northward to Macleay and Hastings Rivers (*Beckler*); southward to Illawarra (*A. Cunningham*).

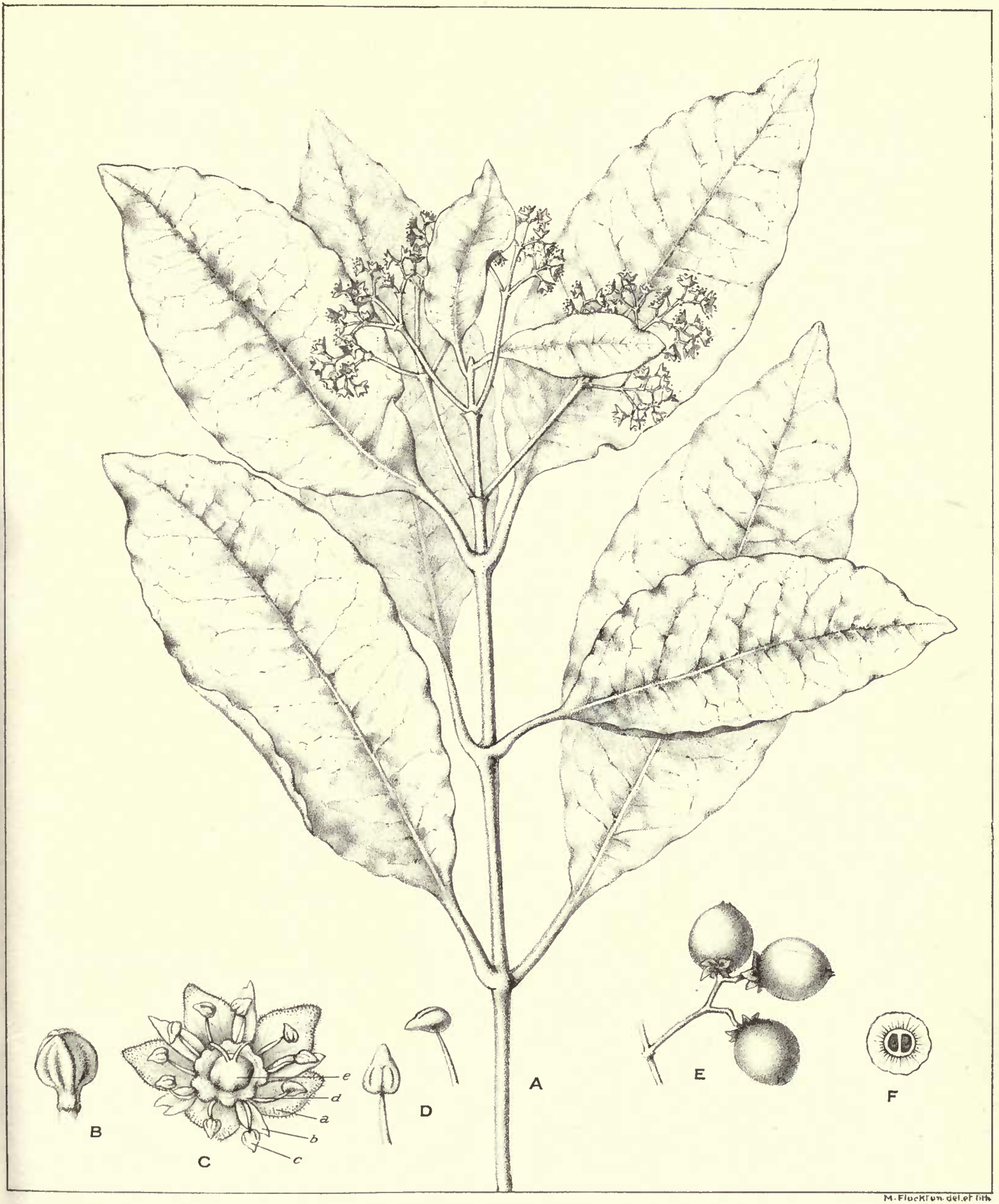
This remains true (so far as our knowledge goes) of its range to the south, but on the north it extends to New England (being very plentiful in the brush forests on the eastern edge of the northern portion of that table-land), and it is common in the Dorrigo, the Richmond River, and the Macpherson Range. Thence it extends to Queensland, where, Mr. Bailey says, it is a denizen of the scrubs along the North Coast Railway.

EXPLANATION OF PLATE 205.

A. Flowering twig.
B. Flower bud.
C. Flower, showing—
  (*a*) Calyx.
  (*b*) Petals, narrow and irregular in shape.
  (*c*) 10 stamens.
  (*d*) Disc, fleshy and undulating.
  (*e*) Ovary with two styles.
D. Anthers showing small appendage.
E. Fruits, a white drupe.
F. Transverse section of a young fruit.

The flowering twig obtained from the Upper Hastings River, and the fruit from Kogarah, Sydney.

* Observations on the gums yielded by two species of *Ceratopetalum.—Proc. Aust. Assoc. Adv. Sci.*, ii, 381 (1890).



WHITE CHERRY.

(*Schizomeria ovata* D. DON.)

On some Natural Grafts between Indigenous Trees.

In 1903, Mr. R. Chappelow, of George's River, near Oatley, Sydney, brought to me a fragment of wood bearing a rough and a smooth bark. On following the matter up, he brought to me a remarkable specimen. It is a composite log of timber showing the smooth bark and the red wood of White Gum (*Eucalyptus hæmastoma* Sm., var. *micrantha* Benth.) and the fibrous bark and pale-brown wood of Stringybark (*E. capitellata*, Sm.).

The facts concerning the log are these; they were obtained by Mr. J. L. Boorman, Collector, Botanic Gardens, on my behalf:—"There was originally a Stringybark tree, hollow with age, and the top had disappeared. From near the bottom a sucker of the old tree had sprung up, inside the tree. Inside, presumably springing from a stray seed, a young White Gum had also grown. So that there were two young trees, a Stringybark and a White Gum, the old Stringybark serving as a "pot." In process of time the young trees became "pot-bound," and the two young trees became squeezed together and finally fused."

Mr. C. T. Musson, of the Hawkesbury Agricultural College, Richmond, published in the College Journal of the 18th January, 1904, an account of a natural graft to be seen on the farm. Out of a tree of *Eucalyptus tereticornis* Sm., there is growing a smaller tree of *Angophora intermedia* (Rough-barked Apple). This natural graft is in rather a bad way, and will apparently not live long. Mr. Musson furnished the following very interesting report to the Principal, who was kind enough to favour me with it:—"It appears to me that a seedling *Angophora* started in a hollow made by a branch of the Eucalyptus breaking, and that the roots eventually reached the ground. The eucalypt is splitting where the Angophora is thickest; *i.e.*, where it comes out of the surrounding gum trunk. That part of the Angophora which is seen has expanded somewhat close to the point of attachment where seen, after the manner of a girdled tree.

It is a "Swamp Gum," and is provisionally referred to *Eucalyptus tereticornis* Sm., var. *latifolia* Benth. It is the *E. amplifolia* of Naudin.

It is not proposed to disturb the graft, and therefore it cannot be stated whether the woods of the two trees are in absolute organic union as they are in the specimen first described. It may be pointed out that Mr. Musson's specimen is especially interesting because two different genera are concerned in the graft.

Ten years afterwards, Mr. Musson was kind enough to report as follows on the specimen:—

The "Natural Graft" still stands, but the host tree is dead, partly in consequence of rubbish having been burned too near the trunk and few remaining leaves.

The "Apple" has bent over a little, opening the cleft near the boss sufficiently to see one side of the junction with the host tree

I think there is no doubt but that the two trees were in real union just below the thickening, and, in consequence of the pressure produced by growth of the Apple, this seems to have been where the two

cambiums eventually met. A mark on the accompanying photograph taken to-day indicates the probable place of union. For a depth of some 5 or 6 feet the root can be traced (or stem possibly). It is about 14 to 18 inches in diameter at 5 feet below the thickening.

We cut a hole in the butt of the Gum at 4 feet from the ground; it was only a shell of 1 inch to 2 inches in thickness, the bark having dropped away long since. The centre of the tree was full of tinder and soil, and one root was seen penetrating downwards: its diameter about 2 inches. A few small roots are enclosed which came from the same opening, 15 feet or thereabouts from the thickening above.

It seems clear that the tree (Apple) is an epiphyte upon the Gum. It started as a seedling in a broken branch, and as it grew the pressure and slight movement brought the cambiums together at the point of junction, beneath the thickening, with probably an actual union there, though but a slight one.

A somewhat similar case to that of Mr. Musson's is perhaps afforded by trees of *Eucalyptus longifolia* Link and Otto, the Woollybutt, and *Angophora intermedia* DC., the rough-barked apple, which have grown together near their roots in the park at Moruya. I am indebted to Mr. H. G. Smith for a photograph of the same.

The Hon. Dr. Nash, M.L.C., informed me of the case of a natural graft between a White Gum and an Ironbark at Wallsend, near Newcastle; and it is hoped that further instances may be carefully observed and the fullest details recorded.

The late Mr. Albert Norton drew attention* to a tree-stump of the Moreton Bay Ash (*Eucalyptus tesselaris* F.v.M.), near Gladstone, Queensland, which for many years was an erect stump of 9 feet high, and had produced no leaves since the top of the tree had been blown off many years previously. The bark had callused over the greater portion of the top edges. "With the exception of a small patch on the side, the bark is as full of sap as that of an ordinary living tree; but it is simply a stump without any appearance of having at any time had a branch growing from it."

In the discussion which took place "Mr. A. J. Turner endeavoured to account for this unusual occurrence by the supposition that the roots of the tree-stump inosculated with those of saplings or other trees which might be growing even at a distance of many feet, and the foliage of which might affect the elaboration of the sap and the assimilation of the food substance on which the vitality depended."

Dr. J. Bancroft quoted the case where a Spotted Gum tree (*Eucalyptus maculata* Hook. f.) maintained life after its natural attachment to the ground had been severed by coalescing with the branches of two neighbouring trees into which it had fallen.

This phenomenon is not uncommon in the case of the Spotted Gum; indeed, it is not rare with smooth-barked trees (Gums). It is especially common in the smooth-barked Apple (*Angophora lanceolata* Cav. See Part XI). It is analogous to the process of inarching.

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* *Proc. Roy. Soc. Qld.*, iii, 39 (1886).

I have called this a "natural graft." Maxwell Masters, in his *Vegetable Teratology*, speaks of this adhesion of the axes of plants belonging to different species as of rather rare occurrence. The adhesion of two individuals of the same species is not rare. We are, of course, familiar with the amalgamation of the woody tissues of our Mistletoes (*Loranthus*) and their numerous hosts.

The Peach can be successfully grafted on the Plum (both *Prunus*), the Apple on the Pear (*Pyrus*), the Pear on the Quince (*Pyrus*), the Tomato on the Potato (*Solanum*). Certain species belonging to different genera unite and grow satisfactorily as the Medlar (*Mespilus*) on the Hawthorn (*Crataegus*) and the Spanish Chestnut (*Castanea*) on the Oak (*Quercus*).

Masters quotes Moquin Tandon, where "by accident a branch of the species of *Sophora* passed through a fork made of two diverging branches of an Elder (*Sambucus*). The branch of the *Sophora* contracted a firm adhesion to the Elder, and what is remarkable is that, although the latter has much softer wood than the former, yet the branch of the harder wooded tree was flattened, as if subject to great pressure."

"It is possible that some of the cases similar to those spoken of by Columella, Virgil,* and other classical writers, may have originated in the accidental admission of seeds into the crevices of trees; in time the seeds grew, and as they did so, the young plants contracted an adhesion to the supporting tree."†

This is obviously the case with Mr. Musson's specimen; the origin of my George's River specimen is not quite similar.

Reverting to the George's River specimen, the fact is evident that the woods and barks of two different species have adhered to each other, have fused in fact, and the different textures of the barks and the different colours of the woods enable us to note the organic union very readily. We have indeed a composite log, but the timbers are joined together by an art transcending that of the most skilful woodworker. The union appears to be nearly as complete as if the log were homogeneous and the result had been arrived at by staining. And yet, looking more closely at the specimen, one observes the lack of continuity of the kino rings which are very abundant in the red wood (*E. hæmastoma*) both in the mature and sap wood, but which largely cease at the junction with the pale wood (*E. capitellata*). That there is organic union between the two timbers is borne out, not only by their obvious fusion, but also by the fact that the red wood "runs" here and there into the paler timber as if the woody fibres, pigmented by red colouring matter (perhaps phlobaphenes or other tannin derivatives), had lent some of their colouring matter to the fibres of the paler timber with which they are in close juxtaposition.

An anatomical study of the wood at the line of junction might throw light upon the relations of the cells and vessels of the two timbers at their points of contact, and I hope someone will make the examination. I suppose the sections

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* Daubeny, "Lectures on Roman Husbandry," p. 156. † Masters' "Vegetable Teratology," p. 56.

would have to be treated as opaque objects unless we are fortunate to find a similar natural graft at a far earlier stage. Obviously the fusion is analogous to the artifical union of parts which occurs in grafting and budding. But in his important paper* Shattock but cursorily alludes to the subject.

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* "On the Reparative Processes which occur in Vegetable Tissues," by Samuel G. Shattock. *Proc. Linn. Soc.*, XIX, 1.

EXPLANATION OF FIGURES.

A. Composite log of White Gum and Stringybark. The line of demarcation between the smooth bark of the White Gum and the fibrous bark of the Stringybark is evident; the letter A has been repeated four times to roughly show the line of demarcation of the two woods, which is very evident in the original or in a coloured drawing.

B. The dark-coloured stem of an Apple-tree (*Angophora*) growing out of the smoother, paler trunk of a Swamp Gum (*Eucalyptus tereticornis*). (C. T. Musson, photo. 1903.)

C. The same. Mr. Musson makes the note "Where the small white patch shows in the centre of the dark area, there has evidently been union." (C. T. Musson, photo. 1914.)

D. Woollybutt (*Eucalyptus longifolia*) and Apple (*Angophora intermedia*) growing together in a remarkable manner in the park, Moruya. (H. G. Smith, photo.)

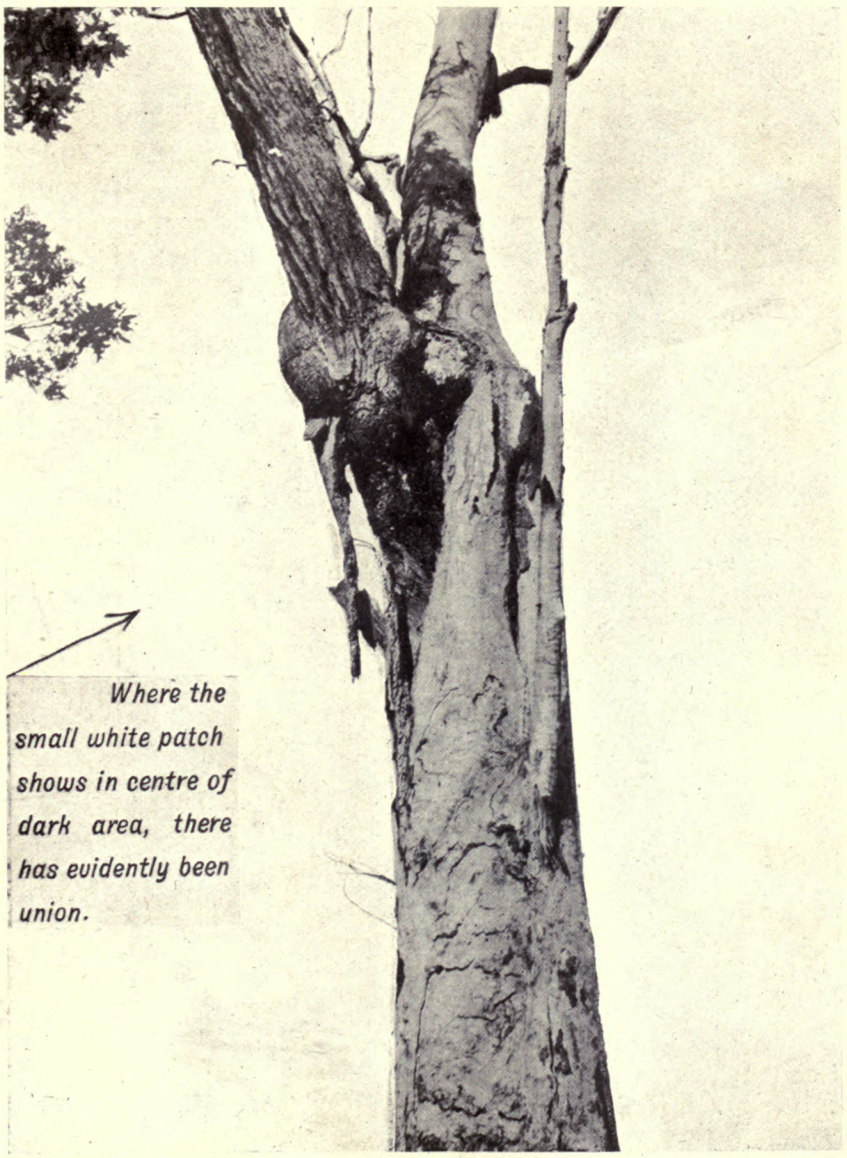


A. NATURAL GRAFT (WHITE GUM AND STRINGYBARK); SECTION THROUGH BARK AND WOOD.



C. T. Musson, photo, 1903.

B. NATURAL GRAFT, APPLE (*Angophora*) GROWING IN FISSURE OF SWAMP GUM.



C. T. Musson, photo, 1914.

C. NATURAL GRAFT. APPLE (*Angophora*) GROWING IN FISSURE OF SWAMP GUM.



H. G. Smith, photo.

D. *Eucalyptus longifolia and Angophora intermedia.* TWO TREES INTERGROWN, MORUYA PARK.

No. 202.

Hakea vittata R.Br.

A Needlewood.

(Family PROTEACEÆ.)

Botanical description.—Genus, *Hakea*. (See Part XLVI, p. 105.)

Botanical description.—Species, *H. vittata* R.Br., in *Trans. Linn. Soc.*, x, 182 (1811).

Following is the original description:—

H. vittata, foliis filiformibus indivisis exsulcis glabris fructu duplò longioribus, capsulis ovatis convexiusculis aequilateralibus basi citiùs dehiscentibus intùs lacunosis, seminis alâ obovatâ, ramulis tomentosis.

The author repeated this description in his *Prodromus*, p. 383.

Then Bentham described it in English in the following words:—

Young shoots minutely ferruginous or hoary, the adult foliage glabrous.

Leaves terete, slender, rigid, finely almost pungent-pointed, not attenuate at the base, 1½ to 3 inches long.

Flowers not seen, except some loose remains which appear to have been like those of *H. Pampliniana*, the perianth silky-pubescent, the torus small, the style rather long with an orbicular lateral stigmatic disk.

Fruit ovoid, nearly ¾ inch long, fully 4 lines broad, spotted or slightly verrucose, scarcely beaked, marked with a broad smooth dark line down each suture, the valves with a short dorsal horn near the end.

Seed-wing decurrent along the upper margin only of the nucleus. (B.Fl. v, 507.)

(He has a query mark before the species name—probably because the material at his disposal was imperfect. Brown himself described it without flowers.)

Then Kippist described in Meisner (DC. *Prod.*, xiv, 395), *H. Pampliniana* without fruit. It came from the neighbourhood of Adelaide, and Meisner adds "Species non satis nota." Bentham (B.Fl. v, 507) accepts the species, and describes the "Fruit 1 inch long, nearly ¾ inch broad, with a short broad straight beak, shaped like the fruit of *H. leucoptera* but smooth, the valves thickened at the end but scarcely horned. Seed-wing shortly decurrent on the upper margin of the nucleus."

In the Key (p. 492) he contrasts it and *H. vittata* as follows:—

Fruit-beak straight or obsolete.

Fruit with a broad gibbous base and scarcely distinct broad beak, without any crest ... ... 34. *H. Pampliniana*.

Fruit ovoid, nearly smooth, with a broad smooth dark line down each suture ... ... 35. *H. vittata*.

It has been found that the fruits (as described) of the two species run into each other, and in other respects there is no difference of importance between the two species.

Botanical Name.—*Hakea*, already explained (see Part XLVI, p. 106); *vittata*, Latin, bound with a fillet or head-band (used of the hair of Roman priests, priestesses and poets). In reference to the dark band around the fruit at its dehiscence (see Plate 206).

Vernacular Name.—In common with many *Hakeas* with short, terete, pungent leaves, it goes under the name of "Needlewood."

Aboriginal Names.—It is one of several western New South Wales shrubs (*e.g.*, *Acacia Cunninghamii* Hook., *penninervis* Sieb.), which go under the name of "Motherumbung."

Synonym.—*H. Pampliniana*, Kippist, as already explained.

Timber.—The timber is small, reddish-brown, and of an ornamental character very similar to that of *H. leucoptera*. The trunk itself is not of commercial importance, although it has some limited local use.

The root-stock is used for pipes, as is that of *H. leucoptera* (see Part LIII, p. 38).

Size.—It is a shrub or small tree, attaining a height of 20 feet, with a trunk diameter of 6 or 9 inches.

Habitat.—The type came from "In Novæ Hollandiæ orâ australi; Flinders' Land: in campis sterilibus, prope littora,"—in the vicinity of Port Lincoln, South Australia.

It is found in the States of South Australia, Victoria, New South Wales, and also South-western Queensland.

It is a native of regions of low rainfall, and careful examination will greatly increase the number of recorded localities. I have no doubt that it is commonly passed over for other species.

It is in the National Herbarium, Sydney, from the following places:—

Victoria.—Victorian Alps, also on the Buffalo Mountains (C. French, Junr., and C. Walter). Previously only recorded from the south-west and north-west (Mallee country) of Victoria; Airey's Inlet (J. Staer).

New South Wales.—Moama (W. N. Watson); Zara, *viâ* Hay (Miss E. Officer); near Hay (K. H. Bennett); "20 feet high, common on the plains," Forbes district (H. W. Garling); Dubbo (A. R. Samuels); Nyngan, on sandy



A NEEDLEWOOD.

(*Hakea vittata* R.Br.)

ridges (E. F. Rogers); West Bogan (J. Gregson); Cobar (L. Abrahams); Cobar to Wilcannia Road (W. Baeuerlen); Bourke district (O. C. Macdougall, A. W. Mullen); Byrock (J. L. Boorman); Pilliga (J. L. Boorman).

Queensland.—Curwillinghie, as recorded in the Flora Australiensis. Now spelt Currawillinghi, and near Angledool. It is near the N.S.W.-Queensland border.

EXPLANATION OF PLATE 206.

A. Flowering twig from Cobar, N.S.W.
B. Twig, showing more flowers, from Zara, *vid* Hay.
C. Bud.
D. Unopened flower.
E. Opened flower, showing—
    (*a*) Four-lobed corolla with sessile anthers in the concave laminæ.
    (*b*) Style.
    (*c*) Stigma.
F. Portion of flower (corolla removed) showing—
    (*a*) Hypogynous gland.
    (*b*) Stipitate ovary.
    (*c*) Style.
    (*d*) Stigma.
G. Anther.
H. Stigmatic disc.
I. Fruit from Cobar, N.S.W.
K. Fruit from Zara, *vid* Hay, N.S.W.
L. Fruit from Bourke district, N.S.W.
M. Winged seed.
N. Young growth.
O. Young growth magnified, showing pubescence.

No. 203.

Eucalyptus Caleyi Maiden.

Caley's Ironbark.

(Family MYRTACEÆ.)

Botanical description.—Genus, *Eucalyptus.* (See Part II, p. 33.)

Botanical description.—Species, *E. Caleyi* Maiden in *Proc. Linn. Soc. N.S.W.*, xxx, 512 (1905).

A tall Ironbark tree, often glaucous, and finally becoming glabrous, but remaining dull-coloured.

Vernacular Names.—Called "Broad-leaved Ironbark" at Howell in comparison with the local "Narrow-leaved Ironbark," which is *E. sideroxylon*, and which is rare in the immediate district. Also called "Silver-leaved Ironbark," but not to be confused with *E. melanophloia*, which is not found in the neighbourhood, but which is exceedingly abundant near Bingara, Inverell, &c.

Bark very deeply furrowed and hard, with much less kino in grains throughout the bark than *E. sideroxylon*, and therefore not a true "Fat-cake Ironbark" like that species.

Timber deep red in colour, locally esteemed, and apparently a timber of good quality.

Juvenile leaves nearly orbicular, 3 inches in diameter being the usual dimensions. The leaves are symmetrical, and taper rather abruptly into a petiole of about ½ inch. Texture thick and coriaceous, dull and even glaucous. Midrib rather prominent, and the intramarginal vein at a considerable distance from the edge. The secondary veins (of which the intramarginal vein is one) numerous, usually about ¼ inch apart, roughly parallel, but converging and finally becoming nearly parallel to the midrib.

Mature leaves broadly lanceolar, up to a breadth of 2 inches, and a length twice as great and rather more. Nearly symmetrical, blunt-pointed, tapering at the base into a petiole of about an inch. Coriaceous and rather thick, equally dull on both sides; often glaucous. Intramarginal vein at a considerable distance from the edge. The secondary veins rather prominent and wide apart, and disposed at about an angle of 45 degrees to the midrib.

Buds.—Operculum conical, and of less diameter than the calyx, which tapers much more than does the operculum. The buds often glaucous.

Flowers axillary, becoming terminal by reduction of the upper leaves. Up to 7 in the head, the common peduncle rather slender, and about ½ inch in length, each flower on a distinct pedicel. Anthers almost quadrangular in shape, opening in pores nearly terminal, which are a little wider in the direction of the broad portion of the anther. Filaments often tinged red and minutely glandular. In full flower in August.

Fruits pear-shaped, slender, tapering into a distinct pedicel. Diameter, say ¼ inch, with a length about twice as great. Dark brown and glossy when fully ripe. They have a marked dark coloured thin rim, such as is common in *E. sideroxylon* and *E. melliodora.* Valves well sunk, usually half-way down the capsule.

Botanical Name.—*Eucalyptus*, already explained (see Part II, p. 34); *Caleyi*, in honour of George Caley, Banks' Botanical Collector in New South Wales (1800–1810), and whose shrewd observations in regard to another Ironbark have been referred to at p. 94, Vol. 5, of this work.



M. Flockton, del. et lith.

CALEY'S IRONBARK.

(*Eucalyptus Caleyi* MAIDEN.)

Vernacular Name.—It goes under the name "Mountain Ironbark," although I am aware it cannot claim exclusive use of the name. I have known it to also go under the names of "Drooping-, Broad-leaved-, Silver-leaved-, Ironbark." The name "Caley's Ironbark" is short, it commemorates a worthy pioneer botanist whose work requires much more emphasis than it has hitherto received, and perhaps it is as good as any.

Synonym.—*E. sideroxylon* A. Cunn., var. *pallens* Benth. (B.Fl. iii, 210) probably. As I have not seen the type, I am not quite certain. At p. 96, Part xii, of my "Critical Revision of the Genus Eucalyptus," I have discussed the matter at some length.

Flower-buds.—Note that the operculum is conical, and of less diameter than the calyx, which tapers much more than does the operculum.

Timber.—Very little is known about it, as it is often confused with the better known *E. sideroxylon*. Mr. Gordon Burrow, formerly Forest Guard at Inverell, reported that it "is a good timber for mining props or any purpose where young undersized timber is required, and straight young trees can be obtained. It is also a first-class timber for fuel."

The timber is red and durable, and I believe it to be valuable, although it is not as abundant, nor as readily available in good merchantable sizes as are most of the other Ironbarks.

Size.—A tall or medium-sized tree.

Range.—It appears to be widely distributed over the northern table-land of New South Wales, extending from the Rylstone (Mudgee) district north-east to near the Queensland border, and as far east as Emmaville. The range of the species requires to be more fully defined, but it appears to be found in a scattered manner over the greater portion of New England.

We have it in the National Herbarium, Sydney, from the following localities (among others):—

Murrumbo, Rylstone (R. T. Baker); Bacrami, 14 miles west of Denman (R. H. Cambage); Howell (Type, J. H. Maiden and J. L. Boorman); Emmaville (Gordon Burrow); Ashford (J. L. Boorman).

EXPLANATION OF PLATE 207.

A. Juvenile leaf.
B. Twig with buds.
C. Fruits.
All from Type, Howell, N.S.W.
D. Fruits from Rylstone, N.S.W.
E. Fruits, over-ripe, showing cracked rim, from Emmaville, N.S.W.
F. Anthers having terminal pores.

No. 204.

Acacia Dorothea Maiden.

Dorothy's Acacia.

(Family LEGUMINOSÆ: MIMOSÆ.)

Botanical description.—Genus, *Acacia*. (See Part XV, p. 103.)

Botanical description.—Species, *A. Dorothea* Maiden, in *Proc. Linn. Soc. N.S.W.*, xxvi, 12 (1901), with a plate.

An erect shrub of several feet, with angular branches, more or less covered all over with appressed white hairs, occasionally rubbed off on the old leaves, very dense on the young shoots.

Phyllodia linear-lanceolate, falcate, rather more than 2½ inches long and 4 to 5 lines broad, rarely attaining ½ an inch in breadth, obscurely veined, except the prominent mid-voin, with prominently thickened margins, and frequently with a small oblique or recurved point, the single large marginal gland about half-way between the point and the base.

Flower-heads oblong, about 6 to 8 on short pedicels, in stout axillary or terminal racemes much shorter than the leaves.

Flowers about 20 in the heads.

Calyx small, shortly 5-lobed, very hairy.

Petals 5, glabrous or nearly so, more than twice as long as the calyx, united at the base.

Ovarium densely hairy.

Pods flat, stipitate, generally 1 to 1½ inches long, and about ¼ inch broad, somewhat curved, with thickened margins, much constricted between the seeds, densely covered with soft hairs, especially in the unripe state.

Seeds longitudinally arranged, small, ovate, only 2 or 3 or solitary in the few ripe pods seen; funicle folded under the seed, the last fold much thickened. (*Proc. Linn. Soc. N.S.W.*, xxvi, 12 [1901].)

Since the publication of the description of this species in these Proceedings, xxvi, p. 12, 1901, we have received numerous specimens from Blue Mountain localities, which do not much enlarge the very limited geographical range of the species, but which necessitate the transposition of the species into the Section *Juliflorœ*. The new material, especially specimens in bud from Leura (A. A. Hamilton and others), show distinctly that the flowers are in short spikes, ¼–½ inch (5–11 mm.) long, though often appearing globular when in full flower.

This transposition makes the affinities of the species still more difficult to trace. There is not a single Acacia in *Juliflorœ* with prominently 1-nerved phyllodia, so the species stands isolated in this Section. Its nearest affinities are doubtless in *Uninerves*, but in this Section it would stand isolated by its spike-like inflorescence.

The position of this Acacia is therefore one not free from doubt.

Bentham regarded the *phyllodia characters of primary importance*, and kept a number of Acacias with spicate inflorescence under the Section *Pungentes*. Mueller regarded the spicate inflorescence as of more importance than the phyllodia, and removed Bentham's spicate *Pungentes* to *Juliflorœ*.

If we take Bentham's view, we must leave it in *Uninerves*. If we take Mueller's view, we must remove it to *Juliflorœ*. (*Maiden and Betche in Proc. Linn. Soc. N.S.W.*, xxxiv, 358 [1909].)

In the Census of New South Wales Plants, now in the press, it will appear under a new under-section (*Uninerves*) of *Juliflorœ*.

Affinities.—In the original description we made the following statement:—

The affinity of this species lies with *A. rubida* A. Cunn, *A. obtusata* Sieb., and *A. amœna* Wendl.; but it is distinguished from them all by the *oblong flower-head* attaining fully ¼ inch in length, and almost connecting it with the section *Juliflorœ*. Its hairy pods distinguish it also from the allied species.

As regards *A. rubida* and *A. amœna*, these two species have long glabrous pods, with funicles which twice encircle the seed, nor does *A. Dorothea* flower while bipinnate leaves are present. There are other differences, as may be seen from the plates.

Perhaps, on the whole, the closest affinity of *A. Dorothea* is with *A. obtusata*, and therefore it may be convenient to set out the differences as follows:—

	obtusata.	*Dorothea.*
Branchlets ...	Glabrous, speckled, angular.	Silky tomentose; angular.
Phyllodes ...	Inclining to spathulate, slightly mucronate; glabrous, one gland.	Narrowing at the tip, mucronate, usually recurved *tomentose* (silvery, often golden at the tips), one gland.
Inflorescence ...	Flowers in round heads of about 16–18; calyx tufted with hairs at the top; corolla glabrous, except a few scattered hairs. *Ovary glabrous.*	Flowers in short spikelets, about 20–24; calyx tomentose; corolla glabrous, except a few scattered hairs. *Ovary densely tomentose.*
Pods	Broad, long, containing 7 or 8 seeds. *Smooth.*	Small, containing 2 or 3 seeds. *Tomentose.*

Botanical Name.—*Acacia*, already explained (see Part XV, p. 104); *Dorothea*; *loc. cit.* occur these words, "The species is named in honour of my daughter, Acacia Dorothy Maiden (in fulfilment of a long-standing promise)."

Foliage.—This is silvery leaved, with the young leaves (phyllodes) sometimes golden.

Flowers.—They are sweet scented and of a bright yellow colour.

Fruits.—This appears to be a shy fruiter, and seeds seem to be excessively rare. It seems to rely upon vegetative reproduction more than on seeds.

Habitat.—It is confined to the Blue Mountains and spurs, so far as is known at present, being very abundant at Leura, and extending to Clarence Siding, Mount Wilson, and the Jenolan Caves. It occurs at Newnes Junction (A. A. Hamilton), and also about 15 miles north of Clarence, towards Wolgan.

In "Observations on the occurrence of two rare Acacias at Leura, Blue Mountains," "Australian Naturalist," ii, 180, Mr. A. A. Hamilton gives some detailed notes as to habitats for this species.

EXPLANATION OF PLATE 208.

A. Flowering twig.
B. Oblong flower-head.
C. Individual bud.
D. Flower.
E. Flower opened out, showing—
  (*a*) Calyx.
  (*b*) Corolla.
  (*c*) Pistil (stamens removed).
F. Bract found at the base of the flowers.
G. Pods.
H. Seed.

(All drawn from the type.)



DOROTHY'S WATTLE.

(*Acacia Dorothea* MAIDEN.)

No. 205.

Ackama Muelleri Benth.

A Corkwood.

(Family CUNONIACEÆ.)

Botanical description.—Genus, *Ackama*. A. Cunn. in *Ann. Nat. Hist.* ii, 358 (1837).*

Calyx-tube short, campanulate; lobes 5, valvate.
Petals 5.
Stamens 10, inserted round a crenate disk; anthers small, tipped by a minute gland-like appendage to the connective.
Ovary free, two-celled, with several ovules in each cell; styles filiform, deciduous.
Capsule small, turgid, septicidally dehiscent.
Seeds few, ovoid, hairy; embryo cylindrical in the axis of a fleshy albumen.
Trees.
Leaves opposite, pinnate.
Flowers small, very numerous, in compound panicles, in terminal pairs, becoming axillary by the elongation of the central shoot. (B.Fl. ii, 444.)

Botanical description.—Species, *A. Muelleri* Benth., in *Flora Australiensis* ii, 444 (1864).

A tree, glabrous or nearly so, except the inflorescence.
Leaflets usually 5, rarely 7 or 3, ovate-elliptical or ovate-lanceolate, acuminate, obtusely and very shortly serrate, usually 3 or 4 inches long, but sometimes much larger, narrowed at the base, and more or less petiolate, somewhat coriaceous, penniveined, with usually a minute tuft of hairs in the axils of the principal primary veins underneath.
Flowers very small and numerous, clustered along the short ultimate branches of a very compound panicle, the branchlets all minutely pubescent.
Calyx about ½ line long.
Petals slightly exceeding the calyx-lobes.
Stamens exserted.
Capsule ovoid-globular, 1 to 1½ lines long. (B.Fl. ii, 444.)

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* The full title of Allan Cunningham's work, sometimes referred to under the simple title of "A. Cunn. Precur," or "Precursor," is as follows, and it is of especial interest to students of Allan and Richard Cunningham's work :—

FLORÆ INSULARUM NOVÆ ZELANDIÆ PRECURSOR; OR A SPECIMEN OF THE BOTANY OF THE ISLANDS OF NEW ZEALAND.

Comprising, in a synoptical form, those plants that were discovered by Sir Joseph Banks and Dr. Solander, during the first voyage of Captain Cook, that have been, for the most part, already published:—as also those that were collected in the subsequent voyage of our great Circumnavigator, which were described by Dr. Sparmann, and afterwards published in the work, known as Forster's Prodromus;—to which are added some new plants, gathered by Allan Cunningham whilst on a visit to the Bay of Islands and circumjacent country in 1826; the few that were found by the French Naturalists attached to the voyages of La Coquille and L'Astrolabe, as indicated by the recent Essay of M. Achille Richard;—and, finally, those interesting discoveries which Richard Cunningham made during his excursions on the northern Island, in portions of the years 1833 and 1834.

(The whole arranged and edited by his Brother, Allan Cunningham, Esq.)

The first part appeared in Hooker's "Companion to the Botanical Magazine," vol. ii, p. 222, and the remaining portions in the "Annals and Magazine of Natural History," vols. i–iv.

Only another species has been described, viz., *A. rosæfolius* A. Cunn., the New Zealand tree on which the genus was founded.

Var. **hirsuta**, Maiden and Betche.

Proc. Linn. Soc. N.S.W., xxxvii, 246 (1912).

Branchlets, rhachis of the pinnate leaves and principal veins on the underside of the leaves densely covered with short, spreading, pale-brown hairs, more sparingly hairy on the smaller reticulate veinlets. Upper side of the leaves quite glabrous, or with hairs on the midvein only or sparingly sprinkled with hairs even on the reticulate veinlets.

This is apparently the form mentioned by Mueller in *Fragm.* vi, p. 188, from Camden Haven, Macleay River and Bellinger River, but it is such a very distinct form that it should be constituted a named variety, in our opinion. It seems to be confined to the coast district and mountain ranges from Camden Haven to the Bellinger River, or from about 30° to 32° S. lat. It does not seem to extend into Queensland, so far as we know.

Speaking of this species in the *Agric. Gaz. N.S.W.*, v, 609 (1894), I used these words :—

My specimens have leaves all either perfectly entire, or with serrations so small as to be detected with difficulty. In the Dorrigo Forest Reserve (and, perhaps, also in Glenfernie) there is a form of this species with softly tomentose leaves and young shoots, and with the leaves more digitate than in the type form. This is evidently the plant referred to by Baron von Mueller (*Fragm.* vi, 188) from Camden Haven, the Macleay and the Bellinger. The Dorrigo is, therefore, an important additional locality. The variety is so marked that I would suggest to the Baron the propriety of designating it *tomentosa*.

I wrote to Baron von Mueller, but he did not adopt the suggestion, apparently thinking that he had referred to it sufficiently.

Botanical Name.—*Ackama*. Allan Cunningham, in his definition of the genus (*op. cit.*), says, "The name of this distinct genus has been invented by anagrammizing that given to the tree by the natives." His brother, Richard Cunningham, had given the Maori name as "Maka-maka."

Muelleri, in honour of the late Baron von Mueller, Government Botanist of Victoria.

Vernacular Name.—Because of its corky bark, it invariably goes under the name of "Corkwood" in the districts in which it grows. It shares this name with a number of other trees.

Synonym.—*Weinmannia paniculata* F. Muell., *Fragm.* ii, 83, afterwards altered to *W. paniculosa*, and maintained by Mueller in his "Census of Australian Plants."

Mueller follows Asa Gray in combining *Ackama* and *Weinmannia*. *Ackama* differs from *Weinmannia* in the paniculate inflorescence and valvate calyx, which is uniformly racemose in *Weinmannia*, which gives the two genera a different habit. The fruit also is different.

Leaves.—Mueller describes the leaves as "foliis trifoliolatis v. pinnatim quinquefoliatis." Trifoliolate specimens seem to be rare (*e.g.*, Glenfernie Forest Reserve, Grafton-Armidale Road), all our other specimens have at least 5 leaflets.

The species varies in the size of the leaves and of the domatia. Sometimes they are almost absent. References to domatia will be found at pages 83 and 148 of Vol. III of the present work.

Flowers.—The inflorescence is soft, feathery and graceful, and the species well worthy of cultivation in the shrubbery, partly on that account. Later on it becomes too large for a small garden.

Timber.—It is likely to prove of value, but it is one of many timbers imperfectly known. It is hardly to be distinguished from that of *Eucryphia Moorei*. When fresh it is drab with a purplish cast, close in the grain, tough, and dresses with facility.

The late Mr. Augustus Rudder, an experienced forester, said of it: "I am inclined to think that, for some purposes, it will also prove of exceptional value. For instance, butter boxes, carving, beadings, and mouldings, &c., as it is fine in the grain and very easy to work, being free from knots and splinters. On the Coast country it is small, but on some inland mountain brushes I have seen it with good clear boles up to 2 and 3 feet in diameter. In some parts of Forest Reserves 101 and 102, near the head of the Williams River, I have seen it of these sizes, and it is fairly plentiful."

Mr. N. Stewart, when Forest Guard of Glen Innes, reported:—"I believe this will be a useful timber for cabinet work in the future. It has not been tested here yet, as it is rather far from market; not very plentiful."

Size.—Usually a medium-sized tree, but under favourable circumstances it becomes a large tree.

In the Dorrigo it is (or was) a magnificent tree of great height.

"Up to 3 feet in diameter in some of the mountain scrubs of the Gloucester district" (A. Rudder).

"Slim tree of 40 feet, 15 feet to first branch, girth 22 inches at 3 feet." Bellinger River (E. H. F. Swain).

"Forty feet in height, and 12 to 18 inches in diameter." Ourimbah (A. Murphy).

Habitat.—It is a native of Eastern New South Wales and Queensland.

It is confined to the coastal districts, or to the gullies of the mountain ranges, having an easterly aspect. It has been recorded from as far south as the Hawkesbury River, but its range in Southern Queensland is not yet ascertained.

It is in the National Herbarium, Sydney, from the following localities:—

New South Wales.—Ourimbah (A. Murphy); Boolambayte (A. Rudder); "Pink Corkwood," Taree district (Dist. Forester Hardiman); Port Macquarie (J. L. Boorman); Upper Hastings River, ascent to table-land (J. H. Maiden); Bucca

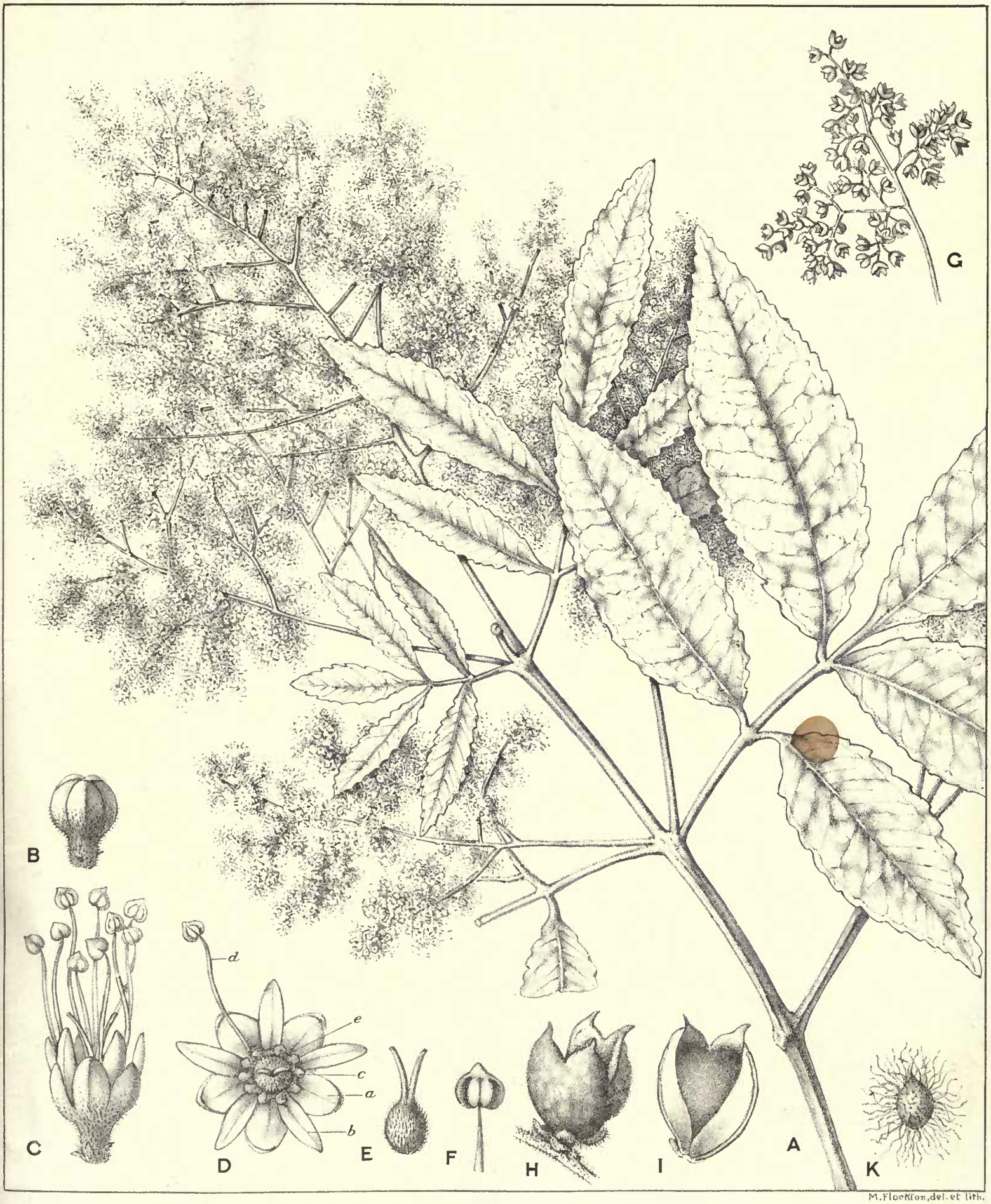
Creek (J. L. Boorman); Fernmount, Bellinger River (E. H. F. Swain); Styx River, *viâ* Hillgrove and Kempsey (J. L. Boorman); "Cork Wood," fruit bright red when ripe, Coramba (J. L. Boorman); Coff's Harbour to Grafton (J. H. Maiden and J. L. Boorman); brush forests from Pheasant Creek on to Tenterfield (N. Stewart); Acacia Creek, Macpherson Range (W. Dunn); Tweed River (E. Betche).

Queensland.—Mr. F. M. Bailey records it from "Scrubs along the North Coast Railway." I have collected it within the Queensland border, at Wilson's Peak, Macpherson's Range.

EXPLANATION OF PLATE 209.

A. Flowering twig.
B. Bud.
C. Flower.
D. Flower opened out, showing—
  (*a*) Calyx.
  (*b*) Petals.
  (*c*) Stamen (inserted between the crenulations of the disk).
  (*d*) Crenate disk.
  (*e*) Ovarium and styles.
E. Ovarium with bipartite style.
F. Anther.
G. Fruit, natural size.
H. Capsule opened.
I. Showing half of capsule.
K. Seed.

(Flowers from Coramba, N.S W.; Fruits from Tweed River District.)



A CORKWOOD.

(*Ackama Muelleri* BENTH.)

FORESTS CONSIDERED IN THEIR RELATION TO RAINFALL AND THE CONSERVATION OF MOISTURE.

SYNOPSIS.

1. Introductory.
2. The Historical Method.
   (*a*) General observations.
   (*b*) The case "Forest destruction *does* diminish the rainfall."
   (*c*) The case "Forest destruction *does not* diminish the rainfall."
3. The vastness of rainfall conditions.
4. Clouds may strike against trees and deposit moisture.
5. Not merely a question of large trees.
6. Rainfall measurements in forests and open country.
7. Physiological action of trees—transpiration.
8. Some uses of forests:
   (*a*) To temper floods.
   (*b*) To conserve springs, and to aid in the more even distribution of terrestrial waters.
   (*c*) The relation of forests and snow.
   (*d*) To prevent evaporation of water.
   (*e*) To give shelter to stock, crops, &c.
   (*f*) The leaves of forest trees, &c., afford manure and mulch.

1. INTRODUCTORY.

I bring before you the subject which is often conventionally known under the title of "Forests and Rainfall," and in regard to which it may be fairly said that there still exists, in New South Wales at least, a considerable amount of misapprehension. Even the clear-cut statements of Mr. Russell, our late Government Astronomer, that forests do not increase rainfall, have failed to carry conviction to some people, for the reason, I take it, that the broader subject of the effect of vegetation on the *conservation* of moisture has not been fully considered in some of the public discussions that have taken place. The term "Forests and Rainfall" has been adopted by many writers, because of its compactness, but if its use becomes misleading, then it should be amplified. We want to carefully separate two issues:—

1. The effect of forests and other vegetation in increasing the rainfall.
2. The effects of the same in conserving moisture.

I approach the subject with but elementary meteorological knowledge, but I have had much experience of Australian forestry. Taking an extensive territory, it appears to be indisputably proved that forests do not increase rainfall; it is as fully well proved that they conserve the rain that falls, and therefore every effort should be made to save them from unnecessary destruction.

Most of what follows is based upon a paper read by me before the Royal Society of New South Wales in 1902, republished in the *Agricultural Gazette of New South Wales* for September, 1906.

A thoughtful paper by Mr. Walter Gill,* Conservator of Forests of South Australia, is well worthy of perusal. He deals with evidence gathered from official reports and other sources, in different countries, in regard to the effects of forests and their destruction on the rainfall and available moisture generally. The paper is temperately worded, and contains much sound advice, which should be well pondered over by "every individual member of an intelligent democracy."

Let me invite attention to *Bulletin* No. 7 of the Forestry Division of the United States Department of Agriculture, entitled "Forest Influences." It contains masterly papers by Professors M. W. Harrington and B. E. Fernow, to which I am much indebted.

There is so much postulation, theory, and uncertainty of observations in regard to the whole subject, that I am unable to classify the statements as rigidly as if I were dealing with exact science. I have, however, avoided repetition as far as possible.

2. The Historical Method.

(*a*) *General Observations*:—

Popular writers usually rely upon the historical method in support of their well-intentioned arguments on this question, but although this method has been superseded by the scientific method, which relies on observation and experiment, it is proper to deal with historical evidence at this place.

Löffelholz-Colberg published, in 1872, a comprehensive catalogue of publications on forest questions which is, of course, now much out of date. His list begins with Fernando Columbus, the son of Christopher Columbus, who attributed the heavy rainfall of Jamaica to its wealth of forests, and the decrease of rainfall on the Azores and Canaries to the removal of their forests. In the sixteenth and seventeenth centuries the subject was already attracting the attention of the French Government, and in fact Governmental interest in the subject goes back to the time of the immediate successors of Charlemagne. It is interesting to read over the abstracts of opinion which are recorded by Löffelholz-Colberg. Every variety of opinion can be found there, from those which attribute to the forest almost everything which is desirable in climate, and even endow it with a powerful influence on morals, to those who believe it to be entirely without influence; and from those who think that its influence does not extend beyond its own margin, to those who would attribute the deterioration of the climate of the Old World to the removal of the forests of the New.

Leaving out of account the solutions which are purely sentimental or purely theoristic, the conclusions usually consist in finding a country which has been once wooded, but from which the forests have been removed, or one which was once open, but later became wooded. The climate at the beginning and end of the time involved is then ascertained or assumed, and the changes in the climate are attributed to the change of the forest cover. The uncertainties of this method are so great as to make it generally useless. It is seldom possible to be sure of the early forest condition of any particular country.—(M. W. Harrington, *op. cit.*)

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* "Deforestation in South Australia; its causes and probable results." Adelaide meeting, *Aust. Assoc. for Adv. of Science* (1893).

(*b*) *The case "Forest Destruction* does *diminish the rainfall":—*

I think that the few authors about to be cited are fairly representative of the evidence that is usually adduced. There is a certain amount of vagueness in some cases as to whether it is intended to state that the amount of rainfall is diminished by the destruction of trees. My first illustration is given, because in one version or another it is so often quoted in the periodical discussions that have taken place in New South Wales.

The most fertile of all provinces in Bucharia was that of Sogd. Malte Brun said, in 1826:—

For eight days we may travel and not be out of one delicious garden.

In 1876, another writer says of the same region:—

Within thirty years this was one of the most fertile spots of Central Asia, a country which, when well wooded and watered, was a terrestrial paradise. But within the last twenty-five years a mania for clearing has seized upon the people, all the great forests have been cut away, and the little that remained was ravaged by fire during the civil war. The consequences followed quickly, and this country has been transformed into a kind of arid desert. The watercourses are dried up, and the irrigating canals are empty.

It is certain that the fertility of these regions in ancient times was due to stupendous irrigating devices and canals, and when these were neglected, through wars and other untoward circumstances, the fertility necessarily ceased. It is certain that there are ruins of enormous irrigating ditches and canals in Babylonia where history indicates that there was once a teeming population and great fertility, but where now only a sandy desert greets the eye.*

The late Sir William Hooker wrote:—

That from Ascension there continued to be received encouraging accounts of the increased fertility and moisture of the island consequent on the extension of the plantations.†

It is proper to point out that in this statement it is not asserted that the *rainfall* is alleged to have been increased.

It is remarked by Marsh, that "It has long been a popularly settled belief that vegetation and condensation and fall of atmospheric moisture are reciprocally necessary to each other, and even the poet sings of—

Afric's barren sand,
Where nought can grow, because it raineth not,
And where no rain can fall to bless the land,
Because nought grows there.

Here we have an illustration of the converse fact; one measure of humidity promoting vegetation, and vegetation not only arresting the desiccation, but so reversing the process that an increased humidity is the consequence.‡

While the extract just quoted may be interpreted as not stating that forests increase rainfall, the same work contains many instances (not well classified) of the effects of the destruction of the forests and of varying degrees of value, but affording a lengthy list from which a writer working up a case can obtain his illustrations.

In connection with the systematic destruction of timber in Australia, it is mentioned that in the Ballarat district this destruction has been accompanied by a corresponding diminution in the rainfall, and since 1863 there has been a more or less regular reduction, from 37·27 inches in 1863 to 14·23 inches in 1868.§

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* Professor H. A. Hazen before Annual Meeting of American Forestry Association, Nashville, Tenn., U.S.A., 22nd September, 1897; quoted in "Nature," 30th December, 1897, p. 213.

† Report of the Director of Kew Gardens for 1864.

‡ J. Croumbie Brown's "Forests and Moisture," pp. 144-5.

§ "Nature," i, 261.

This is inconclusive, for the reason that the years referred to may have been in a rainy cycle.

It is recorded of these (part of the Leeward Islands) that, in former times, they were clothed with dense forests, and the oldest inhabitants remembered when the rains were abundant and the hills and all uncultivated places were shaded by extensive groves. The *removal of the trees was certainly the cause of the evil.* The opening of the soil to the vertical sun rapidly dries up the moisture, and prevents the rain from sinking to the roots of plants. The rainy seasons in these climates are not continuous cloudy days, but successions of sudden showers with the sun shining hot in the intervals. Without shade upon the surface the water is rapidly exhaled, and the springs and streams diminish.*

See also a paper by the Rev. W. B. Clarke, M.A., F.R.S., on the "Effects of Forest Vegetation on Climate,"† which contains references to a number of authors, and which provoked an interesting discussion.

A pamphlet by Mr. F. S. Peppercorne‡ gives a number of instances of countries whose present aridity is attributed to diminished rainfall, caused by extensive cutting-down of trees.

Aragua affords an interesting example of the evil influence of the wholesale destruction of trees in lessening running streams.§

J. Croumbie Brown (*op. cit.*, p. 112) gives additional information in regard to this interesting locality.

The Report of the Director of the Botanic Gardens of Adelaide for 1881 has an appendix on "The Influence of Forests on Climate," which mainly repeats the instances given in "The Forest" of Prof. Schacht.

Mr. J. G. O. Tepper, an earnest writer on philosophical questions pertaining to plant life, has a paper‖ which is well worthy of perusal. It enumerates a number of the oft-quoted examples of altered climatic conditions attributed to destruction of forests, and also deals with the problems of physics which are involved in a proper understanding of the subject.

(*c*) *The case "Forest Destruction* does not *diminish rainfall":—*

With us forest destruction takes two forms:—

1. The felling, removal, and burning off necessary for agricultural and other settlement, and which many thinking men are of opinion is often carried out in too drastic a manner, to the detriment of the owner of the land himself, who often finds he has got rid of shelter and timber he would afterwards be glad of.
2. Ringbarking, which is necessary to fit much of our land for grazing purposes and which like (1) is undoubtedly done ignorantly and recklessly, particularly, I think, losing sight of the incipient creeks which are the beginnings of floods and washaways. This is a very wide question, which I have dealt with on a previous occasion (*Agricultural Gazette*, June, 1905, page 540).

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* Letter from Dr. Hooker to Lord Kimberley, 1870.
† Journal Royal Soc., N.S.W., 1876, 179 *et seq.*
‡ "The Influence of Forests on Climate and Rainfall," Napier, N.Z., 1880.
§ J. M. Spence, "The Land of Bolivar," i, 159.
‖ "The Influence of Vegetation on Climate and Rainfall," read before the Royal Soc. of S.A., 3rd May, 1898 (printed by *Adelaide Observer*).

Our late Government Astronomer has given special attention to the "Forests and Rainfall" subject for many years, particularly with reference to Australia, and I cannot do better than quote some of his published statements.

Mr. Russell speaks,* in regard to forest destruction and climate, of "the tiny efforts of men" in the way of forest destruction, and the enormous quantity of felling and ringbarking that followed the Free Selection before Survey Act of 1861. He proceeds: "How is it that in India, where trees are conserved instead of destroyed, drought of extreme severity overtakes the country, and this too at times coincident with our droughts in Australia?" He also gives instances of droughts in the Pacific Islands and South Africa.

Mr. Russell formally reported on the subject, and his report was laid before Parliament on 30th November, 1898. He quotes the reports of the Meteorological Society of Edinburgh in 1859, in connection with the forests and rainfall question, which stated that "there were no grounds for thinking the rainfall of Western Europe was getting less." He adds:—

An elaborate investigation of the rainfall records by Mr. Symonds (the highest authority on such matters in England) had led to a similar conclusion. An investigation carried out in the United States by the Smithsonian Institution resulted in a decision that no evidence was to be found of a decreasing rainfall, and in America they had destroyed forests wholesale. Professor Marsh, in his book, "The Earth, as modified by human action," had discussed the question fully; and after considering all the available evidence, he concluded that there was no evidence that the annual rainfall had diminished by the action of man in the destruction of trees. Those parts of the State which had suffered most from the drought—Western Riverina and the Darling country—had done practically no ringbarking.

Mr. Russell adds:—

. . . . So far as New South Wales is concerned, he felt quite certain that the destruction of trees had not decreased the rainfall, but would rather appear to have increased it.† As an instance, the average rainfall over the whole colony—1889 to 1894, inclusive—was 24·7 per cent. above the average of all years.

Mr. T. Kidston, a gentleman of much experience, states:—

I entirely dissent from the opinion that forest destruction diminishes rainfall. I have been through Upper and Lower Canada, Nova Scotia, and the New England States of North America, where the greatest amount of timber cutting has taken place in the world's history in a like time, and yet the rainfall statistics show that during the last sixty years the rainfall has slowly, yet continuously, *risen*; and one of the most eminent meteorologists (Professor Marsh, from memory), after a life-long study, has recorded his opinion "that rainfall is not increased or diminished by anything that man has done, but by some great cause *external to the earth.*" In this western‡ country, if ridden over a fortnight after a fall of 2 or 3 inches of rain, it will be found soft and boggy, if ringbarked; but the adjoining unringed country will be comparatively firm and sound. In the latter (green timbered country) the enormously increased evaporating surface of the leafage, compared with the area of the plot occupied by the tree, has carried the moisture off into the air, which is still retained in the soil among the dead ringbarked timber, and the grasses are nourished long after the soil among the live trees is parched and dry. The main cause of the water disappearing more rapidly from rolling or hilly country now than formerly is the solidification of the soil by the trampling of stock, more especially sheep. In Western Queensland, or any new country, before being stocked, the surface was soft and spongy, and a large part of the rainfall sank directly into the soil. Now, when trodden down and hardened by stock, the water more readily runs off, and so tends to form

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* Letter to *Sydney Morning Herald*, 31st December, 1898. See also Hazon.

† I have dealt with the subject of natural forest growths appearing without human agency in my Presidential Address, *Proc. Linn. Soc. N.S.W.*, 1902, p. 785, and would say that we have few data as to the net forest area in New South Wales, showing how forest destruction is balanced against planted and natural growth.

‡ "Ringbarking in Western New South Wales." *Agric. Gazette, N.S.W.*, November, 1894.

creeks and waterholes, which did not formerly exist. The sheep also trod into the damp soil the pine seed which formerly perished on the surface, or was swept into the rivers by heavy rains. Hardening the surface soil will account for the more rapid rise of floods and the greater erosion of river beds.

Mr. R. Wyndham writes*:—

The Hunter River Valley is now, generally speaking, all ringbarked, with the result that now dry creeks are running creeks, and dry gullies have waterholes in them.

. . . . Before the valley was ringbarked the Hunter River was generally a chain of waterholes every summer; now it is always a running stream. I have no fear of ringbarking causing droughts, but I fear it will cause higher floods, as it stands to reason that creeks and gullies full of water cannot carry off the rain that dry creeks and gullies can. . . . To show how trees make the ground dry and hard, I may mention that I once gave a contract for fencing on ringbarked country where I had clumps of trees left for cattle camps. The fence went through one of these clumps, and the ground was so hard that the men had great difficulty in getting down their post-holes.

The writer forgets to point out that cattle make ground very hard around shelter trees through trampling. The tramping of cattle, in its effects of hardening the soil, of forming tracks and incipient water channels, breaking down the banks of watercourses and setting up new conditions, is a most important factor in connection with the conservation of water and the mitigation of floods.

* * * * * * * * *

The questions of ringbarking is a most important one in connection with my subject. I have already referred to it incidentally, and it is worthy of a little more emphasis in this place.

One writer says:—

Squatters know the value of shade too much to carry the practice (of ringbarking) to too great an extent.

Another says:—

The number of persons who give the matter a second thought is very small.

I would ask—How many gentlemen in New South Wales have ever critically supervised ringbarking on their holdings? Is it not usually, "So many acres to ringbark; so much per acre"? Are important details connected with the topography of the land dealt with, or, in many cases, even thought of?

Most thoughtful men are of opinion that additional restrictions should be imposed on ringbarking on Crown lands. Mr. Inspector Forester Manton† speaks very clearly as to the situation in the Murray River district.

I do not oppose ringbarking—it would be absurd to do so—for the effect on the grasses is not open to question, and trees are sometimes killed because they afford shelter for vermin; but I am speaking of careless ringbarking. I repeat, without any fear of effective contradiction, that there is much room for more intelligent control of ringbarking in regard to the following points:—

1. Proper time to minimise suckering.
2. Valuable timber and shade trees should not be unnecessarily sacrificed.
3. The position of a tree with respect to the natural get-away of water in a particular paddock or mountain side should be considered.

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* *Sydney Morning Herald*, 10th January, 1899.

† "Notes on Ringbarking and Sapping, based on Foresters' Reports." *Agric. Gazette, N.S.W.*, January, 1894.

It will be seen that in discussing the subject as to whether the destruction of forests does or does not diminish rainfall, the authors quoted do not always approach the subject in the same way. I proceed to give a quotation from Mr. Ribbentrop, one of the most eminent of living foresters, in which he shows, from his point of view, that it is not incorrect to state that destruction of forests *does* diminish rainfall. At the same time, it will be observed that Mr. Ribbentrop has refused to dissociate from the main question that of the local effects of the forest cover, which he has a perfect right to do. For the purposes of the present essay, I have endeavoured, for the sake of clearness, to enumerate issues somewhat in catalogue form, but that method may have the effect of leading a careless reader to forget that the subject of "rainfall and forests" possesses many ramifications, and a certain amount of repetition in dealing with the subject is unavoidable, and, perhaps, desirable, in order to emphasise various points of view.

There can be no doubt, whatever may be said to the contrary, that the widely-spread notion that forests tend to increase the rainfall, and that in a warm climate the denudation of a country diminishes its moisture, and, consequently, its fertility, is correct. As already pointed out, the theory is proved by history and ruins; and the rapidity with which changes in the climate of different countries have taken place, entirely forbids that such sudden modifications should be ascribed to cosmic causes. We accept other scientific problems on much more flimsy evidence: but, in this instance, a large number of us suddenly swerve aside, and follow a school which starts new theories on partial observations, and leaves re-evaporation out of consideration. Ebermayer found, from experiments made, that during July, the hottest month in Bavaria, only 6 per cent. of the rain which fell percolated 2 feet deep into the ground in the open, against 61 per cent. which filtered down to the same depth in a forest, the ground of which was covered with complete and undisturbed vegetable mould.

In the one case, the water rapidly runs off into streams and seas by sudden floods and freshets, and this, too, when the whole atmosphere is surcharged with moisture. In the other instance, the water is stored for re evaporation through the foliage of the forests, and is given forth at a time when the air is drier and the winds do not blow from the sea. It may be safely stated that more than half the rain which is thus stored in the ground is re evaporated by the trees in time of need.*

3. The Vastness of Rainfall Conditions.

The quotations that I give should need no comment from me; but I would draw the attention to the point that, in Australia, to go no further, the fact that the conditions for a fall of rain may originate in a distant part of our planet is very imperfectly realised. I have travelled much in New South Wales, and I am sure that it would conduce to a better understanding of the subject by our people if they would lay to heart this fundamental and wide-reaching truth:—

When we reflect that our rain storms are of a very wide extent, sometimes over 1,000 miles in diameter, and may take their origin and bring their moisture from distances of 1,000 miles and more, the thought that man, by his puny efforts, may change their action or modify it in any way, seems ridiculous in the extreme.†

Mr. Russell says‡:—

The monsoons make or mar our climate. Given the monsoons full of moisture, and rain falls abundantly all over the State. If the monsoon wind is dry, it is also very strong, sending frequently and persistently strong hot nor'-westers, which bring no moisture, but dry up the country like veritable siroccos. Droughts are the result of special energy generated in equatorial regions, and distributed over the world by the trade winds and monsoons. The source of this energy, he thinks, is outside the earth; but a full knowledge of it will not be obtained until all countries combine to trace the history of these destructive forces.

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* "Forestry in British India," by B. Ribbentrop, C.I.E., 1900, p. 44.
† Hazen, *op. cit.*
‡ Report to Legislative Assembly, 31st November, 1898.

Professor Hazen has some further remarks that are pertinent in this connection; and, as his paper is one of the ablest contributions to the subject that I have read, I would like to again quote him:—

It has been said that where our densest forests are found, that we have the greatest precipitation. There is no way whereby we can see that such forests would have started unless favoured by rainfall, so that the presence of the forest rather indicated the earlier occurrence of practically the same rainfall as at present. Meteorologists are agreed that there has been practically no change in the climate of the world since the earliest mention of such climates. . . . . When we come down to recent times, and to the records of rainfall measured in New England (U.S.A.) for more than one hundred years, or, at least, before and since the forests were cut, we find a constancy in the rainfall which shows its entire independence of man's efforts. Here it should be noted that totally barren lands of any extent—New England, for example—are to be found only in imagination. Even where the forests have been cut away mercilessly there springs up a growth of sprouts which covers the ground, and answers almost the same purpose in causing rainfall (if there is any effect of that kind) as the forests. Even where land is entirely cleared of a forest, we have at times the green pasture, and at others still heavier crops, which leaves the soil anything but a sandy waste.

Professor Harrington, a learned meteorologist, also says:—

The facts to hand do not prove, with entire conviction, that forests increase the rainfall. The historical method is lacking generally in the character of the data for the beginning of the comparison. Besides, where a change of rainfall has been actually shown to be coincident with a change in the forest growth, it is not entirely certain that the former is due to the latter; it may have been due to what are called secular changes of the rainfall, the reasons for which lie beyond our knowledge. The geographical method is not entirely satisfactory, for reasons already mentioned. The entirely convincing method depends on observations above forests, and with systems of radial stations, as proposed by Dr. Lorenz Liburnau; and from these there is not a sufficient amount of published results.

Let me again quote Ribbentrop:—

Forests can have no influence whatever on the amount of moisture drawn from the ocean, and the general direction of the winds is unquestionably governed by greater causes. But, apart from this, periodical rains are subject to the same general laws as all other rains, and must, therefore, be affected by the same causes, and amongst them by extensive forest growth, in exactly the same way and degree. The air may be charged with moisture, which need not, however, be precipitated.*

Let me quote the same author to again emphasise the point that, while it is indubitably true that rainfall conditions mainly originate many—very many—miles from the scene of deposit, it is simply impossible, and, indeed, undesirable, to lose sight of the local contributing effects of forests:—

The climate of each country and of each district is *primâ facie* dependent upon its geographical position, its elevation, the configuration of the ground, and other cosmic causes, which are independent of local circumstances. It can hardly be denied that the existence or non-existence of large well-wooded areas in a country naturally capable of growing forests, affects its climate in a very marked degree. History proves this to us in numerous instances where the deterioration of the climate of whole districts, and even of whole countries, has followed the destruction of forests.†

4. Clouds may strike against Trees, and deposit Moisture.

Trees cause a distribution of moisture from clouds where bare surfaces do not cause precipitation, but allow the clouds to roll on. A single large tree may mechanically hold, for a considerable time, a large quantity of water; and if this be multiplied indefinitely, as in a forest, an enormous quantity of water will be held or retarded. The effect of transpiration will be dealt with below.

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* *Op. cit.*, p. 45. † *Ib.*, p. 40.

The following statement may be literally true, although the regularity of movement of the cloud referred to is remarkable; and with the size of the tree and the quantity of water rendered available we have nothing to do.

In an old work, mention is made of a celebrated tree in Ferro, which is said to have furnished drinkable water to the inhabitants of the island. According to the statement, every morning the sea breeze drove a cloud towards the wonderful tree, which attracted it to its huge top, and the water flowing from its foliage uninterruptedly, drop by drop, was collected in cisterns.*

Mr. J. Burtt Davy† speaks of the heavy summer sea-fogs, drifting high overhead across the narrow stretch of bluff land, which are intercepted in their course by the trees on the summits of the ridges; or, when they lie low, roll along the broad river valleys and more numerous canyons opening into the redwood forests, saturating the tree tops, and by their means also the soil below, with abundant moisture.

I again quote Professor Hazen :—

There is a class of visual observations which seem to show an effect upon rainfall by the forest. Probably many have seen heavy clouds pass over a plain, but which only precipitated as they passed over a forest ; also, in a hilly region, it is a frequent phenomenon that fog and low-lying clouds hover near a forest, and not over an open plain. One also notes very often, in passing into a forest on a damp day, that the trees drip moisture, possibly condensed from the moisture evaporated from the damp earth underneath. Observations of this nature, however, cannot ordinarily be checked by instrumental means, but show in a general way that the forest tends to conserve moisture and vapour, which, in the case of the open field, would be diffused into the atmosphere.

I quote another American author :—

An illustration of the effect of trees on moisture condensation can be seen at and around Santa Monica. All along the nine miles of country roads planted with shade trees by me, an investigator can now see green grass and verdure. Nowhere else on these plains is there anything green. The difference is due to the condensation by the trees of the evening fogs along the coast. When such occur, the trees dry the air and moisten the soil. There is a regular drip of water from the foliage, and the seeds of the grasses and flowers have germinated and grown. The trees and brush on the mountain do the same thing. Anyone who has tramped through the brush on a foggy morning, or after clouds have rested on the mountains, knows that the condensed moisture on the chaparral‡ will wet him more thoroughly than a sharp rain.§

It does not rain all along the coast of Peru, for, say, 50 miles inland, from 28 degrees S. to the equator, yet, during the months of May, June, July, August, September, every day, at 2 p.m. or thereabouts, there commences to fall a very heavy mist, wetting one through, if exposed to it, in a very short time. During those months all the sandy wastes are covered with a brilliant vegetation of flowers of various sorts. At the same time, these plains are covered with sheep, goats, cows, llamas, alpacas, mares, &c. No running streams of water are necessary, sufficient moisture being contained in the mists settling on the plants and flowers. The cattle and all the animals get fat during their stay on the "Lomas," as they are called. I was indebted to the late Mr. Charles Ledger, of "Cinchona Ledgeriana" fame, for the above particulars. He was long resident in Peru.

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* J. Croumbie Brown, *op. cit.*, p. 31.

† "Stock-ranges of North-western California." Bulletin No. 12, U.S. Department of Agriculture.

‡ Chaparral is the Spanish word for a thicket of low scrubs, and was used by the Spanish-Californians to designate the thickets of scrub-oak (*Quercus dumosa*) which are so noticeable a feature in the rocky ridges of this region. It is now applied promiscuously to any dense brush of prickly or rigid shrubs growing on similar situations, as well as to the individual species of which the mass is composed.—"Stock-ranges of North-western California," J. B. Davy, p. 31.

§ "Forestry in California," by Abbot Kinney.

The deposition of moisture by means of trees is familiar to many of us in New South Wales. We have observed it in the forests covering the coastal escarpment; while the dripping of the trees from the "mountain mist" is a phenomenon very familiar to visitors to such of our mountain districts as are forest-covered.

I again quote Ribbentrop, even at the risk of some repetition, but I desire, most earnestly, to emphasise the point that forests *conserve* rainfall.

"The amount of rain depends on the extent of oceans and seas, on the degree of heat, and on the rapidity with which the air moves over the surface of the waters. None of these conditions are changed (he writes) by the extent or absence of forests. All air-currents blowing from the sea, are, year by year, charged with the same amount of moisture, which precipitates as soon as the air is cooled below the point of saturation. If such precipitation be caused by forests, the air-currents reach the regions behind these forests drier and unable to yield a further supply of water."

"It is thus Oskar Peschel teaches in his well-known work *Neue Probleme der vergleichenden Erdkunde*; but he entirely omits from his calculation re-evaporation of moisture precipitated on the land, and his conclusions cannot, consequently, be accepted. A well-wooded forest area may be compared to a landlord who spends his income derived from the country within it, and for the benefit of his neighbours; whereas, cleared areas resemble absentee proprietors who scatter their revenues in foreign parts. It rains: the drops are scattered on the leaves, and fall in a soft gentle spray or in slow-falling big drops, which have collected on the foliage, on to the spongy forest ground. The water has thus time to percolate slowly into the soil below, whence a large quantity is gradually pumped up again through the roots of the forest trees, exhaled by their leaves, and again assists in forming rain-clouds. Wooded areas, no doubt, extract, under the same circumstances, more moisture out of the air than disforested regions; but they serve as a storehouse, and yield again what they take; whereas a great portion of the water precipitated on barren soil is only recovered by evaporation from rivers, lakes, and oceans. Forests use, therefore, much less moisture than barren areas in the same position and under similar conditions, and augment the atmospheric moisture in regard to regions which are separated by such forests from the sea, instead of diminishing it. Their action in this respect is not the same as that of an intervening mountain range."*

5. Not Merely a Question of Large Trees.

When one speaks of the effects of the destruction of vegetation on the climate, it is a common error to assume that trees (forest trees) are alone referred to. As far as the western country is concerned, the number of trees available for ringbarking has at all times been insignificant in comparison with the coastal

* *Op. cit.*, p. 41.

country and Dividing Range; in other words, they were not there to ringbark. But there has been much vegetation of a smaller kind, and it is believed by many that the eating-out and burning over of much of this vegetation is responsible to some extent for the changed condition of the western country to-day.

The problem for New South Wales is to make the very best use of the water we receive, to keep it as long as we possibly can, and the encouragement of vegetable growth is a factor which tends to enable us to do this.

The main forest covering of the mountains of Southern California consists of chaparral and brush. This covering holds the soil on the steep mountain sides, and detains the rainfall delivery, so that time is given for it to precolate into the water-veins and natural reservoirs. Where these water-sheds are burned over, the importance of the forest covering is at once demonstrated. In such districts the destructive force of the floods increase . . . . The rainfall is thus suddenly delivered to the injury of all. On the other hand, the perennial charaeter of springs and streams is diminished or destroyed . . . . When the forest is gone on these steep sierras, floods and torrents alternate with wide and arid wastes of waterless torrent beds.*

6. Rainfall Measurements in Forests and open Country.

We have large areas in this and neighbouring colonies where the forest is so thick that it will not pay to clear it away. Yet these very rain traps secure no more than the bare country, as I know by actual experiment carried on in one forest for a number of years, and in the dry time they suffer from drought just as the bare country does.†

But the strongest argument adduced in the past to show the influence of forest on rainfall has existed is a comparison between rain-gauge measures in the forest and in the open field. Such records have been made for more than thirty years in France and Germany, and surely we must have here, if anywhere, a sufficient proof of a forest's influence.

Admitting that we have perfect instruments and careful observers, there still remains a most serious doubt as to the immediate environment of each gauge, and as to the possibility of a direct comparison. It is probable that no two gauges 2,000 feet apart can be placed so as to catch the same amount of rain, though to all appearances the exposure is faultless in each case ‡

Extreme caution is, therefore, needed in interpreting rainfall records in forests. We have also evidence of the partiality of rain showers on similar surfaces—*e.g.*, it sometimes rains in one paddock and not in an adjacent one. Professor Hazen gives instances of accurate records in forests and adjacent country by meteorologists, both in France and Germany, and shows the inconclusiveness of the results. Croumbie Brown, in his "Forests and Rainfall," also gives a full account of these researches, which cannot be further alluded to in detail here.

Let me, however, point out that the humidity of a forest is not entirely a matter of rain-gauge measurements. I think, in order to thoroughly test this aspect of the question, the hygrometric state of the atmosphere in various places, whether carrying forests or other vegetation, and whether denuded by the hand of man or not, should be ascertained and compared for a series of years. The districts should be as numerous as possible, but we should not limit the observations to rain which can be measured in a rain-gauge. It will be found that much of the moisture which goes to assist plant growth and to modify climate is not measured by such a crude instrument as that referred to.

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* Abbot Kinney, *op. cit.* See also article IX of my Forestry series, *Agric. Gazette*, N.S.W., June, 1905.
† Mr. H. C. Russell, *Sydney Morning Herald*, 1st December, 1898.
‡ Professor H. A. Hazen, *op. cit.*

Those who desire further information on the subject are recommended to read the chapter "Rainfall in, above, and near Forests," by M. W. Harrington, at page 106 of the work "Forest Influences," already quoted.

7. Physiological Action of Trees—Transpiration.

Another phase of the conservation of water by trees is the question of transpiration. This is the technical word for what may be described as the perspiration of plants. The tree absorbs moisture by its roots, which is utilised to continue the functions of the plant, and a portion of it is exhaled in the form of vapour by each leaf, and passes into the atmosphere. The effect of a single tree is a very large multiple of that of a single leaf, and that of a forest is similarly greater than that of a single tree. This emission of vapour by plants is more or less fully dealt with in all works on vegetable physiology. In this way a forest has an appreciable effect on the humidity of the atmosphere, and this is one of the reasons why, on the ground of transpiration alone, the atmosphere of a forest is moister than that immediately above the surrounding land, and it is desirable to conserve the forest growth on that account.

Botanists have made many measurements of its amount, and their results are extremely varied, due partly to the fact that this function varies much naturally, and still more to the fact that experiments are generally made under conditions which are not natural to the plant. Sachs says that it is no rarity for a tolerably vigorous tobacco-plant at the time of flowering, or a sunflower the height of a man, or a gourd-plant with from fifteen to twenty large leaves, to transpire from 1 to 2 pints of water on a warm summer day; and so far as may be judged by the use of branches with the cut end in water, it may be believed that large fruit-trees, oaks or poplars, absorb, transport through their stems, and transpire through their leaves, 10 to 20 or more gallons of water daily. It is not generally practicable to compare the transpiration with known meteorological phenomena, such as evaporation from a water surface, or from the soil, or the precipitation, but some such comparisons have been made. For instance, comparing the leaf surface to an equivalent water surface, Unger makes transpiration from the former 0·33 of the evaporation from the latter; Sachs, for white poplar, 0·36, the sunflower 0·42. Comparisons have also been made between the transpiration from plants and from the evaporation from the surface over which the plants stand. Schleiden thought that the transpiration from the forest was three times that of the water surface equal to the territory covered by the forest; Schübler thought it only a quarter; and Pfaff, who studied a solitary oak in a garden, found that it varied from 0·87 to 1·58. Comparing the transpiration of plants with the evaporation of the bare soil which would be covered by them, Hartig thought the transpiration of a forest less, Schübler found it 0·6 for the forest and 3·0 to 5·0 for the sod. Marie-Davy found it for firs 1·18, for beeches 1·32, for sod 1·86.

The quantity of water so used is as variable as the amount of precipitation, and, in fact, within certain limits depends largely upon it. That is to say, a plant will transpire in proportion to the amount of water which is at its disposal. Transpiration is also dependent on the stage of development of the plant, on the nature of its leaves, and the amount of its foliage, on temperature, humidity, and circulation of the air, on the intensity of the sunlight, and on temperature and structure of the soil and other meteorological conditions. Rain and dew reduce the transpiration, wind increases it. The amount of transpiration depends considerably on the thickness of the leaves, therefore the surface of the foliage is not a reliable measure, but should be compared with the weight. With so many factors to vary them, the values which may be given for the amount of transpiration of various kinds of trees can only be approximations of its range within wide limits. (Harrington, *op. cit.*)

All vegetation takes up a certain amount of water, a part of which is consumed in building up its body, and a still larger part returned to the atmosphere by transpiration during the growth.

The factor of dissipation having being fully discussed, it need not be further considered here, except to recall the conclusion that forest growth transpires considerably less than other kinds of vegetation.

Since this water is given off again to the atmosphere in the locality where it has fallen—thus enriching the atmospheric moisture—and is, therefore, only diverted temporarily for the purpose of doing duty in producing useful substance and retaining it in the locality where it has fallen for a longer time, transpiration may even be considered as an element of conservation.

There is still to be considered a certain amount of moisture which is retained and stored up in the body of the plant, partly as a necessary permanent constituent, partly as a temporary constituent, being evaporated when the plant dies or the wood is seasoned. The amounts thus retained vary considerably according to age, capacity for transpiration, site, soil, climate, density, slow or rapid growth, weather, seasons, and even the time of day. It is, therefore, almost impossible to give anything but very rough approximations, especially as also the different parts of the tree vary considerably in the amounts of water present. (Fernow, *op. cit.*)

8. Some Uses of Forests.

(*a*) *To temper Floods.*

I will deal with this subject in another paper, on "The Mitigation of Floods by Forestry Operations," hence I propose to give more cursory treatment in this place than its importance demands. I think very few men will dispute the use of forests in mitigating the effects of downpours of rain in regard to the flow of watercourses.

The effects of forests in retarding the flow of the rainfall after its precipitation has been established, I consider, beyond all question.*

Already the rivers that rise in those regions (Northern United States) flow with diminished currents in dry seasons, and with augmented volumes of water after heavy rains. They bring down larger quantities of sediment, and the increasing obstructions to the navigation of the Hudson, which are extending themselves down the channel in proportion as the fields are encroaching on the forests, give good grounds for the fear of irreparable injury to the commerce of the important towns on the upper waters of that river; unless measures are taken to prevent the expansion of the improvements, which have already been carried beyond the limits of a wise economy.†

Professor Fernow says :—

The present policy of forest destruction and of allowing our waters to run to waste, not only entails the loss of their beneficial action upon plant production, but permits them to injure crops, to wash the fertile mould from the soil, and even to erase and carry away the soil itself.

And again :—

Here the comparative lengths of the affluents alone may become all important, since the simultaneous or non-simultaneous arrival of flood-waters may determine the occurrence or non-occurrence of floods. As far as the forest cover is concerned in such cases, deforestation in one side of the valleys and consequent rapid discharge, may become an advantage for the water to flow in the main river, by allowing its removal before the arrival of the flood-waters of another affluent. In view of these considerations it would, therefore, be folly to assign to the conditions of the forest cover in the catchment basins an all-determinative function. Nevertheless, in general, the influence of favourable forest conditions in the catchment basin upon river flow cannot be doubted, although it may become practically of no account in abnormal floods. . . . In the torrent of Bourget, which had been reforested and corrected in its bed, a simple, somewhat turbulent run of water was observed, which at the overflow reached the height of 45 centimetres (18 inches), and lasted about three hours.

The report thus continues :—

The facts show the importance of the forest cover. Thanks to the dense growth planted, the flood-waters, divided in numberless runs and retarded constantly in their movement over the declivities in the upper basin, arrive only successively and little by little in the main bed, instead of these formidable masses of water and *débris* which, rapidly agglomerated, rush into the channel; the brooks called to replace the torrent receive only pure water; flood-waters flowing off gradually and made harmless by the regulation of the torrent bed and of the slopes.

Let me make three quotations from Ribbentrop :—

The Ratnagiri District, in the Bombay Presidency, is almost bare up to the crest of the Ghâts, and here, Sir Dietrich Brandis says, the effects of denudation have shown themselves in this way :—

There are four principal streams in the district, which, rising in the Ghât mountains, run a short course to the sea, all of which were formerly navigable and important for the trade of the country. For small boats they are still navigable, but they are gradually silting-up, because the hills at their head-waters have become denuded of forests.‡

The denudation of the Deccan highlands and the Eastern Ghâts has resulted in the gradual silting-up of rivers. When the English, French, and Dutch first made settlements on the Coromandel Coast, they were able to take ships up the rivers Godavari and Kistna. Narasapur (English) and Yanaon (French), on the Godavari, though now only approachable by small native crafts at high tide, were once the chief ports for that part of the coast. At Masulipatam, the Dutch ships used to come close up to the fort, but now even native vessels of small draught have to anchor 5 miles out in the roads.§

The periodically recurring breaches in the railway embankments, especially those of July, 1866, are, there is good reason to believe, due to the denudation of the Sewaliks and other sub-Himalayan hills.‖

I do not know to what extent the silting-up of our rivers, owing to the washing away of the soil on their banks and on higher levels, has been studied in New South Wales, but undoubtedly it is a subject worthy of the attention of our best intellects.

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* J. Croumbie Brown, *op. cit.* † Peppercorne, *op. cit.* ‡ *Op. cit.*, p. 52. § *Op. cit.*, p. 52. ‖ *Op. cit.*, p. 54.

Take the case of the Hawkesbury River, which comes to my mind as I write. Everyone knows that in the "early days" this river was navigable as far as Windsor for fairly large craft, but the navigation of the river to any but the smallest boats has long been impossible. Why? Simply because the river has silted-up. What has caused the silting? In my view, the indiscriminate cutting down of the forests in the watershed of the Hawkesbury, and the cultivation of the land too close to the banks of the Hawkesbury and its tributary streams. The quantity of silt that comes down the river, even by a "fresh," is surprising. Much of this is deposited in the bed of the river, and does not pass out to sea. The same remarks apply to the Hunter and other rivers. I am fully aware that much of this cutting down of forests and cultivation are quite unavoidable; but I also assert, without fear of effective contradiction, that much of this cutting down of trees and clearing away of vegetation, and also this greedy cultivation of land towards the margin of streams and in the line of washaways, is the result of cupidity and ignorance, and must result in national impoverishment as certainly as the night follows the day.

In 1905 a meeting of the International Navigation Congress was held at Milan, Italy.

One of the questions taken into consideration was "the influence which the destruction of forests and desiccation of marshes has upon the *régime* and discharge of rivers," and seven papers bearing upon the subject were read and discussed. Of these, three were from Austria, and the others from Germany, France, and Russia. The problem as to the effect of forests on the water supply of rivers and of climate is of great social importance, on account of the agricultural and commercial interests which are so closely connected with the use of timber, and with the utilisation of running water. It is allowed by all the authors of these papers that, due to the improvident way in which the forests have been dealt with, there has been marked change in the water supply of the neighbouring rivers; that where forests have been cut down brooks have disappeared, and many small rivers that at one time were useful as sources of power are so no longer for want of water; that in the larger rivers torrents have become more impetuous and flooding more frequent, while, on the other hand, navigation suffers at times for want of water.

The greatest harm has been done in the mountain districts, where the steep slopes allow the rain-water to run off too rapidly, carrying away the surface soil and transporting pebbles and boulders into the rivers, causing shoals, and thus decreasing their capacity to discharge the flood-water. The extent to which forests, both on the Continent and in America, are being cut down and destroyed, and large areas of land, which at one time were covered with primæval forest, have become barren waste by fire or the lumberman's axe, without any attempt at reafforestation, was one of the subjects dealt with in the presidential address of Mr. J. C. Hawkshaw, at the Institute of Civil Engineers, in 1902. . . . .

The question for consideration at the Congress was whether the wholesale destruction of forest land for cultivation or for timber supply is having any material effect on the rainfall and consequent water supply; and the effect of forest destruction on the rivers of the country from which the trees are removed was also considered. The physical conditions of forest land are that, owing to the shelter from sun and wind, the atmosphere is generally colder and damper than in the open country, and evaporation consequently less. It is calculated that a hectare of forest land (2½ acres) gives off every day 37 cubic metres of oxygen and 37 metres of carbonic acid, leading to a great expenditure of heat; and that from every hectare of forest land sufficient heat is abstracted to melt 316 cubic metres of ice. Ligneous plants also withdraw from the ground and discharge as vapour more than 40,000 gallons of water per hectare per day, which causes a sensible reduction of temperature. When clouds pass over a forest they encounter a cool, damp atmosphere, the point of saturation comes closer, and rain is caused. This condition of forest land has been remarked on by aeronauts, who find that a balloon is invariably affected, and drops when passing over forests. . . . .

On the other hand, it has been contended by some of those who have made a study of sylviculture that forests do not increase the quantity of water flowing to the springs and rivers, but reduce it. The numerous striking facts quoted do not bear out this contention, which is mainly based on the fact that the

substratum water stands at a lower level on forest land than on the adjacent cleared ground. The fact is generally to be admitted to be the case at one period of the year. As the result of many years' observations, it has been found that the maximum level of underground water is reached in May, that the water accumulates in the ground from August to January, and that the rivers are supplied by this reserve; and were it not for this accumulation many brooks and river feeders would cease to flow in summer.

Several very striking examples are given by the authors of the papers as to the deleterious effect of cutting down forests, especially in hilly districts. In the commune of La Bruguière the forests on the slopes of the Black Mountain were cut down; the consequence of this removal of the trees was that a brook which ran at the foot, and the water from which was used for driving some fulling-mills, became so dried up in summer as no longer to be of any use, while in winter the sudden floods caused very great damage in the valley. The forests were replanted, and as the trees grew up the water coming to the brook was so regulated as to serve its former useful purpose in driving the mills, and the torrents were moderated. Several other examples of a similar character are given. In Switzerland, amongst other examples, is quoted one that occurred in the canton of Berne, where, owing to the replanting of the mountain side with fir-trees, the water again appeared at a spring which had ceased to flow. After a period the trees were cut down, and the land converted into pasturage, since when the spring has almost disappeared, only opening out at occasional intervals.

In the Kazan district of Russia, once celebrated for its forests of oaks and linden, which are now nearly all cut down, there were formerly seventy water-mills, constantly at work. Less than half now can be worked, and even they only run half-time, and are idle in summer for want of water, while in winter the little rivers that worked these mills are converted into impetuous torrents, breaking up the mill dams, and doing other damage. These abandoned water-mills stand out as a standing proof of the consequences of the destruction of forests. In Sardinia, where the surface consists of plutonic rocks, with a thin layer of earth, all the streams have a rapid slope. The woods, which occupied in 1870 an area of more than two-and-a-half million acres, or about 43 per cent. of the whole surface of the island, now are reduced to about one-sixteenth of this area. Since the removal of the trees, the floods in the rivers rise with a rapidity and flow with a velocity never known before, and a great number of bridges have been destroyed by the floods. The beds of the channels have been raised in some places above the surface of the land, owing to the detritus brought down in floods.

In Wisconsin, U.S.A., the settlers cut down the forests, and converted the land into tillage and pasture. During a period of about seventy years nearly the whole of the forest land was thus cleared, with the result that, as the forest disappeared, the water in the river became lower. Finally, 30 miles of the channel entirely dried up, and many water-mills that were formerly worked by the stream are now deserted and useless, owing to the want of water to run them. In Sicily, owing to the cutting down of the forests on a vast scale in the province of Messina, the bed of the river has been raised by the stones and earth carried down by the torrents so as to stop all drainage from the land, and great damage has been done by the floods. Several other examples are given to the same effect where forests have been cleared in the same district; and these are compared with other streams where the forests still exist, and their condition remains unaltered. In the former case, land-slides from the mountains have become very frequent.*

(*b*) *To conserve Springs, and to aid in the more even distribution of Terrestrial Waters.*

These subjects are intimately associated with the preceding, the necessity for the tempering of the floods being only an extreme case of the conservation and distribution of water.

Under the forest shade, the soil is in a state of perpetual increment from the humus afforded by decaying foliage, and trunks and roots hold it together; the branches break the violence of the rainfall; the spongy absorbent nature of the soil enables it to retain it; and this, slowly sinking into the underlying rock, preserves the needful moisture in the soil, and becomes the source of perennial springs. But if such a mountain forest be suddenly laid low, we have not only to fear the appearance of an undergrowth prejudicial to tree reproduction, but we have to fear the total loss of the soil, which exposed to the violence of the falling rain and no longer held together by the tree-roots, gets washed down into the valley below, until the bared subsoil or rock is unfitted for the support of any but the scantiest herbage.†

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* *Agric. Journal, Cape of Good Hope*, May, 1906, pp. 613-615. † Amery, "Notes on Forestry," p. 12.

And again :—

It has been well established that forests have a most important bearing upon the conservation of rainfall; that the forest floor permits a seepage of water to the source of springs, and thus maintains their steady flow; that they hold back the precipitation that falls, especially in the form of snow, thus preventing or ameliorating the effects of dangerous freshets. There is not the slightest doubt of their great importance to the welfare of man, but all these facts do not affect the question of their influence upon precipitation.* Two years' observations are insufficient to show any definite variation in the annual average of the quantity of rain. But, so far as they go, they show that at Marmato the mass of running water had diminished in spite of the larger quantity of rain which fell. It is, therefore, probable that local clearings of forest land, even of very moderate extent, cause springs and rivulets to shrink, and even to disappear, without the effect being ascribable to any diminution in the amount of rain that falls.†

It is an almost universal and, I believe, well-founded opinion, that the protection afforded by the forest against the escape of moisture from its soil by superficial flow and evaporation, ensures the permanence and regularity of natural springs, not only within the limits of the woods, but at some distance beyond its borders, and thus contributes to the supply of an element essential to both animal and vegetable life. As the forests are destroyed, the springs which flowed from the woods, and, consequently, the greater watercourses fed by them, diminish both in number and volume.‡

Some other references to various authorities incidentally touch upon the effects of forests on the flow of springs.

I will take further examples in our own State, quoting some that are of especial interest to us at this time, because they are on the catchment area of the Sydney Water Supply. There are places on slopes, *e.g.*, at Cordeaux River and East Kangaloon (*e.g.*, the properties of Messrs. Brooker and Kirkland), in which there were intermittently dry creek-beds before the arrival of the white man. Since the felling of trees has taken place from the vicinity of the creek bed, a permanent water supply has resulted. In fact, in one case in which there was no creek at all within human knowledge, the selector has had to provide himself with a small bridge. (I have referred to this already in connection with the statements of Mr. R. Wyndham, and others.)

Again, the Cataract River rises on Mount Keira in densely timbered country—the Coast Range, where there is a rainfall of (say) 60 inches—yet this is an intermittent stream. On the other hand, the Cordeaux River, which rises at the back of Mount Kembla, further south, is more sparsely timbered, and has been cleared up to nearly the head of the river, yet it never ceases to flow. It is also in country with less average rainfall than the preceding.

Mr. Harris, the Ranger of the Catchment Area, informed me that there are two tributaries running into the Cordeaux River on its left bank, viz., Sandy Creek and Wattle Creek. The former, perhaps, drains a larger area than the latter. Sandy Creek is well timbered; Wattle Creek is sparsely timbered. During the drought of (say) 1900–2 Sandy Creek ceased to flow, while Wattle Creek was still running. He is emphatic in attributing this increased flow to the denudation of the timber, stating that the trees transpire or absorb the water which is dissipated into the atmosphere.

I have found that a spring in the parish of Dulladerry, about 2 miles from Meramburn Railway Station, went dry during the drought of 1884, but has given no indication of failure during the recent

* H. A. Hazen, *op. cit.* † Boussingault, quoted by J. Croumbie Brown, *op. cit.* ‡ J. Croumbie Brown, *op. cit.*, p. 167.

dry weather. Since 1884 the country from whence it derives its waters has been ringbarked. Observant, practical men asserted several years since that the spring would not go dry, as the basin of the creek in which the creek is situated is ringbarked. Their prediction has proved true.*

In this case it may have been that the absorption and transpiration of the water by the trees is greater than by the grass, which increased in the ringbarked country. It seems like an argument in favour of cutting down forest trees to improve the moisture conditions of the country. Or it may have been that the rain ran off this particular area of country as a forest, or scattered forest, more rapidly than when the surface was covered with grass. The question of conservation of moisture is many sided, and must be considered in all its bearings in order to form just conclusions.

To say that the regular and permanent flow of the streams is owing to the felling of trees is easy, but to explain the causes is difficult. I have already stated that the natural forest growth retards the flow of the water, and hence tempers floods. The continued cutting of trees may cause the flow to be regular under normal (*i.e.*, non-flood) conditions. What is the cause? Is it transpiration? I think there is still much room for research on the subject, for some of the statements appear to be absolutely contradictory at first sight.

We have very few data of practical value not only in regard to transpiration but also in regard to absorption. We have many laboratory results, but these inductively applied to a congeries of roots, or a congeries of leaves forming a forest, produce in many cases absurd results. For example, we have results when worked out which show that a gum-tree absorbs and transpires incredible quantities of moisture, figures which literally make one's mouth water in this thirsty land.

Professor Fernow gives a remarkable illustration of the difficulties that surround attempts at quantitative determinations of hydrographic investigations of a watershed. For example, the amount of annual discharge of the River Rhone corresponds to a rainfall of 44 inches over the watershed, while the rainfall records themselves for a certain period give a precipitation of only 27·6 inches. Truly meteorological and kindred data require to be interpreted by experts. Professor Fernow makes the suggestive statement:—

> The water capital of the earth consists of two parts, the fixed capital and the circulating capital. The first is represented not only in the waters of the earth, but also in the amount of water which remains suspended in the atmosphere, being part of the original atmospheric water masses which, after the rest had fallen to the cooled earth, remained suspended and is never precipitated. The circulating water capital is that part which is evaporated from water surfaces, from the soil, from vegetation, and which, after being temporarily held by the atmosphere in quantities locally varying according to the variations in temperature, is returned again to the earth by precipitation in rain, snow, and dew. There it is evaporated again either immediately or after having percolated through the soil and been retained for a shorter or longer time before being returned to the surface, or, without such percolation, it runs through open channels to the rivers and seas, continually returning in part into the atmosphere by evaporation. Practically, then, the total amount of water capital remains constant; only one part of it—the circulating capital—changes in varying quantities its location, and is of interest to us more with reference to its local distribution and the channels by which it becomes available for human use and vegetation than with reference to its practically unchanged total quantity.

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* Mr. James Anderson in *Sydney Morning Herald*, 10th January, 1889.

Reference may be made to a paper, "The Relation of Forests to Stream Flow," by James W. Toumey, in the Year Book of the U.S. Department of Agriculture for 1903, p. 279.

(c) *The Relation of Forests and Snow.*

This subject is not of such importance to Australia as to many other countries, but we have extensive areas over which snow falls more or less, while we have heavy falls in south-eastern New South Wales, north-eastern Victoria, and in Tasmania.

In Bulletin No. 55 of the Agricultural Experiment Station of the Agricultural College of Colorado, under the subject of "Forests and Snow," Mr. L. G. Carpenter arrives at the following conclusions on the subject :—

CONCLUSIONS.

1. The mountain streams in the early irrigation season are largely supplied by melting snow.
2. There is a marked diurnal fluctuation, greater with high water than with low, due to the daily variation in the rate of melting.
3. The stream at high water may be one-half greater than at low water on the same day.
4. Cloudy weather in the mountains, protecting the snow from the radiation of the sun, causes the fluctuation to disappear and the flow to decrease.
5. This decrease is so great that the cloudiness associated with continued rain usually more than counterbalances the gain from the rain.
6. The loss of snow by evaporation is considerable, especially when exposed to winds.
7. Snow remains in the timber and in protected spots much longer than where exposed.
8. This is due not so much to drifting as to shelter from the radiation afforded by the forest cover.
9. Hence, the greater amount of forest cover, the less violent the daily fluctuation, the more uniform the flow throughout the day and throughout the season, and the later the stream maintains its flow.
10. The loss of the forest cover means more violent fluctuation during the day, greater difficulty in regulating the head-gates and keeping a uniform flow in ditches, and hence an additional difficulty in the economic distribution of water. Also, the water runs off sooner, hence the streams drop earlier in the summer, and, on account of the lessening of the springs, the smaller is the winter flow.
11. The preservation of the forest is an absolute necessity for the interest of irrigated agriculture.

(d) *To prevent evaporation of water.*

In the Journal of the Royal Agricultural Society, New Series, vol. ii, page 110, there is a statement by Mr. R. Orlebar, of Wellingborough, on the advantage of planting trees around ponds, in which he says :—

> It is astonishing what effect a little shade has in checking evaporation. A pond that is well shaded will hold water for weeks after one of equal dimensions, but lacking shade, will become dry.*

This is a matter of considerable importance to us, as in most parts of the country the conservation of water is the first consideration. Officers having control of roads are usually very particular, where the road is at all damp, to cut down the trees by the side of it, in order that the sun and wind may play upon the road and dry it up. It is quite true that trees by the side of water absorb some of it during the process of growth and emit it into the atmosphere by the process of transpiration,

* Brown, *op. cit.*, p. 55.

as I have already stated, but as a very general rule, it would effect economy in water if dams and other receptacles for water were surrounded by a thick belt of trees. The question of diminution of evaporation should always be considered in cutting down trees from the vicinity of any stagnant or flowing water in this country.

The matter of shade is stated in another way when we draw attention to the fact that clumps of trees or forests prevent desiccation of the ground—the forest floor.

(*e*) *To give shelter for stock, crops, &c.*

This is a mechanical action of forests, and their value in that respect is so evident as not to be open to argument.

Professor M. W. Harrington (*op. cit.*, pages 23–4) says that the forest is to be considered, in its effects on climate and weather, as a special form of surface covering. Its effects are of the same order as those produced by a covering of sand, or sod, or water, but the forest effect has some peculiar features which are due to the fact that the covering is elevated to some extent above the soil. This imparts to the soil in some degree the climatic characteristics due to a topographical elevation, and also causes a series of wind-break effects which are not found with the other forms of surface covering. On account of this distinctive feature, the problem of forest climatology separates into two problems, which must be considered each by itself. The one relates to the climate of the interior of the forest, and the other to the effects of the forest on the climate of the country around it. The two are quite different; the first is of relatively little importance, except as it relates to the second. It is the second which is of interest and importance, so far as relates to the suitability of a climate for residence and agriculture. The same authority, at page 118 (chapter "Forest, Wind and Storms"), speaks at greater length on the wind-break question.

(*f*) *The leaves of forest trees afford manure and mulch.*

This is less evident in the dry country than in the well-watered coast belt and coastal mountain ranges, and is of less importance in Australia, where trees are mainly non-deciduous as regards their leaves. But the matter is one of extent rather than principle, for we have *débris* of all kinds from living trees, consisting not only of leaves, but of flowers and fruit, limbs and trees, and, as regards our Eucalyptus forests, a large percentage of naturally shed foliaceous bark. All this serves as a manure and mulch to the forest floor, and thus the evaporation of the moisture is diminished.

Mr. Marsh speaks of the ever-renewed and increasing vegetable mould as a perpetual mulch, and in reference to the humidity of forest soil he cites the following passage from "Etudes sur l'Economie Forestière," by Jules Clave :—

> Why go so far for the proof of a phenomenon which is repeated every day under our own eyes, and of which every Parisian may convince himself without venturing beyond the Bois de Bologne, or the forest of Meudon? Let him, after a few rainy days, pass along the Chevreuse Road, which is bordered on the right by the wood and on the left by cultivated fields. The fall of water and the continuance of the rain have been the same on both sides; but the ditch on the side of the forest will remain filled with water,

proceeding from infiltration through the wooded soil, long after the other, contiguous to the open ground, has performed its office of drainage and become dry. The ditch on the left will have discharged in a few hours a quantity of water which the ditch on the right requires several days to receive and carry down to the valley, and, but for this drainage into the ditch, the water might have remained there for an indefinitely longer time.

Speaking of the forest floor, irrespective of a leaf-mulch surface, Professor Harrington quotes Fesca to the effect that the downward movement proceeds quickest in a dry dust, only slowly in clay soils, the same amount of water being drained through the former in one hour which took two days to drain through the latter, and emphasises the point that the service conditions of the soil of a watershed are the only controllable factors in the problem.

The necessity of preserving the dead leaves to form humus should be strongly insisted on. It has been proved by Grandeau and Henry, two of the Nancy professors, that besides serving as food for earth-worms and other organisms, the activity of which keeps the soil porous, friable, and superficially rich in nutritive mineral matter, dead leaves fix atmospheric nitrogen to the extent of 12–20 lb. per acre annually. To deprive a forest of its dead leaves is like robbing a farm of its dung.

It may be argued that evaporation from open ground is much more intense than from soil covered by forests. No doubt this is the case, and Ebermayer, in his "Die Physikalishen Einwirkungen des Waldes auf Luft und Boden," gives the following data:—

The forest alone, without the cover of dead leaves, diminishes the evaporation by 62 per cent., as compared with that in the open. Evaporation is, consequently, 2·6 times less in the forests. A covering of dead leaves and vegetable mould diminishes evaporation by a further 22 per cent.

Forests with an undisturbed covering of dead leaves and vegetable mould lessen the evaporation as compared with that in the open by 84 per cent.

These data are based on observations made in Bavaria during the summer months. In the Indian climate the difference, which increases in proportion to the heat and dryness of the atmosphere, would be even more considerable.*

I now submit the whole subject for consideration of my readers. The matter of forest meteorology, and the questions that crop out of it, present many puzzling problems to us in Australia, and some of them have as yet baffled the meteorologists of long-settled countries. A proper understanding of the principles which underlie the relations of forests and moisture is of interest to us in two special ways: first, as regards the water supply of a large city (Sydney); and, secondly, as regards the distribution and conservation of moisture over the whole of the State. Reasonable expenditure for research would be justifiable, if we could be thereby placed in a position to deal less empirically with the rainfall we receive, and to know how to conserve it more wisely than we do at present. A certain amount of rain falls upon New South Wales. Do we take care that it will do us most good, and remain with us, benefiting us as long as possible? Many public questions that loom large in the public eye should really claim less of our attention than this.

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* Ribbentrop, *op. cit.*, page 43.

116

A Critical Revision of the genus Eucalyptus.*

THIS work is, like the present one, issued in Parts, and each Part also contains four plates (except Part IV, which contains twelve plates). It contains botanical details and critical observations which would be unsuitable for the present work, which is more of a popular character.

Of the New South Wales species of Eucalyptus, the following are dealt with in the "Critical Revision" (the number of the Part of which is given in brackets) :—

Eucalyptus acacioides A. Cunn. (XI).
" *acaciæformis* Deane & Maiden (XXII).
" *acmenioides* Schauer (IX).
" *affinis* Deane and Maiden (XIII).
" *amygdalina* Labillardière (VI).
" *Andrewsi* Maiden (VII).
" *apiculata* Baker and Smith (IX).
" *Baueriana* Schauer (XIII).
" *Behriana* F.v.M. (X).
" *bicolor* A. Cunn. (XI).
" *Boormani* Deane and Maiden (X).
" *Bosistoana* F.v.M. (XI).
" *botryoides* Smith (XXIII).
" *Caleyi* Maiden (X).
" *calycogona* Turczaninow (III).
" *capitellata* Smith (VIII).
" *cinerea* F.v.M. (XXI).
" *Considenіana* Maiden (X).
" *coriacea* A. Cunn. (V).
" *crebra* F.v.M. (XII).
" *dives* Schauer (VII).
" *elæophora* F.v.M. (XIX).
" *eugenioides* Sieber (VIII).
" *fruticetorum* F.v.M. (XI).
" *gigantea* Hook. f. (XX).
" *Gillii*, Maiden (XV).
" *globulus* Labillardière (XVIII).
" *goniocalyx* F.v.M. (XIX).
" *hæmastoma* Smith (X).
" *hemiphloia* F.v.M. (XI).
" *incrassata* Labillardière (IV).
" *leucoxylon* F.v.M. (XII).
" *longifolia* Link and Otto (XX).
" *Luehmanniana* F.v.M. (IX).

Eucalyptus macrorrhyncha F.v.M. (VIII).
" *Maideni* F.v.M. (XVIII).
" *melanophloia* F.v.M. (XII).
" *melliodora* A. Cunn. (XIV).
" *microcorys* F.v.M. (IX).
" *microtheca* F.v.M. (XI).
" *Muelleriana* Howitt (VIII).
" *nitens* Maiden (XIX).
" *obliqua* L'Héritier (II).
" *ochrophloia* F.v.M. (XI).
" *odorata* Behr and Schlecht. (XI).
" *oleosa* F.v.M. (XV).
" *paniculata* Sm. (XIII).
" *pilularis* Sm. (I).
" *piperita* Sm. (X).
" *Planchoniana* F.v.M. (IX).
" *polyanthemos* Schauer (XIII).
" *populifolia* Hooker (X).
" *pulverulenta* Sims (XXI).
" *regnans* F.v.M. (VII).
" *robusta* Smith (XXIII).
" *Rudderi* Maiden (XIII).
" *saligna* Smith (XXIII).
" *siderophloia* Bentham (X).
" *sideroxylon* A. Cunn. (XII).
" *Sieberiana* F.v.M. (X).
" *Smithii* R. T. Baker (XII).
" *squamosa* Deane and Maiden (XVII).
" *stellulata* Sieber (V).
" *umbra* R. T. Baker (IX).
" *uncinata* Turcz. (XIV).
" *virgata* Sieber (IX).
" *vitellina* Naudin (VII).
" *vitrea* R. T. Baker (VII).

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* Quarto. Government Printer, Sydney. Two shillings and sixpence a part (Part IV, Six shillings). Part IV will be charged Two shillings and sixpence to subscribers only. For this work Mr. Maiden has received Eucalyptus specimens from the principal Herbaria throughout the world.

Sydney : William Applegate Gullick, Government Printer.—1914.

No. 206.

Stenocarpus sinuatus Endl.

The Wheel Tree.

(Family PROTEACEÆ.)

Botanical description.—Genus, *Stenocarpus.* (See Part VI, p. 135.)

Botanical description.—Species, *S. sinuatus* Endl., *Gen. Pl. Suppl.* iv, 88 (1847).

A tree, sometimes small and slender, sometimes attaining 60 to 100 feet, glabrous or the inflorescence minutely tomentose.

Leaves petiolate, either undivided oblong-lanceolate and 6 to 8 inches long, or pinnatifid and above 1 foot long, with 1 to 4 oblong lobes on each side, mostly obtuse, quite glabrous but reddish underneath, penniveined and minutely reticulate.

Peduncles terminal, either 2 or more together in a general umbel, or several at some distance forming a short broad raceme, each peduncle 2 to 4 inches long, and bearing an umbel of 12 to 20 bright red flowers, the pedicels about ½ inch long, radiating in a single row round the disc-like dilated summit of the peduncle.

Perianth tube 1 inch long or rather more, straight, tapering upwards, the limb recurved, globular, about 2 lines diameter.

Ovary densely pubescent, on a glabrous stipes, with a rather thick glabrous style.

Ovules 12 to 14. (*B.Fl.* v, 539.)

Endlicher's "description," *loc. cit.* solely consists of the following words :—

Stenocarpus sinuatus Endl., *Stenocarpus Cunninghamii* Hooker, *Bot. Mag.* t. 4263, non R.Br., *Agnostus sinuatus* A. Cunningh. in Loudon *Hort. Brit.* 580. Novâ Hollandiâ orientalis, Moreton Bay.

Botanical Name.—*Stenocarpus,* already explained (see Part VI, p. 136); *sinuatus,* Latin, crooked or bent, referring to the irregular edges (comparable to sinuses or bays of the coast) of the leaves. It is only possible, in the drawing, to give a small indication of the innumerable variations of the margins of the leaves.

Vernacular Names.—Known as "Wheel tree" from the arrangement of the flowers, also "Fire tree," because of their brilliancy.

The users of the latter name must not confuse this tree with the Flame-tree (*Brachychiton acerifolius*) with its numerous thimble-like scarlet flowers. This is also a native tree, but we must not in its turn confuse it with the Coral tree, which is not a native. It has scarlet pea-shaped flowers, is deciduous, and is commonly planted in the coastal districts for shade. Its botanical name is *Erythrina indica.*

In Northern Queensland it is known as "White Silky-oak," from the paleness of its timber, and the late Walter Hill, of Brisbane, called it "Tulip-tree."

Aboriginal Name.—"Yiel-Yiel" of the aborigines of the North Coast o New South Wales. "Yill-gill" or "Yil-Yil" are variants of the above.

Synonyms.—Meissn. in DC. *Prod.* xiv, 451; *Agnostus sinuatus* A. Cunn., in Loud. *Hort. Brit.* 580 (name only). *Stenocarpus Cunninghamii* Hook. *Bot. Mag.* t. 4263 (copied into *Fl. des Serres* iii, 189, t. 7) not of R.Br.; Paxt. *Mag.* xiv, i, with a fig.

This plant is often erroneously sent out as *Stenocarpus Cunninghamii* by nurserymen at the present day, the origin of the name for this particular tree being Hooker's description as above, with a beautiful coloured figure. Hooker did not know that sixteen years previously (*i.e.*, in 1830) Robert Brown had given the name *Stenocarpus Cunninghamii* to a different species from North-west Australia (Vansittart Bay), and which, like the present species, also occurs in Northern Queensland.

Leaves.—They are exceedingly variable in shape, often pinnatifid and sometimes a foot long. Mr. Sydney W. Jackson sent me some as large from Atherton in Northern Queensland, from the play-ground of the "Tooth-billed Bower-bird."

Flowers.—A bunch of flowers of the above, put in a vase and placed indoors, has been found to kill flies in large numbers (W. Baeuerlen).

The arrangement of the flowers affords a good example of what is known as an umbel, *i.e.*, when the individual flowers spring from a common point, like the ribs of an umbrella. The umbels of flowers are about 3 inches in diameter. They are so remarkable as to lend themselves, in a remarkable manner, to the work of the designer.

The following paper is worthy of reference:—Dott. Fl. Tassi: Le Proteaceae, in specie dello *Stenocarpus sinuatus*, Endl: (Studio anatomo-morfologico comparativo.) (*Bull. Lab. ed Orto Botanico di Siena*, Italia.) Anno 1, Fasc. 2-3, p. 67, and also p. 80 (1898). A valuable paper. The following plates refer to *Stenocarpus sinuatus*:—1, 2, 3, 4, 5, 6, 7, 8, 9 (partly).

Timber.—The wood pale-coloured or whitish, nicely marked, and admits of a good polish. Its medullary rays render it an ornamental timber; it is close grained, moderately hard, and durable, and is used for staves and veneers, and is suitable for cabinet-work.

In Northern Queensland it is in places sufficiently abundant to be used for general building purposes, palings, &c.

Size.—It attains a size of 100 feet, with a stem diameter of 3 or 4 feet.

Habitat.—It is recorded in the *Flora Australiensis* from:—

Queensland.—Brisbane River, Moreton Bay (A. Cunningham, W. Hill); Araucaria Ranges (Leichhardt); Queensland Woods, London Exhibition, 1862 (W. Hill, n. 17).



Govt. Printer, photo.

Stenocarpus sinuatus ENDL., BOTANIC GARDENS, SYDNEY.

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M. Flockton, del. et lith.

WHEEL-TREE. (FLOWERS)

(*Stenocarpus sinuatus* ENDL.)



WHEEL-TREE. (FRUITS)

(*Stenocarpus sinuatus* ENDL.)

New South Wales.—Richmond River (C. Moore, Fawcett); Tweed River (C. Moore).

Hooker (quoting Heward) says that Cunningham found this plant on the banks of the Brisbane River in 1828, but he did not name it, as he saw it in leaf only. On this occasion he described a number of novelties, and tradition points to a number of trees in the Botanic Garden, Sydney, which Cunningham brought down on that trip. It is possible, indeed probable, that two of the largest trees of *Stenocarpus sinuatus* in the Botanic Garden form part of this collection. He sent two young plants to Kew at the same time.

In New South Wales it occurs as far south as the Bellinger River, where I have received it from Mr. E. H. F. Swain, from Marx Hill, and also from Mr. G. S. Briner, M.L.A., from a gully. This is the most southerly locality known to me, but it doubtless occurs in the brushes further south.

In Queensland Mr. J. F. Bailey found it on the Barron River, and it is plentiful around Atherton, in the Cairns district.

Propagation.—By seed. The chief use of the tree is for ornament, and a very dignified use too. It will grow well about Sydney and in coast districts considerably south of the metropolis, provided the situation is sheltered. It grows into a small tree, not too big for moderate-sized gardens. Its foliage is handsome, while its flowers are as gorgeous as they are remarkable, the prevailing colours being coral-red and orange. The trees like deep, well-drained soil.

I strongly recommend it to those who desire to cultivate our choicest native trees.

EXPLANATION OF PLATE 210.

A. Flowering twig.
B. Unopened flower.
C. Flower opened out.
D. Pistil showing—
  (*a*) Hypogynous glands, almost obsolete.
  (*b*) Stipitate ovary.
  (*c*) Oblique stigmatic disc.
E. Tip of corolla lobe, showing sessile anther in the concave laminæ.
F. Stigmatic disc.

EXPLANATION OF PLATE 211.

A. Leaves showing variation of form.
B. Fruits. Opening follicles full of winged seeds.
C. Winged seed enclosed in a membranous sheath.
D. Winged seed (*a*), leaving membranous sheath (*b*).
E. Winged seed.

PHOTOGRAPHIC ILLUSTRATION.

Stenocarpus sinuatus. Botanic Gardens, Sydney. (Government Printer, photo.)

No. 207.

Eucalyptus affinis Deane and Maiden.

An Ironbark Box.

(Family MYRTACEÆ.)

Botanical description.— *Genus, Eucalyptus.* (See Part II, p. 33.)

Botanical description.—Species, *E. affinis* Deane and Maiden, in *Proc. Linn. Soc. N.S.W.*, xxv, 104 (1900), with a plate.

A tree of moderate size, attaining a height of 80 feet, and a diameter of 2 feet 6 inches.

Bark.—To quote from a letter by Mr. R. H. Cambage:—" In appearance it looks half Ironbark and half Box, and has strong affinities to both. Often the butt in old trees is nearly as rough as that of *E. sideroxylon*, but seldom quite, while the upper part resembles *E. albens* (*E. hemiphloia* var. *albens*); but in general it has a dark brown, fairly rough bark an inch thick, and is easily distinguished from the other trees. The bark is thinner and softer than *E. sideroxylon*, but harder and thicker than *E. albens*."

Timber.—Of a medium brown colour, inlocked, hard and tough, greasy to the touch, better esteemed locally than the wood of either *E. hemiphloia* or *E. sideroxylon*, among which it grows.

Juvenile leaves.—Alternate, ovate, obtuse, slightly emarginate and mucronate (in our specimens); about 3 inches long by $1\frac{3}{4}$ broad; intramarginal vein at a considerable distance from the edge.

Mature leaves.—Lanceolate, slightly falcate; pale coloured, dull on both sides, rather coriaceous, usually 2 to 3 inches long; veins at an angle of about 30° with the midrib, but inconspicuous except the midrid and the thickened margin; intramarginal vein inconspicuous and at some distance from the edge.

Peduncles axillary, flattened at first, but nearly terete when the fruit is ripe; with three to seven flowers.

Buds.—Shaped like a tip cat, to use a homely expression, *i.e.*, tapered equally towards base and operculum; somewhat angular, the operculum attenuate. Calyx-tube likewise attenuate, tapering into a short pedicel. Anthers in the bud all folded; stamens white, the outer ones seemingly all fertile; anthers opening in terminal pores. Style and stigma as figured at fig. 6, *E. hemiphloia*, in the Eucalyptographia.

Fruits.—Ovate-truncate, tapered at the base, somewhat contracted at the orifice, about 3 lines in diameter, the rim narrow, slightly convex and dark-coloured; the capsule depressed (*loc. cit.*).

It exhibits a good deal of resemblance, so far as herbarium specimens are concerned, to *Eucalyptus Caleyi*, which has been dealt with in Part LV.

E. Caleyi is, however, an Ironbark with red timber. *E. affinis* is an Ironbark Box with a pale brown timber, often with a dash of red in it, which may be assumed to vary according to the preponderance of the Ironbark parent. Further, the colour of a timber varies within certain limits with the age and climatic conditions of the tree.

It has not the egg-in-egg-cup appearance in the bud which is seen in *E. Caleyi.*

Botanical Name.—*Eucalyptus*, already explained (see Part II, p. 34); *affinis*, Latin, related to, because of the close affinity of this species to a White Box (*E. hemiphloia* var. *albens*) and an Ironbark (*E. sideroxylon*), to which it is assumed to be closely related. Ironbarks and Boxes seem to cross with especial facility, although it is proper to point out that the vast majority of trees attributed to such crosses cannot be absolutely proved.

Vernacular Names.—"Tallow Wood" at Murrumbidgerie, owing to the greasy nature of its wood, and "Black Box" at Stuart Town; "White Ironbark" and "Ironbark Box" at Grenfell and above Mt. McDonald, at the junction of the Abercrombie and Lachlan Rivers, according to Mr. Cambage; "Bastard Ironbark" at Minore (J. L. Boorman).

Timber.—Pale brown, hard and interlocked, durable and much prized. The trees are, however, not gregarious, and hence it would be difficult to fill a large trade order for this timber. In consequence, a detailed account of the uses to which this timber has been successfully put, and its characteristics, is not available.

Size.—A medium-sized tree attaining an exceptional height of 80 feet, with a diameter of 2 or 3 feet.

Habitat.—It is confined to New South Wales, and, so far as is known at present, to the table-lands and western slopes.

Following are some localities, and these will be readily added to as soon as the tree is better known by bushmen and the trade.

Between Wellington and Dubbo, towards Molong and Parkes, Grenfell, and other parts of the Western districts. It also occurs near Inverell, and it should be especially looked for in New England and in the Stanthorpe district of Queensland. So far it has only been recorded from New South Wales.

"Tallow tree," Murrumbidgerie, Great Western Railway (Andrew Murphy). Type of the species.

"Bastard Ironbark." "Pretty fairly distributed amongst *E. hemiphloia* and *E. sideroxylon*, to which it appears to bear an affinity. Rough, scaly, hard bark, not corrugated, dark brown. Sapwood yellow, centre red. Bark ribbony two-thirds from the base. Tips of branches of a claret colour. Leaves 'atropurpureus.' The whole tree has a graceful pendulous habit." Stuart Town (J. L. Boorman).

"White Ironbark" or "Ironbark Box." "Seems to be between *E. albens* and *E. sideroxylon*." Grenfell, also Grenfell-road from Cowra, and 17 miles east of Parkes (R. H. Cambage).

"Black Box." "Fine large trees, sparsely scattered amongst the Ironbark (*E. sideroxylon*) and Box (*E. hemiphloia* var. *albens*) of the district. Bark rough, slightly suberous, sapwood thin, with dark hard centre, fine timber for most purposes, being exceptionally tough and heavy." Lue, Mudgee Line (J. L. Boorman).

Inverell District (Forest Guard Gordon Burrow), who writes as follows:—

I am forwarding specimens of bark, wood, twig with buds, and fruit of a tree growing on Forest Reserve 26,227, Parish Cameron, County of Hardinge.

I only know of a few of these trees in this district; they seem to be a hybrid between White Box (*E. hemiphloia* var. *albens*), and Red Ironbark (*E. sideroxylon*). This specimen shows more of the Box than some.

The wood is very hard, and when cut up cannot be distinguished from Ironbark.

There is a rough bark outside the ordinary bark, about 10 to 15 feet up the trunk, which looks like an Ironbark, only much lighter in colour; above that, the ordinary or inner bark looks like Box bark. This tree, like Ironbark, exudes at times a large quantity of kino.

The leaves are more like those of the Ironbark in the locality than those of the Box, though the buds are smaller.

Box in the locality has long finished flowering, but Ironbark, like this hybrid, though long in bud, has not flowered, owing, as I believe, to the late frosts.

I could only secure two very imperfect specimens of fruits.

The wood is a dark red (gets paler on drying.—J.H.M.) almost to the outer edge, particularly towards the butt, where there is only about an inch of white or light sapwood.

The local name is generally "Bastard Ironbark." I have also heard it called "Bibble," and more rarely "Ironbark Box."

EXPLANATION OF PLATE 212.

A. Twig with buds and fruit. From Murrumbidgerie. Type specimen.

B. Sucker-leaves from Stuart Town, Great Western Railway.

C. Juvenile leaf. From Murrumbidgerie.

D. Anthers, varying in shape.



I. Flockton, del et lith.

AN IRONBARK-BOX.

(*Eucalyptus affinis* DEANE AND MAIDEN.)

No. 208.

Acacia longifolia Willd.

Sydney Golden Wattle.

(Family LEGUMINOSÆ: MIMOSÆ.)

Part 1.

Botanical description.—Genus, *Acacia*. (See Part XV, p. 103.)

Botanical description.—Species, *A. longifolia* Willdenow, *Species Plantarum*, iv, 1052 (1805).

Following is the original description:—

"*Acacia longifolia*; inermis, foliis lineari-lanceolatis utrinque angustatis trinerviis striatis, spicis axillaribus geminatis cylindraceis." I have been unable to see the type, and suggest that it was that referred to in the following paragraph, to which the name *longifolia* would be specially appropriate.

In the "Botany of Cook's First Voyage" (Banks and Solander), edited by J. Britten, *Acacia longifolia* Willd., is depicted at Plate 86, from a painting by F. P. Nodder, 1781. It displays a very long-leaved (phylloded) form up to as much as 22 cm. The specimen came from Botany Bay, but there was no description in the original MSS. Phyllodes as long as these are unusual in the species.

In Aiton's *Hortus Kewensis*, 2nd Ed. v, 461 (1813), the species is stated to have been introduced into England in 1792 by John Ord, Esq.

In Andrews' *Botanists' Repository*, iii, 207 (1802?), it is figured under the name of "*Mimosa longifolia*, Long-leaved Mimosa." The length of the phyllodes is under 1 dm., and the average width is 1·5 cm. This is the common Sydney form.

The figures of this species under the names of *Mimosa longifolia* Ventenat, *Plantes de Malmaison* 62, and *Mimosa macrostachya* Poiret, *Suppl.* i, 61, I have not been able to consult.

In *Bot. Mag.* to 1827 (1816) a very fair figure of the species is given, but with no additional information. What is shown is rather a weak, pale-flowered specimen. Under t. 2166, it is referred to as variety α "foliis apice elongatis, spicis exacte cylindraceis."

A. longifolia is figured in *Bot. Reg.* v, 362 (1819), a rather weak specimen, and showing the venation very imperfectly.

In *Bot. Mag.* t. 2166 (1820) it is figured under the name "*Acacia longifolia β.* Thick spiked, long-leaved Acacia." This so-called variety is described as "foliis latioribus, spicis cylindracea-conicis axillaribus terminalibusque."

The phyllodia as depicted are however scarcely more than 1 cm. wide and the bulge (probably incorrect) of the widest one is only 1·5 cm. The conical appearance of the ends of the flower-spikes is accidental. I cannot find that there is any classificatory value in the spikes "exacte cylindraceis" contrasted with those "cylindracea-conicis."

Loddiges' *Bot. Cab.* t. 678 (1822) figures *A. longifolia*, but the figure inclines to the broad-phyllodia or Sophoræ group.

The figure of *Acacia longifolia* in Paxton's *Magazine of Botany*, iv, 197 (1838), is bad. The spikes follow the tapering form depicted in *Bot. Mag.* t. 2166, but the phyllodes are shown lanceolate, and with an erroneous spreading venation.

There is a very good figure of *A. longifolia* (with phyllodia 6–7 cm.) in Maund's "Botanist," ii, No. 77 (*circa* 1840).

So far I have only been referring to the typical or approximately typical form.

In the following description Bentham includes a number of varieties:—

An erect shrub, sometimes low and bushy, but attaining often a considerable size, or growing into a small tree; glabrous or slightly pubescent when young; branchlets angular.

Phyllodia from broadly oblong to oblong-lanceolate or linear, very obtuse or almost acuminate; usually narrowed towards the base, with two to five more or less prominent longitudinal nerves, and conspicuously or faintly reticulate between them, varying in length from 2 to 3 inches in some varieties, to 5 or 6 in others.

Spikes axillary, loose and interrupted; flowers not imbricate, almost always 4-merous.

Calyx very short, toothed.

Petals smooth, united at the base or sometimes quite separating.

Pod linear, often several inches long, 2 to 4 lines broad, or rarely more; valves coriaceous, convex over the seeds, usually contracted between them.

Seeds longitudinal, often distant, funicle not much folded, thickened almost from the base into a turbinate almost cup-shaped aril at the base of the seed, and sometimes nearly as large. (B.Fl. ii, 397.)

Bentham (*B.Fl.* ii, 398), following Mueller, enumerates six forms (varieties) as follows:—

(*a.*) *phlebophylla*, from the Victorian Alps.
(*b.*) *Sophoræ.*
(*c.*) *typica*, including *A. obtusifolia* A. Cunn.
(*d.*) *mucronata.*
(*e.*) *floribunda.*
(*f.*) *dissitiflora.*

He goes on to say that these forms, different as they generally appear, are connected by such a gradual chain of intermediates that they cannot be separated by any positive characters, except, perhaps, the first (*phlebophylla*), which seems o have a much broader pod, but it is as yet not sufficiently known.

In the present work I can only deal, with some degree of fulness, with *Sophoræ, typica, mucronata,* and *floribunda,* which occur in New South Wales. In addition, I shall deal with two reputed varieties, *prostrata* and *Bylongensis.*

In the present Part (LVI) we will deal with the normal form, and with varieties *Sophoræ, prostrata,* and *Bylongensis.* In Part LVII varieties *floribunda* (*A. floribunda* Sieber) and *mucronata* will be taken.

We will now deal with these varieties after dealing with *typica,* which includes the normal form or type of the species.

(1.) *typica* Bentham, *i.e.,* those plants which he includes under the normal form. I have already given the descriptions (chiefly by the older botanists) of the normal form which goes under *typica.* In the case of a species such as the present one, which has shown itself so adaptable as regards habitat, it is not surprising that it has shown itself variable, and we see this even in *typica.*

A. spathulata Tausch., in *Flora,* 1836, 420, and *A. intertexta* Sieb., in DC. Prod. ii, 454 (" with broad phyllodia "), are both referred by Bentham to *A. longifolia typica,* but I have not seen them. The type of *A. intertexta* is *Pl. Exs. nov. holl.* No. 453.

Acacia obtusifolia A. Cunn. is described in the following words :—

" Foliis elongato-lanceolatis obtusis basi attenuatis binerviis venosis, spicis cylindraceis geminatis, legumine teretiusculo intus siccato-pulposo. Blue Mountains. Allied to *Acacia longifolia* Willd." A. Cunn. in " Geographical Memoirs on New South Wales " (Barron Field), p. 345.

Bentham refers this to *A. longifolia typica* (" with narrow phyllodia "), and I am in some doubt as to whether *A. obtusifolia* A. Cunn. may not be sufficiently distinct from *A. longifolia* to constitute a valid species. In December, at Mt. Wilson, it bore brown, nearly cylindrical pods. Funicle white, connected to the edge of the valve by a long prolongation of the arillus.

It may be looked upon as the higher mountain form (as we go south it is found at diminishing elevations) of *A. longifolia,* and is in flower usually at mid-summer, but sometimes later (normal *longifolia* usually in spring or late winter) ; its favourite situation is on ridges or dry slopes, not near watercourses. It forms a compact bush or small tree, far more dense in growth than *typica.* Its flowers also are usually of a paler yellow, and the venation is more reticulate.

Mr. R. H. Cambage and I collected it on the Cox's River, the type locality, and some of the phyllodes are by no means narrow.

It is common on exposed places—Hassan's Walls, near Bowenfels, Mt. Wilson, at Mt. Victoria, Blackheath, Katoomba, Wentworth Falls, &c., and also on the Southern Railway line, *e.g.,* at Hill Top (E. Cheel). In some of these localities the normal form is also found.

It also occurs as a dwarf form (18 inches) in moist, wet altitudes, near the summit of Monga or Sugar Loaf Mountain, near Braidwood (J. L. Boorman).

Dwarf form (2-3 feet) growing on the highest altitudes, Buddawang or Baldy Mountain, near Braidwood (J. L. Boorman). It is also on Currockbilly.

Bega (E. Breakwell).

Vernacular Name.—The normal form of *A. longifolia* is usually called Golden Wattle, and as most of the other States have their own special Golden Wattles, the name "Sydney Golden Wattle" will be distinctive for this species.

Aboriginal Names.—It is singular that we have no record of the aboriginal name for such a conspicuous and widely diffused plant as the typical species.

Botanical Name.—*Acacia*, already explained (see Part XV, p. 104); *longifolia*, Latin, long-leaved.

Phyllodes.—In Southern New South Wales, Mr. W. Baeuerlen informed me many years ago that it has been observed that horses and cattle eat the young shoots, even when grass is by no means scarce.

Timber.—Timber light, tough, and hard; sometimes used for tool-handles, &c.

It is of a pale colour, and only available for small objects, for it is too small to be called a timber tree.

Insects.—In my "Illustrated Flowering Plants and Ferns," p. 28, will be found a preliminary account, based on information supplied by Mr. Froggatt, of the insect enemies of this species, which may be suggestive.

Habitat.—The normal form was doubtless originally described from a specimen obtained from either the Botany Bay (Banks and Solander) or Port Jackson district.

In the Flora Australiensis it is enumerated from all the States, except Western Australia, but this includes all the forms.

It occurs in the States of Victoria, New South Wales, and Queensland. In Victoria, it is found in Gippsland; in New South Wales, it extends from south to north of the State, being confined to the coastal district and table-lands; in Queensland, it is recorded only from south-eastern areas in juxtaposition to the New South Wales boundary.

Following are the localities represented in the National Herbarium, Sydney.

VICTORIA.

Snowy River (E. E. Pescott).

Mississippi Creek, near lower Tambo River (J.H.M.).

NEW SOUTH WALES.

Southern Districts.—Twofold Bay; Bateman's Bay (J. L. Boorman); Ulladulla; Milton, towards Table Mountain (R. H. Cambage); Jervis Bay (J.H.M.); Hill Top, with broadish phyllodes (J.H.M., J. L. Boorman, and E. Cheel).

See also localities already given for that form which Allan Cunningham called *A. obtusifolia.*

Sydney District.—Sutherland, Kurnell, and Port Jackson.

Western Districts.—Karrabri, 23 miles north of Rylstone (R. T. Baker); Wentworth Falls (W. Forsyth).

See also the Blue Mountains localities already given (see page 125) for that form called *A. obtusifolia* by Allan Cunningham.

Northern Districts.—Nelson's Bay (J. L. Boorman), and Port Stephens generally.

Creek banks, Gloucester district (A. Rudder); Bowman River (Jesse Gregson); Bullahdelah (E. Cheel); Bismuth, near Deepwater (A. McNutt); Pheasant Creek, Glen Elgin (J. L. Boorman); Woolgoolga (E. H. F. Swain); Tabulam to Drake (J.H.M. and J. L. Boorman); Summit of Mt. Warning (W. Forsyth); Wallangarra and over the Queensland Border (J.H.M. and J. L. Boorman).

(2.) Variety *Sophoræ*, F. Muell. Pl. Vict. ii, 30.

Phyllodia obovate-oblong, very obtuse, coriaceous, about 2, or rarely 3 inches long, ½ to 1 inch broad, smaller veins reticulate. Calyx rather larger than in the other varieties. Pod usually much curved and thick, either slender and narrow, or 3 to 4 lines broad, and very thick.—*Mimosa Sophorae* Labill Pl. Nov. Holl. ii, 87, t. 237; *A. Sophorae* R.Br. in Ait. Hort. Kew. ed. 3, v, 462; DC. Prod. ii, 454; Lodd. Bot. Cab. t. 1351; Hook. f. Fl. Tasm. i, 110.—Often abundant, chiefly on the sea coast, Moreton Bay, New South Wales, Victoria, Tasmania, and South Australia.

The above is as defined in B.Fl ii, 398.

The type came from Tasmania, and was figured by Labillardière at the place cited. Figures L, M of Plate 213, also from Tasmania, are perhaps rather less diagrammatic than Labillardière's figure.

Aboriginal Names.—This form had two names given to it by the now extinct Tasmanian aborigines, viz., "Gur-we-er," our authority being Allan Cunningham, in Capt. P. P. King's "Narrative of a Survey of the Intertropical and Western Coasts of Australia," (1827), i, 162. The other name is "Boobialla" or "Boobyalla," see Appendix D of Backhouse's "Narrative of a Visit to the Australian Colonies" (1843).

The name Boobyalla has been applied in south-eastern New South Wales to *Myoporum acuminatum.* Whether the blacks applied this name to the plant, or whether it is a term of more or less general application to spreading coastal shrubs, I do not know.

Vernacular Name.—The Spreading Coast Wattle, because of its spreading scrambling habit which has suggested its use for the arrest of sea sand.

Phyllodes.—Sometimes very thick, almost fleshy. Miss Meares collected a specimen at Wollongong an eighth of an inch in thickness. In comparison with those of *typica*, they are short and broad.

Fruits.—The natives of Tasmania used to roast the ripening pods of this Wattle, pick out the seeds and eat them (Backhouse). In Tasmania they are usually curved, broad and fleshy, with a large fleshy arillus. As we go north along the mainland, the pod becomes straighter and thinner.

Bark.—Mr. W. Adam informed me that Sydney fishermen often tan their sails and nets with this bark, and are well pleased with it, the articles being pliable after use.

Timber.—The tree is quite small, but the wood is white, hard, and tough, and is said to be durable.

Habitat.—It is the spreading Coast Wattle and its favourite place is on the sandy seashore or along the banks of brackish or salt-water creeks. It extends along a very long coast line, occurring not only in many places in Tasmania, but also in Kangaroo Island and South Australia, all along the coast of Victoria and New South Wales to Southern Queensland.

In New South Wales it is in the National Herbarium from Twofold Bay; Bermagui (W. Baeuerlen); Gerringong (W. W. Froggatt); Wollongong (C. Moore); Maroubra Bay, Lady Robinson's Beach, &c., and the Sydney district generally; Ettalong Beach, near Broken Bay. Pod nearly straight, Narara Creek, salt-water (A. Murphy); Port Macquarie (G. R. Brown).

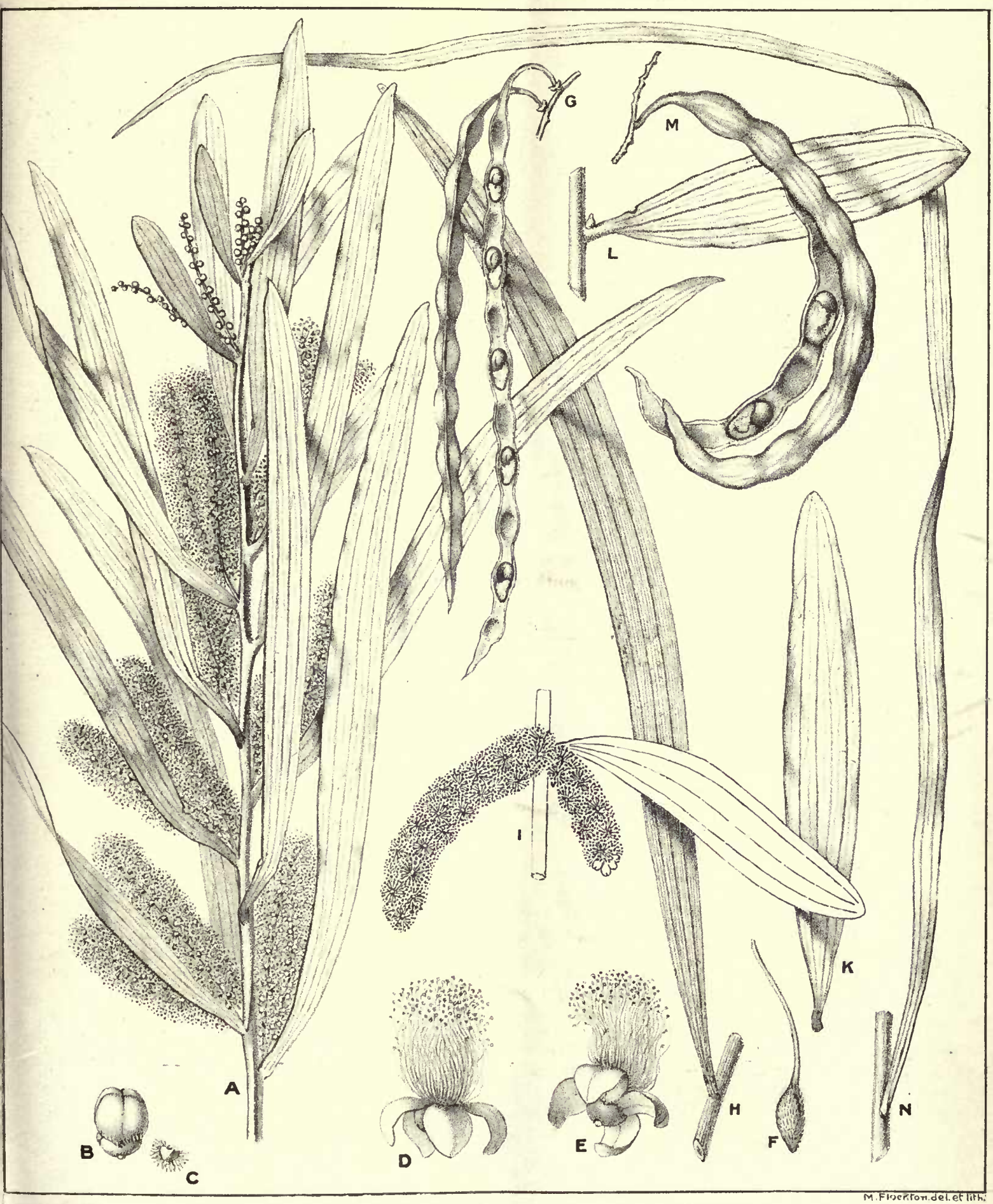
Contributions of more northerly specimens would be acceptable.

(3) Variety *prostrata*, C. Moore and E. Betche, in "Handbook of the Flora of New South Wales," p. 170. "Stems almost or quite prostrate. Sandy seashores."

It seems to differ in habit only from normal *longifolia* and from var. *Sophoræ*. It possesses sand-binding properties in an exceptional degree, creeping along the sand and rooting, on the loose sand running 6 or 7 feet along the ground.

It is common enough in the Sydney district, where it has been most observed, but it is found north and south of Sydney. Variety *Sophoræ* also has this creeping rooting habit, and I am unable to see in what way var. *prostrata* can be differentiated from it.

(4) Variety *Bylongensis*, R. T. Baker, in *Proc. Linn. Soc. N.S.W.*, xxi, 443. With phyllodes 16 to 20 inches long and $\frac{1}{4}$ inch broad. Bylong Creek, Upper Goulburn River, N.S.W., also Gulf Road and Camboon (R. T. Baker).



M. Flockton del. et lith.

SYDNEY GOLDEN WATTLE, A-I, AND VARIETIES.

(*Acacia longifolia* WILLD.)

There is some uncertainty about this form, as Mr. Baker himself points out. The racemes are shorter than those usually seen in *A. longifolia*, and it may be that the form is referable to *A. doratoxylon*, A. Cunn.

EXPLANATION OF PLATE 213.

A. Flowering twig from Jervis Bay.

B. Bud.

C. Bract covered with white hairs, found at the base of each flower.

D and E. Flowers.

F. Pistil.

G. Pods from Maroubra Bay, near Sydney.

H. Phyllode from Plate 86, Vol. I, of "Botany of Cook's First Voyage," Banks and Solander.

I. Phyllode and flower spikes of *Mimosa longifolia* from Vol. III, plt. 207, of the Botanists' Repository, by H. Andrews.

K. Phyllode of var. *prostrata* from Lady Robinson's Beach, N.S.W.

L. Phyllode of var. *Sophoræ* from Adventure Bay, Tasmania.

M. Pods of var. *Sophoræ* from Adventure Bay, Tasmania.

N. Phyllode of var. *Bylongensis* from Bylong Creek, N.S.W

THE MITIGATION OF FLOODS BY FORESTRY OPERATIONS.

I.—The situation; denudation.
- (*a*) The outlook serious.
- (*b*) European and American experience.

II.—Intelligent control of ringbarking the beginning of all remedial measures :—
- (*a*) Shelter for stock should be adequate.
- (*b*) Danger of cutting trees too near the watercourses.

III.—Deviation of roads.

IV.—Falling in of banks.

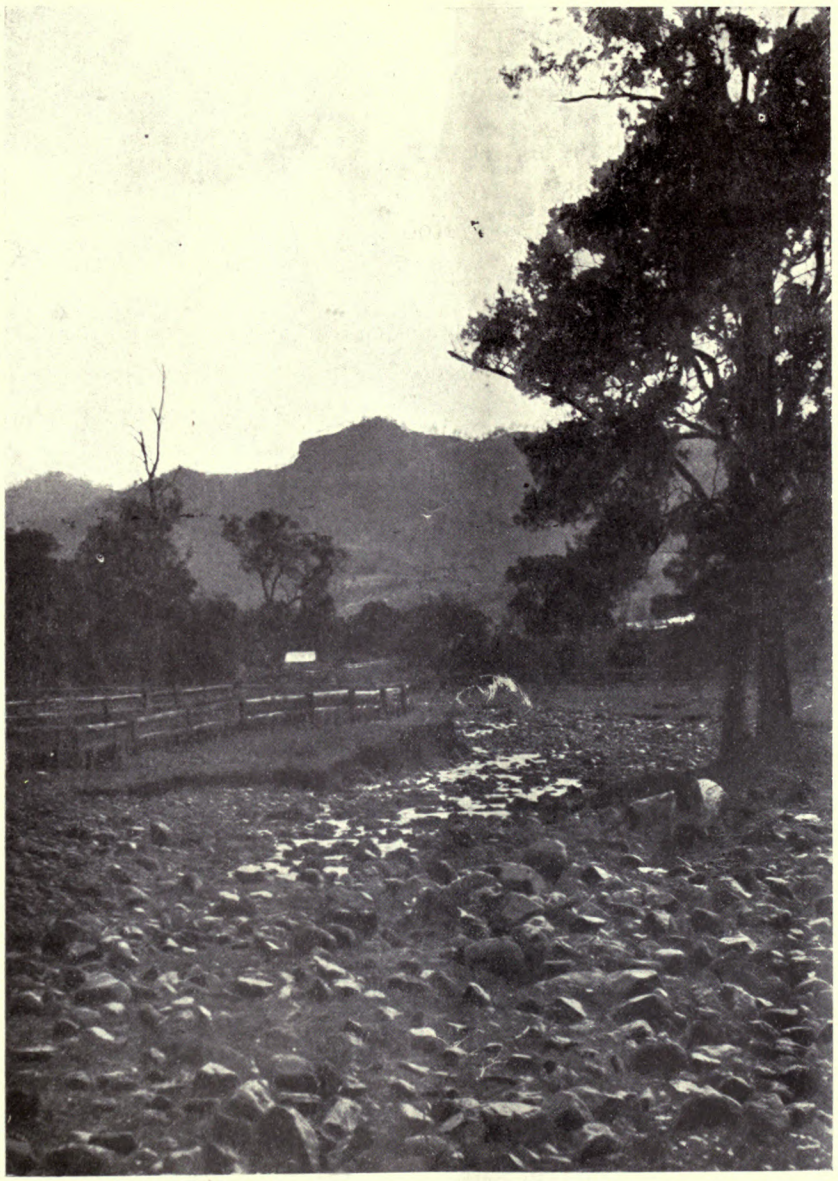
V.—Floods and weeds.

VI.—Some miscellaneous factors in erosion :—
- (*a*) Boulders.
- (*b*) Dead trees.
- (*c*) Stock.

VII.—Remedial and preventive measures :—
- (*a*) Control of ringbarking.
- (*b*) Fencing.
- (*c*) Embankments.
- (*d*) Chamfering of banks.
- (*e*) An American proposal.
- (*f*) Planting and conservation.
    1. Natural bank protectors.
    2. Other bank protectors (exotic).
    3. Plants recommended for Upper, Middle, and Lower Hunter.
    4. Nurseries.

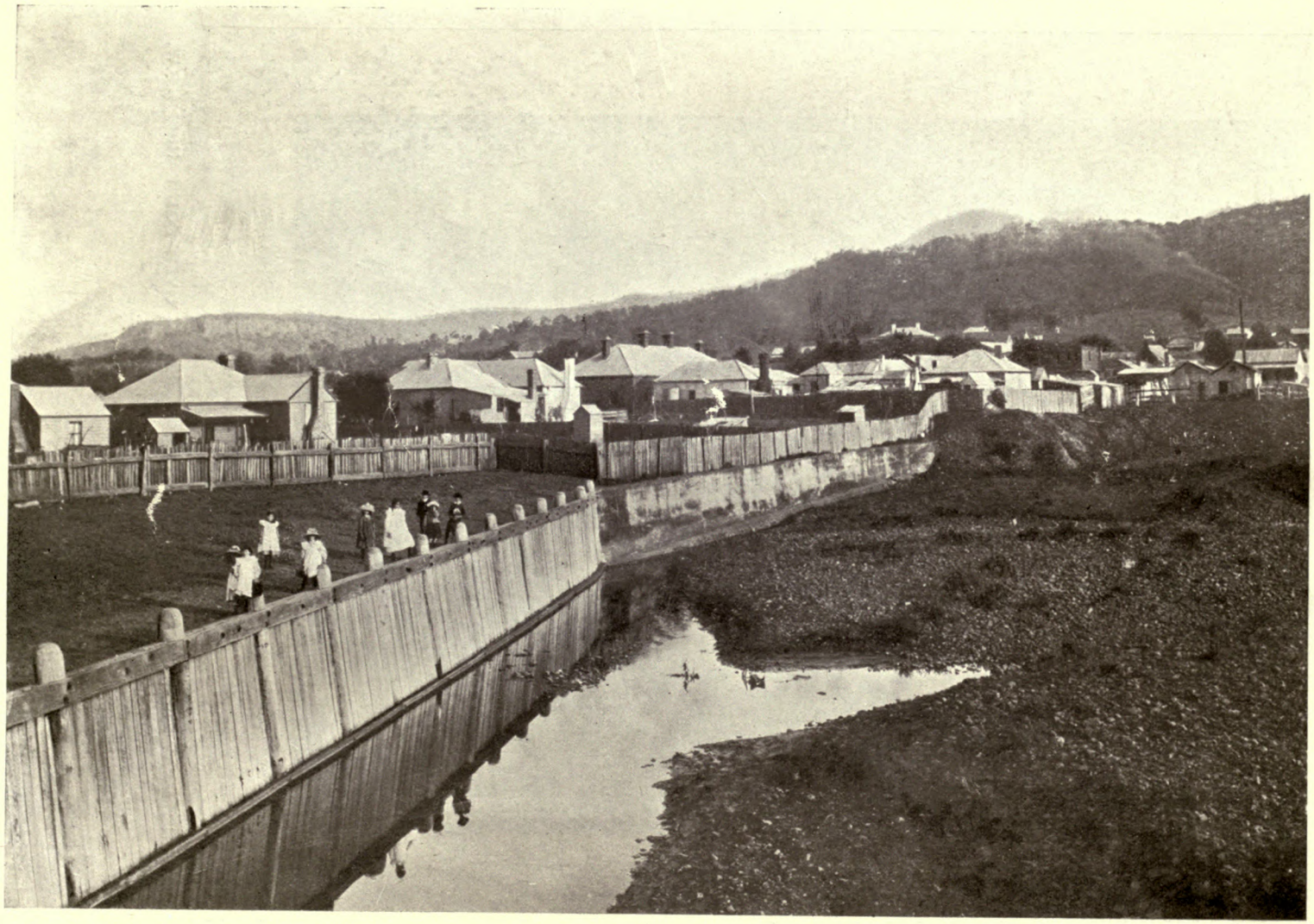
VIII.—Summary of the measures recommended for mitigation of floods.

If one's knowledge of Australian forestry were confined to what one sees in letters to the newspapers, one would imagine that its sole object is the furnishing of timber to the saw-miller. That is but one object, albeit an important one, other phases of forestry being the combating of drift-sand, planting for the mitigation of floods, the up-keep of river banks, the planting of shelter belts, and so on. The forester has as much right to claim credit in the national balance-sheet for improvements such as these as from the revenue arising from timber royalties. The report of the Western Lands Commission has vividly brought home to us, a few years ago, the fact that dealing with sand-drifts is not a coastal question confined to Sydney and Newcastle, but one of magnitude to the far West, and one that must be coped with unless we are prepared to abandon large areas of pastoral country. The question of dealing with drift-sand belongs properly to a Forest Department, and it



Judge Docker, photo

WASHING AWAY OF RICH RIVER FLATS, MOMBRI CREEK, LIVERPOOL RANGE, N.S.W.
NOTE THE ROUNDED BASALT STONES.



WASHING AWAY OF THE BANKS OF RICH SOIL AND WOODEN EMBANKMENT, PAGE RIVER, MURRURUNDI, N.S.W.

is of such great local importance to both east and west of our State that I would not continue to leave it to be dealt with in a desultory manner, but would make a sub-branch of the Forestry Department responsible for this service.

Let me deal with the subject of the mitigation of floods by forestry operations. What follows is based upon a paper that I read before the Royal Society of New South Wales in 1902, with reference to the Hunter River, but most of what is written is of general application.

I.—The Situation—Denudation.

Coming to first principles, the beginning of streams and floods with which we are concerned is—1. Rain falls more or less on the land. 2. Some sinks into the ground. 3. The remainder drains away. Thus a single paddock may be an object-lesson in regard to forces at work in the whole of New South Wales, as I will endeavour to show presently. I shall seek to prove that our treatment of paddocks affords an illustration of the truth of the ancient saying to the effect that, "Every act of man is the forerunner of a chain of consequences, of which no one can foresee the end."

The natural forests on the rounded steep hills of the Upper Hunter, have, in many cases, been destroyed, and the sheep and cattle tracks are everywhere in evidence, even in the steepest places. The innumerable sheep tracks are accentuated, and the ground everywhere is pulverised by the feet of the sheep wandering after the scanty herbage after a period of drought. When the rain falls, much of this pulverised soil, carrying with it grass plants (latent) and seed of grasses and various forage plants, must be washed into the creeks, and again into the Hunter, which becomes discoloured. As the country is nearly all rung, it is to be hoped that many of these seeds will be arrested by the fallen timber. As we proceed towards the hills from the watercourses, we come to the clay and sandy land and to the masses of undecomposed basalt, which have no manurial value, but are a potentiality for future ages.

The poorer uplands can sometimes only be profitably used in conjunction with the rich flats on which they abut. This is clearly brought out in the evidence* in regard to the proposal of the late Mr. Price to dam the Hunter below Denman. In fact, if we lose our flats, large additional areas will be thrown out of occupation.

(*a*) *The Outlook serious.*—My view is that it is only a matter of a brief historical period when, unless preventive steps are taken, these rich river and creek flats will find their way into the Pacific Ocean. Some people, including men of great experience and careful thinkers, are, however, of a different opinion. They view the erosion with more or less equanimity, considering that what is taken off

* "Hunter River, Floods Prevention." Minutes of Evidence, Parlt. Stand. Committee, Public Works, Questions 1128, 1385, &c. 1901.

one bank is deposited on the other. Of course, erosion is going on all over Australia, and to what extent compensating influences are at work is a question for geologists; but I believe the amount of loss far exceeds the gain.

I do not like the *laisser faire* argument as applied to the Hunter. It seems an argument analogous to that, because there will always be evil in the world, efforts for the betterment of man's position should be abandoned. As a matter of fact, man's existence in the world is dependent on his maintaining an incessant warfare against what are called "the forces of nature." As regards the particular case now under consideration, it is, of course, a matter as to how far expenditure of effort and money are justified by the results they secure.

Let us not act as if we were content simply for the agricultural flats to last our time, and then—"Après nous le déluge." Like the nuggets of gold, and the forest monarchs (now sadly diminishing) we convert into timber, human agency has done nothing to produce them. Let us not deal with these rich flats simply as if they are capital to be got rid of in a brief period, but rather let us act in the capacity of faithful trustees, realising that maintenance of the property is expenditure that must be incurred, and that it is vital to the very existence of the property.

I do not wish to weaken my argument by overstating the case, but wish at the very outset to show how, in other countries, the seriousness of denudation by rivers is realised, and the conservation of forests is looked upon as a palliative.

(*b*) *European and American Experience.*

A.—The rivers Volga, Garonne, and Loire afford special lessons to us, and since the injudicious felling of trees is attended by evil consequences the wide world over, we should lay the lessons to heart in New South Wales.

"The Alps and Pyrenees, exposed to the same treatment, have been similarly affected. The deforestation paralyses the development of the pastoral industries in these regions by lowering the limits of forest vegetation. The valleys are ravaged by a devastating erosion. Entire mountains slide down slowly, carrying with them the pastoral villages which they bear on their surface, accumulating ruin and disaster.*

"These processes do not affect the mountain alone. For, by the very fact of this deforestation, the rich plains of the Garonne and the Loire are subjected to disastrous floods which make the fate of agriculture in these regions very precarious. This state of things has not failed to arouse apprehension among the inhabitants. Researches with regard to the question have shown that the devastating character of these inundations is due to the destruction of the forests which formerly covered the Central Plateau and the Pyrenees. The waters, no longer absorbed and regulated by the forest vegetation, flow away on the surface in enormous and sudden waves. The débris thus carried away in vast quantities contributes to the formation of barriers, and gives to the waters their destructive power.

* Demontez, "Traite pratique du reboisement, etc.," 2nd edition, 1882. Also J. Croumbie Brown.

"But the danger does not cease there. The navigation of the great rivers gradually silted up by this waste from the mountains is rendered very difficult. So much is this the case that even Russia, a country so uniformly flat, is threatened in the use of its great waterway, the Volga. The investigations ordered by the Russian Government have demonstrated that this is the result of the drainage of the marshes and the deforestation of the low hills which give birth to the river."*

B.—"The soil, once denuded of its forests and swept by torrential rains, rapidly loses first its humus, then its rich upper strata, and finally is washed in enormous volume into the streams, to bury such of the fertile lowlands as are not eroded by the floods, to obstruct the rivers, and to fill up the harbours on the coast. More good soil is now washed from these cleared mountain-side fields during a single heavy rain than during centuries under forest cover.

"The regulation of the flow of these rivers can be accomplished only by the conservation of forests." (President Roosevelt's letter of transmittal to the Senate of a report of the Secretary for Agriculture relating to the Southern Appalachian region, 1901.)

C.—I will conclude with a graphic account by Mr. McGee of the destruction going on at present to form the "bad lands" of the State of Mississippi. I do not think that truth has been sacrificed to fine writing, and do feel that what has been taking place in the Mississippi Valley has its counterpart in the Hunter Valley, New South Wales. The quotation is from Bulletin No. 7 of the Forestry Division of the United States Department of Agriculture.

"With the moral revolution of the early sixties came an industrial evolution; the planter was impoverished, his sons were slain, his slaves were liberated, and he was fain either to vacate the plantation or greatly to restrict his operations. So the cultivated acres were abandoned by thousands. Then the hills, no longer protected by the forest foliage, no longer bound by the forest roots, no longer guarded by the balk and brush dam of the careful overseer, were attacked by raindrops and rain-born rivulets, and gullied and channelled in all directions; each streamlet reached a hundred arms into the hills, each arm grasped with a hundred fingers a hundred shreds of soil, and as each shred was torn away the slope was steeped, and the theft of the next storm made easier.

"So, storm by storm and year by year, the old fields were invaded by gullies, gorges, ravines, and gulches, ever increasing in width and depth until whole hillsides were carved away, until the soil of a thousand years' growth melted into the streams, until the fair acres of anti-bellum days were converted by hundreds into bad lands, desolate and dreary as those of the Dakotas. Over much of the upland the traveller is never out of sight of glaring sand wastes, where once were fruitful fields; his way lies sometimes in, sometimes between gullies, and gorges—the 'Gulfs' of the blacks,

* A. Woeikof, "De l'Influence de l'homme sur la terre," *Ann. de Geogr.*, X, 1901. (Quoted by Marcel Hardy in *The Scottish Geogr. Magazine*, May, 1902.)

whose superstition they arouse—sometimes shadowed by foliage, but oftener exposed to the glare of the sun reflected from barren sands. Here the road winds through a gorge so steep that the sunlight scarcely enters; there it traverses a narrow crest of earth between chasms scores of feet deep, in which he might be plunged by a single misstep. When the shower comes, he may see the road rendered impassable, even obliterated, within a few minutes; always sees the falling waters accumulate as viscid mud torrents of brown or red, while the myriad miniature pinnacles and defiles before him are transformed by the beating raindrops and rushing rills so completely that when the sun shines again he may not recognise the nearer landscape.

"The destruction is not confined to a single field, nor to a single region, but extends over much of the upland. While the actual acreage of soil thus destroyed has not been measured, the traveller through the region on horseback daily sees thousands or tens of thousands of formerly fertile acres now barren sands; and it is probably within the truth to estimate that 10 per cent. of upland Mississippi has been so far converted into bad lands as to be practically ruined for agriculture under existing commercial conditions, and that the annual loss in real estate exceeds the revenues from all sources. And all this havoc has been wrought within a quarter of a century. The processes, too, are cumulative; each year's rate of destruction is higher than the last.

"The transformation of the fertile hills into sand wastes is not the sole injury. The sandy soil is carried into the valleys to bury the fields, invade the roadways, and convert the formerly rich bottom lands into treacherous quicksands when wet, blistering deserts when dry; hundreds of thousands of acres have been destroyed since the gullying of the hills of a quarter of a century ago. Moreover, in much of the upland the loss is not alone that of the soil, *i.e.*, the humus representing the constructive product of water-work and plant-work of thousands of years. The mantle of brown loam, most excellent of soil stuffs, is cut through and carried away by corrosion and sapping, leaving in its stead the inferior soil stuff of the Lafayette formation. In such cases the destruction is irremediable by human craft—the fine loam once removed can never be restored. The area from which this loam is already gone is appalling, and the rate of loss is increasing in geometric proportion."

See also "Washed Soils: how to prevent and reclaim them" (*Farmers' Bulletin*, No. 20, U.S. Dept. of Agric., 1894, which contains admirable illustrations of "An eroded field in the South" and "Another effect of erosion." These illustrations are taken by officers of the U.S. Geological Survey, and are to be also found, with valuable additional information, in Hilgard on "Soils."

II.—Intelligent Control of Ringbarking.

Going back to ultimate beginnings, to the creeklets, the source of all the troubles is the indiscriminate ringbarking and cutting down of vegetation by individual owners. The ringing or felling of trees in paddocks is, of course, necessary;

but the requirements of the natural drainage seem not to be considered. The consequence is that in the dry creeks rifts appear, which gradually widen, and carry soil, often the best soil, into the creeks, and so on, *ad infinitum*. The remedy lies in the intelligent control of ringbarking. Where there is an even contour of the land the operation is usually safe enough, but directly the land shows widening depressions that may carry water to lower levels, then operations should be undertaken with caution, since the water goes along the line of least resistance. In every paddock there is a getaway for the water, or if not, the water will make one. This getaway is the weak point of the paddock, or other tract of country; but very often it receives no special notice or consideration. The trouble is accentuated in rich lands simply because of the finer texture or friability of such soils.

The State of New South Wales is mainly made up of paddocks! The paddock is the unit in considering the effects of erosion. Much of the mischief has already been done, but intelligent conservation of existing and future trees has vast possibilities for good. It ought to be made penal to ringbark up to a certain distance from a watercourse, or to cut down a river oak on any of the rivers (watercourses), except under a special license only to be obtained after due inquiry. The reason of the suggestions is that improper ringing and felling affects the riparian owner lower down, and he has quite enough difficulties to contend with, which are beyond human control, to be victimised by the ignorant act of his fellow-man higher up the stream. I could give an instance where a man cut down river oaks to make culverts; the river oak timber is now perished, and if he had gone but a few yards away he could have got almost imperishable ironbark. He now has to repair his culvert, but his river oaks are gone, his banks are falling away where he removed them, and a larger culvert is now required. In the case of a casual labourer, this would have been termed living from hand to mouth. In the present instance, it is miserable expediency and opportunism unworthy of thinking men. If the results of acts like these would alone affect the doer, we could view the matter with complacency.

(*a*) *Shelter for stock should be adequate.*—Shelter for stock is necessary; a few acres of trees should be left, and not an odd tree or two, which die out. The ruthless cutting down or sapping of trees has its basis in self-interest. A man desires to get the fullest advantage out of his land, and until it comes home to him that he is acting against his own interest in not conserving sufficient trees, he will blunder along. The advantage of leaving adequate shelter for stock is so obvious as not to be arguable.

(*b*) *Danger of cutting trees too near the watercourses.*—All over the State people have made a mistake in sapping too near the rivers and watercourses. The dry, dead timber at the edge of the watercourse no longer holds the banks, for the reason that their roots have shrivelled and decayed, and have no gripping power; then the tree gets top-heavy, and breaks down the banks, and the second chapter of mischief begins.

The innumerable creeks will doubtless require to be dealt with in any effective remedy for the mitigation of floods. There is evidence everywhere of broadening streams, of banks breaking down, and good soil washed away. Apple (*Angophora intermedia*) and River Oak (*Casuarina Cunninghamiana*) doubtless filled these flats, and they have been removed in order to cultivate the rich land to the fullest extent. The denudation is going on in geometrical progression. There are farmers even in a small valley like that of the Page, near Murrurundi, who have lost as much as 50 acres through breaking down of banks.

What we see in the small creeks is repeated in the big rivers, so this is not a local matter merely as regards the little creeks. With friable banks, every fresh carries down soil to the lower levels, and the stronger the current, of course, the greater the débris. This tends to work destruction at the lower levels. By all means, therefore, let us encourage people to prevent the erosion of the land higher up. It is not only that land is lost by erosion, but the land becomes a motive power to destroy property lower down. Much of the silt that people complacently see deposited on their ground is, of course, the soil of some unfortunate cultivator.

The matter might settle itself eventually by there being no more friable material to be washed away from the upper lands. If one could estimate the percentage of "flats" area which has disappeared since the advent of the white man on some of the Upper Hunter streams, I think the result would be startling.

III.—Deviation of Roads—Under Drainage—Manuring.

The annual cost to the Roads Department of deviations necessitated by washaways and repairs necessary by washaways must be very considerable, and having made special inquiries, I find that many of these washaways are the direct result of the destruction by private owners of trees along the getaways for water. If the cost to the Roads Department and to private citizens of road deviations (with culverts, &c.) necessary through the washing away of the banks of rivers and creeks in the Hunter Valley were available, I think it would surprise a great many people.

If the Public Works Department were to select, say, a hundred definite places on rivers, creeks, and furrows, in cleared land (what I might term "incipient creeks") and photograph them every year for, say, five or ten years, the results would be of the highest educational value. They would be of value to the whole State, for the phenomena of aqueous denudation are in operation everywhere, although the results may not be, in most places, so disastrous as on the Hunter.

Under-drainage preserves the roads, and wherever practicable it should be resorted to. The sides of roads should not always be used as drains, as torrents may tear the road away. Of course, a certain amount of surface drainage is indispensable, but it should always be borne in mind that under-drainage preserves the roads and makes the fields normally drier and sweeter.

Then we should bear in mind (as suited to special circumstances) the use of *chemical means*, in the application of manures and fertilisers and in the accumulation of organic matter, which change the texture of the soil and make it more porous and more absorbent of water, so that there is less to run off over the surface.

IV.—Falling in of Banks.

These friable, rich soil banks of the Hunter and some of its tributaries fall to some extent, wet or dry. In dry weather they crack and tumble into the bed of the stream because of their lack of cohesion. It wet weather the rain soaks them, expansion takes place, cohesion again fails, and the result is the same. These banks are, in fact, in a condition of unstable equilibrium.

V.—Floods and Weeds.

Another aspect of floods often lost sight of is the havoc committed in the lower lands by the transmission of weed-seeds and plants to lower levels, *e.g.*, Nut Grass (*Cyperus rotundus*), Yellow or Prickly Poppy (*Argemone mexicana*), Yellow Indigo (*Cassia spp.*), Bathurst Burr (*Xanthium spinosum*), Yellow Thistle (*Kentrophyllum lanatum*), Chinese Thistle (*Centaurea calcitrapa*), and other thistles and pests of various kinds. The undisturbed propagation of weeds in the bed of an upper creek thus means loss to any rich lands on a lower level. Therefore, although for engineering purposes the consensus of opinion is to work from Newcastle, my view as regards weeds prevention is to begin as high up the Hunter and its tributaries as possible. They not only float the seeds down, but nice rich silt to give the weed-plants a fair start in life.

VI.—Some Miscellaneous Factors in Erosion.

(*a*) *Boulders.*—The small stones and boulders in the bed of a stream are set in motion by floods, and forming eddies, &c., grind down the banks. Good rich basaltic land is very fine-grained, and washes away readily. The stones which are always found in it more or less help to break it away. Sometimes they form masses of considerable weight. The black soil everywhere rests on a bed of gravel. The water gets underneath and through the black soil, these gravel-stones facilitating the circulation of the water and the disintegration of the superimposed soil.

(*b*) *Dead trees.*—The dead trees and branches felled for stock, unless they are dry enough for burning before the floods come, do much damage. So many river oaks (and other trees) are cut down during a drought that if a flood comes soon, enormous damage is done through these dead trees tearing down the creeks and rivers. Dead timber, of course, threatens the bridges, and also churns up the banks and works destruction. The courses of creeks are so irregular, and the water comes down so suddenly, that a stream may become a succession of grinding whirlpools.

There are evidences that in former times the beds of nearly all our rivers, especially the larger ones, occupied from time to time the lowlands adjoining their present course. These ancient depressions or beds may now be readily traced—the original courses suddenly changed by the blocking up of the river by trees

or logs with rubbish in time of flood. In 1849 I made some surveys in the town of Gundagai, which was situated on an island formed by the Murrumbidgee and an anabranch. Consequently when the flood came there was no escape for the inhabitants, and seventy persons were drowned. I took an early opportunity of visiting this river from Yass downwards, and, shortly on rounding a steep point, came upon a remarkable excavation, 3 or 4 feet broad, about 2 feet deep, too broken and uneven for spade work—something approaching to three or four furrows of a plough. I followed it up, and soon ascertained the cause, a large-sized gum-tree had been washed down head first, and would have been carried completely across the low flat at the base of the hill; but it was firmly held by a powerful root which acted like an anchor, but had torn up the ground so far *en route*, and thus caused this remarkable excavation. The cause of these anabranches and islands in these rivers was thus readily explained.—(J. F. Mann, in a letter to the Author.)

(*c*) *Stock.*—I desire to emphasise the damage caused by the trampling of horses and cattle, and by the nibbling and eating out of all vegetation in drought seasons. Let each landowner have his special crossing-places for cattle, such places to be so arranged and prepared that the minimum damage of banks may be secured. (See pages 131.)

VII.—Remedies and Preventive Measures.

(*a*) *Control of Ringbarking* (see page 134).

(*b*) *Fencing.*—Let me insist upon the judicious fencing of banks to protect their edges from stock and other traffic. I look upon this as one of the most important factors in preventing the erosion of the banks of rivers.

(*c*) *Embankments.*—At present, owners of houses and shops, and farmers, are put to an increasing expense in protecting their properties by means of stone, pile, or paling embankments; but in many cases the methods they are adopting are those of Mrs. Partington sweeping back the ocean, for the floods get at the back of their fortifications and the last stage is worse than the first. In many cases the owners have large areas of additional land, and do not bother about the problems concerned in the erosion of river banks. The probability is that if a man had only 40 acres, and he lost 10 by a washaway, he would become alarmed, while a large landowner might treat the matter with comparative indifference.

What we see in West Maitland—houses perched on crumbling banks, and left more or less stranded—we see on a smaller scale, *e.g.*, at Murrurundi on the Page River, and in many other towns and villages on smaller creeks. If the welfare of West Maitland were alone at stake, then it might be worth while to resume the town, and to sell the site for farms. But what really is at stake is the rich soil along the whole course of the river, and we should do all we can to prevent this marrow of the country from being wasted.

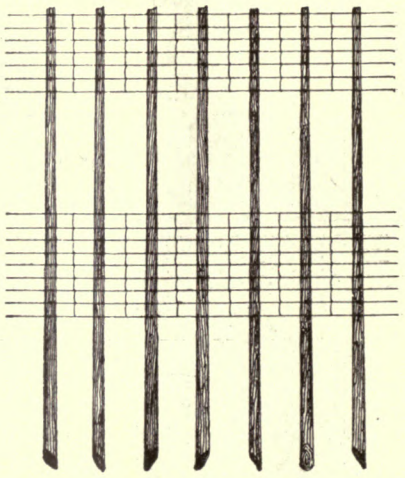
It is really pitiable to witness the destruction now going on; all our rivers are suffering—in the Castlereagh, Lachlan, Hunter, and Cudgegong; in fact, the silting up of valuable waterholes and the washing away of alluvial flats everywhere is a serious matter. I recommend many settlers to endeavour to save their property by means of fascines properly constructed, but they are mostly satisfied by throwing a few saplings, which are carried down by the first flood, and do more harm than good.

Attracted by a fine stretch of water in the Cudgegong River, about 10 miles above Rylstone, a friend of mine purchased a property and built a fine house on the bank of the river; the river soon showed signs of silting up, and although in the first instance he could row a boat on the stretch of water, in a few



Judge Docker, photo.

WASHING AWAY OF BANKS, HUNTER RIVER, MUSWELLBROOK, N.S.W.



PALING OF WILLOWS INTERLACED WITH WIRE.

SEE *An American Proposal*, p. 139.

years' time it was but a sand bed, and he had to obtain galvanised tanks to secure water for his household. No doubt many of these deep ravines and washaways have been caused by cattle tracks; these soon become watercourses, and then good-bye to your beautiful meadow flats and water supply.—(J. F. Mann, in a letter to the Author.)

(*d*) *Chamfering of Banks.*—I would recommend that the soft banks be chamfered in some places. Where soft banks overhang, as we see in many places, they fall over and tear away enormous quantities of soil. One sees the remains of trees in many of the banks, and they do damage in precisely the same way as do the embedded boulders already referred to.

(*e*) *An American Proposal.*—I desire to bring prominently under notice the simple method of dealing with caving river banks by means of a paling of willows interlaced with wire, as described in the following statement and illustration :—

Caving River Banks.—At many places along the stream the flood has left perpendicular banks of soft soil that are being constantly undermined by the current, causing the land to cave into the river from time to time. It is very important that such places be protected, for every such caving bank is a menace to all the land lying back of it in the valley.

In such a valley, where the bed of the stream does not come within scores of feet of bedrock, the use of stone structures for protecting the river banks is very expensive, and at the same time ineffective. The most successful method of protecting a soft alluvial river bank is to make it sloping instead of perpendicular, and to keep it covered with vegetation.

The willow is admirably adapted to holding alluvial soil in place. It is far more serviceable for this purpose than walls of masonry, and the facility with which it reproduces itself by seeds, suckers, sprouts, and cuttings, both natural and artificial, makes its use very simple and inexpensive.

The great difficulty with planting any sort of tree on perpendicular banks is that the caving of the soil is so rapid that the planted tree has no opportunity to get a start before it is undermined and precipitated into the river. An excellent scheme has been proposed by Mr. E. Bayles, Linwood, Kansas. The plan is as follows :—Green willow poles, 18 to 20 feet long, are secured in the spring, just after the ice goes out of the stream. These poles are laid on the ground near the bank 2 feet apart, with their butts all pointing toward the river. Woven fence wire is then stretched along over the poles, and stapled fast to each one. Sections of wire about 100 feet long can be handled to best advantage. After the wire has been securely fastened to the poles, they are all pushed over the bank together, so that the butts of the poles will fall and sink into the soft mud at the water's edge. As the bank caves off some of the falling soil will lodge on the wire, partially burying and weighing down the poles, which will consequently strike root and grow. The wire will serve to hold the mass of willows together until they have become firmly rooted. The ends of the woven wire should be made fast to wire cables running back over the bank some distance and fastened to posts set firmly in the ground. The caving and erosion of the bank will soon round off its top corners, and the growing willows at the water's edge will catch the soil as it rolls down the declivity, causing a bank to form of just the right slope to resist erosion most effectually. The following diagram illustrates the method of fastening the poles to the wire.—(United States Department of Agriculture, Bureau of Forestry, Circular No. 27, by Pinchot.)

(*f*) *Planting and Conservation.*—It appears to be very necessary to educate people not to destroy timber and other vegetation on the banks and in the beds of creeks, and in certain places to proceed with replanting. It is quite true that re-planting may in many cases mean the utilisation of good land; it is equally true that if remedial measures be not proceeded with, there will eventually be no good land left to plant on at all. Planting close to the edge is, I reiterate, a mistake, and arises from a natural desire to make the most of the land—to cultivate as much as possible for crops or grass. But trees and other plants placed too near the edge of a friable bank may be a source of danger, and not a real protection, since they may act as a lever to break down the banks.

1. *Natural Bank Protectors.*—Let us observe the interlacing and ramification of the roots of trees in good soil (such as these flats and river banks). It is very extensive, and their mechanical action in arresting washaways is obvious. One can see evidence that the banks of the Upper Hunter streams were much more lined with trees than at present. In many parts of the Hunter and its tributaries one sees large river oaks (many of them past their prime), leaving no descendants to continue their work of bank preservation. The young seedlings are palatable to stock, and hence they are eaten out if they have free access to them. This points to the necessary precaution that stock should not have unfettered access to the bed of a stream as if it were a public highway. The seedling oaks should be carefully conserved until they are out of reach of stock.

One lays stress on the value of the river oak for purposes of bank protection, for the reason that it has for ages been the natural bank protection of these streams, and has become largely adapted to its environment. At the same time, the acquisition of these lands by the white man, and his method of dealing with the banks and adjacent country, constitutes a marked change in the conditions, and it may be that other trees are even better than the river oak for the purposes of bank conservation. River oaks have not a large tap-root; they have rather flat, spreading roots, which penetrate the rich soil and sit on the bed of gravel already alluded to. When this gravel becomes hard, as it does in so many places, the river oak heels over and falls into the stream just as a boulder does.

2. *Other Bank Protectors* (*exotic*).—Here and there one finds that plants other than river oaks have been utilised to protect the banks. Willows are the favourites, and, I think, rightly so. They grow naturally on the banks of streams, and during the winter months propagate naturally or artificially by cuttings very readily. Thus a flood which breaks off branches is the means of establishing other trees lower down. Stakes of willow up to 6 inches in diameter may be driven into the banks near the water, and in an ordinary season may be relied upon to flourish. At Segenhoe there is about a quarter of a mile of *Nicotiana glauca*, a South American weed, under the steep bank, which is of some value as a protector of the banks. It forms a dense scrub, and prefers drier situations than willows. On the Upper Hunter the common passion-vine has been found useful, in connection with willows, as a bank protector. Doubtless other riparian owners pin their faith more or less on other plants.

My view is that on the Upper Hunter the main bank protectors should be trees; on the Middle Hunter, small trees or scrub; and on the Lower Hunter, where the banks are usually low and friable, I would recommend creeping shrubs and grasses, and other plants with underground rhizomes. I therefore make the following suggestions of readily available plants for the districts stated. Although prepared for a specific locality, it will be suggestive in preparing lists for other localities.

3. *Plants recommended for Upper, Middle, and Lower Hunter.*

A.—List of trees recommended for the banks of the Upper Hunter :—

1. *Casuarina Cunninghamiana*, Miq.—The "River Oak," which has been referred to in the body of this paper. It may form a very large tree.
2. *Angophora intermedia*, DC., and *A. subvelutina*, F.v.M.—These are rough-barked "Apple-trees." They attain a large size on the flats liable to inundation. Natives of Eastern Australia.
3. *Podocarpus elata*, R.Br.—The "She, Brown or Berry Pine," which flourishes best on the banks of some of our rivers.
4. *Melia Azedarach*, Linn.—The "White Cedar." One of our few deciduous trees. It is also a native of Asia. It grows readily from seed, which it produces abundantly. While this grows readily on river banks and among *débris*, it will flourish on the drier mountain sides, where it may be necessary to develop a rapid forest growth.
5. *Tristania conferta*, R.Br.—The "Brush or Bastard Box," which requires a good depth of moist soil for its full development. It is, perhaps, better known under its nursery name of "Lophostemon."

The following are exotic trees :—

6. *Acer negundo*, Linn.—The "Box Elder" of the United States, a deciduous maple, which affords an excellent summer shade.
7. *Ailanthus glandulosa*, Linn.—A native of Asia, which has several merits. Goats and other animals do not enjoy browsing upon it. Not only will it grow on the banks of rivers, and bind them with its suckering roots, but it is one of the few that will flourish in the almost pure sand of the coast and of the Hunter River estuary.
8. *Plantanus orientalis*, Linn.—The "Oriental Plane," native of Europe and Asia. A noble tree, which can be propagated by cuttings or seeds.
9. *Populus angulata*, Ait.—The "Water Poplar" of the Eastern United States, so called because of the damp situations in which it flourishes. Also many other species of Poplar.
10. *Robinia pseud-acacia*, Linn.—A native of the United States, and commonly known as "Acacia." It is remarkably tolerant to heat and cold, lack of moisture and plenty of it, and to poverty of soil. It will bind shifting sand.
11. *Salix babylonica*, Linn.—The common or "Weeping Willow," which is perhaps the best of all trees for consolidating river banks. Its roots form a net-work which bind soil; it will grow by the very brink of a stream, and its pendulous branches that are broken down by the floods and winds take root lower down the stream.*
12. *Taxodium distichum*, Rich.—The "Virginian or Swamp Cypress," which in its native country flourishes in sour, undrained swamps. It is less tolerant in cultivation, but it flourishes on the banks of waters where its roots can have full play.
13. *Ulmus campestris*, Linn.—The common "Elm," which is well worthy of introduction in the Upper Hunter Valley as a soil-binder.

B.—List of small shrubs or scrub recommended for the banks of the Middle Hunter :—

1. *Buddleia madagascariensis*, Lam.—A well-known plant which forms a rapid-growing, tall, shrubby mass. It is readily propagated by cuttings.
2. *Commersonia Fraseri*, J. Gay.—A tall native shrub, which naturally grows on the banks of water-courses.
3. *Cudrania javanensis*, Trécul.—The "Cockspur Thorn," also a native shrub, which forms an impenetrable mass of dense growth, well calculated to bind soil and prevent further destruction. Propagated by cuttings.

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* For years the Gunnedah (N.S.W.) Common Trustees have cultivated willows and lopped them for the stock every summer. Cattle especially thrive well on this food, eating every part except the big limbs. Besides being useful for stock, and ornamental if planted on steep banks, willows keep the driftwood back at flood-time, and, by catching drift-stuff, gradually fill up and bind the banks. ("Corvus," in *Sydney Bulletin*, November, 1902.)

4. *Duranta Plumieri*, Jacq.—A tall-growing shrub from the West Indies, which forms dense masses Readily propagated by cuttings.
5. *Hymenanthera dentata*, R.Br.—This is a tall native shrub, which forms large masses in good soil in many places in our coast districts. In the Upper Hunter district it flourishes remarkably well in many parts—Moonan Flat, for example.
6. *Ligustrum spp.*—The "Privets," of which there are several species and varieties. They are al more or less soil-binders, and can be readily propagated by cuttings.
7. *Lycium barbarum*, Linn.—A "Box Thorn," which is a well-known hedge plant. It is not particular as to soil or situation.
8. *Olea europea*, Linn.—The common "Olive." It likes good soil, and although it prefers proximity to the sea, there are many places in the Middle Hunter where it will flourish. The wild olive, which yields but a poor fruit, could be planted ; but I would like to see truncheons planted of the best pickling and oil-yielding olives obtainable.
9. *Polygala myrtifolia*, Linn.—A shrub of moderate size from the Cape. Not of special merit.
10. *Salix aurea*, Salisb. (a variety of the Huntingdon Willow, *S. alba*, Linn.).—The "Golden Willow." Most willows are valuable for the purpose under reference.
11. *Tamarix gallica*, Linn.—The "Tamarisk." A native of Europe and Asia, which is very tolerant as regards soil and situation. It grows readily from cuttings, and is a well tested soil-binder, even of sand.

C.—List of grasses, creeping shrubs, &c., recommended for the banks of the Lower Hunter:—

1. *Cynodon dactylon*, Pers.—The "Doub" or common "Couch-grass" of Eastern Australia. It is an excellent soil or sand binder, so well known as not to require extended notice at this place. This, and the five grasses which follow, form a dense turf.
2. *Panicum plicatum*, Lam.—This is a broad-leaved grass from Southern Asia, which forms a coarse turf when eaten down.
3. *Paspalum dilatatum*, Poiret.—During the last few years this American grass has come into great prominence for grazing for dairy cattle. It and several other Paspalums are excellent sand-binders, and should be encouraged on the Lower Hunter.
4. *Paspalum distichum*, Linn.—"Silt Grass" or "Water Couch." A native grass, and a good soil-binder in most situations.
5. *Paspalum cochinchinense* somewhat resembles No. 2 in general experience, and is well worthy of trial.
6. *Stenotaphrum americanum*, Schrank.—The well-known "Buffalo Grass" of New South Wales. This is a native of America. The nearer the sea the more it flourishes, and it will stand droughty conditions which will destroy many grasses.
7. *Andropogon Schimperi*, Hochst.—A tussock grass from Abyssinia, which stools readily, and which promises to be a valuable grass for New South Wales. I believe it will prove to be a valuable soil-binder for the Lower Hunter.
8. *Cortaderia argentea*, Stapf. (*Gynerium argenteum*, Nees.).—The well-known "Pampas Grass" of South America, which grows in large tussocks. See "Pampas Grass to prevent Sluits" (Washaways), *Agric. Journ.*, Cape, May, 1907, p. 712.
9. *Imperata arundinacea*, Cyr.—The "Blady Grass" of Eastern Australia, which is a most effectual soil-binder, though not like most of the grasses recommended, a useful fodder plant in addition.
10. *Psamma arenaria*, R. et S.—The well-known "Marram Grass" of North Europe and North America. Its value as a sand-binder in Victoria and New South Wales has now been proved beyond question.
11. *Chloris virgata*, the "Rhodes Grass" from South Africa, is certainly a most valuable grass.
12. *Arundinella nepalense*, Trin.—A New South Wales grass worthy of further experiment for the purpose indicated.
13. *Arundo donax*, Linn.—This handsome "Bamboo Reed" is now well acclimatised in New South Wales, and flourishes in moist situations. It is a good soil-binder.

14. *Arundo phragmites*, Linn. (*Phragmites communis*, Trin.).—The "Bamboo Reed" of New South Wales and many other parts of the world. It grows naturally along the margins of lagoons and water-courses, and its growth should be encouraged on the Lower Hunter. I believe it to be the "Small Cane" referred to in the enclosed letter to me by Mr. Charles Ledger, the well-known South American traveller of "Cinchona Ledgeriana" fame:—"The valleys of the Sama and Locumba are somewhat like those of the Hunter. In the first (Sama) is situated 30 miles of sandy plains near Tacna (Peru). During December, January, February, and March (or rainy season) its river, increased by the rains in the interior, rushes down its course from west to east with great force, undermining the banks on both sides, carrying away in that manner acres of soil where the banks are not protected by rows of *small cane* growing to a height of 10 to 12 feet. This small cane breaks the force of the rushing waters, and thus the river overflows its banks without carrying away the soil as formerly. In the same way the valley of Locumba is protected, indeed all valleys so situated in Peru."
15. *Bambusa gracilis*, Hort., and *B. nigra*, Lodd.—Two more small bamboos that I can recommend as bank-protectors.
16. *Arundinaria falcata*, Nees.—One of the smaller Himalayan bamboos recommended for soil-binding. Small bamboos of any species should be tried on the Lower Hunter. They spread from the roots and their tough stems are very tenacious of life.
17. *Cyperus alternifolius*, Linn.—An ornamental sedge from Madagascar, which flourishes in damp situations.
18. *Mesembryanthemum æquilaterale*, Haw.—The well-known "Pig's Face" of our coasts. A succulent-leaved plant, which is useful as a sand-binder where there is not much traffic over the plants themselves.
19. *Phormium tenax*, Forst., and *P. Colensoi*, Hook. f.—Two species of the well-known New Zealand flax, which possesses considerable merit as bank-protectors.
20. *Plumbago capensis*, Thunb.—A well-known shrub which forms a dense bushy growth.
21. *Rhagodia hastata*, R.Br., and *R. Billardieri*, R.Br.—Two of our salt-bushes that may be recommended as sand-binders in brackish or seaside situations.
22. *Rubia tinctorum*, Linn.—The "Madder" of Europe, which forms a low, smothering growth. It is worthy of a trial as a soil-protector.
23. *Lippia nodiflora*, Linn.—A low-growing plant which forms a mat on nearly pure sand. It belongs to the Verbena family, and has been found on the coast at Tuggerah Lakes and further north. The smaller *L. repens* is worthy of trial. It has been recommended for very dry situations, forming a close turf

4. *Nurseries.*—Each land-owner should have his own nursery of trees, shrubs, &c. The river oaks yield abundance of seed, and they are easy to rear, and the raising of trees and other plants is not beyond the power of any intelligent citizen. No one doubts the capabilities of our people as eradicators of vegetation; it should be brought home to them that it is to their advantage to act judiciously in a contrary direction.

VIII.—Summary of Proposals.

I will now summarise my proposals for the mitigation of floods. They are not sensational, but they are all practical, and if they be given a fair trial I think that it will be found that they are based on sound principles.

1. Intelligent control of ringbarking or felling. This is the beginning of all things, the attempt to get at the little rifts in the ground-surface that have such mighty consequences.
2. Repair of little incipient rivulets by gradual replanting or placement of obstructions (logs, &c.).

3. Planting of willows and other trees, shrubs, grasses, &c.
4. Chamfering of the banks.
5. Fencing of banks.
6. Burning as much as possible of the dead timber and branches to prevent their finding their way into the watercourses and scouring the banks. There is an especial abundance of dead timber after a drought.

Appendix.—Mountain Torrents in Europe.

I add a statement from one of the best modern works on forestry* in regard to flood mitigation in Europe. The mountain torrents are, as a rule, different in character from the Hunter River, and some of the methods in vogue in Europe would be impracticable here on account of the expense. I repeat my advice "to meet the danger at its source." Let us guard against undue erosion by the creeklets and creeks, and the big river will largely take care of itself. I am only referring to floods which have their origin in the Upper Hunter.

Private agency can usually do nothing or little to prevent floods. The action of the State is indispensable, as the cost of the erection and maintenance of the works necessary to secure this object is quite out of proportion to the value of the property on which they must be erected; and the work of fixing the beds of mountain torrents and hillsides in process of denudation must be carried out over a large area. The most effective measures depend on the management of the collecting areas of dangerous water-courses, *the main principle being to meet the danger at its source* . . . (the italics are mine.—J.H.M.).

Serious and successful action, however, is being taken in France, Switzerland, and the Tyrol to counteract the causes of floods. The chief rules to be followed are :—(*a*) Revetment of torrents and their feeders. By this means earth, gravel, and boulders are retained in the mountains. Works of the following nature should be designed in accordance with the nature of the locality, the characters of the torrents, the area of the collecting ground, and the funds available :—

1. Barricades of trees, with their entire crowns thrown across the torrents.
2. Wattle fences across the bed of torrents.
3. Dams made of fascines or masonry, to cause the deposition of coarse material, to be constructed across the torrents at suitable distances.
4. Paving the bed of the torrent.
5. Wattle-fencing on revetments along the banks of torrents to moderate the cutting action of the water.

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* Schlich's "Manual of Forestry," Vol. IV, page 501.

No. 209.

Orites excelsa R.Br.

Prickly Ash or Silky Oak.

(Family PROTEACEÆ)

Botanical description.—Genus *Orites*, R. Brown in *Prod. Flor. Nov. Holl.*, p. 387 (1810).

Flowers hermaphrodite.

Perianth regular, nearly cylindrical in the bud, the segments free or nearly so, dilated at the end into short, usually concave laminæ.

Anthers all perfect, enclosed in the perianth laminæ in the bud, but with short filaments inserted below the laminæ, the cells adnate to the slender connective which is not produced beyond them and is often scarcely conspicuous.

Hypogynous glands linear, obtuse.

Ovary sessile, with a terminal filiform straight style, scarcely thickened at the end, obtuse, with a small terminal stigma; ovules 2, amphitropous, laterally attached at or below the middle.

Fruit an obliquely acute, coriaceous follicle, more or less boat-shaped, the dorsal suture curved, the ventral one nearly straight.

Seed compressed, with a terminal oblique or falcate wing, sometimes decurrent along the margins

Shrubs or trees.

Leaves alternate, more or less petiolate, entire, toothed or rarely (in the same species) lobed.

Flowers small in terminal or axillary spikes, sessile or nearly so, in pairs within each bract.

Bracts concave, imbricate in the very young spike but falling off long before the flowers expand (B.Fl. v, 410.)

Botanical description.—Species, *O. excelsa* R.Br., *Prot. Nov.*, 32.

A handsome tree of 40 to 60 feet, usually quite glabrous.

Leaves on the flowering branches lanceolate, obtuse or acute, tapering into a rather long petiole, entire or slightly toothed, 4 to 6 inches long (and longer), flat, reticulate, shining above, glaucous underneath; those of the barren branches often larger, toothed or deeply divided into 3 or 5 lanceolate toothed lobes.

Spikes axillary, interrupted, shorter than the leaves, usually glabrous, the flowers in distant pairs.

Bracts at first ovate acute, and imbricate, but falling off at a very early stage.

Perianth glabrous, about 3 lines long.

Filaments broad, attached to about the middle of the claws.

Ovary glabrous; style short.

Follicle acuminate, about 1 inch long.

Seed flat, the nucleus about 4 lines long, with a terminal wing at least as long. See also Meissner, in DC. *Prod.* xiv, 423. (B.Fl. v, 411.)

Var. *fissifolia* F.v.M. in Fragm. v., 153, with trifid or pinnatifid leaves, with the margin remotely serrate, cannot be separated from the normal form, leaves of all these shapes occurring on the same tree. The name cannot be retained.

Botanical Name.—Robert Brown gives the derivation of *Orites* in describing the genus. It is from the Greek *Oreites* = monticola (Latin), for, said he, "these shrubs (*O. excelsa*, a large tree, had not then been discovered) grow on the highest mountains" (in Tasmania). *Excelsa* is a Latin word meaning noble or stately.

Vernacular Names.—The name "Prickly Ash" which appears to be more in use in the Dorrigo than anywhere else, refers to the serration of the leaves; the name Ash is unfortunate. "Silky Oak" is in reference to the Oak-like grain of the wood, which often has a silky sheen; it was first applied to *Grevillea robusta*, which has a very similar timber. It is sometimes known as "Cooper's Oak" for obvious reasons.

Leaves.—Robert Brown (*Proteaceæ Novæ*, p. 31), speaks of the "Glandulae cutaneae" as only on the under side of the leaf in *O. diversifolia*, *revoluta* and *excelsa*; in *O. excelsa* broader than long; in *O. acicularis* scattered over the terete leaves.

Simple leaves on the flowering branches from Tintenbar are as much as 10 inches long. The plate indicates the protean shapes of the leaves, the lobed forms being common on the barren branches. Many plates would be required to show its variability.

Exudation.—In cavities of this timber considerable deposits of a whitish substance are frequently found, and it is objected to by sawyers because it dulls the saws. It has been chemically examined by Mr. H. G. Smith.* He found a remarkably large percentage of Alumina in the ash, which is the more remarkable because Aluminium is a rare constituent of plants according to previous researches, and it had never before been found except in small quantities in any important tree.

Reference has already been made (under *Grevillea robusta*. See Vol. I, p. 5, and Vol. II, p. 183, of the present work).

Timber.—The timber is pale coloured, with the usual figuring of a Proteaceous timber. It so resembles in appearance the better known "Silky Oak" that I cannot tell the difference, and, as far as I am aware, one may be fairly substituted for the other, as indeed it usually is. Reference to *Grevillea robusta* timber (Vol. I, p. 4, of this work) will therefore be useful. So far as New South Wales is concerned, *Grevillea robusta* of spontaneous growth is very much less common than *Orites excelsa*, but the former is so extensively cultivated, both for pot culture and as an avenue and garden tree, that it is very much better known than the latter.

Mr. Robert Kaleski, then of Mountain Top, Dorrigo, thus speaks of it:—

Timber sound but rarely straight or big enough for mill; like all oaks splits on the quarter. Makes fair rails and sometimes shingles. Trees on the same acre of ground vary very much in durability. Bad burner; timber pink with cross grain. Grows all over Dorrigo in fair land. Hard to chop green on account of woolly grain, chip having to be wrenched.

When in the Dorrigo in 1893, I wrote as follows, but since then the forest has been largely destroyed for agricultural purposes:—

"I can best describe the timber of *Orites excelsa* by saying that at present I do not know in what respect it differs from that of *Grevillea robusta*, the true "Silky Oak." As that valuable timber is now

* "Aluminium the chief inorganic element in a Proteaceous tree, and the occurrence of Aluminium Succinate in trees of this species." (*Proc. Roy. Soc. N.S.W.* xxxvii, 107 [1903]).

comparatively scarce. I believe that *Orites excelsa* will prove in every respect an efficient substitute for it, and the quantity of mature timber available in the Dorrigo at the present time will probably be sufficient for the Colony's needs for many years to come, without making any allowance for the natural reproduction of the plant."

Almost an unlimited supply in Mt. Royal and Carrow Forest Reserve. Locally known as Coopers' Oak. (Singleton District).

Suitable for tallow-casks, as oregon and other timbers turn the tallow black. Useful for railway car-lining, housework, 30 years in use. (Bolivia).

Like other Silky Oaks, it does not last well in the ground, but it is invaluable as a furniture wood.

Size.—It is a large tree, one of few of the Proteaceæ which attain the magnitude of first-class trees. It has been recorded as 100–120 feet on the Dorrigo. Upper Gloucester 70–80 feet high, 14–15 inches in diameter (Rudder).

Habitat.—The type came from near the source of the River Hastings, New South Wales, and it was collected by Charles Fraser in 1818. This was on Oxley's 2nd Expedition; see "Journal of two Expeditions, &c." At page 314, when on the Upper Hastings, he says, "The valleys and hills are astonishingly rich in timber of various kinds, many new, and their botanic supplies were inexhaustible. Indeed, our cargo now principally consists of plants."

The localities given in the *Flora Australiensis* are:—

1. Deep shaded forests at the sources of the Hastings River, *A. Cunningham* (Robert Brown attributes the plant to Fraser).

2. Macquarie River, *Fraser*. (The Macquarie is an impossible locality, being an interior river. Port Macquarie is doubtless meant, which is at the mouth of the Hastings River.)

3. Tweed, Richmond and Clarence Rivers, *C. Moore*.

It is in the Sydney Herbarium from the following localities:—

Stroud district; also Upper Gloucester River (A. Rudder).

"Piri Brush" (Leichhardt). The clue to this is another label of Leichhardt on a specimen of *Polyosma Cunninghamii*, which reads, "Brushes of Piri, Mt. Royal, Coora Creek, January 29th, 1843." This is doubtless Upper Hunter. Under *Polyosma Cunninghamii*, page 13, Part LI of the present work, I stated that I did not know where "Brush of Piri" was.

Hastings River (G. R. Brown); Dorrigo (J.H.M.); Surface Hill, *via* Tenterfield (Armstrong Bros. and Rand); Mullumbimby, Brunswick River and Tintenbar (W. Baeuerlen); Acacia Creek and Macpherson Range generally (W. Dunn).

It extends, therefore, from the Hunter River district to southern Queensland. In the latter State Mr. F. M. Bailey gives it from Mount Mistake. I have found it on the Macpherson Range within Queensland territory. It is found in New South Wales on tablelands and mountain slopes at an elevation of 2,000–3,000 feet, in rich volcanic soil.

Of the seven species of the genus, four are endemic in Tasmania, one (*lancifolia*) occurs in the Alps of Victoria and New South Wales, and on Bimberi Peak, Upper Cotter River, at a height of 6,200 feet, while *O. excelsa* is the only species which occurs in warmer climes, being found in north-eastern New South Wales and extending into Queensland. A seventh species (*O. fragrans*), described by Mr. F. M. Bailey, is a tall shrub or small tree found on the highest peaks of the Bellenden Ker Range, northern Queensland.

Prof. A. J. Ewart in his "Plants indigenous to Victoria," Vol. ii, plate lxxii, figures Mueller's plate of *O. lancifolia*. The reference in Fragm. vii, 133, is "*Orites lancifolia* is figured in the *Plants of Victoria*, plate 72."

EXPLANATION OF PLATE 214.

A. Flower-spike and leaf.

B. Individual bud.

C. Flower.

D and D 1. Petals, with stamens.

E. Pistil with glands at the base.

F. Glands only, enlarged.

G. Tip of flowering spike much enlarged to show—

(*a*) Buds.

(*b*) Bracts.

H. Fruiting twig.

I. Winged seed.

K. Leaf showing variation in shape, from Dorrigo.

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M. Flockton, del et lith.

PRICKLY ASH OR SILKY OAK.

(*Orites excelsa* R.BR.)

No. 210.

Eucalyptus Baueriana Schauer.

The Blue Box.

(Family MYRTACEÆ.)

Botanical description.—Genus, *Eucalyptus*. (See Part II, p. 33.)

Botanical description.—Species, *E. Baueriana* in Walpers' *Repertorium* ii, 924, Suppl. i (1843).

The original Latin description will be found in Part XIII, p. 120, of the present work.

It may be described in the following words:—

A tree of medium size with rough dark bark on the trunk and ultimate branchlets. With a rounded head of dense foliage.

Juvenile leaves from nearly orbicular to broadly lanceolate in shape, dark green on both sides, thin, margin undulate, the intramarginal vein at a very considerable distance from the edge, venation almost triplinerved at the base, distant from each other, and spreading.

Mature leaves ovate to nearly rhomboid-ovate, shortly acuminate, margins undulate, venation rather distant from the edge, subtriplinerved, venation spreading, rather thin in texture. Lamina 2–2½ inches long, 1–2 broad, with a peduncle of 3–4 lines.

Flowers five to seven in the axils of the leaves, the buds tapering gradually into the very short pedicels, the opercula conical and pointed, the anthers very broad, truncate, and sometimes so widely opened as to almost lose the appearance of pores terminally dehiscing. (Here we have evidence of transit between the Eucalypts with truncate anthers and the *E. hemiphloia* group of anthers.)

Fruits conoid, often widened at the flat, thin rim, capsule sunk.

Variety.

Variety *conica* Maiden (*E. conica* Deane and Maiden).

This variety will be illustrated by a special plate in the next Part (LVIII). Intermediate forms between the normal form and its variety have been noted at the following places:—

1. Banks of the Lachlan (Cowra district); also Morongle Creek near Cowra.

2. Tingha and Bolivia.

3. Acacia Creek, Macpherson Range, and Wallangarra (both on the New South Wales-Queensland border).

It will be more convenient to speak of the form and its variety when the variety has been illustrated and described.

Botanical Name.—*Eucalyptus*, already explained (see Part II, p. 34); *Baueriana*, in honour of Ferdinand Bauer, who collected it in the Port Jackson district and whose original specimen is in the Vienna Herbarium, where it was described by Schauer. For the botanical investigation of Australia, 1800–1804, Sir Joseph Banks sent out Robert Brown as botanist, and Ferdinand Bauer as botanical draughtsman, who was a most distinguished worker in that field. He was born at Feldsberg, Austria, 20th January, 1760, and died at Hietzing, near Vienna, 17th March, 1826. He did a large amount of work for Sir Joseph Banks, but must not be confused with his brother Franz, even more distinguished as a botanical draughtsman, and who also worked much for Sir Joseph Banks. The latter was, by King George the Third's sanction and through the liberality of Banks, appointed botanical draughtsman to the Royal Gardens at Kew, a post he held for fifty years, and there he died. Full particulars of both the Bauers will be found in my " Sir Joseph Banks; the Father of Australia " (1909).

See also a note by Mr. James Britten on the drawings of plants by Ferdinand Bauer in the British Museum in the *Journal of Botany* for April, 1909, p. 140.

Vernacular Names.—" Blue Box " is the commonest, and almost universal name, owing to the peculiar blue cast of the foliage. It is called " Cabbage Box " in eastern Gippsland because of the round-headed, dense-foliaged appearance of the younger trees. I have heard it called " Apple Box " in the same locality.

It is said to have been known as " Lignum-vitæ," certainly a most inappropriate name, for one fails to see what character our timber and Lignum-vitæ have in common. The name would be much more appropriate to *E. polyanthemos* Schauer, our Red Box.

In all my travels I never heard our tree (*E. Baueriana*) called Lignum-vitæ except in Sydney. As it does not appear to be widely used, and to have helped to cause confusion, it might be dropped.

Aboriginal Names.—George Caley (collector for Sir Joseph Banks, 1800–10) gives the name of this species in the Sydney district (Counties of Cumberland and Camden) as " Nettaring " Box or " Berryergro." Later on Sir William Macarthur gives the name " Boorrayero-Gourroo " as the equivalent of the " True or Yellow Box of Camden." It is probable that " Berryergro " and " Boorrayero " are the same name, though what Macarthur's " True or Yellow Box of Camden " is, is uncertain, as herbarium specimens were not always carefully preserved in the early days. In the present work (vol. I, 131), I have identified a specimen as *E. hemiphloia* F.v.M., and the name, as used by the blacks, may prove to be more or less synonymous with the name " Box " as used by the early colonists. The matter may perhaps be cleared up as additional herbarium specimens collected by Sir William are discovered.

Synonyms.—1. *E. polyanthemos* Benth. non Schauer. *E. polyanthemos* and *E. Baueriana* were confused both by Bentham and Mueller.

2. *E. Fletcheri* R. T. Baker, *Proc. Linn. Soc., N.S.W.*, xxv, 682 (1900)

Following are some points in which *E. Baueriana* and *E. polyanthemos* Schauer differ:—

(*a*) The bark of *E. Baueriana* is fibrous, "fuzzy," or woolly; that of *E. polyanthemos* being, as a rule, ribbony rather than Box-like.

(*b*) The wood of *E. Baueriana* is pale brown, and that of *E. polyanthemos* red.

(*c*) The leaves of *E. Baueriana* are thinner, and the rim of the fruit likewise thinner, than that of *E. polyanthemos*.

Leaves.—The blue-green of the leaves is worthy of special note.

Bark.—The bark is rough to the ultimate branchlets.

Timber.—A few notes will be found under Habitat. It is a pale coloured timber, brownish in contradistinction to that of *E. polyanthemos*, which is red.

It is a very durable timber, posts in buildings on the South Coast having been found to be sound after more than forty years (R. H. Cambage).

This durability extends also to its fire-resisting qualities. Mr. G. R. Cherry, a former inspector for the Fire Underwriters' Association of New South Wales, as the result of some tests that he employed, found the present timber to be the best fire-resister, being even better than Turpentine (*Syncarpia laurifolia*) in that respect.

The durability in the ground, taken in conjunction with its resistance to fire, renders it almost an ideal timber for fencing purposes. Land-owners having clumps of these trees on their property should think twice before destroying them. Small and middle sized trees are objects of beauty, and should have some consideration on that account.

Size.—It is a tree of medium size, not one of the largest of the Eucalypts. It attains a height of, say, 70 feet, and a stem diameter of 3 feet.

Habitat.—It is impossible to absolutely define the range of this species, as regards the normal form, as it imperceptibly runs into a variety *conica*, which will be dealt with in the next Part.

It extends from eastern Victoria, along eastern New South Wales, to southern Queensland. It has been found in eastern New South Wales as far north as Singleton, and then it has been recorded from the head-waters of the Macleay, near Uralla. Then there is a great gap until New England, at the Queensland border, is reached. It is obvious that connecting localities require to be searched for.

VICTORIA.

E. polyanthema.—Of this type there are two varieties, which, however, are not sufficiently marked to justify me in separating them, as I have done in other cases. Where it occurs in the littoral districts, as, for instance, at the Lakes' Entrance, or river flats at Heyfield or Bruthen, it has full foliage of a rather dark green colour, and the leaves somewhat thin in texture. The tree grows to some size, but in many cases, as Baron von Mueller has already pointed out, become so hollow as to form a mere shell. (A. W. Howitt in "The Eucalypts of Gippsland," *Trans. Roy. Soc. Victoria*, ii, 96 (1890).

Later on I was able to convince Dr. A. W. Howitt of the validity of *E. Baueriana* in contradistinction to *E. polyanthemos*. The previous paragraph refers to the former.

Dr. Howitt deserves the credit of working out the range of *E. Baueriana* in Gippsland. In that portion of Victoria it is known as "Cabbage Box." It occurs about Metung, Nowa Nowa (an arm of Lake Tyers), Heyfield, and Bairnsdale, on the littoral strip about the Lakes' Entrance, also on river flats only. It does not occur in South Gippsland.

I found it called "Apple Box" around Metung, and have received it from the Werribee River from the late C. Walter.

New South Wales.

Southern Localities.—George's River (collected by Robert Brown, 1802–5). Distributed from the British Museum at least as early as 1876, under the number 4,734, under the name of *E. subrotunda*, and also that of *E. polyanthemos* Schauer.

Grose River and banks of Nepean River, near its confluence with the Grose. Robert Brown collected here about May, 1803, and January, 1805. Mr. R. H. Cambage and I collected it here.

North Richmond, near the Hawkesbury Agricultural College (C. T. Musson). Richmond (W. Woolls). Dr. Woolls always called it Lignum vitæ or Poplar-leaved Box. The three last localities are near to each other.

Penrith (J.H.M. and J. L. Boorman). St. Mary's, South Creek (R. T. Baker). Type of *E. Fletcheri*.

All the above localities are Sydney to the Blue Mountains.

"Blue Box," Bankstown and Cabramatta (J.H.M. and J. L. Boorman); Liverpool (H. Deane); Edensor Park, Liverpool (J.H.M.); Glenfield to Minto and George's River (J. L. Boorman).

Cobbitty, Banks of Nepean, near Camden (J.H.M. and R. H. Cambage).

Thirlmere (W. Cuneo). Co-type of *E. Fletcheri*. Also collected by R. H. Cambage. Milton (R. H. Cambage), who furnishes the note: "Bark rough up to ultimate branchlets." Mr. J. S. Allen, Inspecting Forester of the district, says that it occurs from Milton to Eden.

I collected it about Pambula. At the saw-mill there it is known as "Black Box," because of the dark foliage of the tree. The timber is much valued locally, though in this district it is rare to get a log large enough for milling purposes.

The rough bark is up to the ultimate branchlets. It is hard to grub out, and it suckers badly. It seems to be usually found in good land. It also goes by the name of "Round-leaf Box," "Broad-leaved Box," and "Brown Box."

Wolumla (A. W. Howitt); Moruya (E. Breakwell); near Cobargo (W. Dunn).

The above four are localities south coastal from Sydney.



M. Floekton, del. et lith.

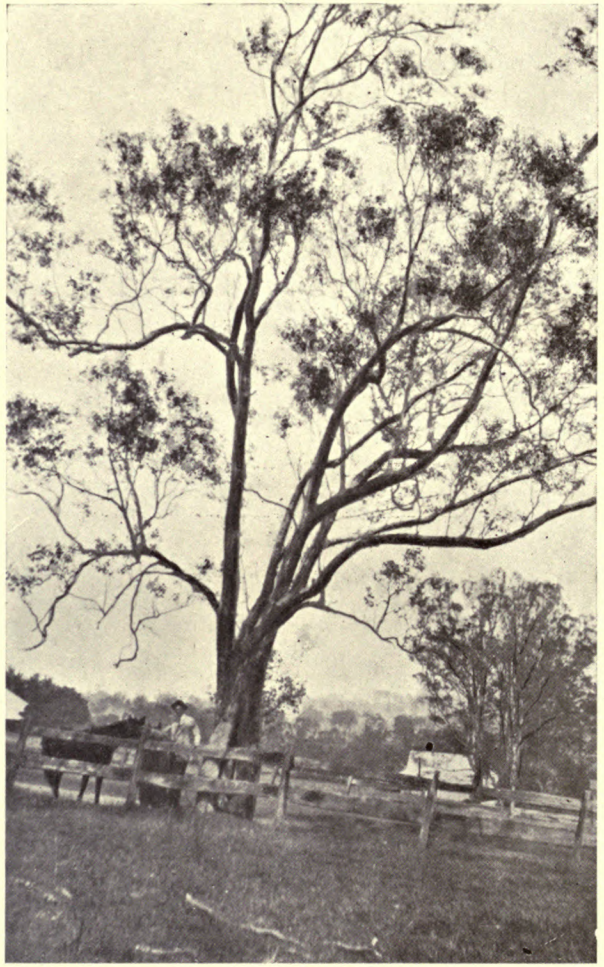
BLUE BOX.

(Eucalyptus Baueriana SCHAUER.)



R. H. Cambage, June, 1913.

Eucalyptus Baueriana. COBBITTY. N.S.W.



R. H. Cambage, December, 1913, *photo.*

Eucalyptus Baueriana. MILTON, N.S.W.

1522

Northern Localities.—Putty, *via* Singleton (A. C. Barwick, through R. T. Baker).

Enmore, 18 miles east of Uralla, Head-waters of the Macleay River. "On Silurian (?) slate formation, 3,300 feet above sea-level, greatest elevation known to me for this species" (R. H. Cambage, No. 3,776).

Acacia Creek, Macpherson Range. Here both the normal form and variety *conica* are found (W. Dunn).

Jennings or Wallangarra (J.H.M. and J.L.B.). Abundant in district and extending into Queensland as far as followed. Both the normal form and variety *conica* are found here.

The above two localities are both sides of the New South Wales-Queensland border.

QUEENSLAND.

"A Box-tree growing 13 miles out from Stanthorpe with bark like *hemiphloia*, and continuing rough out to the young limbs. Timber very hard. Fruits very large." Intermediate between the normal form and variety *conica* (A. Murphy).

There is no authority whatever for the statement that *E. Baueriana* is a tropical species.

EXPLANATION OF PLATE 215.

A. Sucker leaf from Thirlmere.

B. Flowering twig.

C. Fruits from Stanthorpe, Q.

PHOTOGRAPHIC ILLUSTRATIONS.

1. Trunk of tree, Nepean River, near Cobbitty, New South Wales, to show texture of bark.
2. To show habit of rather a large tree. When the tree is small, it is remarkably bushy Milton, New South Wales.

Both photographs by Mr. R. H. Cambage.

No. 211.

Acacia floribunda Sieb.

Sally.

(Family LEGUMINOSÆ : MIMOSÆ.)

Botanical description.—Genus, *Acacia*. (See Part XV, p. 103.)

Botanical description.—Species, *A. floribunda* Willd., *Species Plantarum* iv, 1051 (1805).

Then we have DC. Prod. ii, 454 (1825), who quotes Willdenow and gives the following :—

Phyllodiis lineari-lanceolatis utrinque attenuatis integerrimis tenuiter 3–5 nerviis, spicis axillaribus solitariis simplicibus, calyce sinuato-4-dentato . . . . Pet. 4 basi coalita, apice reflexa. Ovarium subsericeum.

This is translated as usual by G. Don, " A General History of the Dichlamydeous Plants " . . . ii, 407 (1832), in the following words :—

Phyllodia linear-lanceolate, attenuated at both ends, quite entire, with 3–5 fine nerves; spikes axillary, solitary, simple; calyx sinuately 4-toothed. Native of New Holland, on the east coast. . . . Petals 4, joined at the base, reflexed at the apex. Ovary rather silky.

Then Mueller in " Plants Indigenous to the Colony of Victoria," ii, 31, makes the species his fourth variety of *A. longifolia*, as follows :—

4. *Acacia floribunda*, Willd. Sp. Plant. iv, 1051; Benth. in Hook. Lond. Journ. i, 371; *A. angustifolia*, Lodd. Bot. Cabin. t. 763; *A. intermedia*, A. Cunn. in Bot. Mag. t. 3203; *Mimosa floribunda*, Vent. Choix, t. 13. In the colony of Victoria observed on the River Tambo; found in various parts of New South Wales, extending to New England and the frontiers of Queensland. The phyllodia narrower than in *A. longifolia*, generally of thinner consistence, more closely streaked and with less prominent primary nerves; the marginal gland obliterated; the spike short-peduncled, with slender rachis and mostly remote flowers; the bracteoles very caducous or diminutive; the pods of less hardness.

In *B.Fl.* ii, 398, Bentham follows Mueller (*Pl. Vict.* ii, 31) in reducing *A. floribunda* to a variety (*floribunda*) of *A. longifolia* Willd. in the following words :—

Phyllodia linear or linear-lanceolate, usually narrowed at the end or acute, 3 to 4 or even 5 inches long, less coriaceous than in the preceding forms, the smaller veins less anastomosing and passing into long parallel veins scarcely finer than the principal nerve.

This action on Mueller's part, especially as it was adopted by Bentham, has for many years been accepted, but there is no doubt that *A. longifolia* and *A. floribunda* are distinct species, in spite of the fact that the structures of the flowers in the two species resemble each other very closely.

The habit of the two species is different, *A. longifolia* being a somewhat spindly shrub, with comparatively broad phyllodes and intensely yellow flowers. *A. floribunda* has narrower phyllodes, is more bushy, and even attains the size of a small tree. The young growth of *A. floribunda* has a clothing of very fine hairs, not seen except by magnification.

Since Part LVI was written, I am indebted to Prof. A. J. Ewart for the loan of a copy of Mueller's "Plants Indigenous to the Colony of Victoria," Vol. ii, of which only pages 25 to 32 appear to be extant, and copies of these pages are excessively rare. The imperfect work is quoted by Bentham in the *Flora Australiensis*.

Following is the description of *Acacia longifolia*, which is worthy of quotation because of the difficulty of obtaining access to it:—

Acacia longifolia Willd. Spec. Plant. iv, 1052; Bot. Regist. t. 362; Lodd. Cabin. t. 678; Bot. Magaz. t. 1827 and 2166; Maund's Botanist, iv, 197, xii, 269; Turpin, Dict. Scient. Nat. t. 259; Benth. in Hook. Lond. Journ. of Bot. i, 373; *Mimosa longifolia*, Andr. Rep. t. 207; Vent. Malmais. t. 62; Kern. Hort. t. 177; *A. intertexta*, Sieb. in Cand. Prodr. ii, 454; *A. obtusifolia*, All. Cunn. in Field's New South Wales, 345.

Shrubby or arborescent; branchlets very angular; stipules minute, semilanceolate, extremely fugacious; *Phyllodia elongate and narrow oblong-lanceolate, almost straight, with two or three primary somewhat prominent and several thinner secondary vein-like nerves*, imperfectly and distantly reticular-venulose, glabrous; marginal gland conspicuous, above the base or from it somewhat remote; *spikes rather laxly many-flowered*, solitary, geminate or ternate, sessile; *calyx broader than long, as well as the minute roundish or rhomboid sessile bracteole much shorter than the four-cleft corolla*, quadrifid or four-toothed or subtruncate; pods thin-cylindrical, almost straight, rostrate, rigid-coriaceous; bivalved, inside continuous, between the seeds slightly or hardly contracted; seeds placed lengthwise, shining, brown-or intense-black, oval, with large lateral areoles; strophiole livid, somewhat cupular, oblique- and short-bilobed, clasping the base of the seed, confluent with the short funicle.

In forest-valleys of the eastern part of Gipps Land; extending thence through New South Wales.

A very tall shrub or small tree. Phyllodia thin-coriaceous or subchartaceous, when well developed 3–8 inches long, 4–12 lines broad, rarely longer or broader, saturated-green-somewhat shining, usually blunt, not closely streaked, terminated by a minute curved tabescent apiculum. Petioles attaining the length of 3 lines, usually, however, shorter or quite obliterated. Spikes fragrant, 1–2 inches long, comparatively slender; the single flowers before expansion not closely packed, but leaving little interstices between them. Rachis glabrous. Bract at the base of the spike semiovate, concurved, about 1 line long, dropping. Bracteoles often shorter than the calyx, dense- and short-ciliolate. Calyx $\frac{1}{5}$–$\frac{1}{3}$ line long; teeth usually deltoid, as long as or shorter than the tube or evanescent, glabrous or ciliolated. Corolla deeply four-cleft, glabrous, about 1 line long. Ovary velvet-downy. Pods $1\frac{1}{2}$–$4\frac{1}{2}$ inches long, $1\frac{1}{2}$–2 lines broad, squalid-brown; valves rather hard, not prominently margined, sometimes very scantily appressed-hairy. Seeds $1\frac{1}{2}$–2 lines long; their areolar lines indicated by paler colour. Strophiole conspicuous, occasionally truncate, partially formed by the closely conduplicated funicle.

The bark of this species is used in tanning; the seeds were formerly used for food by some of the native tribes

The description here furnished is intended for the typical form of *A. longifolia*. It would appear, however, that the following plants can merely be regarded as varieties of this species; for although intermediate forms clearly connecting them are not always known, it must nevertheless be admitted that their distinctions rest on so trifling characters as to render it, judging from analogy and considering the effect of locality on the different forms, much more advisable to arrange them under *A. longifolia* as varieties, than to vindicate their specific differences.

The forms which he arranges under *A. longifolia* as varieties are :—

1. *A. Sophoræ* R.Br.
2. *A. phlebophylla* (*A sophoræ* var. *montana* F.v.M.).
3. *A. alpina* F.v.M.
4. *A. floribunda* Willd.
5. *A. mucronata* Willd.
6. *A. linearis* Sims.

He concludes as follows :—

It thus appears, as far as the material available on this occasion permits us to ascertain, that *A. longifolia*, in a wide range over climatically and geologically very different localities, assumes forms as discrepant as those of *Dodonaea viscosa* and several other highly variable and extensively distributed species. *A. glaucescens*, Willd. Sp. Plant. iv, 1052, from New South Wales and Queensland, of which *A. Cunninghami* and probably also Wendland's *A. homomalla* form varieties, differs from *A. longifolia* in more or less falcate phyllodia, which are closely streaked by subtle secondary nerves and produce a basal not very conspicuous gland, in an usually five-toothed calyx and thus five-cleft corolla, in slightly compressed pods and deep-yellow strophioles. This plant may perhaps exist amongst the subtropical plants of Eastern Gipps Land. The structure of the flowers of *A. longifolia* reminds of that of *A. Riceana*, a species in most other characters widely distinct

Taking the forms he then looked upon as varieties in order, we have :—

1. *Acacia Sophoræ* R.Br. in Hort. Kew. ed. ii, vol. v, 462; Loddig. Cabin. t. 1351; Benth. in Hook. Lond. Journ. of Bot. i, 372; J. Hook. Fl. Tasm. i, 110; *Mimosa Sophoræ* Labill. Nov. Holl. Plant. Specim. t. 237. Restricted to the coast, where on sand-ridges it is abundant from the eastern extremity of the Great Australian Bight along the shores of South Australia, Victoria, Tasmania, New South Wales, and the southern part of Queensland. The phyllodia are rather shorter, comparatively broader, lanceolate-oblong, generally of thicker consistence, when well developed often only 2–3 inches long, and fully 1 inch broad, although not unfrequently also longer and narrower; their veins form generally a more complete network; the pods are frequently arched.

[See Part LVI, p. 127.]

2. *Acacia phlebophylla* (*A. sophoræ* var. *montana*, F.M. in Proceed. Linn. Soc. iii, 138). In deep fissures of huge granite boulders at 3,000–4,000 feet elevation on the Buffalo Ranges. The phyllodia are thick-coriaceous, shining, oval-oblong or obovate, generally provided with a conspicuous stout petiole, copiously prominently and regularly net-veined and sometimes fully 2 inches broad; the young shoots are somewhat viscid; the pods are at least often if not always distinctly compressed and attain thus a width of nearly ½ inch. But *A. salicina* exhibits still greater inconstancy in the breadth of its legumina.

[See B. Fl. ii, 398.]

3. *Acacia alpina* F.M. Fragm. Phyt. Austr. iii, 129. On the alpine summits of Mount Useful and on the northern plateau of Mount Wellington. A shrub from a few to several feet high; branchlets almost two-edged; phyllodia coriaceous, remarkably short, inaequilateral, cuneate- or roundish-obovate, oblique ⅔–1⅓ inch long, regularly and closely but finely net-veined; the short-pedunculate spikes are reduced to extreme shortness, ½ inch or often less long, and are thus producing often but few and never numerous flowers; the bracteoles comparatively larger and less densely ciliated; the pods arched.

This is looked upon by Bentham as a distinct species in B.Fl. ii, 397.

4. *Acacia floribunda* Willd. Mueller's observations will be found at page 154 of the present Part.

5. *Acacia mucronata* Willd. Mueller's observations will be found at page 159 of the present Part.

6. *Acacia linearis* Sims. This form is now recognised as too distinct to be considered as a form of *A. longifolia*, and it will be dismissed for the present.

Vernacular Name.—It usually goes under the name of "Sally." Sometimes called "White Sally" (Sally being a corruption of "Sallow," an English name for a Willow), as it is more or less pendulous in habit. The name Sally or Sallow was of very frequent application to native trees in the County of Cumberland in the earliest days of settlement.

Aboriginal Name.—Called "Marrai-uo" by the aborigines of the Illawarra, New South Wales, according to the late Sir William Macarthur.

Synonyms.—(1) In Loddiges' *Bot. Cab.* t. 763 (1823) *Acacia angustifolia* is stated to have "some resemblance to the *floribunda* of Ventenat." The figure is not a good one, with phyllodes 4 cm. long and very narrow. It is hard to say what the original was, but no one can dispute Bentham's suggestion that it is *A. floribunda*.

(2) De Candolle (*loc. cit.*) gives:—

(*a*) *Mimosa floribunda* Ventenat, *Choix des Plantes* t. 13. (This work is not in any Sydney library.)

(*b*) *A. longifolia* Sieb. *pl. exs.* n. 440.

If the same work and same page be referred to we note under *A. longifolia* Willd. the synonym:—

A. floribunda Sieb. pls. exs. nos. 438 and 439. In other words, Sieber, in naming his collections, transposed Willdenow's two species, *longifolia* and *floribunda*.

(3) *A. intermedia* A. Cunn. in *Bot. Mag.* t. 3203. Bentham adds "with broader phyllodia," but I do not agree. I would say that the average phyllode of *A. floribunda* is not narrower than that of the plate of *A. intermedia*.

(4) *A. decussata*, Tenore, *Cat. Hort. Neap.*, 77 (according to Bentham).

Bark.—A specimen was obtained from Cambewarra, N.S.W., in August, 1886, and examined by me with the following result in April, 1890:—Tannic acid, 6·09 per cent.; extract, 14·95 per cent. It was from trees 20 to 50 feet high, locally known as "Sally," or "Sallow." The bark is very like that of the normal species, but from an older tree, and also full of fibre. A specimen of "Sally" from Bolong Swamp, Nowra, collected in July, 1888, and analysed also in April, 1890, gave only 2·54 per cent. of tannic acid, with 13·07 per cent. of extract. It is a useless, fibrous bark, yielding a substance like chopped grass when passed through the mill. It was from trees 20 to 40 feet high, with diameter of 6 to 18 inches, and grown on alluvial soil, which the species in general usually favours. The barks were collected by Mr. Bacuerlen, and do not promise much to the tanner.

Timber.—The earliest published account of the tree is the following passage :—

"Marrai-uo" of the aborigines of the Illawarra and "Sallow" of the colonists. A tall-growing species (40–80 feet, with 12–24 inches diameter) with very long (*sic*) phyllodia, beautiful when young. Its wood much prized for axe helves, or other purposes requiring lightness combined with toughness and strength; of considerable beauty in grain and colour (*sic*), and likely to be valuable to the cabinet maker and turner. (No. 59 of Sir William Macarthur's Woods in *Cat. N.S.W. Exhibits, Paris Exh.*, 1855.)

Mr. G. R. Brown, formerly of Port Macquarie, informed me that the wood was employed for turnery, but I cannot ascertain that, as a general rule, the timber is much used except for fuel.

Size.—A tree of moderate size. I have seen it from 20 to 50 feet, but not such large ones as those recorded by Sir William Macarthur. Up to 30 feet or more it is usually very bushy.

Habitat.—In the *Flora Australiensis* (B.Fl. ii, 398), the following localities are given :—

Port Jackson to the Blue Mountains, *R. Brown, Sieber*, n. 440, and others, northward to New England, *C. Stuart*; Clarence River, *Beckler*; and southward to Tambo River, Victoria, *F. Mueller*.

Extended collecting shows that it occurs in Queensland, so that its range is from Gippsland, from end to end of New South Wales (coastal strip and tablelands) to southern Queensland.

It has a partiality for creek and river banks. Some specific localities are as follows :—

VICTORIA.

Snowy River, East Gippsland (C. Walter).

NEW SOUTH WALES.

Southern Localities.—Eden to Pambula (J.H.M.); Mogo, Bateman's Bay (W. Baeuerlen); Argyle County, N.S.W. (probably Mitchell); Nattai River near Hill Top (E. Cheel); Nattai River, between Picton and Burragorang (J.H.M.); Braemar near Mittagong (J.H.M.); Bent's Basin, Nepean River (E. Cheel and J. L. Boorman); Leumeah, George's River, 8–12 inches diameter (J. L. Boorman).

Sydney Localities.—Penshurst, George's River (J.H.M.); Lane Cove (W. Forsyth); Hornsby, narrow, stunted shrubs, 4 feet high (W. Blakeley); Kogarah (J. H. Camfield); and Port Jackson and Greater Sydney generally.

Western Localities.—Banks of Nepean, near Penrith (J.H.M.); Grose River (J.H.M. and R. H. Cambage).

Northern Localities.—Woy Woy. Has been in flower six weeks (19th September) and looks as bright as ever (A. Murphy); Stroud (Sydney Dodd); Bowman River (Jesse Gregson); Beechwood to Rollands Plains, Hastings River (J. L. Boorman); Port Macquarie (G. R. Brown); Kempsey (R. Helms); In thick scrub. Height 30 feet, diameter 4–6 inches. "The prettiest of the Bellinger Wattles, not plentiful."

Bellingen (E. H. F. Swain); Dorrigo (J. L. Boorman and W. Heron); Tyringham, Armidale-Dorrigo Road (J.H.M.); New England (C. Stuart); Woolgoolga (E. H. F. Swain); Evan's River. Height 20–40 feet, diameter 6–12 inches. (W. Baeuerlen); Wilson's Downfall, No. 2,824 (R. H. Cambage).

QUEENSLAND.

On the river at Paddy's Flat near Killarney (W. Dunn); Stanthorpe. In river bed, 6–10 feet high (J. L. Boorman).

Following are two other Acacias looked upon by Bentham, following Mueller, as forms of *A. longifolia*, and not previously dealt with, to which I shall briefly allude :—

(1) var. *mucronata*, F. Muell., *Pl. Vict.* ii, 31. Phyllodia linear-oblong or linear-spathulate, often very narrow, but coriaceous and obtuse, scarcely veined besides the 3 to 5 rather prominent parallel nerves, mostly 1½ to 2½ inches long, 1 to 3 lines broad.—*A. mucronata*, Willd. *Enum. Hort. Berol. Suppl.* 68 name only); Wendl. *Comm. Acac.*, 46, t. 12; *DC. Prod.* ii, 454; Bot. Mag. t. 2747; Hook. f. Fl. Tasm. i, 110; F. Muell. Pl. Vict. ii, 31; *A. dependens* A. Cunn.; Benth. in Hook. Lond. Journ. i, 372.—Tasmania, *R. Brown*; common throughout the island, *J. D. Hooker*; also in Victoria on sandy heath-ridges near Latrobe River, Corner Inlet, &c., *F. Mueller.*

Mueller's statement in *Pl. Vict.* is as follows :—

Acacia mucronata Willd. Enum. Suppl. 68; Wendl. Comment. t. 12; Bot. Mag. t. 2747; Benth. in Hook. Lond. Journ. i, 372; J. Hook. Fl. Tasm. i, 110; *A. dependens*, A. Cunn. accord. to Benth. l.c. 372; *A. dissitiflora*, Benth. l.c. 371. On sandy heath-ridges near La Trobe's River, also near Corner Inlet. Not uncommon in New South Wales and Tasmania. Phyllodia smaller and especially narrower than those of *A. longifolia*, sometimes almost linear, 1–3 inches long, 2–5 lines broad, rather stiff, generally less distinctly veined; their gland obliterated; spikes often short-pedunculate with generally more dissite flowers; the rachis often and sometimes also the phyllodia short-downy.

(2) var. *dissitiflora* Benth. Phyllodia often very long and narrow as in *A. linearis*, but rather more coriaceous, with 1 or 2 nerves parallel to the principal one, and continued nearly the whole length of the leaf, connecting in some measure the var. *mucronata* with *A. linearis*.—*A. dissitiflora* Benth. in Hook. Lond. Journ. i, 371.—N. coast of Tasmania.

Hooker, *Fl. Tas.* i, 110, states the position as regards *mucronata* and *dissitiflora* which are inextricably involved, as follows :—

A. mucronata Willd.

var. α with rather narrow, linear spathulate phyllodes, obtuse, and usually 3 nerved=*A. mucronata*, Wendl. *Diss.* t. 12, *Bot. Mag.* t. 2747; Benth. in *Lond. Journ. Bot.* i, 372 (Gunn, 130).

var. β *dependens*. Phyllodes as in α, but broader and multiveined. (*A. dependens* A. Cunn. MS. Benth., l.c.) (Gunn, 202, 480, 678.)

var. γ *dissitiflora*. Phyllodes long, linear-laneeolate, 3–5 nerved at the base. (*A. dissitiflora* Benth., l.c.) (Gunn, 130 in part, also 802.)

Rodway (*Tasmanian Flora*, 42) accepts *A. mucronata* Willd. as a species, and omits reference to *dissitiflora*, probably including it within *mucronata*.

He accepts *A. sophoræ* R.Br. (? Labill.) as a Tasmanian species, and eliminates *A. longifolia* Willd. from the flora of that State.

As regards var. *mucronata* F.v.M. and var. *dissitiflora* Benth. as adopted in B.Fl. ii. 399, I think Rodway's view is probably the correct one, to maintain *mucronata* as a species, and to merge *dissitiflora* in it. Transitional forms are abundant, and a mucrone is frequently absent.

A. mucronata as thus understood, also occurs in Flinders Island and also in Victoria. As regards New South Wales, it has been found on Delegate Hill, near Bombala (W. Baeuerlen), and a form certainly close to it in a very different locality, viz., Ettalong Beach, Newcastle (A. Murphy).

EXPLANATION OF PLATE 216.

A. Flowering twig from Grose River and banks of Nepean River, New South Wales (a collecting place of Robert Brown).

B. Bud. The bract usually found at the base of the flower not seen.

C and D. Flowers.

E. Pistil.

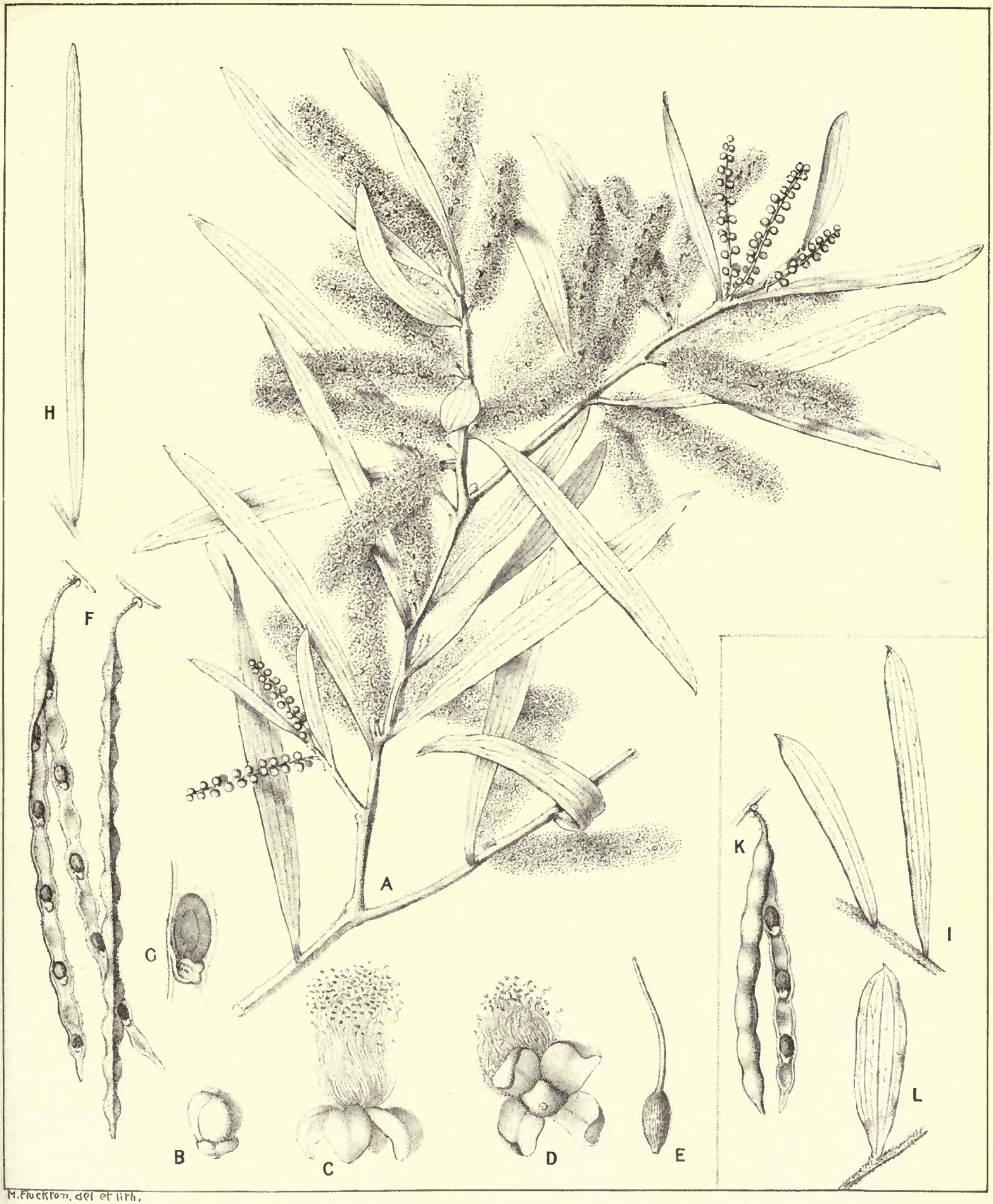
F. Pods from Stanthorpe, Queensland.

G. Seed, greatly magnified.

H. Narrow phyllode from Stanthorpe.
(The young growth of *A. longifolia* var. *floribunda* has very fine hairs upon it, not shown in the plate, and which cannot be shown without magnification.)

I and K. Phyllodes and pods of *A. longifolia* Willd. var. *mucronata* F.v.M. (*A. mucronata* Willd. var. *dependens* Hook. in *Fl. Tasm.*, *A. dependens* A. Cunn. From Archer's Herb. of Tasmanian Plants.)

L. Broad phyllode of *A. mucronata* Willd. var. *dependens* Hook. (Gunn's No. 678.)



M. Flockton, del et lith.

SALLY.

(Acacia floribunda SIEBER.—*A–H.)*

(A. mucronata WILLD.—*I–L.)*

No. 212.

Callicoma serratifolia Andr.

Original Black Wattle.

(Family CUNONIACEÆ.)

Botanical description.—Genus, *Callicoma* Andr. (*Calycomis* R.Br.), in *Bot. Rep.* t. 566 (1809).

The original definition of the genus is as follows:—

Flowers in little round heads, upon foot stalks, with an involucre of about 4 leaves. Calyx of 4 or 5 leaves, the leaflets lanced. Blossom none, stamens from 11 to 19, thrice as long as the calyx, growing from the receptacle. Styles 2, thread-shaped. Stigma simple. Germen above, 1 celled, and many seeded.

Then we have Bentham's description:—

Sepals 4 or 5, free, valvate or the margins slightly imbricate.

Petals none.

Stamens twice as many as sepals, hypogynous; *anthers* ovate, versatile.

Ovary 2-celled or rarely 3-celled, with several pendulous ovules in each; styles distinct, filiform, each with a minute terminal stigma.

Capsule small, separating into distinct carpels opening along the inner edge.

Seeds small, ovoid-oblong, tuberculate; embryo very small, in a somewhat fleshy albumen.

Tree or shrub.

Leaves opposite, simple.

Flowers small, in dense globular heads. (*B.Fl.* ii, 440.)

Botanical description.—Species, *C. serratifolia* Andr., *Bot. Rep.* 6, 566 (1809).

A tall shrub, growing into a tree of 30 to 40 feet, the young shoots often tomentose or villous, the branches soon glabrous.

Leaves from elliptical-oblong to ovate-lanceolate, shortly acuminate, coarsely serrate, 2 to 4 inches long, coriaceous, glabrous and shining above, either white underneath with a minute tomentum, or softly tomentose or villous and more rust-coloured, the parallel pinnate veins prominent underneath.

Stipules ovate, very deciduous.

Flowers numerous, in dense globular heads on peduncles of ½ to 1 inch, of which 2 to 4 are usually on a short common peduncle in the upper axils, and several form a terminal cluster or short panicle.

Sepals and *capsules* not above 1½ lines long, tomentose or villous.

Stamens more than twice as long. (*B.Fl.* ii, 440.)

Botanical Name.—*Callicoma*, from the Greek *kalos*, beautiful, and *kome*, hair, in allusion to the appearance of the heads of flowers; *serratifolia* is from two Latin words meaning saw-tooth leaves (*serrati, folia*).

A figure of the plant is given in Curtis' *Botanical Magazine*, vol. xiii, pl. 1811, where, however, from the imperfect information available at the time, it was described as a shrub 4 feet high. In this work the drawings of the structure of the flower found in Forster's *Characteres Generum Plantarum*, published in the year 1776, plate No. 30, *Cordia* are inadvertently referred to as those of a synonym of our plant. There is a small figure of our plant in G. Don's *Dichlamydeous Plants*, Vol. iii, p. 202.

There is one other species of *Callicoma* found in Australia (*C. Stutzeri* F.v.M., belonging to Queensland), although D. Don's *C. Billardieri* is in the *Index Kewensis* still recognised as distinct. There is one non-Australian species, viz., *C. ternata* Montr., found in New Caledonia.

Vernacular Names.—To the very early colonists it went by the name of Black Wattle, because its young saplings were split for making the rough wattle and daub houses of long ago. It was, in fact, this particular tree that gave the name "Blackwattle Swamp" to what is now a portion of Wentworth Park, between Sydney and the Glebe. The name Black Wattle has, however, for many years been given to an *Acacia;* in fact, many *Acacias* are invariably known as Wattles, an instance of the rare case of complete transfer of a vernacular from one plant to another.

In the Braidwood district it is known as "Coachwood," while we have also heard it called "Native Beech," and even (in the Illawarra) "Rosewood," but all three names are preoccupied and are unsuitable. An intelligent old resident of Mount Victoria called it "Native Quince," and if the fruit, flowers, or foliage resembled in any way that of the quince we perhaps might have adopted the name.

Aboriginal Name.—"Tdgerruing" of the aborigines of County of Camden, according to the late Sir William Macarthur.

Synonym.—*C. ferruginea* D. Don, *Cunon.* II, in *Edinb. New Phil. Journ.*, April to June, 1830, with the leaves softly rusty-tomentose or villous underneath, passes into the common form by every gradation.

Leaves.—The leaves contain saponin according to Greshoff in *Kew Bulletin*. 1909, 404.

Timber.—Close in the grain, works remarkably well to a nice smooth surface. It has no figure to speak of; it is of a pinkish colour when fresh. It is used sometimes for wheelwrights' work, but it is never large enough for anything of much size. It requires very careful seasoning to avoid splitting.

In spite of its name of "Coachwood," I have never been able to learn that it has been used in the direction indicated. The wood of young saplings splits easily in very thin strips for wattling, and was used for basket-making in the early days.



M. Fluekiger, del et lith.

ORIGINAL BLACK WATTLE.

(Callicoma serratifolia ANDR.)

Size.—A tall bushy shrub or small tree. Towards its southern recorded limit it attains a height of 30–50 feet and a diameter of 10 inches.

Habitat.—In the *Flora Australiensis* it is recorded from:—

Queensland.—Glasshouse Mountains (F. Mueller) (?). (Specimens in leaf only).

New South Wales.—Port Jackson to the Blue Mountains (*R. Brown, Sieber* n. 269 and others); New England (*C. Stuart*); Hastings River (*Beckler*).

Its range may be stated from southern New South Wales, along the coast and coast mountain districts, to Southern Queensland. Its favourite habitat is lining the banks of creeks in gullies.

Its southernmost recorded limit is on the Sugarloaf Mountain, Clyde District, at an elevation of about 3,000 feet. Westerly it is found at Mount Wilson.

Following are some localities represented in the National Herbarium, Sydney:—

Sugarloaf Mountain, Braidwood District (W. Baeuerlen); Helensburgh to Waterfall (J. H. Camfield); Mt. Irvine to Mt. Wilson (Jesse Gregson); Newnes and Eskbank, Leura, Springwood, Glenbrook (all A. A. Hamilton); Spring Creek, Hornsby (W. F. Blakely); Galston, with unusually narrow leaves (J.H.M. and J. L. Boorman); (both of these localities are a little north of Sydney); Wallsend (J. L. Boorman); Taree District (District Forester Hardman); Camden Haven (J.H.M.); Upper Hastings River, ascent to Tableland (J.H.M.); Urunga (E. H. F. Swain); Glenfernie Forest Reserve (J.H.M.); Upper Copmanhurst, Clarence River (Rev. H. M. R. Rupp); Woodburn, Richmond River (J.H.M. and J. L. Boorman); also a specimen received from Mueller, marked Queensland, but without locality.

EXPLANATION OF PLATE 217.

A. Flowering twig.

B. Individual flower.

C. Flower, opened out, showing—
  (*a*) Corolla (the segments vary from 4 to 6).
  (*b*) 2-celled ovulary.
  (*c*) Styles. (Stamens removed.)

D. Head of fruits.

(All from Port Jackson.)

THE SAND-DRIFT PROBLEM IN NEW SOUTH WALES.

Introductory.

I. The Coastal Problem.

1. Newcastle.
2. Bondi.
3. The sand-drift problem a forestry rather than an engineering question.
4. The stages in the reclamation of a sand-dune—
   (*a*) Cutting off supply of sand from the ocean.
   (*b*) Incidental discussion of the treatment of sand-dunes as carried on at Port Fairy and Williamstown (Victoria).
   (*c*) Fixing the sand by vegetation.
   (*d*) Maintenance of vegetation—
      (1) Protection against fire.
      (2) Fencing often necessary.
5. Plants recommended for coastal sand-dunes.

Introductory.

The sand-drift question is of national importance to New South Wales, and may be conveniently divided into the Coastal and Western problems. Each may be treated separately, and most people will agree that the latter is the more difficult. At the same time, the coastal problem is increasing in importance, and should be dealt with seriously, otherwise it will become a serious drain on the public treasury and on the purses of our citizens. Stringent regulations should be issued by the Government, forbidding the burning-off or cutting-down of the natural sand binders (trees and shrubs) along our coast, except under suitable regulations.

Most, if not all maritime countries have to face the problem of shifting coastal sands. In " new " countries, the indigenous vegetation has arrived at a state of equilibrium, more or less stable, in regard to the sand; but in the progress of settlement, in order to reach the land from the sea, or to get free access to the seashore from the land, the maritime border of scrub, trees, and binding herbs and grasses is destroyed. In many cases this fringe of vegetation is cut out for fuel, since timber is often scarce in the vicinity of the sea. In a word, the natural sand-binder or sand palisade is disturbed; the particles of sand, reinforced from an inexhaustible source, move over the land; the gap once opened is increased in size by the relentless sea breezes, and finally an area becomes wind-swept, and sand-swept, and desolate. It is a matter of history how the

sterile " Landes " of south-western France have become fixed, and now bear forests of pine, which are the source of the valuable turpentine industry. These developments date from 1789, and the results are an illustration of the triumph of science over the forces of Nature. The state of the French Landes, to be referred to presently, was the result of centuries of neglect and of a special geographical situation, and I trust that no part of the coast of Australia may be neglected for so long a period. Nevertheless, the New South Wales coast provides many examples of shifting sand-dunes, and postponement of treating them is but leaving others to reap the whirlwind.

I. The Coastal Problem.

It would be difficult, and perhaps impossible, to ascertain the money loss which has accrued to the Government, to municipalities, and to private citizens in the suburbs of the cities of Sydney and Newcastle alone, in combating the sand-drift nuisance. Many private landowners, trustees of parks and cemeteries along other parts of the coast, have sand encroachments which they are interested in fixing. I have for a number of years taken an interest in this question, and again draw public attention to it, because I think the nuisance can be abated, provided a little expenditure be incurred and work accomplished be not allowed to be undone through neglect. As instances of what has been done locally in fighting the sand-drifts, I give notes in regard to two well-known cases.

1. Newcastle.

On the 14th October, 1886, was assented to " An Act to authorise the resumption of certain portions of land situate in the Parish of Newcastle and County of Northumberland for the purpose of enabling the Government to arrest, as far as possible, the further deposit of sand thereon, and to reclaim for public purposes and dispose of the said lands as hereinafter provided." During the year 1887 Mr. H. Czerwonka, an engineer of the Public Works Department, set to work to carry out the process of reclamation, his operations consisting of cutting down, trimming, and sloping banks along the sea shore, removal of existing old fences, shifting of sand, erection of brush fences and of new boundary fences, and planting with grass. From first to last a considerable sum has been spent on this work; numerous trees and shrubs, chiefly from the State Forest Nursery at Gosford, have been planted in the reclamation; whilst a resident gardener caretaker was maintained for a number of years after the planting staff had been withdrawn. The area is now a public park.

2. Bondi.

Mr. G. R. Cowdery's work in dealing with the sand nuisance in the vicinity of the tram terminus is referred to below. I would also draw attention to the late Mr. W. A. Smith's paper on the " Treatment of Drift Sand, as applied to the Bondi Sand-dunes " (read before the Sydney University Engineering Society, 27th October, 1902). This recounts the valuable work which has been begun by cutting off the supply of sand from the ocean by Mr. Smith, the District Engineer.

Much of Sydney is built upon sand-dunes, and the following newspaper extracts of little more than half a century ago, in regard to what is now a densely-populated part of Sydney, are very interesting. As population increases, of course an overwhelming number of people become concerned in dealing with the nuisance in cities, but problems exist where population is sparse.

October 4, 1854—The Sand Drifts.—"At Strawberry Hills, the damage done to property by the drifting sand is one of great hardship to the local residents. In some cases so much so that the houses were completely buried in the sand, and on account of the drifts up to the very chimneys. An owner of a tenement in that locality had adopted a singular expedient. In order to keep his well of water clear, he had fixed a cask upon the well mouth. But the sand gained ground, and he topped the cask with another, and so on, until now he has a dip of 15 feet of casks. The people who continued to live on the spot did so only by dint of most energetic exertions to beat back the sand-drifts, some of them using sheepskins to stay its progress. Many of the unfortunate persons were completely surrounded by mountains of sand. The Government ought to bring down a measure to arrest the progress of these drifts, which, if permitted to accumulate as at present, would probably at no distant period overwhelm the city."—Mr. H. Parkes (the late Sir Henry), in the Legislative Council.

The motion of Mr. Parkes in the Legislative Council yesterday, asserting that immediate steps are required to be taken by the Government to prevent the sand-drifts at Strawberry Hills and other places from destroying more property, was passed. Mr. Parkes, in his remarks on the subject, stated that these sand-hills had now grown so extended as to become alarming. Some of the houses had been almost entirely buried, nothing but the last row or two of bricks and the chimneys being above the ground.—16/12/55.

3. The sand-drift problem a Forestry rather than an Engineering Question.

In New South Wales, works for the treatment of sand-drifts are carried out by engineers. In all other countries with which I am acquainted, they are looked upon as the legitimate work of the forester, and hence the planting work is given a prominence that it has never received with us, so far. In France, the work was expressly transferred from the Director-General of "Ponts et Chaussées," in 1862, to the Forestry Department; in the United States the work is in the hands of the Department of Agriculture. Engineers should, if necessary, be temporarily or permanently attached to a Forest Department for special duties. Although the coastal sand-dune works in France are best known, those in England, Holland, Germany, the United States, and Canada are very important.

4. The Stages in the Reclamation of a Sand-dune.

Sand-dune reclamation consists of various stages :—

(*a*) Cutting off the further supply of sand from the ocean.

(*b*) [Incidental discussion of the treatment of sand-dunes as carried on at Port Fairy and Williamstown (Victoria)].

(*c*) Fixing the sand by means of vegetation.

(*d*) Maintenance of such vegetation.

The sand is, of course, primarily brought from the sea by the action of winds and waves. The deposit on the beach is dried, and is then blown by the prevailing winds, forming dunes. Our most violent gales, in the Sydney district, come from the south-east. Let us consider the above points in detail.

(*a*) *Cutting off the further supply of sand from the ocean.*

To do this, what is called the "dune littorale" is formed. The old official system of constructing the protecting dune may briefly be described as follows:—

At a distance of from 150 to 200 yards from high-water mark, a wattle fence,* some 40 inches in height, is erected, parallel to the general coast line, and at right angles to the direction of the prevailing wind. The drifting sand is arrested by this fence, and mounting up to windward forms a gradual slope towards the sea. After some little time, this fence is overtopped, and a second is put some 6½ feet from the base of the steep leeward slope formed partly by the sand which has been forced through the interstices of the first fence, and partly by the sand which has blown over the top, and parallel to the first fence. The space between these two fences is soon filled up, and the embryo dune assumes a certain profile. Midway between the two fences a palisade is erected. This palisade is formed of pine planks sharpened at one end, 5 feet long, 7 inches to 8 inches wide, and 1¼ inches thick. The planks are driven into the ground some 20 inches, and ¾ of an inch apart, their breadth being at right angles to the direction of the wind. As the sand drifts up the windward or west slope of the dune, it is again arrested by the palisade, though part of if filters through the interstices between the planks, and forms a steep slope to the leeward, which serves as a support to the planks. The sand now gradually mounts up, and when nearly flush with the top of the palisade, the latter is levered up some 24 inches. This process is continued until the dune is some 25 to 30 feet high, when a cordon of faggots is planted on the summit of the dune just to windward of the palisade. The palisade is now left in this last position until a third fence, which has been erected some 5 or 6 feet to the east of the leeward slope, is overtopped, and the base of the dune is increased without affecting the height by the sand blowing over the tops of the palisade and cordon. When this fence is covered, the palisade is moved back a few feet, and the sand coming over the tops of the cordon faggots fills in the space between them and the palisade. The latter is then again levered up, and the process continued until the dune assumes the final profile required. The formation of the artificial dune usually requires a period of from fifteen to eighteen years. The growth is naturally irregular, being dependent on the season. Steady, strong winds are the most favourable. On the completion of the dune the surface is consolidated by half burying, in a vertical position, faggots composed usually of pine branches. These faggots have usually a circumference of some 14 to 16 inches and a length of 30 inches, and are planted some 14 to 16 inches apart. Between these faggots is sown the seed of the "Gourbet" or "Marram Grass" (*Ammophila arundinacea*, Host.†), in quantity about 13 lb. to the acre. The consolidation is naturally only requisite on the summit and windward slope‡.

M. Bagneris, Inspecteur de Forêts, states§:—

The sand-dunes at Gironde, in France, are sometimes 230 feet in height, but at Port Elizabeth the greatest height of any sand ridge yet fixed is 46 feet 6 inches, while many of them do not exceed 20 feet in height; and although their appearance is arid and desolate in the extreme, they are by no means devoid of moisture. In ordinary weather the sand is moist even 1 inch or 2 inches below the summits of the ridges, and water is found anywhere a few feet below the limestone crust, in some places at 1 foot from the surface. Numerous wells, 4 feet to 12 feet in depth, have been sunk for supplying the men and animals on the work. Laurent‖ mentions that the dunes in Algeria are so abundantly supplied that wells sunk to a depth of 10 feet or 12 feet contain water. Water is also found in the sands of Namaqualand. Its presence in the sand is generally attributed to capillary attraction.

Schlich¶ describes a somewhat simpler method of constructing the dune littorale:—

Although air currents are capable of moving the sand along level and gently sloping ground, they cannot lift it above a certain height. Hence it is necessary, at a moderate distance (100–300 feet) from high-water level, to form an artificial hill, which is high enough to arrest the forward movement of the sand, and this is done by the construction of an artificial dune, generally called the "littoral dune." With this

* Tea-tree (*Leptospermum*, &c.) would be used in coastal New South Wales.
† *Psamma arenaria*. See Maiden in *Agric. Gazette*, Jan., 1895.
‡ McNaughton, C.B., "The sand-dunes of Gascony."—*Agricultural Journal* (Cape Town), 7th February, 1895. A valuable and exhaustive paper.
§ Bagneris, "Manuel de Sylviculture."
‖ Laurent, "Memoire sur le Sahara."
¶ *Manual of Forestry*, Vol. ii, p. 34. See also iv, 524.

object in view a continuous line of paling is erected, consisting of planks about 6 feet long by 6 inches wide, 1 inch thick, and pointed at the lower end. The planks are inserted into the ground to about half their length, an inch apart, the direction of the line being parallel to the coast. Against this fence the sand is deposited, a certain portion being forced through the interstices and coming to rest in the comparatively quiet air immediately behind the paling. As soon as the accumulation of sand approaches the upper ends of the planks, they are pulled up about 3 feet by means of levers, and this process is repeated until the artificial dune has reached such a height that no sand can be carried over the top. Simultaneously with the first erection of the paling, a wattle fence is placed at a convenient distance behind it, to prevent the sand which has passed through the paling from being carried inland; when the first wattle fence has been entirely covered, a fresh one is made to replace it. In this way the dune is forced to adopt a moderate slope on both sides, which is essential to its permanent maintenance.

Although even this modified method has been, to some extent, superseded by that of M. Grandjean, to be referred to presently, I think it should be followed, to some extent, in special cases, *e.g.*, at Bondi and Newcastle.

In M. Grandjean's method, only Marram Grass is used as a rule, but fascine work is employed in cases where neglect or accident renders this necessary. The Marram Grass is elastic, and is used as a substitute for the more elaborate system of fascines, palings, &c., already described. The grass is freely planted in rows, and the direction and closeness of the rows are modified according to circumstances. As the sand rises, the Marram, even if temporarily submerged, will push its way up and continue to grow. Finally, by judicious planting of the Marram, and encouragement of it, it is possible to obtain the "constant" for a particular spot, indicative of the height beyond which sand from the sea shore or other source is incapable of passing. When this is obtained, the "dune littorale" can be formed, and its fixation and maintenance arranged.

The dune littorale must have a surface as regular as possible, otherwise the wind speedily accentuates the unevenness, and creates ridges and depressions in the mobile sand which steadily increase in size. The profile of the dune littorale must be decided upon according to local experience. In regard to this, as, indeed, in regard to other points in connection with sand-dunes, the personal experience and responsibility of the forester must be exercised.

(*b*) *The treatment of sand-dunes as carried on at Port Fairy and Williamstown (Victoria).*

I have already pointed out that Grandjean's method is in the direction of simplicity, *i.e.*, in the use of Marram Grass pure and simple except in certain cases which require special treatment.

That is the principle of the method carried out at Port Fairy, and at the risk of not confining myself strictly to the classification of items I have made, I give the following account of work carried out in Australia.

In southern Victoria is a large tract of rich basaltic soil, which produces potatoes and onions galore, and hence is called the garden of Victoria. Nearly midway between Melbourne and Adelaide is the principal port of this rich district. It was formerly called Belfast, but now Port Fairy. Agricultural land in this belt has changed hands at £85 per acre, and £70 to £75 is no uncommon figure for the best. Years ago the

sand-dunes invaded this rich land, and I have seen stone boundary walls submerged by the smothering sand. The situation was indeed serious. The natural sand-binders of the district were tried with indifferent success. Baron von Mueller was applied to, and in 1883 sent seeds of a number of plants he thought might be useful. These were duly sown, rather indiscriminately, and those of a grass (the Marram) came up amongst them, and attracted the attention of Mr. S. Avery, then, as now, in the employment of the Port Fairy Council. He kept this grass under observation for two years, and felt that this was the plant of which they were in need. It was propagated by root division, as the seeds are of uncertain germinating power. This was the beginning of the planting of the sand-dunes, which has since become an important industry.

I paid a visit to Port Fairy and saw the planting in operation. The sand-dunes had been planted for 9 miles on the Warrnambool side and for 3 miles on the Portland side. I traversed them for 6 miles, and saw six to seven hundred acres (in 1904) under Marram. The shire has taken up the planting from the town boundary towards Portland.

The Marram Grass is well established in three years, and can then be thinned out for planting elsewhere. It should on no account be disturbed for two years. The method of planting is very simple. A portion planted in each hole is as much as a man can grasp in one hand. The planting is done with a long-handled shovel, in the pure sand, and the bundle of roots should not be unduly loosed. By division of labour, one man digging a hole, a second planting it, and stamping it carefully and evenly with his foot, well drilled men can plant with great rapidity. The direction of the prevailing wind has to be studied in each case, and the grass is planted in rows 5 feet apart, with each plant of the row 2 feet apart from the other; 26 cwt. of Marram plants is required to the acre. The curvature of the rows is about 5 feet in a segment of 50 feet. The object of the curvature is to prevent the formation of straight lines, and thus to interpose obstacles to the free course of the wind through the Marram Grass plantation from whatever direction it may blow. If it be desired to plant a sand-dune, a *sine quâ non* is to *begin to plant from the land side as far as possible, working towards the sea.* Stress should be laid on this, as the natural inclination of most planters is to begin the planting as near to the sea as possible, and to work inland. I made that mistake myself.

It is desirable to complete the planting of a block as far as possible, because much depends upon the planting being uniform. An isolated plant or an isolated row of Marram may cause difficulties through setting up local eddies in the sand. If the natural sand-plants be not removed, they will often cause local inequalities in the surface—hillocks or depressions in the mobile sand. Mr. S. Avery, the experienced ranger at Port Fairy, is emphatic against the use of fences or breaks in controlling the sand, on the ground that they interfere with the drifts.

Thirty-six years ago the Port Fairy sand-hills were let as a common, and brought £5 per annum into the municipal treasury. At the same time the rich lands were gradually being reduced in value by the sand. In 1904 we find the sand-drift nuisance has long been abated, and these despised and feared sand-hills brought in an annual revenue

of £400. This is made up by grazing fees and the selling of the Marram Grass to other States and countries. In fact, the success of Marram Grass at Port Fairy is so obvious that you do not hear the sand-hills talked about as a nuisance; and my opinion is that, when all the sand-hills in their jurisdiction are planted, the municipality will be crying out for more. Furthermore, the planting of Marram and the digging it up for export is winter work, and this furnishes employment for a large number of men, at 6s. a day, precisely at a time when work is slack elsewhere.

Knowing Marram Grass for a number of years, I had my doubts as to its reputed value as a fodder. But I have seen 150 cows feeding on the Marram Grass at Port Fairy, and their food was mainly that grass, with little pickings of other plants under the tussocks. The grazing over these municipal sand-dunes is a regular business. The Council charges the townspeople 6d. per head per week, and this includes taking the cows out to the Marram Grass plantations in the morning, and bringing them into the town in the evening. Any evening one may see the herdsmen bringing home his mob of cows. Arrived at the main street, the cows say good-night to each other, and find their own way down the side streets, right and left, to their homes, quicker than school-boys do. It is an interesting sight. The citizen pays the Council 6d. per head per week, and this fee includes the keep of the beast on the Marram Grass sand-hills, and the driving-out of the beast to the sand-hills in the morning and home again at night. Keeping a cow is, therefore, within the means of all.

The Marram Grass is planted on the sea-front at Port Melbourne, in an enclosed reserve, and has certainly stopped the encroachment of sand on the streets. I have known Port Melbourne for many years, and can speak with definiteness.

But the greatest work near Melbourne accomplished by Marram Grass is the protection of the "short road" between Port Melbourne and Williamstown.* The drawback of Williamstown used to be its inaccessibility to Melbourne. The distance of the Williamstown Post Office from the Melbourne General Post Office is only 4½ miles, as the crow flies; but it was 9 miles by the only route available for heavy traffic up to the end of 1896. This has now been reduced to 6 miles. The trouble in maintaining a direct road was caused by the shifting sand. In fact, for 2 miles it was in a very bad condition, and in one part, for a length of 30 chains, it was almost impassable, being entirely disintegrated and destroyed by blown sand. In 1887 the Engineer of Reclamation Works in Victoria estimated the cost of raising the road to 8 feet above low water, and constructing a steel tramway and tarred metal road, at £17,500. In 1892 the Inspector-General of Public Works proposed to raise the road to the 8-feet level, form a foundation through the sand with clay embankment, and cover the roadway throughout with 15 inches of metal, for the sum of £8,000.

Both these amounts were utterly beyond the resources of the two municipalities concerned—Williamstown and Port Melbourne. The old road had been steadily getting worse, but the engineers of the two municipalities put it into first-class condition for

* For full particulars, with diagrams, see a paper written by H. V. Champion, the Town Surveyor, for the Victorian Institute of Engineers, entitled, "The Construction of the Williamstown short road, and the use of Marram Grass as a sand-stay."

heavy traffic with a tar-paved roadway 16 feet wide, on a rough-pitched foundation, through the sand at a total cost of under £3,000. In this work they called in the aid of Marram Grass. Eight rows were planted alongside the road, and they have undoubtedly prevented the sand encroaching on the road, and having done their work, the tussocks of Marram Grass are now being superseded by a close turf of grass and trefoils. Thus a well-known public nuisance has been removed and the wealth of the community increased by means of a short and direct road suitable for heavy traffic. The work has been carried out at a saving of many thousands of pounds upon the estimates of competent engineers, and this remarkable result was rendered possible by an expenditure of £200 on Marram Grass planting.

Victoria has, in Marram Grass, given the whole of Australia a valuable object lesson, and, surely, we in New South Wales will not fail to profit by the excellent example that has been set us by some small yet plucky municipalities in the sister State.

Some day we in New South Wales will give Marram Grass that test which it has never yet received in this State. Through lack of knowledge we have planted it the wrong way. I believe that in many places all our reclamations can be carried out with Marram Grass and Marram Grass *alone*, without engineering devices.

(c) *Fixing the sand by means of vegetation.*

It became necessary in France to raise trees to pay interest on the outlay, and it may be necessary here. In certain localities the Marram Grass as a crop may pay a fair interest on the outlay, to say nothing of the great pecuniary advantage of having stayed the sand-drift; but let us consider the desirability of supplementing the Marram with other vegetation.

In France the fixation of the sand by mechanical means, and the permanent fixation by means of a permanent crop of trees, proceed simultaneously; it is obvious that the one may precede the other. In France not only is fixation of the shifting sands readily accomplished as part of the ordinary business of the forester, but a timber crop is raised upon these hitherto waste lands. The chief timber tree is the Maritime or Cluster Pine (*Pinus pinaster* Sol.; *P. maritima* Poir). The trees are not only tapped for the turpentine they contain, a flourishing industry being the result, but the timber has considerable local value, and is even exported to England, chiefly for mining purposes.

" As regards the species there was little doubt ' Cluster Pine,' the ' Pin Maritime,' was already flourishing in places in the Landes." What a lesson we have here! The sagacious Frenchman uses his native and well acclimatised vegetation; the Australian seems to prefer to plant anything rather than *his* native vegetation.

I do not, of course, object to the acclimatisation of useful plants, and the Maritime Pine has proved useful here, but I would place native plants first for this particular service. In lieu of the Maritime Pine, I recommend the Norfolk Island Pine (*Araucaria excelsa*) as the main timber tree for the New South Wales coast for the following

reasons:—It revels in the sea air; its narrow leaves and conical shape present comparatively little resistance to strong winds; it is ornamental in appearance, and it furnishes a useful soft wood. For a list of other plants recommended, see page 175.

Hitherto plantings of trees, &c., in sand reclamation works in this State have always been made from plants and not from seed; I desire to emphasise the desirability of sowing seed. If, however, seeding cannot take place, I would advocate the establishment of a small nursery within the sand-drift area. It need not be expensive, but the enormous advantage would accrue of plants being raised from the beginning in situations as nearly as possible similar to those they would ultimately occupy, while, as arrangements would not have to be made for their conveyance from distant parts, they could be planted out at the most favourable opportunity. We will now return to the French method of establishing a vegetable growth on the dunes.

In establishing trees on the dunes it is necessary to raise quick-growing shelter bushes (technically known as "nurses") at the same time. The "nurse" I would recommend for Norfolk Island Pines is Tea-tree scrub, and particularly *Leptospermum lævigatum*. The dune is divided into strips 50 or 60 feet wide, and protected, by means of a fascine fence, against the prevailing wind. The strip is then planted, quincunx fashion, with Marram Grass, the centres of the plants being, say 2 feet apart, the rows 6 feet apart. The seeds of the permanent trees and of the "nurse" are then sown between the clumps of Marram Grass. The sowings should be protected with branches of tea-tree or any other scrub cheaply obtainable, sea-weed, turf, &c., and the branches and other material should be pegged down, for it is of great importance that no disturbance of the surface should occur until the permanent growth or cover is established. Each season another block is similarly treated under the protection of the previous sowing, and thus an area of any required size is put under treatment. In France the plantation of sand-dunes has passed beyond the experimental stage, and there is no reason why we cannot soon say the same in New South Wales.

In the Landes, at the present day, the sowings are made from east to west in the area protected by the dune. Of course, the sea (Bay of Biscay) is on the west.

Under the old system in France it was the other way; sowings were commenced immediately under the dune and proceeded westwards. This necessitated the continual shifting of the wattle fence erected to the east of the sowing to protect it from easterly winds, whereas by sowing in the contrary direction one sowing protects the next from these winds, while the dune protects the whole sufficiently from the west, and the cost of this fence is saved in all but the eastern belt of each block. As soon as the first block is completed, a second is commenced to leeward, under the united shelter of it and the dune littorale. When this second block is in due time finished, a third is begun, and so on, the work of afforesting being steadily pushed forward until the entire area is reclaimed.*

I give two extracts from a valuable paper,† one showing the seeds deliberately planted and those which spring up accidentally from the refuse, and another showing

* C. B. Naughton, *op. cit.*

† "Reclamation of Drift-Sands in the Cape Colony," by Charles Dimond Horatio Braine, *Journ. Inst. Civil Engineers*, Paper No. 3,353, 1902. Reprinted in *Agric. Journ.*, Cape of Good Hope, xxiii, 161 *et seq* (Aug., 1903), with two illustrations of buildings encroached upon by drift-sand and one of a tree left in the air by reason of the soil being blown away; these three from the Western Lands (N.S.W.) Report, 1901. A fourth photo of planting Marram Grass has been taken from the beginning of work on a Port Fairy (Vic.) sand-dune. The origin of these four illustrations is, through inadvertence, not stated.

the trees planted for revenue purposes. As regards the latter extract, it must be remembered that New South Wales is very much more richly endowed as regards tree wealth than is Cape Colony; and therefore what would pay in the latter colony would not be remunerative in the former.

The method of working in practice on the Port Elizabeth sands is to sow broadcast—about 35 lb. per acre—a mixture of seeds, composed principally of *Acacia cyclopis* and *Acacia leiophylla* (*saligna*), with an addition of *Acacia pycnantha*, *Pinus halepensis*, rye, pypgrass (*Ehrharta gigantea*), &c., and then to spread immediately a layer of refuse. Sunflower and lucerne seeds have also been used with very satisfactory results. Tomatoes and pumpkins grow freely, being self-sown with the refuse; and from areas spread with stable-sweepings a large crop of oat hay is reaped annually. In 1895 some 4,000 bundles were harvested from the reclaimed sands, and about 8,000 bundles in 1896 and 1898, at a cost of a little over 1d. a bundle. The market price would have been at least 6d. a bundle.

Plants and Trees used for Reclamation.—Numerous varieties of trees have been experimented with, but, so far, the *Acacia saligna* and *A. cyclopis* have proved the most useful revenue-producing plants. The bark of the former is a marketable commodity, containing a good percentage of tannin, but the bark is said to impart an unpleasant smell to the leather. The *cyclopis* bark is of no commercial value, but the timber of both trees is used for firewood, for which there is a large demand in all South African towns, for domestic use. Many other Acacias have been tried, some of them far richer in tannin than the *saligna*, but the results have been disappointing. Among these are the *Acacia pycnantha*, *A. decurrens*, and its variety *A. mollissima*.

At Bondi and on our coast dunes generally, the sea is on the east, and the winds to protect our plantations against are strong westerlies, hence the plantings should take the reverse direction to those of western France. The soil of the Landes is nearly pure silica, while underneath in places is an impermeable substratum of ferruginous sandstone, locally known as "alios," usually from 9 to 15 inches thick, and at a depth of 10 inches to 2 feet below the surface. We know this to our cost at the Centennial Park, Sydney, an area which gives one much experience of sand planting. Speaking generally, I do not doubt that the "soil" conditions are much the same on the coasts of France and New South Wales.

In the vicinity of cities, *e.g.*, Sydney and Newcastle, the soil may be more or less enriched, without much expense, over limited areas; this is, of course, a local circumstance. If opportunities be watched, road-sweepings and soil can sometimes be obtained for little more than cartage. Even if grass alone be required, it will be found that it is advantageous to top-dress it with soil, while arrangements should be made to secure all the available manure in the vicinity, and top-dress with it. It is a matter of common observation that many people allow the manure of horses and cows to go to waste, and some of them would even cart it free for some little distance, particularly if the municipal by-law in regard to the storage of manure in confined areas be rigidly put in operation. A small area of ground could be set apart at the sand-drift for the storage and rotting of such manure, and it could be applied to the grass and plantation when convenient.

But where soil is not available, ashes (couch grass runs rapidly on cinders and ashes), shale, and other débris may be useful—at least for forming a covering of grass. Adjoining the sand-drift at Newcastle, the Australian Agricultural Company are the owners of a considerable block of land, which is used for colliery purposes. The

Company had for a considerable time been in the habit of depositing shale and worthless coal on a large area of this land, which consisted of shifting sand. The result has been that the sand is fixed, and grasses and other vegetation have already attached themselves to the soil (so-called), completing the fixing process, and forming what will be in a very short time an excellent sward.

A similar policy was followed by Mr. G. R. Cowdery, Engineer for Tramways, in regard to the shifting sands in the vicinity of the tramway terminus at Bondi. Here the sand filled up streets and obliterated fences, becoming a nuisance and an eyesore to the travelling public. Mr. Cowdery levelled the sand and top-dressed it with a few inches of ashes from the tramway engines. A little Couch grass (*Cynodon dactylon*) was dibbled in here and there, and now we have a grassy lawn. The cinders, ashes, shale, &c., should be spread on the surface to a depth, if possible, of 6 inches.

The element of time.—One of the broad dunes on the Landes may be planted according to fixed plans requiring thirty years for their completion. And as regards the exploitation of the timber upon it, it may be mentioned that the rotation at the Forest of La Teste is sixty years for example,—that which began in 1890 will only be complete in 1949. It is necessary to emphasise these points because we are often in a hurry in New South Wales, and some people think plantations may be formed in pure sand and produce merchantable timber in a space of time that experts know to be out of the question.

(*d*) *Maintenance of the vegetation.*

It is a common human failing that we are often satisfied when we initiate a work, and we forget to provide for adequate maintenance. Adequate maintenance in the matter of sand-drift prevention is the life-blood of the whole enterprise. All these sand-drift areas should be placed under the control of the Forest Department, which should have a special staff of officers to deal with reclamation matters (including such works as the reclamation of river banks).* All areas under treatment should be regularly visited and reported upon, a printed schedule of questions being answered by the inspecting officer periodically.

(1) *Protection against fire.*—This is a matter of very great importance. Our bush fires are, in some years, very serious agents of destruction, and it is not easy to lay down useful rules to cope with them. As regards the coastal plantings on sand-dunes, the making of fires should be prohibited under heavy penalties. In many places, the plantations will be naturally protected by the healthy country which runs along the coast line.

(2) *Fencing often necessary.*—And now I make a few recommendations applicable to planted sand-drifts in the vicinity of large centres of population. At one sand-drift reclaimed by the Government, I have seen horses, cattle, and human beings breaking down the sand-banks. The caretaker slopes the sand, plants grass, &c., upon it; cattle tear out the grass, bring down the sand in large masses, and, consequently, destroy the

* See "Mitigation of Floods" (Appendix to Part LVI of this work).

surface with their hoofs. Horses run along the shore for exercise and their owners sometimes put them on the slopes, with a result most disastrous to the reclamation. People have free access to these sandy slopes facing the ocean; they break them down, and with cattle, horses, dogs, and human beings, it is a wonder to me that there is any growth on these places at all. There is but one remedy, and that is the rigorous fencing off above high-water mark. A substantial fence should be erected, barbed wire being freely used in its construction, the wire so close that not even the smallest dog could get in. Trespass within the enclosure should be severely punished. I have emphasised the question of absolutely excluding the public, for this is the beginning of everything, and no more laxity should be shown than is in the case of upkeep of the dykes of Holland. The works at Bondi, when first undertaken by the Public Works Department, were not respected as they should be by a few selfish people. They broke through the fences and trampled within the enclosures to make short cuts, and delayed the work very much.

5. Plants recommended for coastal sand-dunes.

And here I would again assert an axiom in soil-reclaiming experiments. *Use the local indigenous plants to the fullest extent.* They have arrived at their present development through a long course of environment. They have the additional advantage that in many cases they are on the spot.

Indigenous Trees.

Araucaria excelsa A. Cunn. The Norfolk Island Pine.

Lagunaria Patersonii Don. " White Oak " of Norfolk Island.

Cupania anacardioides A. Rich.

Melaleuca leucadendron Linn. " Broad-leaved or White Tea-tree."

Casuarina glauca Sieb. " Salt-water Swamp Oak."

Casuarina equisetifolia Forst.

Pittosporum undulatum Vent. The common Pittosporum.

Banksia integrifolia Linn. f. " White or Entire-leaved Honeysuckle."

Banksia serrata Linn. f. " Red or Saw-leaved Honeysuckle."

Eucalyptus saligna Sm., var. *botryoides* Maiden (*E. botryoides* Sm.). " Bastard Mahogany " or " Bangalay."

Eucalyptus robusta Sm. " Swamp Mahogany."

Endiandra Sieberi Nees. A " Corkwood."

Ficus rubiginosa Desf. " Port Jackson or Illawarra Fig."

Metrosideros tomentosa A. Cunn. The " Pohutukawa " or Christmas tree of New Zealand; a gorgeous red-flowered species.

Pittosporum crassifolium Bks. and Sol.; and other New Zealand species.

Ficus Muelleri (*Henneana*). A large semi-deciduous fig.

Corynocarpus lævigatus Forst. The New Zealand Karaka.

Exotic Trees.

Pinus pinaster Sol. (of which *P. maritima* Poir. is a synonym.) The Maritime or Cluster Pine.
Pinus radiata Don (P. insignis Dougl.).
Pinus pinea L. The " Stone Pine."
Ailanthus glandulosa Desf.
Robinia pseud-acacia L.
Cupressus macrocarpa Hartw. " Monterey Cypress."
Palms of various species, especially
Phœnix canariensis Hort. and *P. reclinata* Jacq. and other species of *Phœnix*. These palms live in sand, and stand the strong sea-breezes well.
Washingtonia filifera Wendl. (the so-called Railway Station Palm).
Erythrina indica Lam. The " Coral Tree."

Indigenous Shrubs.

Correa alba Andr.
Acacia longifolia Willd., var. *Sophoræ*. " Spreading Coast Wattle."
Leptospermum lævigatum F.v.M. " Tea-tree."
Melaleuca ericifolia Sm. " Bottle-brush Tea-tree " and other *Melaleucas*.
Angophora cordifolia Cav. " Dwarf Apple."
Myoporum acuminatum R.Br.
Westringia rosmariniformis Sm.
Monotoca elliptica R.Br. " A pigeon-berry Ash."

Let me particularly emphasise the value of *Leptospermum lævigatum*, Nature's special sand-stay for many parts of coastal New South Wales. It is best developed about Melbourne.

Exotic Shrubs.

Salix acutifolia. " The Sand Willow," which has done much to bind shifting sands in Russia.
Tamarix gallica Linn. The Tamarisk.
Lycium Afrum Linn. African Box-thorn.
Lupinus arboreus Sims. The common " Tree Lupin " of Californian sand-hills.

To aid the lupins to get hold of the sand at the commencement, barley is sown with them as it sprouts in a few days and holds the sand in the second week; the lupin subsequently covers the sand with a dense vegetation in less than a year.

Lupinus Douglasii Agardh, also *L. Chamissonis* Escholtz (*L. albifrons* Benth.) have also been recommended as sand-binders.

Other leguminous shrubs of larger size that may be tried are Tagasaste, from the Canary Islands (*Cytisus proliferus* L., var. *palmensis*), which will eventually come in useful as a fodder plant.

Cytisus stenopetalus Christ., a shrub of a highly ornamental character, bearing a profusion of yellow flowers. The shrub is esteemed as a fodder plant in the Canaries.

Cytisus pallidus Poir., with white flowers, less showy, and with less fodder-value than the preceding.

Genista scoparia Lam. (Scotch Broom). A well-known plant for sandy land.

Ulex europaeus (Furze). Very valuable as a sand-binder, and its thorniness is a positive advantage in the early stages of securing plant-cover.

Myrica cordifolia L., *M. serrata* Lam. and *M. quercifolia* L., all shrubs from South Africa, have been recommended for arresting sand. They are propagated by seeds or cuttings.

M. cerifera L., the " Wax Myrtle " or " Bay-berry," from the sandy sea-coast of eastern North America, is used for a similar purpose, and the fruits of all are boiled in water in order to collect the excellent wax with which they are covered.

Prunus maritima Wagenheim, the " Beach-plum " of eastern North America. A shrubby species recommended for covering coast sands.

Acanthosicyos horrida Welwitsch, the " Narra." This is a native of South African desert sands in the neighbourhood of Walfisch Bay, and it is a most remarkable plant. An account of its nutritive value reads like a romance.

Mueller has a note upon it in his " Select extra-tropical plants." Mr. von Gerard, the Resident Magistrate of Walfisch Bay, has an article in the *South African Agricultural Journal* for January, 1912, p. 102, with an illustration of the thorny plant. It belongs to the Pumpkin family, and is practically the whole of the food of the inhabitants of the territory, which consists of nothing but shifting sand-dunes. If this plant could be acclimatised on our coastal dunes it could be transferred to our inland dunes. The fruit is the size of a small water melon, containing numerous pits.

See also an article on Walfisch Bay which contains an account of the plant by Dr. Macdonald, in " The Nineteenth Century and After," for September, 1914.

Small Plants (non grasses).

Mesembryanthemum æquilaterale Haw. " Pigs' Faces."

Lippia nodiflora Linn. A plant belonging to the Verbena family, which forms a mat in nearly pure sand. Well established in New South Wales.

Lippia repens is a smaller plant than the preceding, which is being tried in New South Wales in various localities to cover bare patches in which no grass will grow, and so give the appearance of a coarse lawn.

This list can be indefinitely extended.

There is an excellent paper entitled " Crops used in the reclamation of alkali lands in Egypt," by Thomas H. Kearney, *Year-book of Agriculture, U.S.A.*, 1902, p. 573. It is based on a personal visit.

The word " alkali " is used in this paper in its popular sense, as applying to excessive accumulations in the soil of soluble salts of any kind, and not in its strict chemical meaning.

The importance of the paper for our conditions consists in the information it contains concerning alkali, but in conjunction with leaching with Nile water. At the same time the plants which stand alkali best are worthy of note, and include *Panicum crus-galli* (Barn-yard Grass), *Tamarix gallica* (Tamarisk), *Trifolium alexandrinum* (Berseem), *Gossypium spp.* (Cotton).

Indigenous Grasses.

Spinifex hirsutus Labill. " Spiny rolling Grass."

The coarse creeping stems attain an enormous length (I have followed them 30 or 40 feet), powerfully rooting at the joints. On the principle that " a prophet is not without honour save in his own country," the merits of this native grass are apt to be overlooked in contemplation of the imported Marram Grass, whose merits I do not for a moment deny.

Festuca littoralis Labill.

Cynodon dactylon Rich. " Couch Grass."

Zoysia pungens Willd. " Coast Couch Grass."

Imperata arundinacea Cyr. " Blady Grass."

Exotic Grasses.

Psamma arenaria R. et S. (Syn. *Ammophila arundinacea* Host.) " Marram Grass."

Stenotaphrum americanum Schrank. " Buffalo Grass," the St. Augustine's Grass of the United States.

Saccharum arundinaceum Retz. (Syn. *S. cilare* Anders.). The " Mung-grass " of India.

Duthie* speaks of the value of this grass in sandy ground near rivers.

For a further account of this grass, see *Dict. Econ. Prod. India,* vi (Pt. 2), p. 2.

Saccharum spontaneum (" Kans-grass ").

Plays an important part in the process of reclamation. Kans possesses an enormous amount of vitality in its stems, which are capable of producing plants at every node and joint.—(Duthie, *op. cit.*)

For a further account of this grass, see *Dict. Econ. Prod. India,* vi (Pt. 2), p. 11. Both of these grasses are coarse, and are only eaten by cattle when young.

* Report on Mr. C. E. Gladstone's planting and grass-sowing operations in the Umballa District (India)—*The Agricultural Ledger,* 1896, No. 21 (Agricultural Series, No. 18).

These hills are composed of absolutely pure blown sand, but the grass, if planted in tufts during the rainy season, strikes root and very soon effectually retards any considerable advance of sand particles. Encouragement is thus given to the growth of other plants, which are less able to endure submergence in sand, and in this way the ground becomes reclaimed.

The value of *Paspalum dilatatum* and Rhodes Grass (*Chloris Gayana*) for sand-binding purposes has not been thoroughly tested in New South Wales yet. *Paspalum* proved useful on the Macleay River in a case in which I recommended a farmer to try it. A large area of good land had been completely covered with a thick layer of sand brought down by a flood.

Agropyrum junceum P.B., on the sea-coasts of Greece and Tunis.

Elymus arenarius L. The "Sea Lyme," native of the United States, Europe and South Africa. A valuable grass for sand-dunes.

Reference may be made to the admirable paper "Sand-binding Grasses," by F. Lamson-Scribner, in the *Year-book Department of Agriculture, U.S.A.*, 1898, p. 405, which has illustrations of Marram Grass planting in the United States (Cape Cod, Mass.). Also a number of additional grasses are recommended for trial, and for these the paper itself should be perused. It also deals with the problem of forming the *dune littorale*.

II. The Western Problem.

1. Report of Western Lands Commission, &c.
2. Area of sand-drift country.
3. Classification of Western soils.
4. Geological origin of the moving sand.
5. Causes of drifting sands—
   - (*a*) Droughts.
   - (*b*) Overstocking.
   - (*c*) Rabbit pest.
6. Prevailing winds.
7. Remedial measures—
   - (*a*) Method of planting.
   - (*b*) The planting of experimental areas suggested.
8. Plants recommended for Western sand-dunes.

In dealing with the coastal drifting sands, the relation of cause and effect is very obvious; in dealing with the interior sands, their dire effects are very obvious, although their causes and source are less clear. It is with the view of drawing attention to the paucity of information in regard to the causes of our Western Sand-drifts and of endeavouring to outline a method of dealing with them on scientific principles that the present paper is submitted.

1. Report of the Western Lands Commission, &c.

The report of the Western Lands Commission* is a cyclopædia of information in regard to the condition of the far western portion of this State. A note on sandstorms is given at page 8 with references to the evidence of witnesses on the subject. Two remarkable photographs are reproduced, one showing denudation, 3 feet of soil having been removed from the roots of a tree by the attrition of sand set in motion by wind, and the other showing the sand piled up against a station homestead.

Let me invite your attention to a paper by Mr. C. A. Benbow, entitled "Interior Land Changes."† Mr. Benbow also delivered a lecture upon "Drifting sands of the west of New South Wales," on the 30th April, 1903. He did not publish on that occasion, but he presented many facts well worthy of attention by citizens of this State.

Drifting sands have overwhelmed many a fair city, a fact with which every student of history and geography is familiar. By attending only to present requirements people have, by means of their flocks and herds, denuded the vegetation which naturally more or less fixes the soil, and to obtain fuel and timber they have cut down the shrubs and trees, either recklessly or without replacing them by younger growth; they have not guarded against forest or prairie fires, or when these have taken place, have not taken adequate steps to repair the damage. The devastations of war have added to the general destruction. By degrees, perhaps during a period extending over centuries, the carefully adjusted "balance of nature" has been so disturbed that desert sands have encroached on agricultural lands and have overwhelmed villages and even large cities, the cumulative results of neglect being of such magnitude that the resources of the inhabitants have at length been insufficient to cope with them. All these catastrophes are gradual, and if they be studied, and the principles they can teach us be properly understood, then the first step with the view of combating them will have been gained.

In my paper, "Forests in their relation to Rainfall,"‡ I have produced conclusive evidence to show that uncontrolled destruction of trees may be attended with most disastrous consequences to any country; and in my paper, "Mitigation of Floods by Forestry Operations,"§ I have endeavoured also to arrive at the first principles which result in mighty consequences.

As regards the sad state of our Western lands, which has inflicted untold misery on domestic animals and on lion-hearted humanity, am I not justified when I say that inquiries into the subject are usually too much taken up with a sad catalogue of privations and catastrophes, and that too little attention is given to directing the rays of

* Western Division of New South Wales, Royal Commission to inquire into the condition of the Crown Tenants, Parts I and II, 1901. Printed by order of the Legislative Assembly.

† *Agric. Gazette, N.S.W.*, October, 1901.

‡ See Part LV, p. 95 of the present work.

§ See Part LVI, p. 130 of the present work.

science upon the ultimate causes of the existing state of things? Are we not in the position of an anxious physician who is trying to cope with an obscure disease; he must apply his remedies more or less empirically? But, nowadays, medical men are trying to get at the origin of disease, at the pathogenic organism that causes it, at the conditions which promote its growth or retard its development, and treatment and preventive steps are based upon knowledge as far removed from empiricism as possible.

As regards the bacillus of the drifting sands of the interior, Heaven preserve me from the presumption that I have discovered it, or that I am able to suggest a wholly satisfactory remedy; but if the scientific men of this State will give attention to the subject, and systematically make observations and collect data, I do not doubt that the drifting sands of New South Wales will be kept under control.

2. Area of Sand-drift Country.

The sand-drift country extends in its greatest intensity from our western boundary to the Darling. To a lesser degree it includes most of the Cretaceous and Cainozoic territory of our geological maps. Reference may be made to the Vegetation Zones Map of New South Wales published by me in the June, 1906, issue of the *Agricultural Gazette*. Much of the country marked 6 in that map is liable to sand-drifts.

Photographs of the Gin-bottle, Goonery Sand-hills on the Bourke-Wanaaring Road, will be found at Vol. IV, page 155, of the present work, together with a few explanatory remarks.

3. Classification of Western Soils.

The Western country may be divided into three classes :—

(*a*) The black earthy plains (the "black-soil plains") which crack when dry, but which do not move.

(*b*) Soil with more or less clay in it; this may blow away, but it does not drift. Much of this country is subject to inundation during high floods.

(*c*) Drifting sands. The soil is composed of clay, vegetable matter, and sand. The lighter component parts blow away during seasons of extreme drought when the surface is denuded of vegetation. The remaining sands—mostly red in colour, but sometimes white—are the drifting sands of the west.

4. Geological Origin of the Moving Sand.

Where does it originate? In Central Australia, extending further towards the west than towards the east of the continent. As far as our own State is concerned, the Barrier and Grey Ranges arrest the great bulk of the sand tending to come from South Australia, and the Murray River performs a similar service in regard to the desert country in Victoria. In other words, our trouble has originated within our own borders.

Between the Barrier Range and the Darling River there are tracts of sand-hills and undulating sandy country which have been well grassed (the term is comparative) and clothed with vegetation. The vegetation being eaten out, the soil would drift, particularly in seasons of drought. In other words, much of the trans-Darling country is in a state of unstable equilibrium.

The consensus of evidence shows that the sand moves more than it used to do. What prevented this? Simply the vegetation, sparse though it was, which through a long course of ages had tended to knit it together. In fact, in sandy country, all that binds it together is vegetation.

I presume that the drift sand is the product of the denudation or of the disintegration of the Desert Sandstone, but the origin is probably well known to geologists, who have chemical and other data in regard to it. At all events, it is not rich in the elements which go to promote plant life.

However, the actual origin of the sand appears to be a mystery. Mr. H. Y. L. Brown, Government Geologist of South Australia, attributes the origin of much of it to the action of artesian water.

5. Causes of drifting sands.

To summarise in some degree, three causes have resulted in drifting sands :—

(*a*) *Droughts.*

Some authorities even aver that sands did not, in the old days, drift except in droughts. This is not correct, but they are more mobile now.

In the Western country, much depends on the infrequent rains, especially upon the times at which they fall. Rain at a critical period will secure the germination and development of certain plants; if rain be withheld, a particular kind of plant will die out, at least for a period, in spite of a fall of rain at some other period of the year. It is assumed that each plant has a critical period on which its development depends, and the appearance of countless millions of, say, thistles at one time over a given area, and the disappearance of the same for a term of years, is attributed to the timely combination of rain and genial warmth in the one case and in their absence in the other. In Western plantings much depends upon this fortuitous rainfall. If it comes, the success of the venture may be assured; if it be withheld, its success is problematical. It is this element of uncertainty which obtrudes itself into Western operations that renders dealing with this part of the country so very difficult.

(*b*) *Overstocking.*

It is very easy to criticise the pastoralist for overstocking, but there are so many variables to be considered in obtaining the constant as regards the carrying capacity in a particular year, that most of the overstocking is unavoidable, the result of our ignorance of the sequence of the seasons. The mechanical action of a flock of sheep, irrespective of overstocking, is important. They pulverise the soil, and for many years, and in dry times, the position of a flock of sheep has been readily detected in the distance by an attendant cloud of dust.

(*c*) *The rabbit pest.*

This is the real cause of overstocking, and it is involuntary on the part of the pastoralist. This pest has become acute during the past thirty years, and has accentuated any overstocking by sheep.

6. Prevailing Winds.

Mr. Russell told me that the prevailing winds in the Western country, capable of piling sand, vary from north-west to south-east. According to the preponderance and strength of these winds, so will the direction of the sand-ridges vary. It will, of course, be borne in mind that the direction of the ridges will be at right angles to the prevailing wind.

Mr. A. W. Howitt is of opinion that the strongest winds in the Lake Eyre district of South Australia are south-west.

According to the late Mr. R. Helms, the prevailing direction of sand-dunes is east and west, and they are rarely more than half a mile apart.

See a valuable paper by Colin J. McMaster, Chief Commissioner of Western Lands,* where the author points out that the sand-dust is travelling eastward :—

That the imperceptible eastward trend of the sands has not been specially marked in the past is not sufficient ground for assuming that an equally slow rate of progress will take place in the future, because, up to within recent years, the land was more or less covered with vegetation; but now, to an alarming extent, vegetable growth of all kinds has disappeared, and in the future the sands may drift in every dry season, instead of during periods of prolonged and excessive drought, such as this State has recently passed through.

This paper contains also interesting sections of levels across sand-hills shifting north-easterly under the influence of south-westerly drought winds, County of Landsborough, Western Division, New South Wales.

The last features of importance are the sand-hills, which occupy the surface over immense areas of the interior. These are ridges of usually a red, argillaceous sand, having in many localities an approximately parallel arrangement, and therefore with a constant trend, usually north-east and south-west, due to the prevalence of south-east winds, but elsewhere occurring quite irregularly. The trend of the sandhills is to a great degree dependent upon the direction of the prevailing wind, being almost at right angles to this. Separating the ridges are the corresponding diminutive valleys, the floor of which is usually of a much more clayey character than the material of the sand-hills. They have one steep fall, inclined at an angle of about 30 degrees, and situated on the side opposite to the quarter from which the wind blows, the other side having a gentler slope.

The sand-hills rise to very varying heights, 30 or 40 feet being a very common height, while in some cases they reach 70 feet, or even in some extreme cases 100 feet above the level of intervening flats. The highest sand-hills were crossed during the trip from George Gill Range to Ayers Rock, where also the greatest development of them was seen. The surface of almost the whole of this strip of country is occupied by sand-hills, which are clothed over very large areas with "porcupine grass" (*Triodia*). (Report, Horn Scientific Expedition to Central Australia. March, 1896. Part III—Geology and Botany.)

* *Proc. Roy. Soc. N.S.W.*, Vol. xxxvii, 138 (1903).

7. Remedial Measures.

Since our knowledge of the inland drifting sands is so sparse, with such defective knowledge, I am afraid our remedial measures must be largely tentative. Having learnt the principle of arresting the progress of a coast sand-dune from its source and coping with it, we should endeavour, as far as possible, to apply a similar principle to the inland ones also. In dealing with the latter, a large *area* of moving sand may be the *source*; hence we must modify our tactics, forming a number of more or less parallel lines of defence at a comparatively great distance apart, instead of practically one line of defence, as with the narrower strips of sand on our coast.

I think that *conservation of vegetation* should be our watchword. I would subordinate planting to this. An essential condition to success is to keep stock off areas which are being conserved or planted, perhaps for a considerable period. Close planting is necessary, otherwise weeds and grasses compete unduly with the young plants, which can be thinned out as necessity arises. The remarks I have made in regard to the utilisation of the native vegetation, when speaking of the coast dunes, I would particularly emphasise in speaking of those of the interior. I do not propose to exclude exotic plants; but I have no hesitation in saying that the bulk of the work of sand-binding in the interior must devolve on Australian indigenous plants.

(*a*) *Method of Planting.**

I am aware that, on the ground of expense, methods of protection against sand in Western areas can only be applied for the protection of buildings, gardens, and other limited areas of special value. To begin with, one must, in many cases, have a nearly smooth surface of sand, and this must be locally protected with a wattle fence† constructed of bundles of any plant rubbish that can be spared, packed on the windward side. The surface of the sand must then be protected with branches of any kind, pegged down as far as possible. Areas thus protected should each be a few hundred feet long and, say, 50 feet broad, the greater length being at right angles to the prevailing wind. This protected area should be sown with seeds of the indigenous vegetation, and, as in the case of the coast dunes, the fixation of one area would protect a second area, which would be similarly treated, and so on.

Where homesteads are in danger of being overwhelmed by sand I would certainly try Marram Grass, although its value in localities away from the sea has not been tested. The Western sands often contain more or less saline matter, and it is hoped that a good test of Marram Grass may be made at no distant date. Better get the grass started and acclimatised while the seasons are moderately good, without waiting for the increased difficulties inseparable from a spell of drought.

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* In *Agric. Gazette, N.S.W.*, February, 1904 (p. 139), is a translated article "The planting of sandy plains (in Russia) to prevent drifting," but the value of that article for us is discounted by the fact that, in some of the instances quoted, we do not know whether coastal or inland areas are referred to, and the botanical names of the plants recommended are not given, and therefore uncertain. The Sand Willow referred to is *Salix acutifolia*.

† In using this term in Australia, one must remember that the term Wattle has the accidental meaning of Acacia with us. A wattle fence is really a fence of thin or split saplings.

(*b*) *The planting of experimental areas suggested.*

In order to give my suggestions a trial, certain experimental areas could be set apart by the Western Land Board. In the meantime maps could be rendered available of the shifting sands; then depôts could be established in various districts, each depôt being in touch with an experimental area or group of such areas. Each depôt should be in charge of a skilled gardener, a really good man—and we have many such in this State. While he is making his plans for the levelling and sowing of the experimental areas, he would carefully collect seeds of the different kinds of vegetation found in the district, and carefully preserve them as gardeners know how. Then at any time judged to be desirable, he could make his sowings.

He could also, if deemed desirable, establish at each nursery a small experimental nursery. Probably his trees, &c., would have to be raised by the " bamboo method," as flower-pots would be out of the question, and other receptacles (tins for jam, fish, meat, &c.) would be comparatively few. And here I may make the observation that in the afforestation of the Western country old tins would be valuable, and these articles should, as far as possible, be carefully preserved for this purpose instead of being thrown out as at present.

The gardener-in-charge of each depôt would also encourage the native grasses and other tussocky and creeping-stemmed plants to spread. He would plant cuttings of saltbush and other plants. The work of one gardener would be compared with that of another, and they should be encouraged to emulate each other. A good gardener (and let me say that we must have trained men, and not mere labourers, however willing) would master the planting of any sand-dune. He would also be a focus of information for a district, instructing anyone who might seek knowledge. By degrees, under the lee of the sand-dunes and in other favourable places, he would gradually experiment with other plants and would do something towards forming oases in the desert. Personally, I am often in a position to supply seeds for experimental purposes, and if the matter were seriously entered upon, our numerous exchanges with foreign countries would be requested to supply seeds, &c., to further this national work. These depôts would be outposts to reclaim these desert areas, and are as necessary as means of communication. Droughts would recur, and even the depôts would sometimes have a hard fight to exist, but unless it is thought that nothing can be done to re-establish and improve the vegeta tion on the shifting sands, an opinion that, if held, I do not share, let us *systematically* set to work. I am perfectly certain that if anything can be done in this direction good gardeners can do it, and preliminary work can afterwards be extended to any desired extent. There is no necessity to supply a long list of plants for experimental cultivation, either native or exotic. I will content myself with very few. If I were permitted to carry out my plans, I would attach the gardeners-in-charge of the proposed depôts to the Botanic Gardens for a brief period, in order that they might critically examine all plants likely to be useful for their purposes which are growing in the Garden, and for

exchange of ideas, which must be beneficial to all good men. Then I would have experimental plantations made on the coastal sand-dunes near Sydney and study the lessons thus taught.

Mr. McMaster* considers that the cost of plantations is prohibitive, and, admitting that areas are overstocked, is of opinion that the key to the situation is the moving about of stock from one locality to another, so as to prevent the sand-binding plants of any district being eaten out. This can only be done by a system of light railways, and that being the opinion of a man whose view on this subject commands the utmost respect, our people should be educated to advocate them. Mr. McMaster's words are :—

> If these be provided, it is believed that the stock-owners will be able to regulate the quantity of stock their holdings are capable of carrying with safety, and in doing so a condition of affairs will gradually be brought about that will justify the individual as well as the State in giving effect to the valuable proposals by Mr. Maiden. In fact, it may so happen then that nature will assert itself to such an extent that no artificial assistance, other than the railways referred to, will be required to keep the drifting sands in check.
>
> Without railways to relieve the country of stock in times of drought, any attempt to cope with the Sand Problem of the West is regarded as almost hopeless, but with their assistance in the manner indicated, the question will be reduced from one of extreme difficulty to one of comparative simplicity.

8. Plants recommended for Western Sand-dunes.

Just as the Maritime Pine is the principal planted tree of the French Landes, and just as I recommend the Norfolk Island Pine for our coastal sand-dunes, so I recommend the Cypress Pine (*Callitris*) as the main standby for the shifting sands of the West. It is a tree of commercial value, and parenthetically I may enjoin discretion in cutting away existing Pine forests out west. My policy would be to raise rows and cross rows of Cypress Pine in sandy country inside the Barrier Range. It is natural there, and Sturt† floundered over successive ridges of deep, loose sand, and became entangled in a Pine forest near the Barrier Range.

Sugar Gum (*Eucalyptus cladocalyx* (*corynocalyx*); *E. fasciculosa* F.v.M., *E. melliodora* A. Cunn., the "Yellow Box," *E. salmonophloia* F.v.M., the Salmon Gum of Western Australia, and other Western eucalypts (especiallyMallees) should be encouraged.

Various Acacias, such as Mulga (*A. aneura*), Yarran (*A. homalophylla*), Myall (*A. pendula*), *A. sentis*, and many others should be freely grown. The seeds of Acacias maintain their vitality for a considerable period.

Casuarina lepidophloia (the Belar) and *C. Luehmanni* (the Bull Oak). I would also introduce the Desert Oak (*C. Decaisneana*) of Western Australia, the Needlewood (*Hakea leucoptera*), and many other trees and shrubs.

One plant of Porcupine Grass extends in an ever widening circle, the centre becoming dead and hollow. This is a most important natural sand-binder for the sand-hills, and should be conserved. The native grasses in general should be encouraged, as I have already indicated.

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* *Proc. Roy. Soc. N.S.W.*, 1903, p. 141. † *Narrative of an Expedition, etc.* (1849), i, 223; also ii, 34.

Mr. T. E. Grigg, of Fareham, Girilambone, says he knows nothing better than *Nitraria Schoberi* as a sand-binder. It is a spreading shrub, and it is absolutely drought-resistant.

The coastal species, Silky Oak (*Grevillea robusta*), the White Cedar (*Melia Azedarach*), and *Acacia Baileyana* have developed remarkable drought-resistance.

Mr. Grigg has for many years been experimenting on plants under Western conditions, and his short papers are always worth studying—*e.g.*, "Report of experiments carried out at Fareham, Marra Creek" (*Agric. Gaz.*, August, 1906, p. 789); "The deterioration of pastoral country" (July, 1900, p. 610); "A plea for our Western scrub and salt-bushes" (August, 1900, p. 658).

See also R. W. Peacock, "Salt-bushes: their conservation and cultivation" (*Agric. Gaz.*, March, 1904, p. 211); "Salt-bushes" (July, 1901, p. 791); "Salt-bushes and edible trees" (February, 1901, p. 225); "Our Western lands: their deterioration and possible improvement" (August, 1900, p. 652); "The reclamation of scalded plains" (July, 1899, p. 635); and many other papers by the same author on Western cultivation problems.

Turning to exotic plants, some of the Cowpeas (*Vigna Catjang*) have been recommended as sand-binders. I would also try the Sheep's Burnet (*Poterium sanguisorba*) with its large root stock.

On the Mesas of Arizona and Western Texas is found the "Running Mesquite" (*Bouteloua oligostachya*). This would probably be worth a trial.

The Carob tree is very drought-resistant, and might be further experimented with. So also the Pepper Tree (*Schinus molle*), a useful shade tree, though not of use for anything else.

Amongst economic plants the Date Palm takes high rank, and it has for many years been acclimatised in the desert country north of South Australia. I have tasted very fair dates from these palms for several years.

The results of an experimental planting made by the U. S. Division of Forestry in 1890 on the sand-hills of Nebraska seems to have proved that the Banksian Pine (*Pinus divaricata*) is one of the best adapted species for planting in arid conditions.*

Although not referring to such severe conditions as our western sand-hills and other western country, a paper, "Forest planting in a treeless country," Part iii of Bull. IV (U.S.A. Dept. of Agric. and Forests), by B. E. Fernow, will be found suggestive.

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* *Forestry Quarterly*, No. 2, p. 80. See also "Notes on Sand-drift planting in Nebraska," p. 355. *U.S. Year-book of Agric.* (1895).

PHOTOGRAPHIC ILLUSTRATIONS.

Marram Grass, just planted, showing state of sand-hills before planting. Port Fairy, Victoria

Marram Grass. Digging plants three years' growth. Port Fairy, Victoria.

Travelling Sand, near Milparinka, N.S.W.

House in progress of burial by sand-drift. Cobham Lake Homestead.

Tree left in air by reason of the soil being blown away. Mulga-tree, Yantara (N.W. corner of N.S.W.) : 3 feet of surface soil blown away.

Drifting Sands, Shores of Lake Menindie, near Menindie.

Photograph showing how the sands on the shores of Lake Menindie have encroached upon the temporary buildings used as a booth at the Menindie Race Course. Because of the encroachments of sand the course was abandoned and a new one has been established on land not subject to sand-drifts.

Three views of drifting-sands or sand-hills, near Menindie, N.S.W., 1910.

(Photos 3–19 by C. J. McMaster, Chairman, Western Land Board, Sydney).



"MARRAM GRASS." DIGGING PLANTS. THIRD YEAR'S GROWTH.

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"MARRAM GRASS" PLANTING. FIRST YEAR'S GROWTH, AND SHOWING STATE OF SAND-HILLS BEFORE PLANTING.



C. J. McMaster, photo.

TRAVELLING SAND, NEAR MILPARINKA.



C. J. McMaster, photo.

HOUSE IN PROGRESS OF BURIAL BY SAND-DRIFT, COBHAM LAKE HOMESTEAD.



C. J. McMaster, photo.

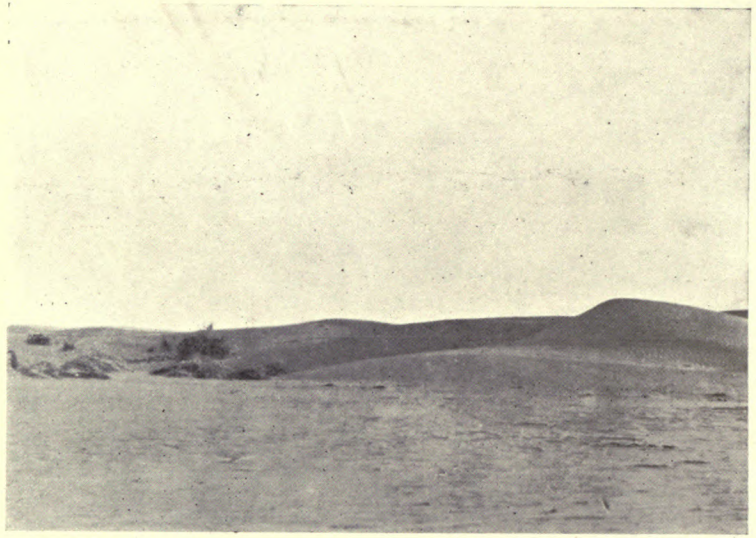
TREE LEFT IN THE AIR BY REASON OF THE SOIL BEING BLOWN AWAY. YANTARA, N.S.W.

1683



C. J. McMaster, photo.

SAND ENCROACHING ON TEMPORARY BUILDING USED AS A BOOTH AT THE MENINDIE RACECOURSE.



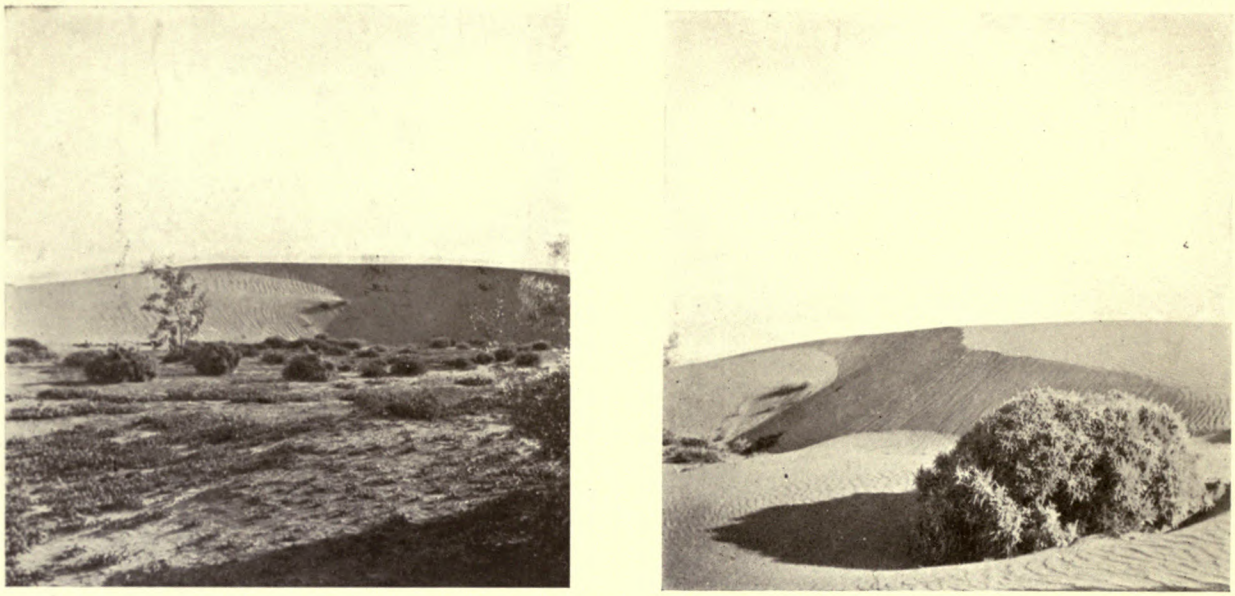
C. J. McMaster, photo.

DRIFTING SANDS, SHORES OF LAKE MENINDIE, N.S.W.

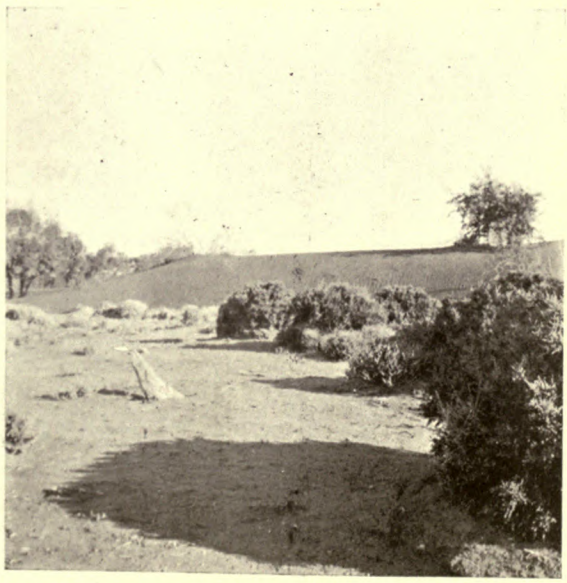


C. J. McMaster, photo.

DRIFTING SANDS, SHORES OF LAKE MENINDIE, N.S.W.



DRIFTING SANDS, MENINDIE N.S.W., 1910.



SAND HILLS, NEAR MENINDIE, N.S.W., 1910.

No. 213.

Telopea speciosissima R.Br.

The Waratah.

(Family PROTEACEÆ.)

Botanical description.—Genus, *Telopea*. (See Part XLIV, p. 69.)

Botanical description.—Species, *T. speciosissima* R.Br., in *Trans Linn. Soc.*, x, 198 (1811); *Prod.* 388. Also the same author's *Proteaceæ Novæ*, p. 32.

A stout erect glabrous shrub of 6 to 8 feet.

Leaves cuneate-oblong or almost obovate, 5 to 10 in. long, mostly toothed in the upper part, tapering into a rather long petiole, coriaceous, penniveined with the midrib prominent, a few rarely quite entire.

Flowers crimson, in a dense ovoid or globular head or raceme of about 3 in. diameter.

Involucral bracts coloured, ovate-lanceolate, the inner ones 2 to 3 in. long, the outer ones few and small, surrounded by a dense tuft of floral leaves like the stem ones, but smaller and more entire.

Bracts under the pairs of flowers very short.

Pedicels thick, recurved, ¼ to ½ inch long.

Perianth glabrous, nearly 1 inch long.

Ovules 12 to 16.

Fruit recurved, 3 to 4 in. long.

Seeds 10 to 20, the nucleus broad, obliquely quadrate, the wing obliquely truncate, ½ to above ½ inch long (*B. Fl.* v, 534).

See also Meissner in DC. *Prod.*, xiv, 446. It is figured in Maund and Henslow's "The Botanist," Vol. ii, No. 71, but the plate is not very good. A representation of this handsome flower is also in Reichenbach's *Fl. Exot.* t. 159.

There is a coloured figure, on a reduced scale, in my "Illustrated Flowering Plants and Ferns," Part 1.

Botanical Name.—*Telopea*, already explained (see Part XLIV, p. 70); *speciosissima*, the superlative of *speciosa*, the Latin word for beautiful or handsome.

Vernacular Names.—"Warratau" was one of the very earliest spellings. By many people this plant is known as the "Tulip" or "Native Tulip." It bears neither affinity nor resemblance to the true Tulip, and the name is probably a corruption of *Telopea*.

We have sometimes heard it said that it was the presence of Waratahs in abundance that caused Botany Bay to receive the name it now bears. That, however, has no foundation on fact. The name is probably a translation of "Coste des herbaiges" (the coast of plants or pastures), a name given in an old 16th century chart to part of Eastern Australia. Those who desire to look into the matter are invited to turn to *The Historical Records of New South Wales*, vol. i, Part i, p. 161. Cook's name for Botany Bay was "String-ray Harbour."

It soon attracted the attention of gardeners in Britain, and was sent home very shortly after the foundation of the Colony of New South Wales. Following are a few later records.

Governor Hunter, writing to Under Secretary King, in June, 1797, says: "I am concerned to say that . . . we can have no prospect of getting the Warata plant home . . . I have long wanted to send some for the King's gardens, but the want of favourable opportunitys have constantly prevented me."

Lieut.-Governor King brought a plant to Sir Joseph Banks, which arrived in London during the same month. Governor King sent a box of Waratahs to Sir Joseph Banks in August, 1801. (*Hist. Records*, iv, 514.)

Governor Bligh sent Warrataw seeds to Sir Joseph Banks in 1807 (*Hist. Records*, vi, 380).

Camellia japonica, variety *anemoniflora*, is a very handsome crimson form with an outer row of petals, corresponding to the bracts of *Telopea*, and is figured in *Bot. Mag.* t. 1654, under Aiton's name of "Warrata'h Camellia."

Aboriginal Names.—The aboriginal name of the Waratah is "Mewah," according to the Honourable George Thornton (*Notes on the Aborigines of New South Wales*, p. 6. Chicago Exhibition publications, 1893).

Waratah is probably an aboriginal name, but its origin does not appear to be clear at the present time.

Synonyms.—*Embothrium speciosissimum* Sm., *Specimen Bot. Nov. Holl.* i, 19, t. 7; *Bot. Mag.* t. 1128. The bracts are depicted loose in this figure; they are compact and encircle the flowers in a good specimen. *E. spathulatum* Cavanilles, *Icones* iv, 60, t. 388; this is a drawing of a twig in fruit (empty follicles); Cavanilles had not seen the flowers. *E. speciosum* Salisb. *Parad. Lond.* t. 111. *Hylogyne speciosa* Knight, *Prot.* 126.

Flower.—The colour of the flower is crimson and strikingly handsome. It is a solid flower of great permanence, and it has, in an informal way, come to be looked upon as the national flower of New South Wales. It lends itself in a remarkable degree to decorative treatment, and hence is frequently depicted literally, or as a *motif*, in wrought-iron, wood, and stone carving, stained-glass, and pottery decoration.

As early as 1793, it was recorded by Smith ("A Specimen of the Botany of New Holland") that the natives made an agreeable repast by sucking the flowers, which abound in honey.

The late Dr. George Bennett has a paper entitled "On variation of Colour in the flowers of the Waratah (*Telopea speciosissima*) and several other indigenous plants of New South Wales." (*Journ. of Bot.* vi, 36).

This particular Waratah flower was almost an albino, and came from the Kurrajong. Such flowers are from time to time found, always rarely. In all cases which have come under my notice, the finders have so concealed their plants in the hope of selling them for large sums, that I have never had an opportunity of trying them under cultivation. Until they are tested in the garden they will have no money value.

Stem.—In the early days of the Colony the smiths used to give the aborigines trifles for a supply of the stems of this plant, which they used for twisting round their punches and other implements while working heated iron.

Fruit.—The fruit is a follicle. One Waratah "flower" (composed, of course, of a large number of individual flowers) matures, under favourable circumstances, twelve to twenty follicles.

Propagation.—From seed, which readily germinates when fresh. The Waratah is a plant which is coming increasingly into favour in private gardens, and under cultivation it attains a luxuriance unknown in its wild state. It is one of the most gorgeous of all sub-tropical plants under cultivation. Our experience of it is that it may flower the third year from seed.

A gentleman, whose name I have forgotten, gave me the following figures on the blooms on three Waratah plants in his garden—43, 108, 230.

In a paper by Dr. George Bennett, "The Waratah or Native Tulip-tree of New South Wales (*Telopea speciosissima*)" (*Journ. of Bot.* iii, 363.), the following passages occur:—

> The first year the Waratah blossoms it throws out from two or four shoots from each flower-head in the second year only two, and in subsequent years only one, or more rarely two. To ascertain the way these shoots are produced, it is necessary to procure a flower-head full-blown or just fading, and on looking closely among the flowers, from one to two or four shoots will be observed just developing themselves, and these will form the branches of the following year, from each of which a flower-head will most likely be produced. A knowledge of this fact will explain why the plucking of the flowers destroys the new branches, injuring its natural development, and keeping the shrub stunted in growth, and prevents its flowering in the ensuing year. The Waratah produces seeds every second year . . .
>
> In suitable situations, in their wild state, they usually flower when about 4 to 6 feet high, and when at that time stripped of their blossoms, they become stunted, devoid of beauty, and so remain until suckers are thrown up from the roots, by which flowering branches are reproduced.

In a subsequent paper, "Additional Notes on the Native Tulip-tree of New South Wales (*Telopea speciosissima*)" (*Journ. of Bot.* v, 140), Dr. Bennett modifies some of his previous remarks, stating that he has since ascertained, by careful examination, that plucking the flowers generally, but not invariably, destroys the flowering of a particular stem during the following year.

Dr. Bennett says that the best time for transplanting Waratahs from the bush is when they are in flower. Our experience seems to bear out that view, though, with our changeable seasons, we have had successful plantings at other periods.

It is to be borne in mind that while Waratahs appear to flourish in very barren soil, it may be that the soil underneath may be peaty and the conditions altogether better than may appear on the surface. At all events it is an important error to treat Waratahs as if they disliked good treatment. Some of the best Waratah plants I have ever seen were in a rose border, the soil stiff, and fairly enriched with manure.

Distribution.—The Waratah is found on the coast and mountain districts of New South Wales, from the New England in the north to the Clyde and Braidwood districts in the south. It is one of those plants which finds its southern limit where the sandstone formation ends; it does not pass over to the granite there. It delights in rocky situations, and if it were not for the fact that it grows frequently in very rough country, it would be threatened with extinction. It is, of course, common in the Blue Mountains.

Mr. W. J. Bate, of Tenterfield, informs me that it grows at Pheasant Creek, 25-30 miles north-east of Glen Innes, on high unsettled country on the watershed between the Mitchell and the Rocky or Timbarra River. This is west of the Rocky River.

Mr. John Whitton, Tenterfield, describes much the same locality as 40 miles south-east of Tenterfield on the eastern watershed on a high table-land range near Mt. Spiraby.

Mr. J. Kneipp, of Glen Innes, says the only place known to him where the Waratah grows in New England is about 42 miles north-east of Glen Innes. It grows high on the mountain in very barren country, gravel and white sand, thickly timbered, and with many kinds of undergrowth.

Mr. J. F. White, of Shannon Vale, Glen Innes, defines the local Waratah country as a tract between Glen Elgin Station and Pheasant Creek Tin Mines about 40 miles in a north-easterly direction from Glen Innes. The country at first sight is much like the country about Gosford, but of granite instead of sandstone. It is useless for grazing, and about 2,800 feet above sea-level. Mr. White says that many of the bush flowers of the coast are here, including he believes the Flannel Flower, but he has not seen it. This is the locality visited by Mr. E. C. Andrews, Geological Surveyor, who also found the Waratah so far north.

Mr. H. A. Smith, of Tenterfield, speaks of the same locality as Pheasant Creek Tin Mines, 45 miles east or north-east of Glen Innes. Very poor granite country.

1922



THE WARATAH.

(Telopea speciosissima R.BR.)

Mr. Andrews informs me that from Poverty Point in the north to Morven, and thence by Morgan and Pheasant Creek to Dundahra Plateau, is a good lot of exceedingly sandy granite (76 per cent. or more of Silica) occurring as large irregularly-shaped masses. Rainfall, good. *Botany.*—Waratahs, Geebungs, Five-corners, Flannel Flowers, Boronias, &c.

EXPLANATION OF PLATE 218.

A. Flowering stem from Springwood.

B. Bud.

C. Flower opened.

D. Pistil showing—

- (*a*) Hypogynous gland.
- (*b*) Stipitate ovary.
- (*c*) Style.
- (*d*) Stigma.

E. Part of perianth showing the anthers enlarged.

F. Follicle with seeds.

G. Seed.

No. 214.

Eucalyptus Baueriana Schauer, variety *conica* Maiden.

Fuzzy Box.

(Family MYRTACEÆ.)

Botanical description.—Genus, *Eucalyptus*. (See Part II, p. 33.)

Botanical description.—Species, *E. Baueriana* Schauer, variety *conica* Maiden, in *Proc. Linn. Soc. N.S.W.* xxvii, 216 (1902). *E. conica*, Deane and Maiden, *ib.* xxiv, 612 (1899).

Following is the original description (as *E. conica*):—

A box of medium size; a pretty, graceful tree, with pendulous branches.

Vernacular names.—"Fuzzy Box," "Bastard Box," "Yellow Box," "Grey Box" or "Woolly Butt," "Apple Box."

Bark of the ordinary "box" character, but in districts where the two trees grow together, rougher than that of *E. hemiphloia*; persistent in all cases, right on to the small branches.

Timber reddish-yellow, and very tough when dry; much redder than ordinary box (R. H. Cambage). [It is brown as compared with that of *E. polyanthemos*, or Red Box.]

Juvenile leaves.—Pale green, not glaucous; broadly ovate; the intramarginal vein considerably distant from the margin, and, with the midrib, giving the leaf a triplinerved appearance.

Mature leaves lanceolate, ultimately narrow-lanceolate, and, say, 4 inches long by half an inch broad; varying, however, in length and width, and some branchlets including very wide leaves; the intramarginal vein is distinctly removed from the edge of the leaf, although this is of course less marked in the case of narrow leaves; the venation is oblique, but few of these secondary veins are as prominent as the intramarginal vein. The foliage is drooping and has frequently long stalks.

Buds clavate, the calyx-tube greatly exceeding the operculum in size; the operculum nearly hemispherical, with a small umbo; the calyx-tube tapering gradually to the common point of attachment to the stalk, the buds being sessile.

Flowers.—This is a very floriferous species; the inflorescence is arranged in panicles of several inches, the individual umbels having a maximum of six or seven flowers. Stigma hardly dilated; anthers small, opening in terminal pores, all fertile and inflected in the bud.

Fruits narrow conical (hence the specific name), tapering to the point of attachment of the common stalk. Often not quite symmetrical, and somewhat pear-shaped. Greatest length, say $\frac{3}{8}$ inch by, say $\frac{5}{32}$ inch broad. Thin rim; the valves, which are three or four and very small, are deeply sunk. Of a pale brown colour and shining.

Contrasted with *E. Baueriana* Schauer, the chief characters of the variety appear to be:—More erect tree, foliage narrower and pendulous, fruits smaller. Although different enough at first sight as regards the typical forms, the present form seems to be the western or usually narrow-leaved form of *E. Baueriana*, but it insensibly connects with the typical species found on the coast or table-lands. The type species has also more glaucous leaves than the (usually) more interior form. Further, the often broad juvenile leaves, and the broad mature leaves especially common on the northern table-land present, to me, at present, an insuperable barrier to keeping the two forms apart as distinct species.

At page 198 will be found references to some intermediate forms. Morphologically, the transition of these forms is quite striking; at the same time I admit that there is some evidence (and more may be forthcoming) to justify the separation of the variety *conica*, and its re-establishment as a distinct species.

As compared with *E. hemiphloia* F.v.M. the "White or Grey Box" (see Part VI) the fruits of that species are sub-cylindrical, not conical as is the case with *E. Baueriana*. The var. *conica* of *E. Baueriana* is more likely to be confused with the western form of *E. hemiphloia* (var. *microcarpa* Maiden) than are the coast forms. *E. hemiphloia* has the true box-bark. The timber of *E. hemiphloia* is paler than that of *E. Baueriana*.

As compared with *E. bicolor* A. Cunn, the "Black or Flooded Box" (see Part LXIV) the two species are confused in some herbaria. *E. bicolor* is a western species, and can only be confused with the var. *conica* of *E. Baueriana*. But their fruits will readily separate them; the timber of *E. bicolor* is red. Both species have sub-fibrous ("box") bark.

As compared with *E. Rudderi* Maiden, a "Red Box," (see *Crit. Rev. genus Euc.*, Part XIII) that species is, as regards herbarium specimens, very likely to be confused with var. *conica*. The foliage of *E. Rudderi* is thinner, the fruits less conical, and the timber red.

As compared with *E. Stuartiana* F.v.M., (see *Crit. Rev. genus Euc.*, Part XXIV), the resemblance to var. *conica* on the Lachlan River is so close that the latter goes under the name of "Apple Box," *E. Stuartiana* being known as "Apple." The leaves of *E. Stuartiana* are thicker and longer, the fruits have exsert valves, and the fruit is paler and altogether inferior.

Synonym.—*E. conica* Deane and Maiden; *Proc. Linn. Soc. N.S.W.* xxiv, 612 (1899).

Vernacular Names.—"Apple Box," "White Box," "Grey Box," "White Peppermint," are all names, more or less applied, which it shares in common with other species. Most usually it is simply called "Box."

"Fuzzy Box" is a name occasionally given to it by bushmen, and is in reference to the woolly character of the bark under the axe. As I do not remember this name having been applied to any other tree, I suggest its adoption for this one.

The names "Blue-leaved Box" and "Narrow Blue-leaf Rough-top Box," applied to it by Mr. District Forester Swain when he was in the Pilliga Scrub, are interesting. Mr. Swain is a good observer, and he did not know when he adopted these names, that the only other "Blue Box" is *E. Baueriana*, and that he was unconsciously indicating an affinity of *E. Baueriana* and its variety *conica*.

Aboriginal Names.—"Morongle" the name formerly given by some Lachlan River blacks (G. W. Orr, through R. H. Cambage).

Timber.—Brown in colour, used for the ordinary requirements of the bush, but I cannot get a critical account of its economic value, as the testimony of my informants breaks down under cross-examination when I confront them with the timbers of other Boxes of the drier country.

Size.—Of medium and even large size. Up to 60 or 70 feet high, and up to 6 feet in diameter of trunk.

Habitat.—It is found only in New South Wales and Queensland, so far as I know at present. As regards the former State, it occurs in much of the country west of the Dividing Range and its spurs, forming, with *E. hemiphloia*, *E. odorata*, and other species, much of the "Box" in the western country. When it is better known, I expect it to be found over a much wider area in Queensland than recorded at present.

New South Wales.

West of Wyalong, "Apple Box" (R. H. Cambage). "White Box," Wyalong (District Forester Osborne).

"Bimble Box," Grenfell (District Forester Arthur Osborne). The mistake of confusing this with the true Bimble Box (*E. populifolia*), or rather of applying this name to a second Eucalypt, is common in the district, and should be discouraged.

Weddin Forest Reserve (J.H.M.); Young (W. W. Froggatt); Cowra, a "Box" with persistent bark on small branches (H. Deane). Banks of the Lachlan, 6 miles south-east of Cowra; also 2 miles north-east of Cowra, a "Grey Box" or "White Box." Some of the leaves medium broad, and certainly intermediate between *Baueriana* and the variety (R. H. Cambage). "Grey Box," drooping branches, bark rougher than *hemiphloia* or its var. *albens*. Resembles *Stuartiana* so much that on the Lachlan it is called "Apple Box." "Wood much redder (*sic*) than ordinary Box; grey bark to top of branches." Two miles north-east of Cowra (R. H. Cambage).

"Morongle Trees." Sent by G. W. Orr from Morongle Creek, near Cowra. Said to be the blacks' name, but now not in use. "Box" or "Apple." Leaves medium-broad, certainly intermediate (R. H. Cambage).

Murga (H. Deane); Forbes district (H. Deane, also R. H. Cambage); Parkes (H. Deane). "This is what I think is the 'Blue Box,' only the capsules are much smaller than those I got in Queensland (Stanthorpe)." Forbes (A. Murphy). This is strong testimony to the variation of *E. Baueriana*, for Mr. Murphy has very wide experience.

Eumungerie, Dubbo district, " White Box " (Assistant Forester A. R. Samuels). Midway, near Dubbo (W. Gill and J. L. Boorman). " Tall pendulous trees of 40–60 feet; 4–6 feet in diameter. Known locally as Blue Box and Fuzzy Box. Grows in moist, sandy localities." Dubbo (J. L. Boorman). Dubbo (R. H. Cambage, also J. V. de Coque). It is the " Grey Box, No. 2 " of Mr. de Coque's notes. " Blue Box," Minore (J. L. Boorman). Tomingley, Peak Hill, Narromine, and Dubbo (J.H.M.).

Bidden Road, 7 miles northerly from Gilgandra, sucker leaves broadish (R. H. Cambage, No. 1,091).

" Fuzzy Box," Wellington. " Formerly looked upon as *E. largiflorens*." (Received from Rev. Dr. Woolls with this information). Banks of Mitchell's Creek, between Gulgong and Wellington (A. Murphy). The juvenile leaves very thin, showing marked venation, and rather narrow.

" Yamble Box." Yamble, 15 miles from Gulgong (A. Murphy).

Gulgong (J.H.M. and J. L. Boorman). In swampy or low-lying country, rarely on hills; sometimes known as " Bastard Box." With broader leaves than those of the Dubbo trees; the juvenile leaves identical with those of the coast form, even if not quite so broad. The stems of the suckers are yellow, turning red later. The tree has a glaucous cast of foliage like *E. polyanthemos;* the surrounding trees of *E. hemiphloia* F.v.M. var. *microcarpa* Maiden are glabrous. Known locally as " Fuzzy Box," or " Bastard Box," with rough bark up to the branchlets. The fuzziness or wooliness of the bark is a useful diagnostic character in this species. The timber is hard to cut, but more chippy and short-grained (brittle) than *E. hemiphloia.* It is locally esteemed as a durable timber and a valuable firewood. The bark and timber appear to be in no way different from those of the coast or typical form.

Merriwa (J.H.M. and J. L. Boorman), with much *Loranthus* on it. On the river flats and taluses of the ridges—a usual situation.

" White Peppermint." A huge tree, with rough white bark. Parish Nangarah, County of Darling, near Barraba (W. A. de Benzeville).

" Box." Rough bark to top. 40 feet high, 3 feet 4 inches diameter. Sandy soil Parish of Bomera, County of Pottinger, near Gunnedah (M. H. Simon).

Colley Creek, near Quirindi (G. Valder).

" Blue-leaved Box," with Pine and Narrow-leaved Box. 60 feet high, branching low. Pilliga Scrub. Parish of Kenebri, County of Baradine (E. H. F. Swain).

" Narrow Blue-leaf Rough-top Box." 16 miles, Coonabarabran Road, County of Baradine. Pilliga Scrub (E. H. F. Swain).

Following are northern localities:—

" A Box-tree." Bark not so woolly as on Lachlan River trees; same red twigs. About quarter mile south of cemetery, on granite, 2,800 feet above sea-level, Tingha, with leaves of intermediate size (R. H. Cambage, No. 993).

Bolivia. Bark persistent to smallest branches (H. Deane). With broadish leaves; another intermediate form.

Wallangarra, abundant. Flowering in the broadish-leaved stage. With pink filaments in some flowers (J.H.M. and J. L. Boorman).

Acacia Creek, Macpherson Range (W. Dunn). Some specimens with broadish leaves.

The broadish-leaved forms of var. *conica*, almost as broad as that of the typical form, are especially common in northern localities.

QUEENSLAND.

Wilson's Creek, Macpherson Range, on the Queensland as well as the New South Wales side of the border (W. Dunn and J.H.M.).

Wallangarra, on the Queensland as well as the New South Wales side of the border (J. L. Boorman and J.H.M.).

Texas, with quite narrow leaves (J. L. Boorman).

Warwick, leaves perhaps as narrow as *conica* (J. Shirley). "Box," Gowrie, Little Plain (W. F. Gray).

To summarise: intermediate forms (as between *E. Baueriana* and var. *conica*) are found at:—

1. Banks of the Lachlan, 6 miles south-east of Cowra; also Morongle Creek, near Cowra.
2. Tingha; Bolivia.
3. Acacia Creek, Macpherson Range, and Wallangarra (both on the New South Wales-Queensland border).

EXPLANATION OF PLATE 219.

A. Juvenile leaf from Merriwa, N.S.W.

B. Juvenile leaf, rigid and thick, from Dubbo, N.S.W.

C. Flowering twig, from *Proc. Linn. Soc. N.S.W.*, Plate xlviii, fig. 1 (1899). (Type of *E. conica* Deane and Maiden.)

D. Anthers opening in terminal pores.

E. Fruits from Wallangarra, N.S.W. (Queensland border.)

F. Fruits from Merriwa, N.S.W.

G. Intermediate form between *E. Baueriana* and variety *conica*.



M.L. Flockton. del. et lith.

FUZZY BOX.

(Eucalyptus Baueriana SCHAUER, *Var. conica* MAIDEN.)

No. 215.

Acacia Maidenii F.v.M.

"Maiden's Wattle."

(Family LEGUMINOSÆ: MIMOSÆ.)

Botanical description.—Genus, *Acacia* (see Part XV, p. 103).

Botanical description.—Species, *A. Maidenii* F.v.M. in *N.S.W. Linn. Soc. Macleay Memorial Vol.* (1893), with plate xxviii. A mistake in the pod and seed has been corrected by R. T. Baker, *Proc. Linn. Soc. N.S.W.*, xxii, 232 (1897).

The original description is as follows:—

Arborescent; branchlets somewhat angular towards the summit.

Phyllodes large, of chartaceous texture, lanceolar-falcate, gradually narrowed into the petiole, very closely striolated by fine longitudinal venules with some few of these more prominent, almost glabrous or slightly greyish from hardly visible hairlets; marginal glandule near the anterior base of the phyllode, inconspicuous.

Spikes almost sessile, solitary, or two or three together, their rachis tomentellous; bracts inconspicuous.

Calyces broader than long, much shorter than their corolla, short-lobed, subtle-pubescent.

Corolla almost glabrous, deeply cleft into usually 4 lobes, not streaked.

Fruit narrow [considerably compressed] much twisted, outside beset with minute hairlets.

Seeds placed longitudinally, ovate-ellipsoid, shining-black, their aureole on each side large.

[*Funicle* pale reddish, completely or extensively encircling the seeds, suddenly doubled back from the summit, folded at the lower side.] (In this description, and in the original plate, Mueller had the pod and seed of *A. melanoxylon* R.Br. before him, and Mr. Baker corrected this. Figures E and F of the present plate will make the matter quite clear. The fruit is not "considerably compressed," and the funicle does not encircle the seeds at all, but its folds are confined to the top of the seed. J.H.M.)

Near the Richmond River (Mrs. Hodgkinson, W. Baeuerlen); Mooloolah River (Eaves).

A tree to 50 feet high, with a stem-diameter of 1½ feet. (*Op. cit.*).

Affinities.—(In reading Mueller's comparisons with various species, the fact that he considered *A. Maidenii* to have a flat twisted pod with a seed-encircling funicle must be borne in mind). His notes are valuable, nevertheless.

1. With *A. glaucescens* Willd.

"To the sagacity and circumspectness of Mr. J. H. Maiden it is due, that this Acacia became recognised as a species distinct from *A. glaucescens*, for which previously it had been passed. It is however, clearly different in carpic characteristics particularly, inasmuch as the fruit of the genuine *A. glaucescens* is straight and still more compressed, the seeds are longer, but proportionately narrower, the

funicle is almost colourless, and stretching only to the lower portion of the seed, there forming an arillar fold. Moreover, in *A. glaucescens* the phyllodes are less destitute of hairlets—an original specimen of Sieber's *A. cinerascens*, available here to me, being very instructive in this respect, and so an authentic specimen of Wendland's *A. homomalla*; further, the calyx is more decidedly velutinous, and the corolla, is usually five-lobed, not like that of *A. longifolia* and its allies four-cleft; but how far this note holds good, requires yetfu rther to be ascertained. Already De Candolle, and later Hooker, seized on this characteristic, when briefly defining *A. cinerascens* of Sieber, which may have possible other distinctions between that supposed species and *A. glaucescens*. Sprengel, who one year later than De Candolle promulgated *A. cinerascens* by a diagnosis too brief, lays also stress on the characteristic of grey-velutinous branchlets, which does not apply to *A. Maidenii*; it is, therefore, unlikely that Mr. Maiden's plant should be connected by intermediate forms with *A. cinerascens*, which authentically was not gathered in fruit. Contrarily, Bentham seems to have been quite right in combining it with *A. glaucescens*, of which Mr. A. R. Crawford says, that the phyllodes of young plants are roundish. *A. leucadendron*, reduced by Bentham to *A. glaucescens*, represents perhaps also the form *cinerascens*, as in Hooker's Lond. Journ. I, 374, the spikes are called, probably by a mere writing error, semi-pollicares, instead of sesqui-pollicares (when fully developed); this can only be cleared up from Cunningham's collections.

"Furthermore, it should be remarked, as pointed out by Mr. Maiden, that *A. glaucescens* is in the lowlands of New South Wales a southern species, while *A. Maidenii* is a northern, from regions not accessible to Sieber during his only seven months' Australian collecting visit to Port Jackson and its vicinity from June, 1822, to January, 1823. (At the time, 1893, we only knew it from northern localities.—J.H.M.) Here it may be of further interest to state, that a letter from Sieber appeared in the Ratisbon bot. Zeitung 'Flora' of 1824, at pp. 250-256 and following, in which communication he speaks of the marvellous forms of Australian Acacias, specimens of about 150 species being shown him there and then by Allan Cunningham (F. C. Dietrich in Eichler's Jahrbuch, 1881, p. 287). But as yet the fruit of *A. cinerascens* remains unknown, to confirm absolutely the specific identity of that plant with *A. glaucescens*. The preponderance of four- or five-cleft corollas can best be ascertained by examining great masses of flowers on living plants at their indigenous places. The localities, annotated under *A. glaucescens* in the Flora Australiensis, II, 406-407, for northern New South Wales and for Queensland, belong probably all to *A. Maidenii*; indeed, the most northern station for *A. glaucescens*, with certainty represented in the Melbourne Herbarium, is on the eastern slopes of New England at the Apsley River (A. R. Crawford), therefore in a cool region; while its southern limit is at the Genoa on mountains (Baeuerlen). The very flexuous fruit (not correct—J.H.M.) of *A. Maidenii* resembles that of *A. implexa*, but the arillar funicle in that species are much like those of *A. glaucescens*, therefore basal only to the seeds." (Mueller, *op. cit.*).

Acacia glaucescens is figured at Plate 145 (Part XXXVIII) of the present work, and it would be well to compare the two plates. *A. glaucescens* has glaucous foliage, as its name denotes, and its inflorescence is very abundant and showy, that of *A. Maidenii* being less floriferous and less yellow. The pods of *A. glaucescens* are straight and tomentose, those of *A. Maidenii* are glabrous and twisted. The funicles are different. The timber of *A. glaucescens* is denser and darker.

2. With *A. Cunninghamii* Hook.

"*A. Cunninghami* comes very near to *A. Maidenii*, particularly also in the venulation of the phyllodes, though the main venules are more prominent; but the branchlets are very angular and more robust, the phyllodes more inequilateral and thus indicate an approach to those of the Dimidiatæ, the calyces are nearly glabrous, the corollas are usually five-cleft, necessitating a five-denticulate calyx also, the fruits are still less broad, the seeds distinctly narrower but quite as long, the arillar appendage extends only to the basal part of the seed, and forms there a thick appendage from almost consolidated foldings of the funicle.

"*A. Cunninghamii* is evidently a more frequent species than *A. Maidenii*; thus it occurs in the distributed collections of Madame Dietrich from Port Mackay, Lake Elphinstone, and Rockhampton under the following numbers, so far as can be judged from flowering samples, all her specimens being devoid of fruit: 254, 381, 486, 539, 553, 622, 851, 1651, 2502, 2539. The following localities are also additional

to those recorded in 1864 in the second volume of the *Flora Australiensis:* Gwydir and Wide Bay (Leichhardt), Walloon (Bowman), Darling Downs (Lau), Richmond River (Fawcett), Leichhardt Downs (Wuth), Barcoo (Schneider). Confirmatory fruit specimens are wanting also from all these localities, so that still some doubts may be entertained about the identifications, especially for the plants from the far inland places." (Mueller, *op. cit.*).

There is a figure and description at Plate 137, Part XXXVI of the present work. As compared with *A. Maidenii* its pod is smaller and curved, but not twisted, and the seed is pendent with a slender funicle. *A. Cunninghamii* is found in drier areas, and is less umbrageous than *A. Maidenii*.

3. With *A. holcocarpa* Benth.

"*A. holcocarpa*, which has the venulation of *A. glaucescens* is easily distinguished from *A. Maidenii* in various respects, particularly in its rigid, almost cylindric, somewhat furrowed, fruit, dark-brown turgid seeds, and long straight funicle, ending in a very small, nearly cupular aril, as shown in the eleventh decade of the 'Iconography of Australian Acacias.' Mr. Dallachy noted this species as dwarf, the fresh flowers as fragrant and—strange to say—as white; so they must at all events be very pale; but Solander likewise indicated the flowers of *A. calyculata* as white, and thus the question arises whether perhaps the two species are identical.

"Specimens, but in flower only, from Fitzroy Island (Walter) seem referable to *A. holcocarpa*, but they accord so far also fully with the description of Cunningham's plant from there; the fruit, sent with his flowering specimens, may really belong to the rather widely distributed *A. aulacocarpa*. Visitors to Fitzroy Island could easily solve this enigma. *A. holcocarpa* has become further known from Cape Sidmouth (C. Moore), Trinity Bay (W. Hill), Rockingham Bay and Hinchinbrook Island, where it is common (J. Dallachy). It seems to be essentially a plant of coastal regions." (Mueller, *op. cit.*).

This species, being confined to Queensland, will not be figured in the present work. It is, however, figured in Mueller's "Iconography" as he points out, and it will be seen that the pod is nearer to that of *A. Maidenii* than Mueller imagined it to be.

4. With *A. leptocarpa* A. Cunn.

"*A. leptocarpa* is distinguished from *A. Maidenii* in the phyllodes showing hardly any conspicuous anastomosing venulation, the interstices between the venules being also wider, in flowers less crowded along the rachis, the glabrous calyces, in generally 5-parted corollas, and in numerous almost consolidated folds of the funicle, these forming downward an appendicular mass of a length as great as the seed itself, or even greater, though basal only; I find, however, the fruit-valves to a considerable extent flexuous. The phyllodes are without lustre." (Mueller, *op. cit.*).

A Queensland species not figured in Mueller's "Iconography." As compared with *A. Maidenii*, its pods are more curly, and its valves thinner.

5. With *A. julifera* Benth.

"*A. julifera* resembles in close venulation of the phyllodes *A. glaucescens*, from which it differs in phyllodes of a more falcate form, terminated by a callous glandule, which reminds of that of *A. stigmatophylla* and *A. leptocarpa*, by smaller spikes and deeper cleft calyces; but the fruit-specimens from Edgecumbe Bay, alluded to by Bentham, may not perhaps belong to the same species, as they are nearer to *A. Cunninghamii* also as regards foliage.

"Mr. Bowman gives the height of *A. julifera* as only up to 10 feet at Nerkool Creek and the Upper Flinders River, and says it is early flowering in the season. It is contained in Madame Dietrich's collection from Port Denison under 2812, mixed with *A. Solandri*. That species agrees in venulation of the phyllodes certainly with *A. julifera*, but the phyllodes are narrower and straighter, the spikes longer, with remarkably dissite flowers like in *A. aulacocarpa* and *A. cincinnata;* the calyces are short-lobed and glabrous, the fruit curled-flexuous, compressed, about $\frac{1}{6}$ inch broad, the seeds ellipsoid, the funicle forms folds, but reaches the lowest parts of the seeds only." (Mueller, *op. cit.*).

This is a Queensland species, not figured in the "Iconography." The notes here given by Mueller on the flowers and pods of various species are valuable in that they express the results of experience collected since the publication of Bentham's notes in the second volume of the *Flora Australiensis*.

The pod of *A. julifera* is twisted like a small ringlet, the convolutions less in diameter than those of the next species.

6. With *A. cincinnata* F.v.M.

"*A. cincinnata* almost agrees, as regards carpologic characteristics, with *A. Maidenii*, but the phyllodes are somewhat dimidiate, more protracted upwards and more distinctly callous-glandular at the apex, reminding thus far of *A. julifera*; their two or three primary venules are more prominent, the rachis is less tometose, the flowers are more distant in the spikes, the calyces are deeper lobed, the corollas generally 5-cleft, the fruits narrower and more closely coiled, the funicle is nearer the base of the seed more folded.

"All the species mentioned may differ from each other besides in habit, predilection of places of growth, bark, wood, odour of blossoms, time of flowering, as also fruiting, and perhaps in some other respects not observable on mere dried branchlets." (Mueller, *op. cit.*).

This is a Queensland species, not figured in the "Iconography." The pods are totally different, those of *A. cincinnata* being very twisted with the convolutions of the pods pressed close on each other, almost like a concertina, and they do not resemble those of *A. Maidenii* as Mueller imagined.

7. With *A. longifolia* Willd.; and

8. With *A. floribunda* Sieb.

Mueller has already made a brief reference to *A. longifolia*. The 4-merous flower of *Acacia Maidenii* closely resembles that of *A. longifolia* and *floribunda*.

A. longifolia has a white bract at the base of each flower, not seen in the other species. The pod shows an inclination to curve in var. *Sophoræ*, resembling *A. Maidenii* to some extent, but the pod of *A. Sophoræ* is coarser and more fleshy and the funicle more embraces the seed.

The funicles are almost identical in *A. Maidenii* and *A. floribunda*, but in *A. longifolia* the funicle nearly covers the seed. (See Plate 213, Part LVI, and Plate 216, Part LVII, of the present work.) *A. longifolia* is a sparse-foliaged, slender small shrub with intensely yellow inflorescence. *A. floribunda* has smaller leaves, and, with flowers intermediate in depth of colour between those of *A. longifolia* and *A. Maidenii*. The pods of both species are straighter than those of *A. Maidenii*, those of *A. floribunda* are sparsely hairy, while those of *A. Maidenii* are glabrous.

It would appear that the affinity of *A. Maidenii* is closer to *A. longifolia* than to *A. glaucescens* to which Baron von Mueller thought it was most closely related.

9 and 10. With *A. implexa* Benth. and *A. melanoxylon* R.Br. In foliage it resembles *A. implexa* Benth. and *A. melanoxylon* R.Br., but when in flower is at once distinguished from these by the inflorescence, which in *A. Maidenii* is in spikes.

Reference should be made to Plate 153, Part XLI, and Plate 57, Part XV. It should again be noted that Mueller originally confused the pods of A. *melanoxylon* with those of *A. Maidenii*, which would have made the similarity of *A. Maidenii* to *A. melanoxylon* and *A. implexa* closer than it really is.

Botanical Name.—*Acacia*, already explained (See Part XV, p. 104); *Maidenii*, in honour of the writer of these lines.

Vernacular Names.—Mr. Bishop Lyne, of Narrabri, gave me the name "Motherumbung" for this wattle, but as this is shared by others, *e.g.*, *A. Cunninghamii* Hook and *A. penninervis* Sieb., it is not specially appropriate.

"Sally" (sometimes "Broad-leaved Sally"), and "Hickory" are both applied to it, but both are applied to more than one species, and to in each case a better known species. I know no distinctive name actually in use except the modern one I have adopted.

Bark.—Some years ago Mr. H. G. Smith analysed a sample from Lismore, collected by Mr. W. Baeuerlen. He found 35·5 per cent. of extract, and 15·75 per cent. of tannic acid. The bark is therefore but an inferior yielder of tanning material.

Flowers.—The flowers are of such a pale yellow colour that the species will never become popular because of its flowers alone.

Fruit.—A further word of caution as to the original confusion which arose in regard to the fruits of this species.

Galls.—"A young Sally is a handsome and graceful-looking tree, but soon after maturity it becomes infested with the galls of a small wasp, which has been identified by Mr. W. W. Froggatt as *Trichilogaster Maideni* Froggatt, and these galls soon cover the smaller branches and finally quite disfigure the tree." (R. H. Cambage in *Proc. Linn. Soc. N.S.W.* xxxvi, 565, 1911).

Timber.—It yields an inferior timber for constructional purposes, and used only, as far as I know, for fuel for bakers' ovens.

Exudation.—A specimen of gum, collected at Woodburn, N.S.W., was reported upon by Mr. H. G. Smith in the following words:—

"It is in small pieces of a light amber colour, rather brittle, with very bright fracture, but without the dark-brown objectionable portions so common in the Acacia gums, especially *A. decurrens*. When treated with cold water, almost the whole of the gum slowly goes into solution, forming a very pale-coloured liquid which is very adhesive, of good body or having a high viscosity. It is, however, rather tedious to dissolve. The solution is slightly acid to test paper. It forms a solid cream-coloured jelly with ferric chloride, thus showing absence of tannin. It does not thicken with borax solution, nor does it undergo any change with mercuric chloride. It gives a precipitate with basic acetate of lead. It gives a dense white precipitate with alcohol in acid solutions. It slightly darkens to a canary colour when warmed with dilute soda solution. It contains 16·15 per cent. water and 4·67 per cent. ash; the ash consists principally of the carbonates of lime and manganese and potassium, with sulphuric acid, and only the merest trace of phosphoric acid. The ash contains fusible salts and is difficult to incinerate; it contains only a trace of manganese. (Journ. Roy. Soc. N.S.W. XXIX, 400, [1895].)

Size.—A tree of medium size, good shape, and umbrageous. It is well worthy of a place in any collection of the larger Wattles in gardens in the coast districts.

Habitat.—This species is confined to New South Wales and Queensland, chiefly to the coastal belt. It ascends to the table-lands in the less exposed situations, given favourable conditions of moisture and soil. It extends from the Illawarra to as far north as South Queensland; but we do not know its precise range yet, as it is liable to confusion with *A. implexa* and *A. melanoxylon* when not in flower.

The localities quoted in the original description are "Near the Richmond River (Mrs. Hodgkinson, W. Baeuerlen)," and "Mooloolah River, Southern Queensland (Eaves)."

NEW SOUTH WALES.

Southern localities.—Up to 30 feet high, where it is well known under the name of "Sally." Milton (R. H. Cambage, No. 4114).

2½ miles west of Wollondilly Bridge, Yerranderie (R. H. Cambage, No. 2198).

Robbinsville, near Bulli. Flowers very pale yellow, nearly white (J.H.M.) Stanwell Park (J. H. Camfield and J. L. Boorman); Kurnell (J. L. Boorman); Como (J. H. Camfield); Farm Cove, Port Jackson (J. H. Camfield); Prospect, on basalt (R. H. Cambage, No. 1920); Horse-shoe Bend, Grose Vale (W. M. Carne). (This is the most westerly locality known to me in the Sydney district.)

Northern localities.—Woy Woy (A. Murphy); Newcastle (R. H. Cambage, No. 227); Stroud (J.H.M.); Upper Gloucester, 30 feet high (A. Rudder); Belltrees to Stewart's Brook (W. Heron); Moonan Flat (J.H.M. and J. L. Boorman); Hastings River (G. P. Brown); 25 feet high, branching at 10 feet, head of foliage, 18–25 feet, Fernmount, Bellinger River (E. H. F. Swain); Dorrigo (W. Heron); Greenridge, Casino (D. J. McAuliffe); Lismore (A. Tanner); Woodburn and Ballina, Cumbalum, and Tintenbar (W. Baeuerlen); Murwillumbah (R. A. Campbell); 30–40 feet high, Acacia Creek, Macpherson Range (W. Dunn); Jennings and across the border into Queensland (J.H.M. and J. L. Boorman).

QUEENSLAND.

Brisbane River (F. M. Bailey); Jimboomba (J. L. Boorman). Note also the specific Queensland localities already quoted.

EXPLANATION OF PLATE 220.

A. Flowering twig, from R. T. Baker's plate xxix, *Macleay Memorial Volume.*

B. Flower from Woy Woy, showing—

(*a*) Calyx.

(*b*) Corolla with four reflexed lobes of each petal.

(*c*) Stamens.

C. Pistil.

D. Floral bract.

E. Pod, twisted and striate.

F. Seed.

PHOTOGRAPHIC ILLUSTRATIONS.

Acacia Maidenii. Melbourne Botanic Gardens. (W. R. Guilfoyle, photo.).

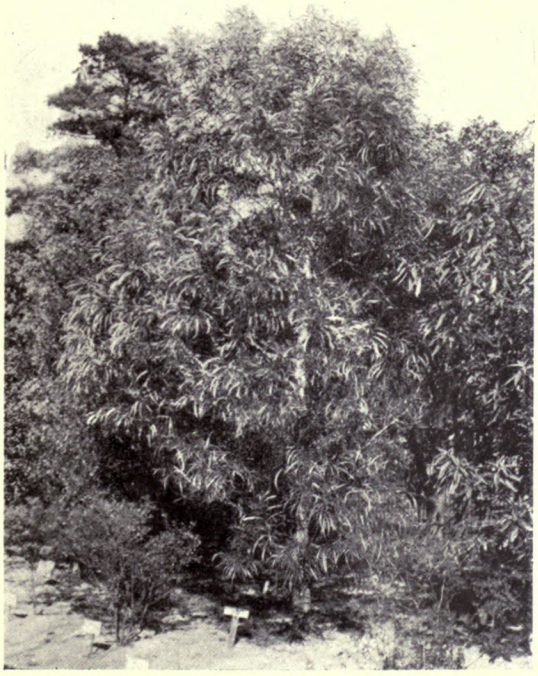
Acacia Maidenii. Milton. (R. H. Cambage, photo.).



M.L. Flockton del. et lith.

MAIDEN'S WATTLE.

(*Acacia Maidenii* F.v.M.)



W. R. Guilfoyle, photo.

Acacia Maidenii, IN MELBOURNE BOTANIC GARDENS.



W. R. Guilfoyle, photo.

Acacia Maidenii, IN MELBOURNE BOTANIC GARDENS.



R. H. Cambage, photo.

Acacia Maidenii, MILTON, N.S.W.

No. 216.

Geissois Benthamii F.v.M.

Red Carabeen.

(Family CUNONIACEÆ.)

Botanical description.—Genus, *Geissois* Labillardière, *Sert. Austr. Caled.* 50, t. 50 (1825).

Following is the original description of the generic character :—

Calyx 4-phyllus; corolla nulla. Stamina 10 hypogyna, antheris ovatis. Germen superum ovato-oblongum, stylo bipartito, stigmatibus acuminatis. Fructus immaturus in capsulam ut vero simillimum abiens bilocularem bivalvem, seminibus alatis, medio valvarum hinc inde affixis.*

This may be translated in the following words :—

Calyx in 4 divisions, corolla none. Stamens 10, hypogynous, anthers ovate. Ovary superior, ovate-oblong, style bipartite, stigmas acuminate. Immature fruit developing into a capsule apparently two-celled and two-valved. Seeds winged, adhering here and there to the middle of the valves.†

Bentham (*B. Fl.* ii, 445) expands the description as follows :—

Calyx-tube very short, adnate to the broad base of the ovary; segments 4, valvate, deciduous.

Petals none.

Stamens indefinite, usually 10 to 15, hypogynous, filaments long, anthers ovate.

Ovary oblong-conical, 2-celled, with several ascending ovules in each cell; styles filiform united at the base.

Capsule narrow, coriaceous, 2-celled, opening septicidally.

Seeds oblong, flat, imbricate, produced upwards into a short wing; embryo in the axis of a fleshy albumen.

Trees.

Leaves opposite, digitately compound; leaflets 3 or 5, petiolulate, coriaceous, entire or with distant serratures.

Flowers purple or red, usually larger than in *Weinmannia*, in simple lateral racemes.

The above description needs only two slight alterations :—

Bentham writes, "Segments 4," it should read "*Segments 4 or 5.*"

Bentham writes, "Stamens indefinite, usually 10 to 15"; it should read "Stamens indefinite, usually 10 to 25."

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* Semina propter imbricata hoc singulare genus sic denominavi. Notanda *ejusdem* analogia quædam cum Rhizobolcis a quibus tamen fructu præsertim sat differt ut, botanica specibus detegendis aucta, sit in posterum occasio novum ordinem Rhizobolcis proximum constituendi.

† I have so named this singular genus on account of the imbricate seeds. A certain analogy of it with *Rhizobolus* is to be noted, from which, however, it differs sufficiently—in the fruit especially—that on botanical authority for determining its species there may in the future be occasion to constitute a new Order near *Rhizobolus*

Now we come to consideration of a species :—

Botanical description.—Species, *G. Benthamii* F.v.M. *Docum. Intercol. Exhib.* (No. 5, Australian Vegetation), 31 (1866). Name only. To be noted in conjunction with the description of *Geissois Benthamii* F.v.M. in Fragm. v, 180 (1866), which is therefore the date of the species. Mueller's description in the latter place is so disjointed that it gives a very unsatisfactory description if translated literally, and therefore I give a free translation :—

A tree said to attain 100 to 150 feet in height, with glabrous branchlets.

Leaflets ovate-lanceolate, acuminate, 2 to 10 inches long, serrulate, prominently penniveined and slightly reticulate veined; stipules coriaceous, orbicular or nearly so, often an inch long.

Flowers in spikes, dense when young and closely resembling the spikes of Polygoni, with canaliculate, semi-lanceolate bracteoles 1 line long, the fruit-bearing spikes several inches long.

Pedicels 1½ to 2 inches long, rhachis slightly silky-hairy.

Sepals 5, valvate, 1½ to 2 lines long, yellow.

Petals none.

Stamens 20 to 25, yellow, twice as long as the sepals, with setaceous filaments.

Anthers with 2 round cells opening laterally.

Styles 2, glabrous, 1½ line long, with minute capitate stigmas.

Ovary imperfectly 2-celled, semi-ovate, silky.

Disc annular (crenulate, J.H.M.), glabrous.

Capsule elliptical-cylindrical, 8 to 9 lines long.

To summarise, we have :—

Leaves in threes or fives (digitate); stipules not seen (perhaps they are deciduous, as in *Weinmannia*); floral bracts, none; calyx lobes, five; petals, none; stamens, about fifteen inserted round disc.

As to "stipules" which are noted by Bentham (*op. cit.*) under Geissois as "Stipules orbicular, coriaceous, more persistent than in most Cunonieæ," and by Bentham and Hooker (*Genera Plantarum* i, 650), as "large, membranous," and under *Weinmannia* as "various, deciduous," one must not confuse these with floral bracts, *i.e.*, larger bracts originally enclosing the inflorescence, which are present in some species, but which do not appear to have been noticed in botanical descriptions.

We have examined *Weinmannia* from New Caledonia, the Philippines, &c., and these possess floral bracts. No specimen of *Geissois* available to us has what may be termed stipules. In the case of *Weinmannia* we have interpetiolar stipules in *W. pinnata*, but such have not been seen in any Australian species so far.

We have also perused two modern works, viz., *Flora of Jamaica*, Fawcett and Rendle (British Museum, Natural History) Vol. 3, Fig. 107, and in a careful figure of *Weinmannia pinnata* L.f., the species on which the genus was founded, stipules are not shown, and apparently only floral bracts at the base of the inflorescence.

In the figure of *W. racemosa* L.f., in Cheeseman's "Illustrations of the New Zealand Flora," i, pl. 43, stipules are not shown; there are floral bracts in the right-hand bottom figure.

There has been some confusion as to the generic limitations of *Geissois* and *Weinmannia*. Referring to Bentham and Hooker's "Genera Plantarum," we may contrast them as follows :—

Geissois.	*Weinmannia.*
(Key to the *Genera*, p. 633.)	(Key to the *Genera*, *p.* 633.)
Petals none. Leaves 3-foliate.	Petals 4–10. Leaves variable. (They are, however, mostly pinnate, J.H.M.)
(*Generic description*, pages 650 and 653.)	(*Generic description*, pages 650 and 653.)
Stamens 10–20.	Stamens 8–10 (6 in the plate of *W. rubifolia*, Part LIX of the present work).
Seeds imbricate. Stipules large, membranous.	Stipules various, deciduous.

I cordially acknowledge the assistance I have received from my assistant, Mr. A. A. Hamilton, and Miss Flockton, in working out the differences between Australian representatives of *Geissois* and *Weinmannia*.

Following is what Bentham, under *Geissois* (*B. Fl.* ii, 445) says of the genus :—

The genus is from New Caledonia, where there are three or four species, but there also appears to be an Australian one, although our specimens are insufficient for defining it. A detached raceme of old capsules with the seeds fallen out, from Cloud's Creek, Hastings River, *Beckler*,* much resembles those from New Caledonia. These capsules are cylindrical, about ¾ inch long, on short pedicels, the epicarp minutely tomentose, the endocarp more or less separating from it. To the same species may very likely belong some specimens in leaf only (in Herb. F. Muell.) from Hastings River, *Beckler*, and Duck Creek, *C. Moore*. They are glabrous. Leaves opposite, 3-foliolate; leaflets petiolulate, ovate, 6 to 10 inches long, 3 to 5 inches broad, coriaceous, remotely and not deeply toothed, green on both sides. Stipules orbicular, coriaceous, more persistent than in most *Cunoniæ*.

I shall return to the relations of *Geissois* and *Weinmannia* in Parts 59 and 60.

Botanical Name.—*Geissois*, from the Greek *geisson*, anything projecting so as to shelter, as the eaves of a roof, and, less directly, the tiles of a roof. The name is in allusion to the arrangement of the minute seeds which are imbricated (that is to say overlapping) in the capsule; *Benthami*, in honour of George Bentham, the distinguished author of the "Flora Australiensis."

Vernacular Name.—"Red Carabeen" or "Red Cheribon" (an old spelling). —N.B.—This is not to be confused with the "Yellow Carabeen" (*Sloanea Woollsii*).

I suspect the name Carabeen to be of aboriginal origin, but it has for many years been adopted by the white man. I have failed to elicit its meaning. Perhaps old bushmen can say.

Because of its bark, it is one of very many trees known as "Leather Jacket."

Aboriginal Name.—It is stated to have been called "Chum Chum" by the aborigines of the northern part of New South Wales.

Timber.—The timber is firm, close-grained, and easily wrought; used for staves and inside work. A soft, bright pink or reddish timber when quite fresh, paler when dry. It is one of the brush timbers, of which we have very many, of whose specific value we know little, and I trust that its value may be ascertained before it gets so scarce that knowledge in regard to it can only have academic interest.

* The Cloud's Creek specimen turns out to be *Weinmannia rubifolia* Benth.—(J.H.M.).

In the present work, Part I, p. 5, I have the following note :—

"Mr. R. D. Hay informs me that in the Dorrigo the Carabeen (*Sloanea Woollsii* F.v.M.) is disliked by the sawmillers, because of a deposit (known locally as "flint") in the log, near the heart, which injures the saw. This deposit resembles lime in appearance, is clipped by a knife with difficulty, and has not yet been subjected to chemical analysis."

I received the specimen from Mr. District Forester Wilshire, of Grafton, in September, 1904, and it has been mislaid. In the above note it is attributed to *Sloanea Woollsii* F.v.M., the Yellow Carabeen, and as Mr. Wilshire's note which I have recently seen, says, "Deposit from the *Red* Carabeen," it is possible that the reference is to the timber of *Weinmannia Benthamii*. It is desirable that Red Carabeen logs and trees should be searched for more of this deposit which may (speaking from memory) be siliceous.

Size.—It is a medium or large-sized tree, say in height 50 to 60 feet, and with a diameter of 18 to 24 inches.

Habitat.—The type came from Forests on the Hastings and Richmond Rivers (Moore, Carron).

Mr. Moore's original note is :—

"This tree attains a large size and is general in thick forests in the coast districts lying between the Manning and Bellinger Rivers. Abundant at Camden Haven."

It was collected by one of the Botanic Gardens Collectors specially sent out (1862-4) to collect material for the *Flora Australiensis*, then in preparation.

Port Macquarie (G. R. Brown); Dorrigo, "Red Carabeen" (Ralph Lowe).

"Large" trees of 20-30 feet, growing in rich undulating country. Such plants as *Wistaria megasperma* and *Araucaria Cunninghamii* grow near it. Bellingen and Coff's Harbour (J. L. Boorman).

Coff's Harbour to Grafton (J.H.M. and J. L. Boorman); "Red Carabeen," Lismore (Forest Guard); "Caramben" (new spelling to me), "Leather Jacket," Alstonville. Large trees, 80-100 feet high, 2-4 feet diameter (W. Baeuerlen); Tintenbar. 60-80 feet high, 1-3 feet diameter (W. Bauerlen); Murwillumbah (R. A. Campbell).

It therefore occurs northward from the Manning to the Tweed in New South Wales. It has been collected in Queensland, near the Tweed.

EXPLANATION OF PLATE 221.

A. Leaflets ovate-lanceolate, toothed.
B. Flowering twig.
C. Bud, valvate.
D. Flower.
E. Vertical section of flower.
F. Gynaecium with two styles and annular crenate disc at base.
G. Fruit capsules.
H. Winged seeds.



M.L. Flockton. del. et lith.

RED CARABEEN.

(Geissois Benthami F.v.M.)

ENEMIES OF TREES.

SYNOPSIS.

I. METEOROLOGICAL.

(*a*) Frost.
(*b*) Snow.
(*c*) Wind. Twist in timber.
(*d*) Lightning.
(*e*) Drought.
(*f*) Rain.

II. FIRES.

III. SOIL.

(*a*) Unsuitable soil. Alkali.
(*b*) Sand encroachment.

IV. PARASITES.

(*a*) True Parasites (Mistletoe, &c.).
(*b*) Hemi-epiphytes (Strangling Figs).
(*c*) Fungi.
(*d*) Weeds.

V. ANIMALS.

(*a*) Grazing.
(*b*) Native animals.
(*c*) Birds.
(*d*) Insects.

VI. MISCELLANEOUS.

(*a*) Fumes from furnaces, &c.
(*b*) Artificial lighting.
(*c*) Destruction by aborigines.

I. Meteorological.

(*a*) Frost.
(*b*) Snow.
(*c*) Wind. Twist in timber.
(*d*) Lightning.
(*e*) Drought.
(*f*) Rain.

On appealing to Mr. H. A. Hunt, Commonwealth Meteorologist, Melbourne, he had the kindness to favour me (October, 1915), with the following information from his reports in regard to the damage, of meteorological origin, to forests in Australia. If observers will only have the goodness to supply such data to Mr. Hunt as they become available, we shall have a mass of information of increasing value to foresters.

Occasional references to damage of the above nature are to be found in meteorological reports already published viz.:—

New South Wales Rain and River Observations (to 1902).
" " " " ... 1903–1908.
Victorian Rain and River Observations ... ... 1840–1910.
Queensland Rain and River Observations ... ... 1869–1913.

With regard to the remaining States, no accounts of a similar nature have yet been published.

The following list dealing with damage to trees, &c., is mainly abstracted from the Monthly Weather Reports which have been published for the years 1910–11–12.

Cause.	Locality.	Date.
Gales	Crookhaven, N.S.W.	1909, June 13th.
	Milton, N.S.W.	" February 26th.
	" "	" June 13th.
	Narrandera, N.S.W.	" January 22nd.
	Albion Park, N.S.W.	" December 14th.
Bush fires	Albury, N.S.W.	" December.
Great heat...	Glenorie, N.S.W.	" January.
Bush fires	Carcoar, N.S.W.	" December 14th.
	Cumberoona, N.S.W.	" December.
	Deniliquin, N.S.W.	1910, December.
	Gloucester, N.S.W.	" November.
Cyclone	Brewarrina, N.S.W.	" January 28th.
	Collarenebri, N.S.W.	" January 20th.
Cyclone and hail	Byrock, N.S.W.	" January 28th.
Cyclone	Blayney, N.S.W.	1913, November 12th.
	Brushgrove, N.S.W.	" November 28th.
	Collarenebri, N.S.W.	" December 25th.
	Kempsey, N.S.W.	" January 5th.
Windstorms	Seven Oaks	" January 3rd.
	"	" May 13th.
Storm	Bronte, Tasmania	1912, March,
	Newcastle, N.S.W.	1910, July.
Tornado	Mackay, Queensland	1911, March.
Floods and squalls ...	South-east corner of continent	" March.
Tornado	Auburn Vale, N.S.W.	" September.

Cause.	Locality.	Date.
Lightning	Bombala, N.S.W.	1911, November.
Cyclone	Tarcoola, S.A.	,, December.
Lightning	Nevilleton, Queensland	1912, November.
Thunderstorm	Darling Downs, Queensland	,, November.
Hurricane	Quambone, N.S.W.	,, November.
Storms	Peninsula Division, Queensland	,, November.
Hurricane	Eyre's Peninsula, South Australia	,, October.
	Crow's Nest, Queensland	,, October.
Hailstorms	New South Wales	,, March.
Wind storms	Lismore, N.S.W.	,, February.
Bush fires	King Island	,, January.
Cyclone	Barrow Creek, South Australia	1913, February 17th.
Tornadic wind	Blayney, N.S.W., and White Cliffs, N.S.W. ...	,, November 12th.
	Wonthaggi, Victoria	,, December.
	Winton, Queensland	,, December.
Bush fires	Lithgow, N.S.W.	1915, January 28th.
	Coonabarabran, N.S.W.	,, January 28th.
Lightning	Jones Island, N.S.W.	1914, January 5th.
	Narromine, N.S.W.	,, January 3rd.
Bush fires	Culcairn, N.S.W.	,, January 5th.
Windstorm	Moree, N.S.W.	,, January 20th.
Lightning	Penrith, N.S.W.	,, January 19th.
Hailstorm	Koorawatha, N.S.W.	,, January 29th.
Bush fires	Wingham, N.S.W.	,, January 29th.
	Taree, N.S.W.	,, January 29th.
	Crookwell, N.S.W.	,, March 20th.
Hurricane	Sydney, N.S.W.	,, March 28th.
Storm	Shepherd's Siding, N.S.W.	,, November.
	Penrith, N.S.W.	,, December 22nd.

(*a*) *Frost.*—Schlich* (iv. 425) says frost causes damage in four ways :—

1. By freezing young woody plants or young organs of plants.
2. Splitting the stems of trees.
3. Causing canker in stems of trees.
4. Uprooting young plants.

We have severe frosts on the table-lands of New South Wales, and exceptionally severe ones, as in 1895. We have, however, made scarcely any observations on their effects on timber trees. Some years ago, under the title " Injury to Forest Vegetation by Frost during the winter of 1895," I† tabulated the reports supplied by some foresters, but the trees referred to were the indigenous forests unplanted by the hands of man, which had become acclimatised to their surroundings during a long period of time. In Europe the forests are mostly planted, and in many cases their resistance to frost remains to be ascertained. The damages done by frost to planted trees are proportionately greater than in our forests, which contain but an infinitesimal proportion of planted trees, and we have yet to deal with the meteorological conditions in a comparative manner, *i.e.*, in regard to the relative resistance of various indigenous and exotic trees under our conditions.

* The work referred to under this title is Dr. Schlich's " Manual of Forestry " in five volumes (1895).

† *Agric. Gaz. N.S.W.*, Jan., 1896, p. 9.

(*b*) *Snow.*—Schlich (iv. 482) deals with the effect of snow on forests in breaking the branches, and, exceptionally, breaking down the tree. A partial thaw, then a hard frost to consolidate the snow, and then a further fall of snow, may result in the aggregate in an enormous weight for the tree and its branches to carry, while swaying by the wind may complete the mischief.

Gifford Pinchot points out that in many regions of the United States snow is so useful in protecting the soil and the young trees that the harm it does is quite overbalanced by its benefits.

In New South Wales snow falls on the tablelands and their spurs, and particularly on the Monaro and the mountain ranges there, but very little notice is taken of the damage it does for the reason, I think, that the forests mostly belong to the State, and, when they occur on private property personal interest in them is largely lacking because they were not planted by the hand of man. Much more notice is taken of the damage snow does in a severe season to Pine Trees (*Pinus radiata* (*insignis*)), because these are not only planted, but stand out prominently against the broad-leaved vegetation.

In the coldest regions of New South Wales the trees are practically all Eucalyptus, and these have wiry, long branches, often pendulous and with few leaves. They have usually smooth trunks and limbs (the latter are almost invariably smooth), and thus the snow rests on the branches with difficulty and slides down the trunks with ease.

The persistence of snow in the forests is connected with the question of stream flow, and Carpenter* notes that snow remains in the timber and in protected spots much longer than when exposed. This is due not so much to drifting as to shelter from the radiation afforded by the forest cover.

(*c*) *Wind.*—Schlich (iv. 455) states the damage done by winds in the following words :—

> Winds dry up and disperse the soil-covering, blowing dead leaves from slopes and ridges, and heaping them uselessly in hollows; they hinder the formation of dew, and spread the spores of fungi and the seeds of forest-weeds. † Easterly and north-easterly winds dry up the soil and young plants, and injure the foliage and fructification of trees. † Strong south-westerly winds cause a misshapen growth of the crowns of trees, especially near the sea-coast and on the south-westerly borders of forests, where the trees are stunted in height and have their crowns bent over towards the east; they also break off blossoms and tender shoots, whilst damp winds near the sea-coast also injure trees by the salt they carry, which the rain washes from their leaves into the soil, rendering it salt and unsuitable for certain kinds of vegetation.

Besides what may be called normal winds, there are exceptional gusts or more or less continuous blows at irregular intervals, called storms, which cannot be predicted much in advance, and sometimes they create much devastation, or at least disturbance of existing conditions. But the results of a windstorm, as we first contemplate the confusion it has caused, are not usually so great when we have had time to appraise matters. Wind does valuable pruning in both garden and forest; weak and dead branches and limbs, which have ceased to perform their functions, are hurled to mother earth; are partly pulverised; and contribute something to the soil. Dominant trees

* "Forests and Snow." Bulletin 55, Agricultural Experiment Station, Colorado.

† The directions of winds are those of Britain.

which have passed their prime and show weakness, are dashed to the ground—often making a great gap in the forest in their fall; but this is Nature's way—the younger trees now have a chance, and a stand of young vigorous trees may take the place of those which have ceased to be efficient.

Most of the pruning and cleaning up that New South Wales forests get comes about in this way. In the time to come this uncontrolled pruning will be replaced by the selective felling of the skilled forester, whose value will depend on that intuitiveness which will show him precisely what trees to remove, and in what direction they should be dropped to do least harm to the existing forest, and to be of the greatest potential benefit to it.

Twist in Timber.

This is the resultant of forces represented by the effect of the sun on the one hand and the wind on the other. I have published* some evidence and many opinions on the subject.

There are some excellent photographs showing twist in British trees in *The Garden* for 20th December, 1913, pages 632 and 633.

The matter is of economic importance, because, in the vast majority of cases, untwisted trunks, yielding straight grained timber, are desired by the timber merchant.

In our New South Wales forests as a rule the greater bulk of the head of a tree is to the north, *i.e.*, it faces the sun, which rises in the east and longest influences the north. I have known bushmen use this method of ascertaining the north when lost or in difficulties.

(*d*) *Lightning.*—A good deal of damage arises from this cause in New South Wales forests, but because of the vastness of the areas concerned, and of the relatively small value of standing timber as a general rule, there are very few data on the subject. Still less are there any data in regard to the relative liability of different kinds of trees to be struck by lightning. Here is a field in which observers all over the State can help by local observations.

Schlich deals with the subject in Europe in iv. 556, in a very useful way.

Lightning is also a source of fires. Silcox† points out that in the United States in 1909, there were reported 294 fires originating from this cause, and he observes that such strokes are only dangerous if unaccompanied by rain.

(*e*) *Drought.*—Speaking in general terms of all forms of vegetation, trees hold out the longest, their roots extending deeply into the soil. A list of trees which resist drought would be a catalogue of those found on our Western Plains, and a number of these are figured and described in previous parts of the present work. But amongst the western trees some only will grow along the banks of creeks or lagoons, or where water lasts longest. The problem is a very difficult one to assess the resistance to drought of various species, especially as it is complicated with the resistance of selected individuals.

* Part XLI, p. 15 of the present work. † Year-book, Dept. of Agriculture, 1910, 415.

I desire to emphasise the point that local climatic difficulties are best overcome by means of local plants which have been acclimatised throughout the ages. And are any plants more beautiful than some of those western plants already described in the present work? Of course we have always to contend with the sneer, expressed or implied, "Can any good come out of Nazareth?" and some native plants get their chance because their planters do not know that they are native.

Following is a tentative list of some indigenous plants which have been proved to stand a considerable amount of dry weather :—

Acacia aneura F.v.M. (Mulga).
„ *Baileyana* F.v.M. (Cootamundra Wattle).
„ *Cunninghamii* Hook. (Bastard Myall).
„ *excelsa* Benth. (Ironwood).
„ *Farnesiana* Willd.
„ *harpophylla* F.v.M. (Brigalow).
„ *homalophylla* A. Cunn. (Yarran).
„ *Oswaldii* F.v.M. (Umbrella Bush).
„ *pendula* A. Cunn. (Myall).
„ *pycnantha* Benth. (Golden Wattle of South Australia).
„ *sentis* F.v.M.
Angophora intermedia DC. (Apple).
Alphitonia excelsa Reiss. (Red Ash).
Alstonia constricta F.v.M. (A Quinine).
Atalantia glauca Hk. (Native Kumquat).
Atalaya hemiglauca F.v.M. (Whitewood).
Banksia integrifolia L. (White Honeysuckle).
Brachychiton populneus R.Br. (Kurrajong).
Callitris calcarata R.Br. (Red or Black Pine).
„ *robusta* R.Br. (White Pine).
Canthium oleifolium Hk. (Wild Lemon).
Capparis Mitchelli F.v.M. (Native Pomegranate).
Casuarina lepidophloia F.v.M. (Belah).
„ *inophloia* F.v.M. (Thready-bark Oak).
Eucalyptus cladocalyx F.v.M. (Sugar Gum).
„ *crebra* F.v.M. (Narrow leaved Ironbark).
„ *hemiphloia* F.v.M. var. *albens* (Grey Box).
„ *melliodora* A. Cunn. (Yellow Box).
„ *melanophloia* F.v.M. (Silver-leaved Ironbark).
„ *microtheca* F.v.M. (Coolabah).
„ *odorata* Behr. and Schlecht. (Western Peppermint).
„ *oleosa* F.v.M.
„ *populifolia* Hk. (Bimble Box).
„ *polyanthema* Schau. (Red Box).

Eucalyptus rostrata Schl. (Red or Flooded Gum).
„ *salmonophloia* F.v.M. (Salmon Gum).
„ *sideroxylon* A. Cunn. (Mugga Ironbark).
„ *terminalis* F.v.M. (Desert Bloodwood).
Ficus macrophylla Endl. (Morton Bay Fig).
„ *rubiginosa* Desf. (Port Jackson Fig).
Flindersia maculosa F.v.M. (Leopard Wood).
Geijera parviflora Lindl. (Wilga).
Grevillea robusta A. Cunn. (Silky Oak).
„ *striata* R.Br. (Beefwood of Interior).
Hakea leucoptera R.Br. (Needlewood).
Melia Azedarach L. (White Cedar).
Nephelium leiocarpum F.v.M. (Native Quince).
Owenia acidula F.v.M. (Gruie or Colane).
Pittosporum phillyræoides A. Cunn. (Butter Bush).
Ventilago viminalis Hk. (Supple Jack).

Let us turn to Exotic species which have been proved to withstand considerable drought in New South Wales. In the first place let it be noted that acclimatisation experiments are full of surprises, and a man will fail if he adheres too closely to meteorological data when he is experimenting. For example, who, *à priori*, could have predicted that *Acacia Baileyana*, a Wattle from Cootamundra, New South Wales, already referred to, would have proved conspicuously hardy in some of the droughtiest places in this and other States :—

Exotics for Dry Districts.

Aberia caffra Hook. f. et Harv. = *Doryalis caffra* Warb. (Flacourtiaceæ). "Kei Apple." *Gard. Chron.* ii, 737. Natal.
Acacia arabica Willd. (Leguminosæ). North Africa, Arabia, India.
Ailanthus glandulosa Desf. (Simarubaceæ). "Tree of the Gods." China.
Albizzia Julibrissin Boiv. (Leguminosæ). Trop. and Sub-Trop. Asia.
Anona Cherimolia Mill. (Anonaceæ). *Bot. Mag.* t. 2011. Tropical America.
Arbutus canariensis Viell. (Ericaceæ). *Bot. Mag.* t. 1577. Canaries.
Argania Sideroxylon Roem. and Schult. (Sapotaceæ). S. W. Morocco.
Bauhinia purpurea L. (Leguminosæ). India and China.
Calodendron capensis Thunb. (Rutaceæ). *Gard. Chron.* May 13, 1905, p. 292. South Africa.
Cedrus Deodara Loud. (Pinaceæ). "Deodar." Himalayas.
Celtis sinensis Persoon. (Ulmaceæ). China and Japan.
Ceratonia Siliqua L. (Leguminosæ). "Carob Bean." South Europe.
Citrus aurantium L. (Rutaceæ) "Orange." Trop. Asia.
Citrus medica L. var. *Limon* (Rutaceæ).
Cordyline Baueri Hook. f. (*C. obtecta* Bak.) (Liliaceæ). Norfolk Island.

Corynocarpus lævigata Forst. (Corynocarpaceæ). "Karaka," New Zealand.
Cryptomeria japonica Don. (Pinaceæ). Sieb. *Fl. Jap.* i, 124. Japan.
Cupressus funebris Endl. (Pinaceæ). China.
Erythrina caffra Thumb. (Leguminosæ). *Bot. Mag.* t. 2431. S. Africa.
Ficus Harlandi Benth. (Moraceæ). Hong Kong.
Ginkgo biloba L. (*Salisburia adiantifolia* Sm.) (Taxaceæ) Veitch *Man. Conif.* 313. N. China.
Gleditschia triacanthos L. (Leguminosæ). Virginia and Carolina.
Harpephyllum caffrum Bernh. (Anacardiaceæ). S. Africa.
Hovenia dulcis Thunb. (Rhamnaceæ). "Japanese Raisin." *Bot. Mag.* t. 2360. Japan and China.
Jacaranda ovalifolia R. Br. (*J. mimosæfolia Don.*) (Bignoniaceæ). *Bot. Mag.* t. 2327. Brazil.
Juniperus bermudiana L. (Pinaceæ). Bermudas.
Kiggelaria africana L. (Flacourtiaceæ). S. Africa.
Lagerstroemia indica L. (Lythraceæ). *Bot. Mag.* t. 405. Japan, China, &c.
Laurus Camphora L. = *Cinnamomum Camphora* Nees (Lauraceæ). China, &c.
Ligustrum lucidum Ait. (Oleaceæ). *Bot. Mag.* t. 2565. China.
Litsea japonica Juss. (*Tetranthera japonica* Spreng.) (Lauraceæ). Japan.
Maclura aurantiaca Nutt. (Moraceæ). *Gard. Chron.*, Dec. 8, 1894, p. 693. Louisiana and Arkansas.
Magnolia grandiflora L. (Magnoliaceæ). *Bot. Mag.* t. 1952. North America.
Nerium Oleander L. (Apocynaceæ). S. Europe.
Noltia africana Reichb. (Ceanothus africanus L.). (Rhamnaceæ). S. Africa.
Ocotea bullata E. Mey. (*Laurus bullata* Burch.) (Lauraceæ). S. Africa.
Olea europaea L. (Oleaceæ). S. Europe.
Orthostemon Sellowianus Berg. (*Feijoa Sellowiana* Berg.) (Myrtaceæ). *Bot. Mag.* t. 7620. Brazil.
Parkinsonia aculeata L. (Leguminosæ). Trop. America.
Paulownia tomentosa Baill. (*P. imperialis* Sieb. and Zucc.) (Scrophulariaceæ). *The Garden*, Aug. 24, 1901, p. 130. Japan.
Phoenix canariensis Hort. (*P. Jubaea* Webb.) (Palmæ). *Gard. Chron.* March 31, 1894, p. 405.
Pinus Pinea L. (Pinaceæ). S. Europe.
Pinus radiata D. Don (*P. insignis* Dougl.) (Pinaceæ). California.
Platanus orientalis L. (Platanaceæ). "Oriental Plane."
Psidium Cattleianum Sab. (Myrtaceæ). "Purple Gauva." *Bot. Mag.* t. 2501. S. Brazil.
Psidium Guajava Raddi (*P. pomiferum* L.) (Myrtaceæ). Yellow Guava. Trop. America.
Quercus Ilex L. (Fagaceæ). "Holly Oak." S. Europe.
Robinia Pseud-acacia L. (Leguminosæ). "Mock Acacia." E. United States, America.
Salix babylonica L. (Salicaceæ). "Weeping Willow." Persia, Western Asia.

Sapindus Mukorossi Gærtn. (Sapindaceæ). India and Japan.
Schinus dependens Orteg. (Anacardiaceæ). *Bot. Mag.* t. 7406. S. America.
Tamarix gallica L. (Tamaricaceæ). Canaries, Trop. Africa.
Thuja orientalis L. (Pinaceæ). "Arbor Vitæ." China and Japan.
Viburnum odoratissimum Ker. (Caprifoliaceæ). India, China, &c.
Washingtonia filifera Wendl. (Palmæ). California.
Wigandia caracasana H.B.K. (Hydrophyllaceæ). *Bot. Mag.* t. 4575. Venezuela.
Zizyphus mucronatus Willd. (Rhamnaceæ). Trop. and S. Africa.

(*f*) *Rain.*—Rain can destroy forests in two ways,—by the formation of floods and torrents, which mechanically break down the forest and wash it away. This aspect of the subject is dealt with at some length under the title "Mitigation of floods by forestry operations." (See Part LVI, p. 130, of the present work. Also see "Forests considered in their relation to rainfall and the conservation of moisture," Part LV, p. 95.)

The other aspect is the soil getting waterlogged, with little mechanical disturbance of the soil. The roots of the trees become drowned and the forest dies. Many trees, such as those known as "Flooded Gums" and "Swamp Gums," are accustomed to such conditions, as the result of a long environment, but in exceptional seasons there is some mortality from excess of rain.

The effect of rain is always most serious when, the ground having got well sodden, violent gusts of wind ensue, and trees may be prostrated in great numbers.

As to records of New South Wales floods, see Henniker Heaton.*

II. Fires.

Here is another subject of practical importance to Australian forestry concerning which few data have been collected. We have had most devastating forest fires, yet, unless there be loss of life or of house property little notice is taken, for Australians view the destruction of virgin forest with a good deal of equanimity. As we have few working plans of our forests, and in many cases we do not know the various kinds of trees and their relative proportions in forest areas, we are unable to say, for example, what trees are the most inflammable. Mr. Rodney Cherry has made† some experiments in regard to the inflammability of certain timbers, and to some extent this would doubtless be a guide to the relative imflammability of the trees in a forest, but it must be borne in mind that the barks of certain trees are factors which must also be taken into account.

A very superficial observation will show that barks are protective in a bush fire. For example, taking Eucalyptus, which forms the bulk of our forests, we have the succulent thick bark of certain Gums, the thick hard bark of the Ironbarks, and the

* "Dictionary of Dates," p. 101.
† "Comparative combustibility of timbers." "The Sydney Record" (*Insurance Institute of N.S.W.*, Sept., 1903).

more or less fibrous barks, varying from the Peppermints and Boxes to the Mahoganies and the true Stringybarks. All these barks resist the ravages of the fire more or less effectively.

Then we have the flaky barks of the arboreal Geebungs (*Persoonia*) and the very flaky and non-conducting barks of the Paper-barks or Tea-trees (*Melaleuca*). It is true that these trees grow mostly in swampy and ill-drained land where fires (certainly not grass-fires) do not start; but, on the other hand, Myrtaceous trees contain essential oil, and it is certainly of advantage to them to be protected, when fires do start, by a non-conducting case.

The conditions of certain organs of forest trees facilitate the protection of the delicate seed which might otherwise be destroyed in a forest fire. Thus we have the hard fruit cases of the Native Pear (*Xylomelum*), of the Hakeas, Honeysuckles (*Banksias*), Eucalypts, She Oaks (*Casuarina*), the tough seed coats of Wattles (*Acacia*).

As regards forest fires, they are of two kinds—grass fires and others. The ordinary protective method for forests is to have strips of land bare of trees, and, indeed, of any other vegetation. In special circumstances the expense of ploughing the strips is gone to. Then back-firing is sometimes resorted to to save larger areas, but it should only be undertaken by experienced bushmen.

Schlich, in Vol. iv, p. 539, discusses "Protection against Forest Fires" as carried on in Europe, and the section is a valuable one and well worthy of perusal, although there is a refinement of methods which is not applicable to our forests at present.

Mr. Howitt* touches lightly on the Australian aspect.

Gifford Pinchot writes "Notes on Some Forest Problems" (Forest Fires),† which is valuable, but he pointed out that few data on the subject had been acquired in the United States.

F. A. Silcox writes later‡ on "Fire Prevention and Control on the National Forests," and the paper is illustrated in an interesting manner. The various causes of fires are dealt with and the various means (telephones, trenching, &c.) for coping with them are explained. The paper is a useful one.

When the fire gets into a forest, urged as it often is by a hot wind of considerable velocity, an area is often beyond human aid. Many of our trees have the bark in loose ribbons, and these ribbons become so many torches which, having been set alight, are carried hither and thither, sometimes for a great distance. They are deposited in the forks of other trees, often meeting a considerable amount of inflammable débris, and thus new foci of devastation are created. One often sees a fire start in a tree 50 or 60 feet above our heads, and how can we stop that? I remember on one occasion being overtaken by a bush fire, and taking refuge in a swamp with my wife and young children. There were certainly no ground fires there, and the trees were untouched, but eventually the trees were set alight from the tops, by means of the flaming torches which were blowing about everywhere in the upper strata, and we escaped with difficulty.

"* Influence of settlement on the Eucalyptus forests," A. W. Howitt in *Trans. Roy. Soc. Vict.* ii, 109.
† "Year-book of Agric." (U.S.A.) 1898, p. 189. ‡ *Ib.* 1910, p. 413.

III. Soil.

(*a*) Unsuitable soil. Alkali.

(*b*) Sand encroachment.

(*a*) *Unsuitable Soil.—Alkali.*—The next great barrier to tree-growth is unsuitable soil. Often there is insufficient soil; often the soil contains alkali or salt, and very often there is hard-pan near the surface which prevents the penetration of roots. It is very seldom that tree-growth is prevented by a lack of nourishing food material in the soil. Although trees are often in a half-starved condition, it is an extremely poor soil which will not support tree-growth of some kind. The formation of grass or savanna land is often due to hard-pan, which is hardened or indurated soil. Hard-pan not only prevents the penetration of roots, but, because of imperfect drainage, the ground is sour and stagnant in nature, and therefore not conducive to tree-growth.

This is how John Gifford* discusses the subject in dealing with barriers to forest extension, and although we theoretically realise the truth of what he says, the subject is practically very little considered in New South Wales.

Taking examples from Sydney that are familiar to so many, let us note the hard pan at the Centennial Park, which renders tree-planting such a costly process. It is at a varying depth below the surface, very hard, and thoroughly impervious. The water which accumulates on the top has a slightly acid reaction. Tree-planting in such country cannot be carried out except by removal of this rock (sometimes several feet below the surface) and replacement of it by better soil.

Take the Lower Botanic Garden, which, for the greater portion of its area has been reclaimed from the salt water. The original salt has never been quite leached out lower than a foot or two, and there is always a fresh supply of salt-water by soakage underneath. So that a balance has to be arrived at with trees which are tolerant to more or less diluted salt-water. In time circumstances arise to induce concentration of the salt in a particular area, and the roots of a particular tree push forward and meet this saline mass, and stunting of growth, and even death may result. Some trees are more tolerant than others. Indeed, the environment precisely suits a number of our trees which are denizens of brackish swamps.

The following experience is instructive in the present context:—

A young man was driving me a number of years ago near Edensor Park, Liverpool, and I saw some She-oaks in the distance which looked to me like the Salt-water Swamp Oak (*Casuarina glauca*). (At that time the species was not known so far from the sea or a salt-water creek). I asked the driver what name he gave to those oaks, and he said, "Oaks." A little later I was able to collect specimens, and then knew that the trees were truly *C. glauca*. I told the driver that I had never before seen this oak except on the banks of brackish creeks or lagoons, and he said nothing. But he was evidently pondering the matter, for in a few minutes he said that all round about those oaks the water was so salt in a dry time that the cattle could not drink it. Here was the solution. Although far away from the sea—that infinite source of brackishness—there was a stock of salts in the soil hereabout. (What is the original source of these deposits is for the geologists to say.) These salts were sufficient to enable *C. glauca* to live and flourish.

* "Practical Forestry," p. 84.

We have alkali, of course, in connection with our bore waters. An artesian bore is sunk, the water is more or less used for drinking purposes by stock, and the rest escapes to impregnate the surrounding soil. In some cases it destroys the few trees in the vicinity and, in order to re-establish tree-growth, careful experiments require to be made in regard to trees known to be saline-tolerant.

(*b*) *Sand encroachment.*

This is dealt with to some extent in Part LVII. of the present work, under the title "The Sand-drift problem in New South Wales."

IV. Parasites.

(*a*) True Parasites (Mistletoe, &c.).
(*b*) Hemi-Epiphytes (Strangling Figs).
(*c*) Fungi.
(*d*) Weeds.

(*a*) *Parasites* (*Mistletoe*).—The word parasite is from the Greek, and was applied by the ancients to persons who intruded, uninvited, into the houses of the rich in order to obtain a free meal. The term is in strictness applied to plants which develop suckers or *haustoria*, which are the roots which feed on the parent plant. The word "haustoria" is from the Latin, *haustor*, a drawer, like the circular leathern suckers that boys amuse themselves with.

According as the parasites affect the *stems* or *roots* of plants we have two principal divisions:—

(1) *Stem parasites, including Mistletoes.*—These consist of plants with more or less succulent leaves which are pendent from the branches of trees, and frequently simulate the foliage of their hosts. The Mistletoes include about 500 species belonging to the family Loranthaceæ, also about twelve species belonging to the genus *Henslowia*, Family Santalaceæ.

(2) *Root parasites.*—A few plants are root-parasites—that is to say they are parasitic on the roots of their hosts. They are much less known than the former.

That *Santalum* is a root parasitic was established in 1871 by John Scott, Curator of the Royal Botanic Gardens, Calcutta. The haustoria of this genus show a structure in all essential points identical with that of the haustoria of *Thesium* (another Australian genus). *Santalum*, of course, produces the sandalwood of commerce, and the above discovery is doubtless the key to its cultivation.

Our Native Cherry (*Exocarpus*) and the Quandong (*Fusanus*) also belonging to the Santalaceæ, are also parasitic on the roots of others, and this probably explains the difficulty that always attends the cultivation of these trees. As regards *Santalum album*, it has been proved to be parasitic on Palms, two large Gramineæ (*Saccharum* and *Bambusa*) and certain Araliaceæ; and Mr. C. A. Barber has recently added *Lantana* and *Casuarina*.

Nuytsia floribunda, the gorgeous Tree Mistletoe, or Cabbage Tree of Western Australia, is root-parasitic, and hence the enormous difficulty of transplanting this desirable plant. The same remarks applied to the allied shrub with sweet-scented flowers, *Atkinsonia ligustrina*, from the Blue Mountains.

Let us turn to the Mistletoes.

The Mistletoe of Europe is known to botanists as *Viscum album*; the commonest Mistletoes of New South Wales belong to the genus *Loranthus*. In Europe the plant is associated with festivity, particularly at Christmas time.

In spite of all the danger that some bacteriologists say is concealed in the osculatory process, I am not aware that the popularity of the mistletoe shows any sign of diminishing, and trade in it amounts to a very considerable sum. It is largely imported into England from Normandy, and in North-western Europe is chiefly found on the apple-tree. It, however, will grow on a very large number of trees. The greatest assortment of mistletoe bearers I ever saw was in the Glasnevin Botanic Gardens, Dublin.

It was an object of worship among the ancient Britons—the ancestors of many of us—the Druids employing it in their rites; and hence, it is supposed, was derived the use of Mistletoe in Christmas festivities. Tennyson, bearing in mind the Druidical ceremonies, speaks of it as "The sacred bush," and amongst the mystic people who invent the ridiculous "language of flowers," Mistletoe is supposed to represent the motto, "I surmount difficulties." Whoever first said so, and why, I do not know, although if it had been applied to Australian mistletoe I could have readily supplied a reason.

The family of Mistletoes—known to botanists as the natural order Loranthaceæ—consists of about 500 species, scattered over the greater part of the world, and divided into thirteen genera. The genus *Viscum*, consisting of about thirty species, and *Loranthus* of about 330, are the most important. *Viscum* occurs sparingly in Australia, though not in the form of *V. album*, the osculatory Mistletoe, but *Loranthus* is well developed here, and forms, in fact, what Australians well know, and, sooner or later, will know too well, as Mistletoe. The word *Loranthus* is derived from two Greek words, loron (a thong) and anthos (a flower) in allusion to the long linear form of the petals. Its seeds are embedded in a sweetish mucilage. In New South Wales I have records of Mistletoe affecting various species of Eucalyptus, Mulga, Yarran, and some other Wattles, various She-oaks (*Casuarina*), Native Cherry, Cypress Pine, the Wilga, the Whitewood, the Leopard Tree, Tea-trees, the Quandong, and a few other trees I need not mention, because I only know them by botanical names.

In north-western New South Wales it is most commonly seen on *Acacia*, and in other parts it is most frequently observed on gum trees (*Eucalyptus*), because of the preponderance of the latter. It is usually to be observed in tufts, often pendulous from the branches, and is of a dull green, somewhat different to that of the tree on which it is found, though on others it affects a wonderful similarity—called mimicry—to the foliage of the host plant.

As regards the spread of Mistletoe in New South Wales, I cannot do better than quote a report by the late Mr. Edward Bulwer Lytton Dickens, sometime Member for Wilcannia, and at the time of his death an inspector of conditional purchases in the far west. He had a long and intimate acquaintance with the western country. His report was made in 1899, to the Under-Secretary for Lands, from whom I received it :—

"A large quantity of valuable fodder trees have already been destroyed by Mistletoe, and, judging by appearances, the results are likely to be more serious in the future, as it is rapidly spreading in all the Mulga country I passed through, fully 75 per cent. of the trees being more or less attacked by this parasite.

"What is generally known as Acacia has been destroyed in large quantities, and will shortly, I fear, be a thing of the past. Although the Mulga (also of the Acacia family) has been destroyed to a considerable extent in places, it does not seem to succumb as rapidly as does the Acacia proper.

"Two things in connection with this matter are somewhat curious, viz. :—Firstly, that the alarming spread of the mistletoe has only been noticeable of late years. Secondly, that it does not seem to affect the inedible trees—the Mallee, for instance, being perfectly free from its attack. Seeing that the Mulga is distributed over a considerable portion of the Western Division, and is, perhaps, the most valuable of all our fodder trees (being the chief stand-by in times of drought), this question is one of importance, and well deserving of scientific inquiry."

Years ago Dr. E. P. Ramsay pointed out that a little bird called the Swallow dicoeum (*Dicæum hirundinaceum*) was instrumental in the dissemination of mistletoe in Australia and in many districts throughout the continent it is, in consequence, known as the "mistletoe bird." In Europe this work is performed by the "mistletoe or mistle thrush," the *Turdus viscivorus* of Linnæus.

A few years ago, in the columns of the *Victorian Naturalist*, Mr. H. F. C. Ashworth tells us how he armed himself with a telescope and watched these little birds at work in a box-tree, and this is what he saw :—He showed that it is not necessary, in all cases, for the mistletoe berries to pass through the bodies of birds before germination. He points out that after plucking a fruit the bird abstracts the seed, with its sticky covering, through an opening in the top, formed by nearly biting it through, and thus forming a sort of lid. Nor is this all, for in the act of picking the fruit a small hole is left where the stalk joined it, and this must greatly facilitate the sucking or squeezing out of the contents. The ground underneath each of these trees was strewn with several hundreds of these discarded berries, each with a lid at one end and a small hole at the other. The seeds are voided by the birds and adhere to the branches on which they have been sitting, as do others which have been removed from the fruit by the birds and are directly placed on the branch by the bird in the act of wiping its beak.

Mr. F. W. Keeble, in his research on the Ceylon Mistletoes (Loranthus), states that the bird known there as the "parasite bird" (*Dicoeum erythrorhynchum*) has adopted the habit of squeezing the seed out of the fruit and rejecting the fruit coat, and that, as a rule, the birds do not swallow the seeds.

Mr. G. M. Ryan, an Indian forest officer, has also been making inquiries in regard to the spread of Loranthus Mistletoe in India, which is recognised in that country as a source of danger to the forests. He had been making inquiries similar to those of Mr. Keeble, and independently of that gentleman makes the very interesting statement that the bird which spreads Loranthus in India is, like the Ceylon bird, also a *Dicæum*, and, in fact, the same as the Ceylon species.

The Indian and Ceylon bird swallows the seed in order to get as much of the sweet, viscid, coating as possible, and Mr. Ryan is emphatic that the seed does pass through the bird. That it is sweet and pleasant to the taste every schoolboy knows, but it might not be wise to eat many of them. The only difference in the method of eating the fruit between the Indian and Australian species is that the former does not open the so-called lid of the fruit, as described by Mr. Ashworth, but squeezes the seed out of the skin of the fruit by pressure at its narrow end. I think, however, that if further observations be made, both in India and Australia, it will be probably found that there is no real difference in the way the two birds get at the mistletoe seed.

Quite recently Mr. Charles F. Johncock has shown in South Australia that two other birds in that State contribute to the dissemination of Mistletoe, viz., the yellow-rumped tomtit (*Acanthiza*), and another bird known as *Ptilotus sonora*. Perhaps New South Wales observers will give attention to the matter, for we still have much to learn in regard to the spread of Mistletoe.

Mistletoe is what is known as a parasite—that is to say, it lives on the juices of its host-plant. It begins life, as we have seen, by being deposited on the branches, as a seed, by a small bird. Germination takes place, and the tiny plant pushes forth its branches into the bark and wood of the tree which supports it. As growth proceeds it contends with the branch for a supply of its sap, and ends by killing the branch and itself, not, however, before it has produced a large number of fruits to propagate its kind. From fodder trees and all other valuable trees it should be cut out with a saw, the cut being made between the bunch of mistletoe and the trunk, so as to cut away the parasitic roots. An important point is that the spread of Mistletoe indicates the increasing debility of the trees, which debility, I contend, has, in the case of kurrajongs and some other trees, been enhanced or brought about by their ruthless lopping. In some districts kurrajongs were never known to be affected by Mistletoe until the drought.

What is the cause of the debility? Senile decay in many cases, the old trees being affected, the young trees, which would naturally succeed them, being eaten out, or not allowed to grow, the ground around the old trees being trodden down and rendered hard.

Mr. Ryan, the Indian forest officer to whom I have already alluded, discusses the best way of getting rid of the mistletoe, and he recommends lopping of the affected branches. He points out (but does not recommend it) that the obvious method is to destroy the birds that live on the fruits; but, apart from the cruelty of such a proceeding, its cost, in Australia, at least, would be quite out of the question, and people might

readily destroy birds of similar appearance which are beneficial to the native vegetation and to crops. It is also to be considered that wholesale destruction of any animal or plant may destroy Nature's carefully-adjusted balance, with unforeseen and possibly disastrous results.

In Europe mistletoe is used to some extent as a food for cattle, and by roedeer in winter. The following is what two New South Wales squatters say of the Armidale district :—

"It is greedily eaten by sheep and is, no doubt, very good food for them at any time, especially during the drought of 1902, but though there is plenty in this part the difficulty is to get much within reach, as it mostly grows high up in the large trees. If the tree is ringbarked it dies with its host."

A Cobar squatter writes that "On the Bogan River (eastern side only, for 60 miles below Nyngan), nearly every Budda tree was affected with a growth not resembling the Budda foliage at all, and this mistletoe was not only readily eaten by sheep and cattle, but eagerly picked out from the abundance of fallen whitewood, leopard wood, &c. The Budda itself, of course, was not touched. Mistletoes on Mulga are mostly left untouched by sheep."

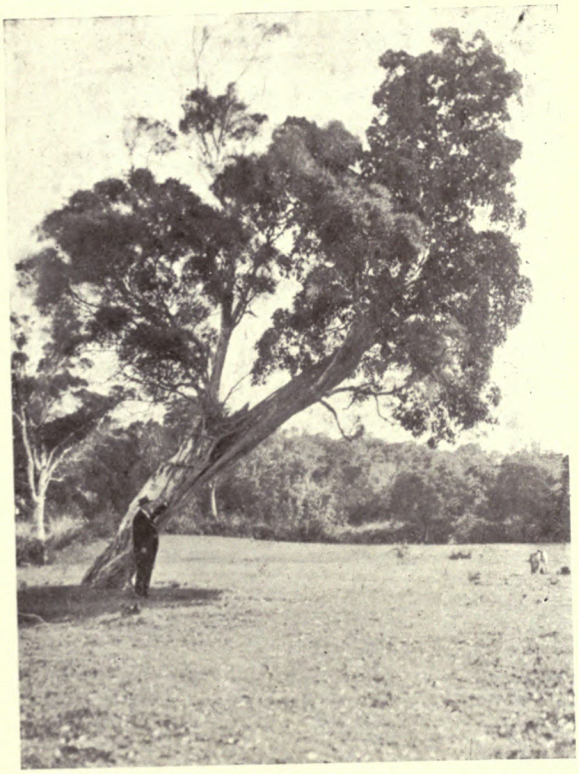
During droughts, stock have eaten Mistletoe to an extent they have not previously been known to eat it. They will not eat it before it wilts, and may be a week before they eat it, but when they have acquired an appetite for it through having been starved to it, they then eat it as long as it is available, just as in the case of the prickly pear. Mistletoe is succulent. I do not know that it has been analysed, and therefore cannot speak of its nutritive value, but it cannot be high. At present I simply look upon it as a famine food.

That the Mistletoe is spreading in New South Wales is proved beyond doubt. Its spread in a measure is in consequence of the advent of the white man and the changes set up by him, and we may not yet, in many cases, have practical remedies for coping with it. I cannot always supply a remedy when I point out a disease, but it becomes a public duty to warn our people in a case like this, in order that they may not view the increase of the pest with indifference, but, where it will pay, they may take remedial measures.

I have a note in the *Agricultural Gazette, N.S.W.* (May, 1915), as follows, and is worthy of consideration :—

Mistletoes as fodder plants.—This subject has again been brought under notice by Mr. Walter Thompson, of Shuttleton, in the Cobar District, and in drawing attention to the prevalence of one of them (*Viscum articulatum*) on the Wilga (*Geijera parviflora*) has suggested that its growth should be encouraged with a view to destroying useless scrub, and at the same time furnishing food for sheep and cattle.

Now mistletoes are propagated through the action of a little bird which eats the fruits and drops the seeds on branches of trees and shrubs. These branches should be smooth, because the young parasite cannot penetrate a great thickness of stringy or hard bark.



His Honor Judge Docker, photo.

FIG-TREE GROWING ON A TEA-TREE. UNANDERRA SOUTH COAST, N.S.W



His Honor Judge Docker, photo.

FIG-TREE STRANGLING A GUM-TREE. CAMBEWARRA RANGE, SOUTH COAST, N.S.W.

The matter of artificially spreading the Mistletoe is one which, although it has often been talked about, has not, in my knowledge, been carried out on a large scale, and if the readers of the *Gazette* know of any such experiments I should be glad to hear of them.

I have in my mind's eye scrub that we deem to be useless, and which grows on land which, as far as we can see, does not support edible plants of any kind. Of course, there is the element of risk that the Mistletoe might get ahead of us and destroy plants that should be preserved but the possibility of getting some feed for flocks and herds out of land which, at the present time, produces none or very little, seems worth keeping in mind."

One parasite may be parasitic on another. Thus in Europe we have *Viscum album* on *Loranthus europeus* while in Australia *Notothixos* is parasitic on *Loranthus*.

(*b*) *Hemi-epiphytes.—Strangling Figs.*—We must carefully distinguish between epiphytes and parasites. Both grow on other plants, which are termed host plants, but the roots of the former simply rest mechanically on their host much in the same way as a weak man might rest on the arm of a strong one, but the roots of the latter bore into the tissues of the host, and may be likened to blood-suckers.

The Orchids which grow on the barks of She-oaks, Myrtles, and other trees are epiphytes. Their long fleshy roots absorb nutriment from the air and from the moisture which is mechanically held by the bark. Besides certain Orchids, certain tree-loving Aroids and ferns get most of their nutriment in this way. Between the true parasites and the true epiphytes there are intermediate stages.

An excellent review of the subject will be found in Dr. William Trelease's "Illustrations of a Strangling Fig-tree."*

These Figs are, as Schimper pointed out, and Trelease emphasises, hemi-epiphytes, as they germinate and pass through their earliest development on trees (as a rule), but subsequently become connected with the ground by their roots, thus passing from the epiphytic to the ordinary mode of nutrition.

The roots of these Strangling Figs are often anastomosed. They attain their greatest development in tropical jungles, and in Australia they are seen to great perfection in coastal Northern Queensland, thence throughout coastal Queensland, and for the greater part of coastal New South Wales as far south as the Illawarra.

These trees are vegetable octopuses, and the plant, whatever its size, that gets within its clutches is doomed, unless surgically released by the hand of man.

The Fig-trees afford excellent shade, but valueless timber.

In the coast districts these fig-trees (*Ficus rubiginosa* is the principal one in New South Wales), often begin life on the moist bark of another tree, and their aerial root-system attains great development. I have referred to this matter at Vol. i, p. 13, and Vol. ii, p. 184, of the present work, and in the latter place there is a drawing of a Fig-tree destroying a Eucalyptus stump. Two photographs by His Honor Judge Docker, herewith reproduced, show doomed trees in various stages of obliteration.

* Sixteenth Annual Report of the Missouri Botanic Garden, p. 161 (1905).

The phenomenon is exceedingly common, but so gradual that it is often not noticed. In the Botanic Gardens, Sydney, near the rockery in the Upper Garden there stood (until 1908), a *Ficus rubiginosa* tree which had never been planted by the hand of man. It arose through the dropping of a bird perched on a 6-foot hardwood fence which enclosed the Director's old garden. The tree finally absorbed nearly a panel of fence with the exception of the upper part of one paling, when the tree was removed.

At the top of Dawes' Point Park, near the residence of the Police Inspector, were some very large *Ficus rubiginosa* trees, removed in 1912. Two of these trees had covered over dozens of palings, the tops of which were showing through the trunks, in which the rest of them were embedded, and the original line of fence was distorted as much as it could be.

I have referred to certain Figs as strangling plants, but another kind of plant also deserves that name. In our coastal brush forests there are many plants which hang down like looping ropes. They are commonest in a tropical forest.

They twine round other plants and sometimes destroy them, but some of them (*Vitis*), have the redeeming quality that they contain water, which can be obtained by cutting them in pieces about a foot long, and draining them into a receptacle. *Ipomaeas* (Morning Glory), and many other twiners develop the strangling habit.

I have referred to the matter and given illustrations under the title " Aboriginal method of obtaining water " at p. 14, Part LI of the present work.

(*c*) *Fungi.*—In a garden, when a limb is sawn off a tree, the careful gardener paints the wound with tar. The object of this is to prevent the adhesion of fungus spores to the cut end, until such time, at least, as the wound has healed.

It is only within the memory of most middle-aged men that the danger of certain fungi to trees has been understood. In Australia the caps (the Mushroom-like part), of many fungi have only recently been traced to their mycelia, and much less has it been known that they were injurious to trees, and therefore to timber. Even now, the life-histories of most of our Australian forest-injuring fungi have not been ascertained, although Messrs. Cleland and Cheel, in their articles in the *Agricultural Gazette of New South Wales*, are doing something to repair this omission.

The article on Forest Fungi in Schlich iv, p. 374, is well worthy of perusal. Some of the species referred to are actually found in Australian forests.

Not so many years ago fungi observed near the butt of a tree, or even growing, cornice-like on the bark, were not recognised as having organic connection with the tree, and therefore the idea that they were responsible for the deterioration of the timber, was not thought of. The Wash Leather fungus was known as *Xylostroma giganteum*, and was not looked upon unfavourably by many, for had not this substance value for bunion plasters? As a matter of fact it is the mycelium of not one, but of many fungi, which are engaged in the destruction of timber in the living tree, or as sawn stuff.



S. W. Jackson, photo.

GIANT SCRUB FIG-TREE (*Ficus colossea* F.v.M.) WHICH STOOD CLOSE TO Mr. S. W. JACKSON'S CAMP IN THE TINAROO SCRUBS, SOUTH-WEST OF CAIRNS, NORTH QUEENSLAND NOVEMBER, 1908.

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S. W. Jackson, photo.

GIANT SCRUB FIG (*Ficus colossea* F.v.M.), LEFT STANDING ON CLEARED SCRUB LAND. TINAROO SCRUBS, SOUTH-WEST OF CAIRNS, NORTH QUEENSLAND, NOVEMBER, 1908.

NOTE REMARKABLE TRUNK ROOTS.

Von Schrenk's paper* on "Fungus Diseases of Forest Trees" is fairly modern, and is very suggestive. It contains some excellent illustrations. It emphasises the point which I have referred to already, and which cannot be too often insisted upon, that it is the raw surface of a tree which is the seat of danger; it is the open portal which admits the fungus-enemy. Such raw surfaces can be left by the careless pruner, but by far the most dangerous surfaces are those long and ragged ones which are the result of breaks and tears. Such injuries are caused by the wind, by lightning, by native animals, by rabbits, by cattle, horses, and sheep; and damage by animals can result in two ways—by gnawing and chewing or by trampling of young trees or crushing of the branches. It will be thus seen that facility for the ingress of the fungus spores is very great. It is indicated that herbivora must be excluded from forests in the most rigorous manner. The exclusion of rabbits is not so easy. We sometimes look upon the depredations of animals on trees as mechanical merely, but the fungus question may be more important still.

Von Schrenk points out that birds such as wood peckers may bore holes in the timber and thus admit fungus spores. Such injuries are very difficult to control, wrapped up as they are with the life of birds whose presence contributes to the welfare of the forest. Any general crusade against birds may readily destroy more friends than enemies.

I have written only in general terms—for the subject is one for the specialist—but in the hope that the attention of my readers may be drawn to the subject, and that they may make observations, and collect specimens of fungi and their effects, which may result in the advancement of knowledge.

(*d*) *Weeds.*—A general account of forest weeds, and the damage they do, will be found in Schlich iv, 344, and it will be there seen how wide the subject is. Some trees suffer more from weeds than others, the various drawbacks of weeds are enumerated, nursery-beds must be attended to, and so on. At page 354 the removal of lichens from trees, which close their lenticels and deprive them of air, is referred to. In this country we only remove lichens from fruit trees, forest trees not being considered sufficiently valuable. When forestry is looked upon as a serious occupation in Australia, the weed question will be seriously studied too. Most of the methods suggested are well known and practised by gardeners; indeed, knowledge of horticulture is of the highest importance to the forester.

Weeds, even small, compete with the tree seedlings, and prevent their making a fair start in life unless carefully watched. This competition begins in the nursery rows, and here the weeds can be kept well under control without much difficulty, but the position is different when the seedlings are planted out, and have to fend for themselves. In our coastal areas and better soils especially the soil seems in the highest degree of receptivity for weed-seeds, and a few thousands of transplants may be spread over a considerable area. So that what with the natural tendency to the firm estab-

* "Year-book of Agriculture," 1900, p. 199.

lishment of weeds and the difficulty, with our scarcity of labour, of giving the small trees careful attention when they most want it, they often have to struggle for existence immediately they are planted out. Weeds contest with the young plant for such plant-food as there is, and there is the additional drawback that they may smother or deform the young tree in its most impressionable stage.

V. Animals.

(*a*) Grazing.
(*b*) Native animals.
(*c*) Birds.
(*d*) Insects.

(*a*) *Grazing.*—Grazing in forests has been already referred to as a serious matter from the point of view of fungus-infection.

Speaking broadly, we may say that the grazing interest is antagonistic to the forest interest. Goats should never be tolerated in a forest under any circumstances, as they absolutely destroy the young growth as far as they are able. Sheep, cattle, and horses do harm in varying degrees, not only by eating out the tree seedlings, but by trampling and hardening the soil, and also by forming tracks which are accentuated by the rain, and form fissures and landslips. Cattle do least harm, as they usually confine their attention to the grass; calves are more frisky, and do harm by running and jumping about, and also by gnawing young trees to a much greater extent than they do when they get more staid in their habits. Horses do much harm to a forest. On the other hand, animals eat much grass and inflammable weedy plants and rubbish; thus they reduce the risk of fire in the forest, and the pasturage of such has a greater or less value.

From special areas where there is, for example, a growth of many young seedlings, stock should be rigorously excluded; but as regards forests in general, it is idle to propose to exclude them altogether. The proper forest policy should be to regulate the grazing. A proper code of forest grazing regulations will, in the course of time, be promulgated by the Forest Department.

It is quite a mistake to suppose that the running of sheep, cattle, and other grazing animals in forest lands is peculiar to Australia. In Europe, in spite of the forest regulations and forest practice which has grown up for centuries, much harm is done by grazing animals in many of the forests. The whole subject is gone into very exhaustively in a very readable chapter* of Schlich's work. The whole matter has to be arranged with a view of balancing the conflicting interests—that is to say, to conserve those of the trees, and at the same time to obtain a maximum revenue from the grass and other forage plants.

* Chap. ii., Vol. v; see also Ribbentrop's "Forestry in British India," p. 160.

In New South Wales cattle are freely admitted into the forest reserves; in the Central and Western Divisions sheep freely traverse such areas. A few years ago Parliament voted a large sum of money for forest-thinning, but during the next drought the return was not so much from the improved growth of the trees as from the improved value of the grasses and other fodder plants within the areas. I believe, therefore, that the country obtained a fair return on the outlay, but what amount of improvement was shared by the trees I am not in a position to say.

In many countries grazing animals are driven from their exhausted pastures of the plains to the succulent herbage of mountain country. For example, the sheep in Lombardy are driven to the Tyrol, those of certain plains in the United States into the high mountain ranges a few miles distant.

In our own State, the best instance we have is where the sheep of the Riverina are sent, in the summer, to feed on the Mount Kosciusko plateau, the rolling grass lands there, with their rich succulent herbage, being apportioned into what are known as snow-leases, from which a certain amount of revenue is obtained. The regulations in force on our snow-leases are very easy, and, consequently, in some years, a good deal of "burning-off" goes on.

In the Western United States the mountains are higher than with us, and an enormously greater area of country is available. It is interesting, however, to note the regulations adopted by the United States Government in regard to these lands. The key-note of these regulations is effective, yet non-harassing, supervision of these grazing forest reserves. It is certainly not in the interests of the forests to allow unrestricted grazing, and it should be brought home to the grazier that he is killing the goose with the golden eggs in not loyally co-operating with the forester. In this State every encouragement should be given to the "reasonable" grazier, and disloyal ones should be visited with sufficiently severe disabilities. In passing, it may be observed that forest officers in all countries have the supervision of grazing land more or less associated with forests.

The following principles, announced by the Secretary of the Interior, form the basis of all grazing regulations in the reserves.* The central idea is co-operation between the Government and the grazing interests in securing the best management and bringing about the best condition of the range :—

(1) The Government, through its forest officers, after consultation with the representatives of the various interests involved, should decide on the number of head to be grazed in each forest reserve, and should establish the boundaries between cattle range and sheep range.

(2) The local association should assign ranges to owners within the limits thus laid down, subject to official approval.

(3) Both owners and local associations should be held responsible for the observance of the terms of permits and the prevention of fire and over-grazing.

* Filibert Roth, "Grazing in the Forest Reserves," Year-book, U.S. Dept. of Agric., 1901. p. 333. See also Gifford Pinchot, Year-book, 1898, p. 187.

(4) Each sheep owner should have the exclusive right to his range (lease), and the same should apply within reasonable limits to groups of cattle owners.

(5) Permits should run for five years.

(6) Residents should have precedence in all cases over tramp-owners and owners from other States.

(7) Local questions should be decided on local grounds and on their own merits in each separate case.

(8) Since the forest reserves are usually summer ranges, provision should be made for necessary routes of transit.

(9) The policy of the Government should be based on regulation rather than prohibition, except in special cases, it being understood that the avoidance of over-grazing is equally in the interests of all parties.

These permits are granted free of charge. The number of animals is limited, and the time of entrance into and exit from the reserve, as well as the district where they are to graze, is decided by the Department of the Interior.

In carrying out these principles the rules now adopted are :—Wherever an association of sheep men exists, which represents the majority of those who have, for at least two years, used the reserve pastures, such an association is recognised. Blank applications are sent to the secretary of the association, and he distributes them and gets them filled and signed. He then transmits them to the supervisor, and the latter to the Department, when permit is issued. To set forth more definitely the requirements of the Department and the conditions of such a permit, the following appears printed on every application and permit :—

This application is also made with the understanding, and full agreement thereto, that penalties will be imposed for a violation of rules as follows :—

Permits cancelled and refused.

(1) For obtaining or attempting to obtain a permit on false representations.

(2) For wilful trespass upon areas where not permitted, either on closed areas or ranges of others.

(3) For setting out fires to clear range.

(4) For *wilful* negligence in leaving camp or other fires.

(5) For refusing to observe promptly any direct order from the Department requiring an observance of any rule.

Other penalties.

The number of sheep covered by a permit to be materially reduced for the following stated causes, viz. :—

(1) For crowding on to a neighbour's range without the consent of the said neighbour.

(2) For bedding sheep more than six nights in succession in any one place, except when bedding bands of ewes during lambing season.

(3) For entering the reserve prior to the date authorised.

(4) For remaining in the reserve after the permit has expired.

(5) For corralling (yarding) within 500 yards of a running stream or living spring.

(6) For gross carelessness in leaving camp fires.

(7) For failure to aid in extinguishing a fire occurring within the range occupied when possible to do so.

(8) And for such other minor violations of the rules as may occur.

(9) For failure to remove sheep promptly, upon order of forest officer, when damage is being done to the range.

(10) For failure of herder to corral for count, upon order of forest officer or ranger, when number of sheep appears to be greater than the number covered by permit.

I also agree to forfeit the permit for a violation of any of its terms, or of the terms hereof, or whenever an injury is being done the reserve by reason of the presence of the animals herein.

Howitt* has also some observations on the effect of sheep on Australian forests.

Under *Eucalyptus piperita* at page 38, Part XXXIII, I have shown some remarkable photographs, and have given some details in regard to the very destructive work of cows barking fibrous barked trees.

Birds and Animals.—At page 116, Part XXXVII, I have touched upon "Birds and Animals as aids to the Forester," but the good or prejudicial effect of animals (other than sheep and goats, cattle and horses), has been little dealt with, and affords much scope to the country observer.

(*b*) *Native Animals.—Hares and Rabbits.*—This is dealt with at Schlich iv, 84, for the mischief they do is similar in kind in most countries in which they are a pest. Hares bite and gnaw bark, and rabbits behave similarly and also injure young forest growth by burrowing. The development of the rabbit in Australia has not its counterpart in any part of the world, and there is an extensive literature in regard to the depredations of this pest.

Opossums, &c.—These animals, native bears, and others, damage the Eucalyptus forests, and this is quite natural, for gum leaves form part of their daily food. There is a reference in Peter Macpherson's paper (*loc. cit.*), also in Woolls.†

So abundant is the Native Bear (sometimes locally called Monkey), in some trees, *e.g.*, *Eucalyptus radiata*, that I have known them to be called "Monkey Gum" on that account.

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* *Trans. Roy. Soc. Vict.* ii, 109. † *Vict. Nat.* viii, 78.

(*c*) *Birds.*—We have very few exotic plantations, and the effect of birds on native forests has not been ascertained. Even where birds are reported to do harm in forests, it is difficult to arrive at a judicial pronouncement on the subject. As a very general rule, birds should be protected, and those who lay down poison, or who use a poisonous spray for the purpose of coping with insect pests, assume a very grave responsibility, and are probably acting prejudicially to their own interests.

(*d*) *Insects.*—Insects are difficult to deal with owing to the extensive and irregular areas of many of our forests. Preventive rules are noted at Schlich iv, 144.

A few years ago it was not generally known that White Ants will attack living trees, but in New South Wales, at least, this is well ascertained now. Sometimes the first obvious evidence that anything is wrong with a particular tree is when, weakened by the insidious enemy, it has been blown down by a gust.

A bushman's observation is that White Ants in a tree are to be found on the opposite to the "weather" side.

Mr. E. H. F. Swain* has briefly written on the ravages of white ants in a few of our northern timbers.

There are some notes on the ravages of insects in forests by Rev. Peter Macpherson,† and the late Dr. A. W. Howitt.‡

For information on Chafers stripping trees in Britain, see White's "Selborne."

In September, 1902, Mr. Froggatt, Government Entomologist, reported that on a recent visit to the Gunnedah district he found large tracts of the scrub upon the ranges dying from what the residents considered to be the effects of the long drought. He states that 10 miles from Gunnedah a large belt of gum-tree scrub, chiefly *Eucalyptus hemiphloia* var. *albens* (White Box), was quite dead, the brown leaves hanging to the twigs just as if they had been ringbarked. At Mount Mullaley, 12 miles further on, the same conditions prevailed, and on all the ranges round belts of dead trees were scattered over the hills, giving them a very curious mottled appearance. Examination proved that every one of these trees was infested with the large white grubs of some undetermined longicorn beetle (probably belonging to the genus *Phoracantha*), which commence by feeding upon the sapwood beneath the bark, and as they become more developed bore inwards towards the centre of the trunk, where they will pupate about the end of the year. Many of these trees contained a dozen or more grubs. It is quite possible that the long drought had caused the trees to become weakened and sapless, but the immediate cause of their death is the presence of the longicorn grubs, which have killed thousands of trees just as effectively as if they had been ringbarked. Mr. Froggatt reports that it is remarkable that only two species of gums were destroyed, the bulk of which are *Eucalyptus hemiphloia*.

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* "The Forests of the Bellinger River," Bulletin No. 5, Forest Dept., N.S.W., p. 7.

† *Proc. Roy. Soc., N.S.W.*, XIX, 85, 86, 91.

‡ *Trans. Roy. Soc., Vict.*, ii, 112.

VI. Miscellaneous.

(*a*) Fumes from furnaces, &c.
(*b*) Artificial lighting.
(*c*) Destruction by aborigines.

(*a*) *Fumes from furnaces, &c.*—A very busy friend of mine often deplored that when the Cockle Creek, near Newcastle, Metallurgical Works were first established in the forest, and we could see from the railway the gradually widening circle of destruction, he had not made a record of the relative resistance of the various kinds of trees to the fumes.

Unfortunately (from the forester's point of view), there are and will be found other foci of destructive influence, for it is obvious that other metallurgical works will be established in other parts of the State, and their effect on the trees should be studied. I should be very happy to name trees for local observers, in order that this aspect of man's activity may be studied in its relations to our indigenous forests.

Schlich, iv, 582, has some observations on the subject, with two photographs showing trees before and after the effect of furnace fumes began to be evident.

I trust that observers who live in the vicinity of smelting works throughout the State will make observations in all cases in which the trees have not yet been destroyed.

The ordinary coal fires of a large city are also deleterious to tree life, though in a diminished degree. This does not affect the forestry question proper, but it very directly affects private and public gardens, and the welfare of trees lining avenues and streets.

(*b*) *Artificial lighting.*—The establishment of powerful artificial lights in big cities is affecting street trees to an extent which has not yet been ascertained. Mr. E. Cheel* has some notes on the effect of the electric lights on the Planes near the Sydney Railway Station.

(*c*) *Destruction by Aboriginal races.*—It may seem ungracious to draw attention to this. The blacks hacked steps in the trees to get animals and honey for food. In this he undoubtedly destroyed trees, but the holes in trees utilised by animals, birds, and bees were not usually made by human beings in the first place. Then he destroyed large numbers of specially selected trees for making his crude carvings upon them, often artistic and varied, considering the tools at his disposal. Then he required saplings for his wretched wurleys to shelter him from the inclemency of the weather.

The Zulus of South Africa are much more advanced in civilisation than the Australian aborigines, and the forests of South Africa are much less abundant than ours, so the figure of a skeleton of a Pondo hut, showing how millions of young trees are used up, shows a really serious state of things from the point of view of the forester. The reference is to Mr. T. R. Sims' fine work.†

* "Australian Naturalist," February, 1912, p. 117. † "The forests and forest flora of Cape Colony."

In conclusion let me invite attention to a thoughtful paper* in which many causes which more or less affect Australian forests are dealt with.

When this was in type, I noticed an interesting paper, "The Forests of Victoria, Part ii. (Destructive Agencies), by A. D. Hardy, *Vict. Nat.* xxxii., 110 (December, 1915), which supplements what I have stated, particularly on the entomological side.

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* A. G. Hamilton. "On the effect which settlement in Australia has produced upon indigenous vegetation." *Proc. Roy. Soc., N.S.W.*, xxvi, 178 (1892).

PHOTOGRAPHIC ILLUSTRATIONS.

Fig-tree strangling a Gum-tree. Cambewarra Range, South Coast, New South Wales. (His Honor Judge Docker, photo.) See p. 225.

Fig-tree growing on a Tea-tree. Unanderra, South Coast, New South Wales. (His Honor Judge Docker, photo.)

Giant Scrub Fig (*Ficus colossea* F.v.M.), which stood close to Mr. S. W. Jackson's camp in the Tinaroo Scrubs, south-west of Cairns, North Queensland, November, 1908. (S. W. Jackson, photo.)

Giant Scrub Fig (*Ficus colossea* F.v.M.), left standing on cleared scrub land. Note remarkable trunk roots. Tinaroo Scrubs, south-west of Cairns, North Queensland, November, 1908. (S. W. Jackson, photo.).

No. 217.

Hicksbeachia pinnatifolia F.v.M.

The Monkey Nut.

(Family PROTEACEÆ.)

Botanical description.—Genus, *Hicksbeachia* F.v.M., in Wing's *Southern Science Record* (Melbourne), February, 1882.

Botanical description.—Species, *pinnatifolia* F.v.M., *loc. cit.*

Mueller has made his description in his own special way; and, also, in view of the fact that the original is now excessively scarce, it may be desirable to follow the author's own words:—

Hicksbeachia.—Flowers bisexual. Petals at first united into a straight tube, soon disconnected, symmetrical. Stamens inserted within the dilated summit of the petals. Anthers longer than the filament, almost cordate; their cells somewhat surpassed in length by the connective. Hypogynous glands four, severed from each other. Style straight. Stigma nearly ellipsoid. Ovary ovate-conical. Ovules two, pendent, oblong, straight. Fruit ovate-roundish, distinctly compressed, indehiscent. Pericarp thick, somewhat woody. Cavity ample. Seeds unknown.

A tree of subtropical eastern Australia, with pinnate leaves, with oblong-lanceolar serrated leaflets decurrent along the rachis, with elongated spike-like allsides flowering racemes, obliterated bracts, paired but connate stalklets, finally deciduous petals, not very long style, and dry, moderately-compressed fruits.

On this new genus is bestowed the name of the Right Honorable Sir Michael Hicks-Beach, Bart., P.C., M.A., D.C.L., in appreciation of the encouragements afforded by him to Science during his tenure of office as Her Majesty's Secretary of State for the Colonies. By this dedication his memory will remain closely connected also in Australian vegetation with the names of three of his distinguished predecessors, in remembrance of whose administration of the British Colonial Empire successively three other genera of proteaceous plants became distinguished.

Hicksbeachia differs from *Kermadecia* in the not diagonally descendent receptacle and not unilateral disk; from *Euplassa* in the not oblique base of the flowers and not carnulent pericarp; from *Roupala* in not bivalvular fruit; from *Panopsis* and *Macadamia* in foliage, in almost sessile anthers, in never annular disk, and from the last-mentioned genus besides in the pericarp not being separated into a coriaceous unilaterally bursting exocarp, and an extremely hard and spherical endocarp, which latter characteristic renders *Macadamia* strictly monotypic. The seeds of the new genus, here defined, may offer additional notes for distinction.

Hicksbeachia pinnatifolia.
Euplassa Hicksbeachii (F.v.M.), Coll.
On the Tweed; C. Fawcett, Esq.

The finder observed, that this tree arises copiously after the clearance of the primeval forest only. Leaves, so far as seen by me, about 2 feet long; leaflets 18–23 in number, sessile, measuring, with exception of the abbreviated lowest, from 5 to 9 inches in length and 1 to 2 inches in width, nearly glabrous, of rigid texture, with spreading and anastomosing primary veins and reticular veinlets.

Racemes, 7–11 inches long (I have seen them 18 inches long.—J.H.M.); their rachis somewhat silky, Pedicels, 1–2 lines long. Petals (generally regarded as sepals) soon reflexed, outside slightly silky, about half an inch long. Style not really longer, though soon exserted, only towards the base as well as the ovary velvet-downy. Fruit measuring about 1 inch in length.

Then follows this supplementary information by Mueller, taken from the Melbourne *Chemist and Druggist* for April, 1883 :—

NOTES ON A NEW PROTEACEOUS TREE.

Quite recently I received, through the zealous circumspectness of Charles Fawcett, Esq., F.L.S., while that gentleman was acting as resident magistrate on the Tweed, from forest country on the boundary line of New South Wales and Queensland, branchlets of a tree, which proved the existence there of an hitherto unrecorded genus or subgenus of Proteaceæ. Although this order is a very large one in Australia, coming next as regards the number of its species to Leguminosæ and Myrtaceæ, and surpassing even Compositæ, it contains only a very limited number of arboreous members, so that any additions to the trees of this ordinal group is of unusual interest. Moreover, Mr. Fawcett sends this species as a second "nut-tree," the only other nut-bearing Australian plant of the order known to us being Macadamia ternifolia monotypic in a genus singular for its thick, very hard, and perfectly free endocarp, thus far reminding of some species of Santalum. The material at first received was fairly complete for elucidation, with the exception of the fruit, which at the time of the discovery of the tree was found only in remnants of the exocarp, belonging to last year's growth. From specimens thus obtained the genus Hicksbeachia was established in the February number of Wing's *Southern Science Record* of the present year, in which publication the species also was defined already as H. pinnatifolia. Since then Mr. Fawcett's further searches were rewarded in getting perfect fruits; of these, the needful account for completing the generic diagnosis is offered now.

Hicksbeachia.—Fruit-rachis undivided, attaining a length of 13 inches, sometimes two or three arising from the same point. Fruit spherical, remarkably variable in size, thus measuring from two-thirds to 1½ inches in length and width, not or but very slightly compressed, a little oblique, at the base and summit impressed, and there remaining somewhat downy, outside bright orange-coloured, along the anterior side furrowed by a narrow impression; stalklets and style retained for a long time; only one in each pair of stalklets ripening a fruit. Pericarp slighty succulent, insipid, forming all around an almost equal layer of from one-quarter to one-third of an inch thickness; endocarp bony, livid, much thinner than the spreadingly fibrous pale mesocarp and firmly adnate to it. Seed in all the fruits hitherto examined solitary, well developed only in good-sized fruits, measuring about half an inch, ovate-globular, filling completely the cavity, affixed near the summit, faintly raised on the anterior side by a narrow prominence. Testa membranous, veined, brownish, suddenly in the lower portion of the seed evanescent. Embryo whitish, somewhat hard, even when fresh; cotyledons equal except at the faintly flexuous summit; radicle semiovate, basal, extremely short, not protruding beyond the cotyledons.

To the brief descriptive account of *Hicksbeachia*, issued already, might be added, that the leaflets are of almost equal green on both sides, though rather more shining above, and oftener alternating than opposite, and that the leaf-stalks are about 2 inches long. Maximum height, bark and wood of the tree as yet unknown. In the first notice of this new acquisition to Proteaceæ it was already stated, that perhaps the plant might be considered a species of the South American genus *Euplassa*, under the name of *E. Hicksbeachii*; access to the ripe fruit now confirms to some extent this view, as very possibly also in our plant occasionally both ovules may develop into perfect seeds. In *Euplassa*, however, the flowers are not quite symmetrical, the stigma is not perfectly erect, and the seeds seem always much compressed. On geographic considerations, no objection could be taken to extending *Euplassa* as a genus to Australia, because the occurrence of *Lomatia*, *Embothrium*, and *Orites*, as well in South America as in East Australia, was shown by R. Brown, Bentham, and myself respectively. The kernels of *Hicksbeachia* are edible, but like those of the South African *Brabejum* might need roasting for any extensive table use. Its grand evergreen foliage, and bright fruits will, anyhow, render this new tree very acceptable to our ornamental shrubberies and to conservatories in countries with a colder clime, while now to the few links of singular connection between the Australian and South American flora a new one is added by the discovery of this remarkable proteaceous plant.

Then the late Mr. F. M. Bailey, in his "Queensland Flora," consolidated the somewhat diffuse description, as follows:—

Hicksbeachia.—Flowers hermaphrodite; *Perianth* regular, the tube straight, the segments soon loose. *Stamens* inserted on the laminæ; *Anthers* longer than the filament, almost cordate, rather shorter than the connective; *Hypogynous glands* 4; *Style* straight; *Stigma* nearly ellipsoid; *Ovary* ovate-conical; *Ovules* 2, pendulous, oblong, straight; *Fruit* ovate-roundish, indehiscent. Epicarp slightly succulent, endocarp bony; *Seed* solitary, ovate-globulars. Testa membranous, veined. Embryo whitish, somewhat hard, even when fresh; cotyledons equal except at the faintly flexuose summit, radicle semi-ovate, basal, extremely short, not protruding beyond the cotyledons. A tree endemic in Australia. (*Qld. Flora*, IV, 1333).

H. pinnatifolia, a tall tree.

Leaves about 2 feet long, lobes from 18 to 20, 5 to 9 inches long, the lowest abbreviated, 1 to 2 inches broad, green on both sides, and all irregularly serrate.

Racemes 7 to 13 inches (18 inches.—J.H.M.) long, rhachis silky.

Pedicels 1 to 2 lines long.

Perianth-segments soon reflexed, silky outside, about ½ inch long.

Style long as the perianth, base and ovary velvety.

Fruit red, oval, 1½ inch long, 1 inch in diameter; exocarp slightly succulent, insipid, about ¼ inch thick; endocarp bony.

Seed solitary (*l.c.* 1334).

These trees always attract the eye as they grow in open clearings after the scrub has been burned off —never before clearing—to a height of 15 to 20 feet with a diameter of about 3 or 4 inches, seldom having more than one branch, and more often none at all. The stalks are straight as a rule; and quite bare till within a few feet of the top of the tree, when the leaves and fruit appear in a bunch forming the head. The leaves, as well as the fruit, shoot immediately from the main stalk without any twigs. (W. P. Pope in *litt.*)

Botanical Name.—*Hicksbeachia*, in honour of Sir Michael Hicks-Beach (the family name of Viscount St. Aldwyn), a former Secretary of State for the Colonies; *pinnatifolia*, pinnate-leaved.

Vernacular Name.—The late Mr. Edward Seccombe, who lived for a long time on the Richmond River, says that the early settlers told him the trees were formerly plentiful, and were locally designated "Monkey Nuts," because the Ring-tailed Opossums consumed the crops. (Opossums, Native Bears, and other marsupials are often known as "monkeys" in the country districts.) The Ring-tailed Opossum is an important factor with all nuts in the bush: for they scent them out in clearings and gardens, even camping in houses for that purpose. In consequence, so the early settlers told Mr. Seccombe, the ripe nuts were rarely procurable.

Aboriginal Name.—I know of none, although they were eagerly sought after by the aborigines.

Leaves.—They are of a pale yellow-green colour, very large and handsome, and prominently reticulated.

Flowers.—"They flower in the winter, and the colour of the flower is a dark brown with a fluffy yellowish centre (anthers) when open, and they emit a very pungent smell, too strong to be pleasant in a room." (W. P. Pope).

Fruit.—Yields edible nuts, but tasting a little acorny. Being rather large, and of a bright scarlet colour, they are very showy. This is the colour as seen by me, but Mr. Pope describes them as pinky-red. "I have seen as many as 20 nuts on the same stalk, but this number is, I think, abnormal. I believe about 10 is the average.

"When the fruit is ripe the nuts are a pinky red colour, and look very pretty suspended by the strings. There are often as many as 12 nuts on a string; when ripe they are about the size of the ordinary olive, and nearly the same shape.

"I believe from October till December is the main bearing season." (W. P. Pope.)

The following refers to the only nuts I saw of cultivated origin, and they were certainly larger than those from the bush.

Mr. E. Seecombe obtained some seed from Murwillumbah, Tweed River, and planted them in his garden at Wollongbar, Ballina Road. "One plant has survived vicissitudes and has been fruiting for several years; it is now some 12 or 14 feet high with a straight single barrel. Its age from seed sowing would be 18 years. I personally know by seeing waste shells under the tree it was fruiting five years ago. It was then a very handsome and striking tree.

"The seeds ripen in May; their weight is less than ½ oz. These cultivated samples are much larger than bush ones. They are good eating, quite like Queensland nuts (*Macadamia*).

"Like the bush nut (*Macadamia*) they shoot freely from the butt when felled in the clearing." (E. Seecombe.)

Timber.—Too small for timber.

Size.—Mr. Seecombe tells me that some trees were fully 30 feet high and branched. The size of the largest trunk coming under his notice was between 5 and 7 inches through.

Habitat.—The type came from the Tweed, from forest country on the boundary line of New South Wales and Queensland. As a matter of fact, Mr. Fawcett's specimens came from the Macpherson Range. Originally discovered on the New South Wales side of the border, the plant has since been found on the Queensland side.

Speaking of Murwillumbah, Tweed River, Mr. W. P. Pope says the trees are always indicative of good soil, either alluvial flats or on the rich chocolate on higher ground. They are never found in forest country, and never appear until the land has been cleared a year or two. They are not found in great quantities here, and are not evenly distributed, but Mr. Pope knew some paddocks where there were numbers of the trees.

The tree was collected in the same district by Messrs. W. Baeuerlen and R. A. Campbell. It is more or less plentiful in the scrubs bordering the railway line between Lismore and Byron Bay and Murwillumbah, *e.g.*; Billynudgel.

The late Mr. E. Seccombe informed me that in 1894 he found the trees comparatively common in the scrub bordering forests in the Parish of Jasper, 22 miles north-easterly from Lismore.

A week or so later, after his Jasper visit, he camped near Wilson's Creek crossing (not far from Jasper) and found many suckering stumps by the roadside.

He added that while found in rich soil they are sometimes found in poor soil.

Mr. A. H. Lawrence sent me the plant from Urunga, at the head of the Bellinger River; this brings its range very much further to the south.

Propagation.—The nut is edible and the tree itself is singular in appearance, lending a pleasing variety to the garden. It will grow in the warmer coast districts if well sheltered, and its cultivation should be encouraged.

EXPLANATION OF PLATE 222.

A. } Tip, and leaflet of pinnate leaf, 2 feet long.
A1. }

B. Parts of spike-like raceme, 18 inches long.

C. Bud.

D. Opened flower showing:—

(*a*) Four-lobed corolla showing the nearly sessile anthers in the concave laminæ.

(*b*) Style.

(*c*) Stigma.

E. Portion of flower (corolla removed) showing:—

(*a*) Four hypogynous glands.

(*b*) Ovary.

(*c*) Style.

(*d*) Stigma.

F. Fruit, a bright scarlet colour.

G. Fruit opened, showing the seed.

H. Seed readily dividing into two cotyledons.

The leaves from Urunga, head of Bellinger River.

The fruit from the Experiment Farm, Wollongbar.

No. 218.

Eucalyptus polyanthemos Schauer.

The Red Box.

(Family MYRTACEÆ.)

Botanical description.—Genus, *Eucalyptus*. (See Part II, p. 33.)

Botanical description.—Species, *E. polyanthemos* Schauer, in Walpers' *Repertorium Botanices Systematicæ*, Tomus ii, p. 924, *Suppl.* i (1843).

Arborea glauco-virens: foll. coriaceis ovatis subito in petiolum contractis obtusis apiculatis, margine crasso subrevoluto cinctis impunctatis, utrinq. opacis; paniculis axillarib, terminalibq., umbellis 3–5 floris, pedicellis brevib. cupulae clavato-turbinatae continuis; operculo brevissime conico acutiusculo vertici cupulae exangulatae imposito,—Foliorum lamina 2 poll. circiter longa, 2¼ poll. lata, petiolus 8 lin. longus, flores cum pedicello et operculo 3 lin. longi, operculum resinoso-punctatum, stamina brevissima. In Novæ Cambriæ australis interioribus septentriones versus ab urbe Bathurst. A. Cunn., Herb. No. 136, 1822.

I have seen the type; it is referred to below. I would invite attention to Schauer's spelling of his specific name.

The original description may be translated in the following words:—

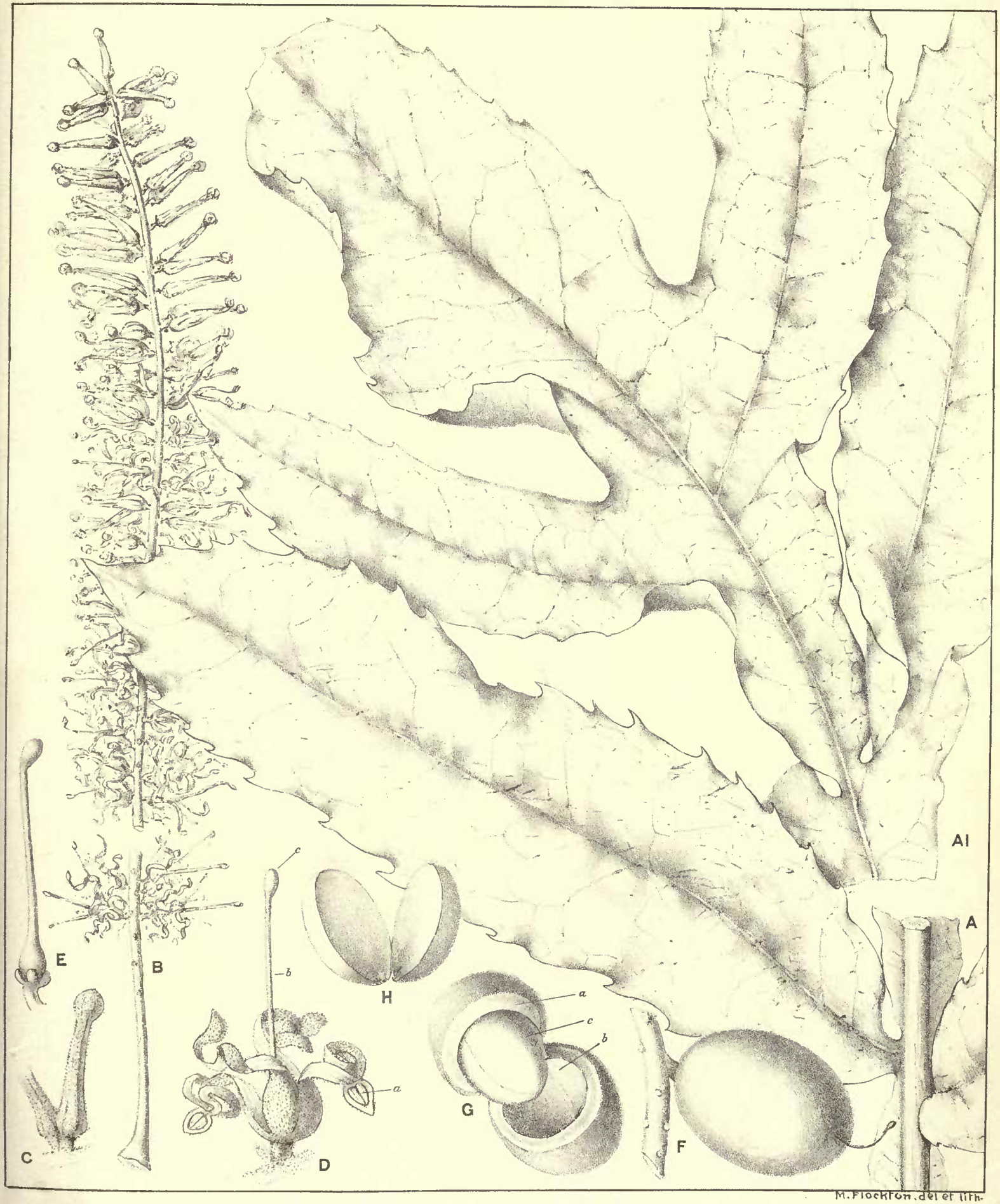
A tree, glaucous-green.

Leaves coriaceous, ovate, narrowed sharply into the petiole, obtuse, apiculate, the margin thick, sub-revolute, without oil-dots, opaque on both sides; *panicles* axillary and terminal; *umbels* 3–5 flowered, the short *pedicels* close to the clavate-turbinate *calyx tube*. *Operculum* very shortly conical, somewhat pointed, with a *calyx tube* which has no angles. *Leaves* about 2 inches long and 2¼ inches broad; *petiole* 8 lines long, flowers with the pedicel and operculum 3 lines long, operculum with oil (resin) dots; stamens very short. In the interior of New South Wales, Australia, towards the north of the town of Bathurst. A. Cunn., Herb. No. 136, 1822.

It is described in English in *B.Fl.* iii, 214, but the synonyms given (*E. populifolia* Hook., and *E. populnea* F.v.M.) must be excluded. See Part X of my "Critical Revision of the genus Eucalyptus," pages 340 and 343, and also some notes under habitat below page 249.

Mueller figures the species in "Eucalyptographia" with some slight confusion with *E. Baueriana* Schauer.

It has a great tendency to be glaucous. I have seen forms varying a good deal in the roughness of their bark but similar in being glaucous all over, as if dusted liberally with flour. Incidentally it may be pointed out that the original description does not indicate a tree with a "Box-like bark."



THE MONKEY NUT.

(*Hicksbeachia pinnatifolia* F.v.M.)



Affinities.

1. With *E. populifolia* Hook.

This is the "Bimbil," "Bibble," or "Poplar-leaved Box." *E. populifolia* has shiny leaves, usually more fibrous bark, and a brown timber. The leaves on this species, also, vary a good deal in width. The anthers are very different.

2. With *E. Baueriana* Schauer. "Blue Box."

This species has long been confused with *E. polyanthemos*, which is the best evidence that it is necessary to issue a caution on the subject, *e.g.*, "Wood close-grained and twisted, very tough, and so hard as to have given rise to the name of Lignum Vitæ for it in some regions of New South Wales" (Woolls). (Mueller in "Eucalyptographia," a passage which really refers to *E. Baueriana*, although under *E. polyanthemos*.) As regards herbarium specimens, those of *E. Baueriana* are less glaucous and often more slaty-looking than *E. polyanthemos*, leaves thinner, the opercula less pointed, and the fruits more conical and with thinner rims. The forester would not confuse the trees for a moment. The bark of *E. Baueriana* is woolly up to the small branches, that of *E. polyanthemos* being usually smooth or ribbony. The timber of *E. Baueriana* is pale brown or brown, while that of *E. polyanthemos* is deep red. The anthers are similar.

3. With *E. melliodora* A. Cunn. "Yellow Box."

Sometimes these two species, from bark alone, are hard to discriminate. They both may have scaly-box bark at the butt for a considerable distance, thereafter ribbony bark or a "White Gum" appearance.

The bark of *E. melliodora* is more persistent than that of *E. polyanthemos*, the ribbony bark, however, never descending so low as in the latter. A man might readily be forgiven if he called one *polyanthemos* tree a Box and another a Gum, and as a matter of fact this is commonly done.

E. melliodora has a very yellow inner bark and sapwood, with longer and narrower and more pendulous leaves and fewer flowers. The anthers are similar. *E. polyanthemos* has a white sap and red heart wood. *E. polyanthemos* has comparatively narrow leaves at the top of the tree.

Following are some field notes:—

"Cullen Bullen to Capertee. *E. polyanthemos* reminds one of Yellow Box (*E. melliodora*) slightly—a ribbony gum on young trees, scaly bark when older, at least as far as the first fork and often beyond. Handsome trees; wood red; we then found a tree 3 feet in diameter, and reminding one a good deal of *E. terelicornis*, the smooth part of a yellow cast. The buds of a yellowish cast and often a little glaucous. Little conical opercula. Wood, red. Very free flowerer. Fruits conoid." (J.H.M.)

Mr. W. F. Blakeley tells me that *E. polyanthemos* at Bowan Park, near Cudal, resembles *E. melliodora* in general appearance, but the foliage is heavier and broader. The bark is lighter in colour. The butt is box-like, but that of the branches runs out fairly smooth, or with curly flakes; *E. polyanthemos* is sometimes called "Yellow Box" by confusion.

I look upon *E. polyanthemos* as a very plastic species. I attach no undue importance to the shape of the leaves, for in some districts they vary from nearly circular to elliptical and thence to lanceolar of various widths. I have been amongst clumps of this species where I have found the shapes of the leaves as variable as in almost any species of the genus. Then their thickness varies a good deal according to soil and situation, while the glaucousness depends upon the elevation and the season of the year. The bark varies greatly as to the roughness and as to the distance it extends along the trunk and branches; while some trees are gnarled and spreading, and others are erect and with a straight, useful trunk.

Botanical Name.—*Eucalyptus*, already explained (see Part II, p. 34); *polyanthemos*, from two Greek words *polus* (*polys*) many, and *anthemon* (= anthos) a flower, hence many flowered, in reference to the profusion of flowers. It is indeed a very free flowerer.

Vernacular Names.—The general name for it is "Red Box," red in reference to the deep red colour of the timber, while "Box" originated with some trees having a Box-like bark. As will be referred to presently, the bark is very variable; sometime the trees are more or less smooth, when they go under the name of "Slaty Gum."

Aboriginal Names.—It is ("Eucalyptographia") stated to be known as "Den" by Gippsland aborigines on Howitt's authority. The use of this aboriginal name might be further inquired into, since I have received "Grey Box" (*E. hemiphloia* var. *albens*) also under the name "Den" or "Dern" from the same locality. Dr. C. S. Sutton gave me "Teering" as the aboriginal name in the Loddon district of Victoria.

Synonyms.—1. *E. ovalifolia* R. T. Baker; and the variety *lanceolata* Baker and Smith.

2. *E. Dawsoni* R. T. Baker. This is a doubtful synonym, and I have changed my opinion more than once concerning it. I incline to the opinion that it may be specifically different from *E. polyanthemos*, but I am not convinced to the point of absolute conviction, and I will below state the facts as they present themselves to me.

Mr. R. T. Baker described two species, viz., *E. Dawsoni* (1899) and *E. ovalifolia* (1900). I will take *E. ovalifolia* first, because I think its position is simpler; that of E. *Dawsoni* is not so clear.

E. ovalifolia R. T. Baker, *Proc. Linn. Soc. N.S.W.*, xxv, 680 (1900).

This is "Red Box" and the habitat is given as Bathurst, Rylstone, Camboon, Hargraves and Gerogery, but it is not stated where the type came from.

It is "a medium sized tree with a smooth bark, decorticating at the base of trunk, producing a roughish appearance." . . . "Growing in poor, sandy, rocky soil." . . . "In botanical sequence it is placed next to *E. Dawsoni* Baker." . . . "There is very little difference in the constituents of this oil and that of *E. Fletcheri* Baker (*E. Baueriana* Schauer), the 'Lignum-Vitae' or 'Black Box' at St. Mary's, as they both contain the same constituents in practically the same amount." Mr. Baker speaks of "the typical *E. polyanthemos* of Victoria," but the type comes from Bathurst, N.S.W., as, indeed, so does one of the co-types of *E. ovalifolia*. I think that Mr. Baker's view that the bark of *E. polyanthemos* is typically Box-like and furrowed, like so much in north-eastern Victoria, colours his conception of *E. polyanthemos*.

Mr. Cambage's paper in *Proc. Linn. Soc. N.S.W.*, xxix, 687, may here be referred to. He says "The Kyamba (towards Tumberumba) trees closely resemble the Bathurst Red Box which has been described by R. T. Baker under the name *ovalifolia*." He also discusses the Victorian and Bathurst Red Box.

I do not see in what way *E. ovalifolia* differs from the typical *E. polyanthemos* from Bathurst.

Later on we have *E. ovalifolia* var. *lanceolata* Baker and Smith, in "Research on the Eucalypts," page 124. See also R. T. Baker, in *Proc. Linn. Soc. N.S.W.*, xxviii, 355, where he says: "This tree very probably owes its differentiation to environment, for I have only found it in rich moist soil."

I am of opinion that in this so-called variety we have some of the trees which (page 246) I have provisionally placed with *E. Dawsoni* or "Slaty Gum."

At an earlier date, in *Proc. Linn. Soc. N.S.W.*, xxi, 448, Mr. R. T. Baker has the following notes in regard to *E. polyanthemos* Schauer. He looked upon them as varieties then, but I do not lay any emphasis on the point. Form (*c*) he afterwards described as *E. Dawsoni*; I mention this only in order that the context may be understood.

(*a*) In the neighbourhood of Rylstone it goes by the name of "Red Box," and the timber is considered of no value whatever. The trees are of no great height, have a dirty scaly bark at the butt, but smooth otherwise, and are found on poor sandstone country. The leaves are uniformly oval, on fairly long petioles, veins oblique, marginal one removed from the edge, under 3 inches long, and glaucous on both sides; flowers small; in flower in December; fruit turbinate under 2 lines in diameter.

(*b*) At Camboon, 7 miles north of Rylstone, there is a variety with smooth bark, long lanceolate leaves green on both sides, the veins oblique; the marginal one *close* to the edge; the petiole long, sometimes twisted; flowers larger than in previous variety, outer stamens sterile; fruits turbinate, 3 lines in diameter, rim thin and notched and similar to the coast *E. polyanthema*; flowers in October, timber good.

(*c*) On the eastern slope of the Dividing Range and extending to the Goulburn River there is, to me, the most important variety known as "Slaty Gum." The trees are large, with very straight barrels, and the timber is highly valued and considered equal to if not superior to Ironbark. The bark is smooth, with a silvery sheen. The leaves differ from those of the other two varieties in being much narrower and glaucous, the venation being the same as in the Camboon variety. The flowers are the smallest of the three varieties, the stamens are all fertile as in the first variety, the fruits glaucous, 1 line in diameter.

As regards (*a*) I look upon these trees as depauperate *E. polyanthemos*, the result of environment, being "found on poor sandstone country." The timber is usually pipy and of little use for works of construction, when grown under hard conditions.

(*b*) There is a slip here. *E. polyanthemos* does not extend to the coast. Perhaps Mr. Baker is referring quite excusably, as so many botanists before him, to *E. Baueriana* Schauer.

(*c*) All three "varieties" are found in a very circumscribed area in the Rylstone-Goulburn River district, and that should be borne in mind in comparing them with *E. polyanthemos* over the whole of its area.

We now come to *E. Dawsoni* R. T. Baker.

Eucalyptus Dawsoni R. T. Baker, *Proc. Linn. Soc. N.S.W.*, xxiv, 295 (1899), with a plate.

Following is the original description:—

A tall tree with a smooth bark, the foliage, branchlets, buds, and fruits glaucous. Young leaves broadly lanceolate, 6 inches long and over 3 inches wide, on a petiole over an inch long, very obtuse, glaucous on both sides, venation distinct. Mature leaves mostly short, oblong-lanceolate, very obtuse, rarely acuminate, occasionally reddish in colour, venation fairly distinct, lateral veins not distant, intramarginal vein close to the edge. Peduncles axillary, but mostly in large terminal corymbs, exceeding the leaves. Buds on *young trees* 3 lines long, 1½ lines in diameter, sessile or on short pedicles; operculum hemispherical, obtuse; on mature trees 4 to 5 lines long, 1 line in diameter, the calyx tapering into a filiform pedicel, operculum conical, acute. Ovary domed at the summit. Stamens all fertile, inflexed in the bud, filaments thick in proportion to the diameter of the anthers. Anthers very small, cylindrical, rounded at the base and truncate at the top, opening by terminal pores.

Fruit small, turbinate, pedicel almost filiform, mostly a line in diameter and under 2 lines long, rim thin, capsule sunken, valves not exserted.

This species is one of the finest representatives of the genus Eucalyptus, whether from a picturesque or an economic point of view. On the whole watershed of the Goulburn River it grows to a great height with a splendidly straight, branchless trunk, and always occurs under the ridges, never being found on the summit nor at the base; and owing to its glaucous leaves it can easily be detected from the dark green foliage of its congeners—the Stringybarks in this particular instance.

I was at one time (*loc. cit.*) inclined to class this species as a variety of *E. polyanthema* Schau., owing to the similarity of fruit and colour of timber, but a further examination of the various parts of the tree and the aid of chemistry have led me to alter my earlier opinions.

The sucker and mature leaves of both species are different, as well as the venation. The leaves of "Slaty Gum" are almost always glaucous, as well as the buds and fruits, a feature rarely found in *E. polyanthema* Schau.

Following are Mr. Baker's notes:—

The smooth bark and reddish timber give it some affinity with *E. polyanthema*, but it differs from this species in other characters and products (page 296). These differences of the two species are, however, not contrasted.

It, in botanical sequence, is placed after the former (*E. polyanthemos*) (page 296).

Following are the "Slaty Gums" in this herbarium. I do not say that all Slaty Gum is what is known as *E. Dawsoni*. Some of it may be *E. ovalifolia* var.

lanceolata. My personal difficulty is that I cannot always separate *E. ovalifolia* var. *lanceolata* from *E. Dawsoni*, in habit, bark, timber, foliage, or any other character available to me.

A pitfall with some is the use of the term "Box" or "Red Box." It has a subjective meaning with many people in the bush. It *ought* to indicate *some* trees with sub-fibrous bark and inlocked timber, but the bushman sometimes only thinks of the inlocked timber, and forgets that the bark may be more or less flaky and may approximate to the entirely smooth. As a matter of fact the bark of typical *polyanthemos* (from a little north of Bathurst) is far less Box-like than *polyanthemos* from Victoria and the southern tableland of New South Wales, but they are all known as "Red Box," and in what part of Australia the term originated for *polyanthemos* I do not know.

"Slaty Gum." Batch 1 (probably all these are *E. polyanthemos*).

"Slaty Gum" on ridges, Mudgee. "Smooth bark, good wood" (W. Woolls). Note by Dr. Woolls on another specimen :—"Leaves vary, more lanceolate in the large trees. Slaty Gum, *E. polyanthema*."

"Slaty Gum or Red Box," Lue, Mudgee Line. "Fine large trees, 40 to 60 feet high, patchy or at times quite smooth, white with patches of grey bark; this is more applicable to the large trees; the smaller are of more of a scaly nature. The latter designated 'Red Box,' the larger 'Slaty' or 'Spotted Gum'" (J. L. Boorman).

"Slaty Gum," Rylstone. "Large tall trees, clean stems, bark falling away in long ribbons, leaving a clean white stem with patches of dark green, the tips of the branches of a mealy, powdery whiteness, sap timber pale yellow, centre red" (J. L. Boorman). "Gum tree bark," Rylstone (R. H. Cambage, No. 2722).

"Red Box," Rylstone. "Trees not so large as those known as 'Slaty Gum,' and the bark is more scaly, but in wood and every other respect identical with 'Slaty Gum'" (J. L. Boorman).

"Red Box," typical for *E. ovalifolia*. R. T. Baker, Rylstone (R. T. Baker). Labelled indifferently "Slaty Gum," "Red Gum," "Red Box," Capertee. "Some trees large and entirely smooth-barked; others small and stunted, with a ribbony bark. A large tree which was felled showed narrow leaves at the top" (J.H.M. and J. L. Boorman).

In 1905 Mr. Andrew Murphy, an experienced man, whose chief occupation is the collection of Eucalyptus seed, wrote to me: "Last week I went to Rylstone intending to get the Rylstone Slaty Gum, *Eucalyptus Dawsoni*. I could not see any difference between it and *Eucalyptus polyanthema*, and came to the conclusion that they are identical. As I have a supply of *E. polyanthema* on hand, I did not collect more."

The Rev. Dr. Woolls wrote me in 1891: "The Slaty Gum is the same as Red Box, and has a splendid timber."

"Slaty Gum." Batch II (including more or less *E. Dawsoni*).

"Slaty Gum of the Mudgee district." Cobborah (District Forester Marriott).

"Red Box," Reedy Creek, near Gulgong. "Narrow leaves; big tree, glaucous all over" (J. L. Boorman). "Slaty Gum," Reedy Creek. "Fine large trees growing on slight ridges away from the creek: at this period (April) of the year the stems are pure white with irregular patches of green; the bark is ¼ inch thick, falling away in long ribbons; the leaves and tips of branches are of mealy whiteness. Sapwood pale yellow, centre red" (J. L. Boorman). "Red Box," Gulgong. "The whole of the tree of a silvery whiteness." A second specimen with leaves from lanceolate to ovate (J. L. Boorman).

"Red Box" or "Slaty Gum," rarely called "Bastard Box," Gulgong. "Leaves on shoots from nearly orbicular to nearly linear lanceolate" (J.H.M. and J. L. Boorman).

"Slaty Gum" is considered the best in the district (Mudgee), but unfortunately the supply is not equal to the demand. Grows in the district west of Reedy Creek. Used for all work where toughness is required. Differs from Ironbark, inasmuch as the log when drying at the butt cracks in rings, while Ironbark radiates from the centre" (Forest Ranger Marriott).

Mr. A. G. Hamilton (*Proc. Linn. Soc. N.S.W.*, xii, 277) states that the "Slaty Gum" is common on the ridges at Mudgee, where it does not attain a great size, but on the flats at Tallewang it runs up into splendid trunks, which are much used in bridge building, &c., and the timber is considered very durable.

"Slaty Gum," Bylong Creek, typical for *E. Dawsoni* (R. T. Baker).

"Red Box," "Mountain Gum," Murrumbo, Goulburn River; Camboon; Bylong (R. T. Baker.) Three specimens showing transition from lanceolate leaves to ovate." Denman (R. H. Cambage).

"Slaty Gum." Type localities for *E. Dawsoni* are ridges on the watershed of the Goulburn River (R.T.B.); across the Main "Divide" at "Cassilis, and north-west of Pilliga" (Professor Warren).

I suggest that Slaty Gum is a large, erect Red Box grown under favourable circumstances. Accompanied by a collector, Mr. J. L. Boorman, I made careful observations. Then I sent Mr. Boorman alone to carefully investigate the trees, and he performed his duty in an intelligent manner. Although satisfied with his reports, I went again into the field with him, and the three trips resulted in the accumulation of a large and varied quantity of botanical material, including timber and bark. I found people indifferent as to the use of the names "Slaty Gum or Red Box," applying them indiscriminately as a very general rule. More than one timber worker told me they were the same tree, and all the evidence I accumulated points in the same direction. As the confusion in regard to "Red Box and Slaty

Gum" has become considerable, I have below given full notes made in the field by my collector and by other observers, and add the following report from him, which was written in the field :—

With reference to your instructions to collect all available evidence in regard to Red Box and Slaty Gum, I respectfully report that I went to Tallewang (some 6 miles from Gulgong), out towards Cobborah, where it grows to fine tall trees on the ridgy ground near to the Reedy Creek ; at Gulgong it grows all around the district of a much more stunted growth. At Lue it grows (large trees) about 5–6 miles in a western direction from the railway line ; the more stunted forms occur all around the immediate district of Lue. There again at Rylstone, some 5 miles on the Ilford Road, it again reaches to fine trees. (The Lue and Rylstone trees probably *E. polyanthemos*. J.H.M.)

From a personal conviction and from reliable information, the Slaty Gum and Red Box are identical. The term "Slaty Gum" is applied to the more robust trees of the "Red Box," from the cleaner stems, for these trees have a greater tendency to throw off the bark more regularly, falling in ribbons, and not in "scales," so to speak, as in the case of the less healthy trees ; this is not invariably the case, as exceptions do constantly occur. This (April) seemingly is the season of the year for shedding of the bark. A Mr. Taylor, native of Rylstone (a carpenter), says there is no difference in the timbers or in the habit of the trees, "Slaty Gum" being only larger than "Red Box." Mr. James Holmes, Gulgong, who pointed out to me the tree at Reedy Creek, calls "Red Gum" and "Slaty Gum" one and the same ; Mr. Hatton, living at Coomber, says that "Slaty Gum" is nothing but "Red Box."

The only scientific way of dealing with two species reputed to be different is to look out for points of difference. As regards *E. polyanthemos* and *E. Dawsoni*, let us try and find them.

"The late Dr. Woolls was *very emphatic* that this tree should be regarded as *quite distinct* from *E. polyanthema*, with which species it had previously been confused" (Baker and Smith, "Research on the Eucalypts," p. 143). The italics are mine. I am probably the only botanist who ever conferred with Woolls on the subject. His attitude as regards "Slaty Gum" was that of enquiry as to whether it differed from "Red Box." His attitude in regard to "Lignum Vitae" (so called) (afterwards identified with *E. Baueriana* Schauer) was more doubting, but he had not made up his mind.

Messrs. Baker and Smith's unconscious exaggeration of Woolls' views in regard to the Slaty Gum question certainly helped to unsettle me from accepting *E. Dawsoni*. There are no grounds for bringing Woolls' testimony forward to support the view that *E. Dawsoni* is an entity distinct from *E. ovalifolia* var. *lanceolata*.

The only pertinent allusion in Woolls' writings that I can find is the following :—

He is speaking of the "grouping" of Eucalypts, and is reviewing Parts 1 and 2 of the "Eucalyptographia" and comparing the work with the "Flora Australiensis." He does not agree with . . . "the Poplar-leaved rough barked *Lignum vitae* on the banks of the Nepean (being considered) as a form of the smooth-barked *E. polyanthema* beyond the dividing range . . . No one who has seen these trees in their native haunts and has noticed their striking differences would

agree in the arrangement." (Woolls' "Lectures on the Vegetable Kingdom," p. 219.) The Lignum Vitae from the banks of the Nepean (*E. Baueriana*) is certainly very different from *E. polyanthemos*; it is not at all like *E. Dawsoni*, which is not referred to, directly or indirectly.

Now let us turn to the bark.

The original description, which, by the way, refers to a tree in the Bathurst district, simply says "arborea glauco-virens"—a greenish glaucous tree. Bentham (B.Fl. iii, 213), however, quotes Mueller. "An ash-grey persistent rough and furrowed bark." Mueller, in his "Key to the System of Victorian Plants," 237, gives the bark as "rough, persistent."

Both these descriptions are true as regards the Victorian tree, but, as one proceeds northward (making proper allowance for geographical elevation and depression) it may be stated in general terms that the trunk tends to get less rough till at length it is often flaky and sometimes nearly smooth.

I attach no undue importance to bark variation. Amongst Box-barks, which vary from rough butts to smooth, *E. microtheca* F.v.M. and *E. melliodora* A. Cunn., are notorious examples, and every field-botanist who has given much attention to Eucalyptus knows that barks in the same species may vary so much that he is quite prepared to accept considerable variation as almost a matter of course.

Coming to the inflorescence and fruits, it seems to me that the only botanical differences between *E. Dawsoni* and *E. polyanthemos* are as follow:—

In *E. Dawsoni* the fruits are smaller (of less diameter), and have the tips of the valves almost flush with the top; they may even slightly protrude. In *E. polyanthemos* the tips of the valves are deeply sunk.

The anthers are strictly truncate and terminal in *E. Dawsoni*, the pores seem to open a little lower down in *E. polyanthemos*, and the anthers are perhaps of a different shape.

In addition, we have such differences in foliage, bark and habit as we think we can define.

Leaves.—The leaves of *E. polyanthemos* are normally oval to nearly circular, but they may be lanceolate of various widths. The foliage is usually glaucous.

In *E. Dawsoni* the adult foliage is usually lanceolate, sometimes oval, sucker foliage larger, sometimes orbicular, more so than in *E. polyanthemos*, but this requires further examination, in view of Victorian material available.

Fruit.—That of *E. polyanthemos* is turbinate to semi-ovate with a thin rim, often fissured when quite ripe, the capsule well sunk below the orifice.

Bark.—The species was originally described from a little north of Bathurst, and *E. polyanthemos* (Red Box) in that district is a somewhat gnarled gum-tree with more or less hard-flaky bark and ribbons on the butt. The branches are smooth.

In the south (including Victoria) it may have a rough Box-like bark, subfibrous and more or less fissured. Such rough bark may extend as far as the first fork.

E. Dawsoni is a gum-tree with nothing about its general appearance suggestive of a Box-tree, *sensu strictu*.

Timber.—That of *E. polyanthemos* is hard and interlocked, deep red in colour, and one of the most durable timbers in the ground. It often has a short trunk and may be pipy, but it is always used, when available, for such trying uses as surveyors' pegs, posts and mining timbers, house-blocks.

The late Mr. J. V. de Coque wrote to me:—"This Box, particularly about Wangaratta, is remarkably durable, and takes the place of Ironbark for railway bridges construction. I used nearly 500 piles in the Myrtleford to Bright railway, all pipy; when piles are driven the practice is to plug the pipe holes."

Size.—It is a tree of medium size, sometimes umbrageous, often gnarled. *E. Dawsoni* is much the larger tree, and somewhat reminds one of *E. tereticornis*. It is erect in habit. To what extent this, a matter of environment, carries this away from *E. polyanthemos*, is precisely the point under investigation.

Habitat.—So far as we know at present, this species is confined to New South Wales and Victoria. The type came from near Bathurst, N.S.W., and it has an extensive range in the colder, drier districts of the two States. We want further inquiries as to its range, both west and north.

It does not appear to have been recorded north of a line about Cassilis along the Liverpool Range, but it may extend towards the Warrumbungles. It does not occur on any part of New England.

The form (or species) known as *E. Dawsoni* occurs at Denman, and about the Baerami Creek, Goulburn River, New South Wales.

In the Flora Australiensis (B.Fl. iii, 214) North Australia and Queensland (entered because of confusion with *E. populifolia* Hook. f.) must be struck out, leaving New South Wales and Victoria as the only States for *E. polyanthemos*.

E. Baueriana Schauer there referred to, is not a tropical species as Bentham surmises, and the specimens referred to by Bentham under New South Wales, under "George(s) River, *R. Brown*, Nepean River, "Lignum Vitæ," belong to that species and not to *E. polyanthemos*.

In the "Eucalyptographia" the range the vicinity of Port Phillip and the Gippsland Lakes, also about Port Jackson and Liverpool, should be struck out. "Tributaries of the Darling River is too vague."

The Red Box (*E. polyanthema*) grows in places all over (this is too wide.—J.H.M.) Victoria. The timber is, however, as a rule, rather small, the boles and limbs crooked, in some places so much so, for instance in the Havelock State Forest, as to be of no value but for firewood. (A. W. Howitt *in litt.*)

In *Trans Roy. Soc. Vict.*, ii, 96 (1890), Howitt considered it had two varieties. The first variety that he describes is really *E. Baueriana*; his second variety, as described in the following paragraph, is the true *E. polyanthemos*.

The second variety is found in the hill country, and ascends from about 100 feet above sea level, as at Heyfield, to an elevation of 2,000 feet, as at the Wellington River and at the Tambo River (Fainting Range). This mountain variety is a much smaller tree than the lowland form; the leaves are thicker in texture, frequently pruinous, or even mealy. At first sight the tree resembles somewhat *E. hemiphloia* (variety *albens*) in its bark, and ash coloured, and sometimes rather lengthened ovate leaves. But it is readily distinguished by the form of the buds, by the outer filaments being anantherous, and by the fruit. The seedlings and young saplings of both have much in common.

You Yangs (J. Staer); Upper Yarra (C. Walter).

Medium-sized tree with bark rough at base and part of stem; branchlets smooth. Bendigo (W. W. Froggatt).

Maryborough (J. Blackburne). Red Hill, Heathcote (W. S. Brownscombe). Habit more upright-growing than the usual form of *E. polyanthemos*. Foliage like Red Box on the lower branches, gradually merging into lanceolate leaves towards the higher branches. Bark like a typical *polyanthemos*. (Note this remark on the variation of width of leaves, which is especially common in this species.)

Benalla (R. Helms).

"Red Box" with red timber and gnarled greyish boxy bark. Euroa, Lilydale, Buchan, Gippsland. It grows on hillsides (A. W. Howitt). Red Nob, Metung to Boggy Creek (J.H.M.). "Bairnsdale Red Box" (A. W. Howitt). Bruthen (R. H. Cambage, No. 3672).

Diamond Creek (J. Staer); Chiltern (A. W. Howitt, J. Staer).

Wangaratta, handsome, spreading trees with rough, furrowed bark, glaucous all over (J.H.M.), hence sometimes called "Grey Box."

"Hill Box," Mt. Kosciusko Range, red wood (Findlay), probably on the Victorian side (National Herbarium, Melbourne).

"36. Eucalyptus polyanthemos, Schauer, l.c.n.5. Beyond Mount Disappointment (Ferd. Muell.)" is a note by Miquel in Ned. Kruidk. Arch., iv (1886).

Snowy River (R. Rowe); Chiltern (A. W. Howitt); McAllister River (Mueller); Broken River, North-eastern Victoria (Mueller, 1853); Kiewa, rough Box-bark (Miss J. Campbell).

NEW SOUTH WALES.

South.—Corowa (G. H. Wiburd), "Bark fibrous, persistent up to branches, then whitish, about 50 feet high. Flowers creamy white." Near Albury (Rev. J. W. Dwyer).

"Red-Box." Small trees of medium size, 40–50 feet high, bark ribbony, or coming off in flakes, leaving a mottled patchy stem of red and grey. Foliage varying in size and shape. A most changeable tree. Timber spoken of as first-class, but seldom reaches mill size in this district. Wyndham (Eden to Bombala) (J. L. Boorman).

"It has a persistent rather rough bark, rarely tall, but spreading. Often called 'Black Box." Bega (W. D. Francis). Quiedong, Bombala. Bark persistent, but deciduous on top of branches. 40–60 feet. Leaves and buds glaucous (W. Baeuerlen).

Tumberumba (Forester Taylor; W. Forsyth). "Red Box," "Round Leaf Gum," "Red Mahogany," Kyamba, Wagga district (Forester Taylor).

"Red Box," Wagga Wagga district (W. Orr). Mr. Forester Taylor has the following note on some other specimens: "Red or round shining leaf Box. Yields a very useful timber of a dark red colour. The only similarity between this and Bimbil (*E. populifolia*) is the roundish shiny leaves, which glisten in the sun." Personally I have never noticed shining, glistening leaves, though in *E. populifolia* this is common enough.

"Round-leaf Gum," Tumut (W. S. Campbell). Tumut (H. Deane). Mr. Deane has the following note: "Deciduous, smooth bark: var. *E. polyanthema*. Very like the Mudgee Slaty Gum. Same as Red Box from Queanbeyan apparently."

"Round-leaf Gum," Tumut (W. W. Froggatt). Some of the leaves tending to lanceolate. The fruits shiny, and showing the cracked appearance at the orifice common in the species. "Red Box," Gilmore-road, Tumut (R. H. Cambage). "Round-leaf Gum," 4 miles from Tumut (W. A. W. de Beuzeville).

"Spotted Gum" (?), near Grenfell (G. W. Hammond). "Smooth bark almost to ground." Canberra towards Murrumbidgee (R. H. Cambage, No. 2974).

"Red Box," Gundaroo, also near Burrinjuck Dam (Rev. J. W. Dwyer); Burrinjuck, near river (E. Cheel).

"Red Box," Gum-tree Bark, slightly flaky at base. Burrinjuck (R. H. Cambage).

"Red Box" ("Slaty Gum"), Queanbeyan (H. Deane). In fruit, otherwise not to be distinguished from the Bombala specimen. Fruits narrow, tapering at orifice.

Murrumbidgee district. So glaucous as to be called "White Box" (J. Duff).

"Red Box" is a most durable timber, and is extensively used for fencing, bridge building, railway sleepers, and wheelwrights' work. It is almost invariably found in company with Ironbark, and in some parts of my district there is a

considerable quantity, but close to Grenfell it is not so common, and is, therefore, not much used (Forester John G. Postlethwaite, Grenfell). Bowning Hill (R. H. Cambage).

West.—"Red Gum or Red Box," Stuart Town (A. Murphy). "Red Box," Stuart Town. "Plentiful all over the district: trees of fair size, with whitish ribbony stems and glaucous tint throughout, leaves and branches pendulous, wood hard but faulty" (J. L. Boorman). Mount McDonald, *viâ* Cowra (R. H. Cambage and J.H.M.). Bumbery, near Molong (J. L. Boorman).

"Yellow Box" (through confusion with *E. melliodora*). Rather low, well-branched trees. The bark whitish or greyish, 40–50 feet, girth 3–4 feet. Mt. Esk, Bowan Park, near Cudal (W. F. Blakeley).

"Red Box," Apsley, Bathurst (R. H. Cambage). "Red Box." "Bark rough at base," Cow Flat, Bathurst, also Rylstone. Typical for *E. ovalifolia* R. T. Baker (*partim*).

"Interior of Southern Australia, N. from Bathurst." A. Cunningham (Herb. Heward, then Herb. Lemann, now Herb. Cant.). Type of *E. polyanthemos*, Schauer. Examined by me, and absolutely identical with the Stuart Town and Bathurst specimens.

The following entry in Allan Cunningham's manuscript journal refers to *E. polyanthemos*:—"20th April, 1817. 18 miles West of Bathurst. A species of Eucalyptus rising about 20 feet, with obovate leaves, inflorescence, umbelled and terminal, is at this period just expanding its flowers on the sides of the hills."

Bathurst to Sofala (R. H. Cambage and J.H.M.).

"The Common Red Box, Gum-tree bark, except at base." Hill End (R. H. Cambage, No. 2751).

Mr. Boorman again describes this tree of his own initiative and in his own language:—

"Slaty Gum or Red Box." This is most variable as regards size and shape of leaves. In this and adjacent districts, the large, tall, well-formed trees are known as "Slaty Gum." The faulty, normally-developed trees are "Red Box." Both names are in use in the district, perhaps "Slaty Gum" is more commonly used, as the trees grow more tree-like in the Mudgee district than at other localities further removed. The robust healthy trees appear to produce more lanceolate forms of leaf than the poorer quality trees, hence the patent differences in the field; in every other respect "Slaty Gum" and "Red Box" are identical.

Upper Meroo, near Mudgee (J. L. Boorman).

"Round-leaf Red Box" and "Narrow-leaf Red Box," on low land, Merrindee, between Mudgee and Wellington (A. Murphy).

EXPLANATION OF PLATE 223.

A. Sucker-leaf from Bumbery, N.S.W.

B. Twig in flower, "interior of Southern Australia N from Bathurst." From type.

C. Fruits from Apsley, Bathurst.



M. Flockton del. et lith.

THE RED BOX.

(*Eucalyptus polyanthemos* SCHAUER.)

No. 219.

Acacia Burkittii F.v.M.

Burkitt's Wattle.

(Family LEGUMINOSÆ: MIMOSÆ.)

Botanical description.—Genus, *Acacia.* (See Part XV, p. 103.)

Botanical description.—Species, *A. Burkittii*, F. Muell, Herb. in Bentham's *Flora Australiensis* ii, 400 (1864).

A glabrous shrub, branchlets slender, nearly terete.

Phyllodia linear-subulate; terete or slightly compressed, with a fine usually recurved but not pungent point, 2 to 3 inches long, striate with very fine parallel nerves, the central one scarcely more prominent.

Spikes oblong, sessile, solitary or in pairs, 3 to 4 lines long.

Flowers mostly 4-merous.

Sepals spathulate, above half as long as the corolla, united in a short cup at the base.

Petals smooth, rather thick at the tips, but without prominent mid-ribs.

Pod unknown.

The following are notes supplementary to the description :—

"Branches are spreading and erect, not drooping. The lowest branches spring almost from the ground—6 inches from the ground, perhaps—they branch out. The bark is a dark brown colour, slightly rough. The bark is a drab colour on the branches; smooth bark on the branches" (W. C. Newbold).

I have examined a piece of the type through the courtesy of Professor Ewart.

The flowers are 4-merous. The calyx is lobed irregularly, divided nearly to the base, and hairy. The sepals are narrow, and are described by Bentham as spathulate, perhaps as good a word as is available, but not quite correctly descriptive.

Petals broad, smooth, free, except at the extreme part of the base.

Pistil covered with hair.

Bracts short, capitate, hairy.

Phyllodes semi-terete, finely striate, smooth, with long wrinkled base, and long hair-like, hooked (curved), fringed on either side, end to the phyllode.

The pods (from Iron Knob, practically the type locality) are described now for the first time.

Pod moniliform, usually 6–12 cm. long (exceptionally to 20 cm., according to Mr. Newbold) by 6 mm. broad, glabrous, almost shiny. The seeds hang pendulous when ripe from a thin funicle of about 5 mm., bent once or twice, and terminating in a small, cap-shaped white aril at the top of the seed. Seeds ovoid and not shining black.

Affinities.—1. With *A. cyperophylla* F.v.M. This species has been confused with *A. cyperophylla* F.v.M. for a long time. Mueller confused them himself, and probably the greater part of the material in herbaria labelled *A. cyperophylla* F.v.M., is really *A. Burkittii*. What *A. cyperophylla* really is will be better understood when Part LX of this work (with a Plate) is available; in the meantime, I may say that *A. cyperophylla* has coarser phyllodes, and the following other important differences:—

Flower 5-merous, glabrous; calyx semi-truncate; pistil hoary.

2. With *A. ephedroides* Benth.—This species comes very near to *A. Burkittii*, but the phyllodes are terete, not sub-terete, with a slightly curved point, hairy at the tip but not fringed on either side of the phyllode before reaching the tip, as in *A. Burkittii*. The phyllodes of *A. Burkittii* are distinctly sub-terete, sometimes becoming quite flat at the tips.

The young growth in *A. ephedroides* is remarkable in being covered with a close mat of silver hairs. I have not seen this in *A. Burkittii*.

The flower comes very near to *A. Burkittii*, being in short sessile spikes, 4-merous, the calyx more cup-shaped and slightly lobed, but this also is subject to variation. The pistil hairy or hoary.

3. With *A. microneura* Meissn.

Bentham says *A. Burkittii* is "very near *A. microneura*, but the phyllodia scarcely broader than thick, and the calyx different" (B.Fl. ii, 400).

The phyllodes of *A. microneura* are flat, with a central nerve, and a slightly-curved point. The flower details are near those of *A. Burkittii* and *A. ephedroides*.

Botanical Name.—*Acacia*, already explained (see Part XV, p. 104); *Burkittii*, in honour of Samuel (?) Burkitt, who first sent the plant to Baron von Mueller from Lake Gillies, South Australia.

Vernacular Names.—There are many (see below) but none distinctive, so far as I am aware.

Aboriginal Name.—"Culbroo" of the natives around Lake Gillies (W. C. Newbold).

Synonym.—*A. Randelliana* W. V. Fitzgerald, in *Journ. W.A. Nat. Hist. Soc.*, Vol. ii, No. 1, p. 14 (May, 1904).

All the material extant of Mr. Fitzgerald's species consists of phyllodes and pods, with nearly ripe seeds. The peculiar phyllodes of *A. Burkittii* and Mr. Fitzgerald's species are precisely similar; flowers are not available; in *A. Randelliana* the funicle is similar to that of *A. Burkittii*, but the seeds seem more globular. At the same time I think the two species are not really different.

Leaves (*Phyllodes*).—Linear-subulate, terminating in an extremely fine hair-like curved tip. (This hairy curved tip is of considerable diagnostic value.)

The phyllode is usually glabrous and finely striate, and in the younger specimens there is a fine fringe of hairs on either side of the phyllode, which continues to the extreme point.

There is a small gland a little way up from the base, seen under a lens; the base is rather long, smooth, and wrinkled.

Length, anything from 8–15 cm., more or less angular in section.

The evidence as to its acceptability to stock is contradictory. It is so woody that I do not think its value stands high, and I rarely noticed stock nibble it. At the same time I have only been a traveller, and not a resident, in the Western districts.

Fruits.—See above, where they are now described.

The natives of the country around Lake Gillies eat the seeds; they roast them green, and when dry they grind them. The pods are sometimes 8 or 9 inches long. The trees are most prolific in pods. They are now (November, 1915) loaded. A tree that was loaded with pods two years ago (1913) has none on this year, so, perhaps, they do not have pods on every year. (W. C. Newbold.)

A. Burkittii is very common indeed in western New South Wales, but I never saw a pod of it until I received it from South Australia. I know the Wattle personally from Nyngan to Bourke, but none of my correspondents could give me pods, nor were they certain that they had seen any. The evidence at present points to the species fruiting far more abundantly in South Australia than in New South Wales.

Size.—The highest, about 10 feet or 12 feet. They run from that down to 3 or 4 feet.

Habitat.—In the *Flora Australiensis* this was only recorded from South Australia.

It is a dry country species, and its range in South Australia is indicated; it is now recorded for the first time from Western Australia.

It is not rare, and in some places abundant, in the western division of New South Wales, and one would expect to find it in western (at least south-western) Queensland.

It is one of several species of Wattle with more or less acicular phyllodes; these are, on casual examination, confused amongst each other, and with such plants (at a distance) as *Hakea*.

SOUTH AUSTRALIA.

Lake Gillies (S. Burkitt) is where the type came from.

Lake Gillies is approximately in lat. 33 and long. 137, and its general direction is north-east and south-west. Iron Knob is a little to the east of the upper part. It is west by south of Port Augusta.

Iron Knob, near Lake Gillies (W. C. Newbold through J. M. Black). Mr. Newbold says—"The trees slightly scattered here, but out on the Gawler Ranges, 40 miles from here, the trees grow in a dense scrub on the foot hills. In places they form the chief scrub."

Mernmerna, about 80 miles north of Port Augusta, on the Great Northern Railway Line (W. Gill).

So that the range of the species in South Australia, so far as we know at present, is the Port Augusta district, from Mernmerna to Lake Gillies, thence to the Gawler Ranges.

WESTERN AUSTRALIA.

Twelve miles north-east of Kanowna (W. V. Fitzgerald). Type of Mr. Fitzgerald's *A. Randelliana*.

Coolgardie (L. C. Webster).

These localities are in what are known in that State as the Eastern Goldfields.

NEW SOUTH WALES.

The localities quoted extend from the western boundary (abutting on South Australia), and coming as far south-east as the Hay district, and, north of the Hay district, as far as Condobolin, which is very nearly in the centre of this State.

"Nealia," Purnamoota, Barrier Range (C. J. McMaster); Broken Hill (A. Loder); 8–10 feet Tarella, *vid* Wilcannia, No. 90, August, 1887 (W. Baeuerlen); White Cliffs (E. P. O'Reilly); "Bastard Nilyah," White Cliffs (E. P. O'Reilly).

"Pin Bush," "Blood Bush." All stock eat it, and when they chew the dry leaves or pods a blood-coloured liquid forms in their mouths, hence the name. Bourke district (A. W. Mullen); 20 miles south of Bourke (R. H. Cambage).

Acacia Burkittii was found a little west of where the Eremeran Road meets the main road from Nymagee to Condobolin, or close to Vermont Hill. It was not seen afterwards, so that this is probably about its eastern limit, at least south of the Bogan . . . its extension from about 40 miles north of Cobar to about 50 miles north-west of Condobolin. In the Nymagee district it is sometimes known as "Kangaroo Bush," and "Cherrypickera" was given me as an aboriginal name, but I had no opportunity of verifying it. (R. H. Cambage in *Proc. Linn. Soc. N.S.W.*, 1901, p. 322.)

"Needle Bush." Grows in gregarious clumps about Elonera, Cobar and Kergunyah; it prefers flat, damp soil. It has spikes of flowers fully half an inch long, and is often found with Yarran and Mulga. Attains the height of about 12 feet (Archdeacon Haviland); Shuttleton. 6–10 feet (P. E. Lewis).

"Punti" or "Bloodbush," Coolabah (C. J. McMaster). "Bloodbush" is also *Cassia.*

About 6–10 feet Coolabah to Girilambone (J.H.M and J. L. Boorman); 5 feet, Wilga Downs, near Nyngan (C. J. McMaster).

"Sifting Bush," Nyngan (E. F. Rogers). "Sifting Bush" is also a name given to *Cassiinia.* It signifies "Straining bush," a bush that arrests sand and rubbish.

Phyllodes a little flattened, Lake Cudgellico (G. S. Home, J. L. Boorman); Palesthan, Condobolin (Miss Clements).

Small trees about 8 feet. Wood hard, and possesses a pleasant smell. Stock will not eat its leaves. Ivanhoe, *viâ* Hay (K. H. Bennett, 1883.)

The Wattle and National Sentiment.—This is a Wattle largely developed in western New South Wales, and very beautiful in the clear dry air of the wide western plains. I do not say that this is the most beautiful species (I would give the palm to *A. decora* Reichb., the western Silver Wattle—see my remarks at Part XLV, page 98, of the present work), but I do say that if one desires to see Wattle in all its glory, in all its prodigal profusion—an emblem of purity, typical of the potential wealth of this wonderful country—then we must journey to the western plains. Just as in Western Australia special trains are run to inspect the native flora (by which locally is meant the "Everlastings"), it will happen a very few generations hence that special trains will be run to see the Wattle, in order that our citizens may appreciate their own native flora just as the Japanese—artistic souls—do theirs. I have travelled in many countries, but I do not call to my mind any plant which impressed me more than the Wattle,—blaze of pure gold (hardly a leaf to be seen), and miles of it. The Australian Coat of Arms bears sprays of Wattle at the bottom of the shield.

I republish three documents which may be of interest in this connection:—

1. WATTLE DAY.

(THE ORIGINAL MANIFESTO.)

With a view of stimulating Australian national sentiment, and connecting it with love of our beautiful flora, we suggest the desirability of setting apart, throughout the Commonwealth, a day on which an Australian national flower—the Wattle Blossom—might be worn, and its display encouraged.

Wattles might also be sown and planted on this day.

It is suggested that a date in September would be universally suitable, but we do not propose that it be a holiday.

It will be necessary to communicate with public bodies and private individuals in the other States in regard to the proposal, and to arrange matters of detail, so that (if approved) the first Wattle Day could be celebrated in 1910.

A committee for each State would be required, and some little expenditure for newspaper advertisements, stationery, and postage would be inevitable.

This would be met by an annual subscription of, say, one shilling. If there be any surplus it could be devoted to some suitable National object.

A preliminary meeting of sympathisers with this movement has been fixed for 4 o'clock in the afternoon of Monday, 30th August, in the hall of the Royal Society (corner of Elizabeth and Hunter Streets), at which your presence is cordially invited.

If you cannot be present, and think well of the idea, perhaps you would, without committing yourself to details, see fit to write a note to one of the undersigned.

HANNAH E. CLUNIES-ROSS.
AGNES L. KETTLEWELL. } Conveners.
J. H. MAIDEN.

Botanic Gardens, Sydney, August, 1909.

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2. WHAT IS AN EMPIRE?

(Address by Mr. J. H. Maiden.)

In an address at the Girls' High School, Mr. J. H. Maiden, Government Botanist, said:—An Empire is a group of nations or States united under a single Sovereign power. Thus we have the British Empire, and Australia (and to a less extent, New South Wales) is a junior partner in this great confederacy. There is no reason at all why, in the course of events, Australia may not be a partner with far greater responsibilities to the Empire as a whole than at present.

Now the Empire can only endure if it be based on the eternal rock of justice to ourselves within the Empire and to other people beyond it. And we can only be just to others if we know more about them, and endeavour to find out their good points. For example, it does good for one school to engage in the friendly rivalry of, say, a game, with another school. You cannot know the good points of the members of that school unless you meet them.

You will remember reading about the old feuds between France and England, which broke out in wars from the time of William the Conqueror. In more recent times such ill-feeling was fanned into a very big flame by the Napoleonic wars, and in England, even boys and girls used to hate France and the French, because they thought it patriotic to do so. But, nowadays, a far different feeling exists, simply because, through travel and other methods of education, the two nations know each other better. Even in Australia we must see that we do not drift into provincialism. Mischievous talkers and writers try to set unthinking people at variance in regard to the merits of one city or one State and another, but the people who say the silliest things are those who know least about the subject. The good citizen tries to see all that is best in his neighbours.

It is always profitable for us to contemplate the experience of nations in the past, and the record of this is what we call history. There have been other powerful Empires earlier than the British one. Let us take the Roman Empire by way of illustration. Where is it now? dispersed, non-existent. And yet this Empire was at one time the proud "mistress of the world," a bragging title I hope the British Empire will never try to assume. Why did the Roman Empire disappear? Simply because of the misconduct of the units composing it. An Empire consists of nations, which again consist of families and individuals. Ancient Rome committed the mistake of thinking that the Empire having been won, there was nothing more to be done. The citizens got lazy and unoccupied, fell into bad habits, and bad habits have the faculty of deteriorating bodily strength. An athlete who desires to keep fit for his work has to be in a constant state of watch and abstemiousness. If he is careless about his food and exercise and habits generally, he is readily defeated by his competitor who is more careful in such matters.

Now, I repeat that a nation, an Empire, is built up of individuals. It is, therefore, our duty to the Empire to be good citizens, true to ourselves, and setting a good example. And remember that we cannot be worthy members of the Empire unless we are good Australians.

In the making of good citizens that subtle intangible thing which we call influence is a great thing and the influence of girls is enormous. See that the influence is exercised in proper directions. You may think and even say that you are weak and of no account, but the most retiring and humblest of you exercise the force of influence. It is, indeed, part of your existence, and you cannot divest yourself of that power even if you wished to do so.

One of the best of Australian citizens, Mr. Thomas Price, who died a short time ago, Premier of South Australia, not long before his death sent a message to school children, in which he stated that at one time he yearned for his own children to be brilliant scholars, but later in life he felt that of far greater importance was the necessity for them to be good. And men and women of mature judgment will almost unanimously say that it is better for a nation for its citizens to be good than to be learned. We can all try to be good. Being good does not mean being namby-pamby, and we surely cannot be good if we neglect our lessons.

The original meaning of an emblem is that which is put in or on—inlaid work, in fact—and hence an emblem is the visible sign of an idea. Now, we have emblems for all sorts of ideas, and some of them are adopted by small sections of the community. A national emblem is the Union Jack, which is indicative of our country, of ourselves. It is only a bit of woven material, bunting, but what does it represent? The majesty of the Empire. The other day I read of some subjects of the Empire who were thought to be in danger from rioters in a foreign city. Happily, they were not injured, but in reporting the incident when the trouble was over the leader of those in danger said: "I had no fear: I had the British flag ready to run up: they always respect that." So that a piece of woven material which stands for the protection of the citizens of the Empire is a worthy emblem.

Now, I want to speak to you of an emblem of peace, one which I trust will never be used as the emblem of a party in time of war. I allude to a flower, a beautiful Australian flower, called the Wattle. Four years ago to-day, in this very room, I suggested the wattle as an Australian national emblem, and, the matter having been taken up, we last year formed the Wattle Day League, and our object is to stimulate Australian national sentiment by means of this flower. Let the Australian wattle have a place beside the rose of England, the thistle of Scotland, and shamrock of Ireland, and the various national flowers I spoke to you about on that occasion.

We do not propose to have another holiday for Wattle Day—perhaps you will be sorry for that—but to wear a spray of wattle, and I believe that if we turn our attention to it on that spring day which we propose to set apart as Wattle Day, we shall study it and love it more because of its beauty and its associations. And the more we study it and admire it the more we shall take care of it, and the shrubs and trees will not be really injured by the sprays we cut off. Indeed, we shall plant more beautiful wattles than ever we did before. Where wattle is not conveniently obtainable we shall have neat representations of it. I want you to think about this Wattle Day League, and tell your fathers and mothers about it.

The wattle stands for sunshine, for purity, for beauty, for goodwill throughout Australia, for a united, happy people, Australians first, and then New South Welshmen next. Then loyalty to ourselves. "To thine own self be true" will make us loyal members of the grand old Empire.—(*Sydney Morning Herald*, 25th May, 1910.)

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3. THE BOTANY OF THE WATTLE.

If the question were to be asked, "What group of plants does most to decorate the Australian bush?" most people would at once reply, "Wattles." It is true that we have hundreds of other ornamental plants, some of which are exceedingly beautiful, and to some of which, as regards single plants or sprays of flowers, the crown of beauty would, perhaps, be awarded before the wattle. Yet, bearing in mind their abundance, their wealth of flowers, their beauty of foliage, their wide distribution, and the prolonged flowering season of one or other of them, wattles bear the palm for the part they take in adorning this bright sunny land.

Probably the first reference to an Australian wattle is that quoted by the late Professor E. E. Morris from Governor Phillip's "Voyage," where, at page 124, occurs the words, "The huts . . . . composed only of upright posts, wattled with slight twigs, and plaistered up with clay." The original wattle employed was that after which Black Wattle Swamp, Sydney (near the head of Darling Harbour), was named, and is a slender tree known as *Callicoma serratifolia*. Very soon, however, the plentifulness and utility of the acacia (or mimosa, as it was more generally known at that time) were recognised, and it supplanted the *Callicoma* both in utilisation and in name.

Wattle is an old Anglo-Saxon word signifying a flexible rod, or a frame-work of such rods; and the very name carries us back to the dawn of civilisation. Although Australia has passed through the stage when wattling was an essential part of a dwelling and a recognised colonial industry, the wattle has still utilitarian associations, for the barks of some species are valuable tanning agents, and thousands of acres are conserved or planted for the yield of this product alone.

For many years, however, the popularity of the wattle has been developing on the æsthetic side, and at the present time probably no plant, or, rather, group of plants, for there are many of them, is so admired and beloved by Australians.

And not content with the name of wattle, we give them many other names, such as myall, mulga, boree, brigalow, cooba, dead finish, gidgee, hickory, miljee, eumung, sally, umbrella bush, wait-a-while, yarran, and I could quote dozens of others. Qualifying adjectives there are in abundance, such as silver, golden, weeping, black, green, broad-leaf, narrow-leaf, prickly, and many others, but very few of them specially descriptive or capable of accurate determination.

The feathery wattle has true leaves and many of them, but Australia has the monopoly of what are termed phyllodineous acacias; that is to say, wattles whose "leaves" are structurally not true leaves, but a flattened expansion of the stem, the blackwood being a well-known example. A few of the North Australian species of this class extend to New Guinea and the Pacific Islands, areas which certainly are within the sphere of Australian influence. Strange to say, the Dominion of New Zealand does not possess a single species of indigenous wattle—those which have been planted of recent years being our tanning wattles, and the blackwood, valuable for its timber.

A well-known group of acacias is that which yields the acacia gum of commerce; they are thorny bushes, or small trees, and are natives of Africa, Asia or America. In no part of the world, however, are acacias such an important and decorative part of the vegetation as with us. The origin of the name is not free from doubt, but it is supposed to be from the Greek akazo (I sharpen) in allusion to the spiny nature of the plants just referred to.

Over 500 species of acacia have been described in various parts of the world, and two-thirds of them are Australian. Rich in species as Australia is, she is wealthy, as we all know, in individuals. It is one of the joys of life to drive through wattle country, particularly on a dull spring morning, and feast the senses on the never-to be-forgotten glories of the golden cascades, and to receive vigour and inspiration from the sweet, dainty perfume.

Wattles are divided into two large groups: one in which the flowers form little fluffy balls, and the other in which they form short rods (botanists call them spikes) respectively. Now a single ball or spike (it is the very embodiment of softness and silkiness in spite of the suggestion of aggressiveness of the name) consists of an aggregate of flowers, and if a magnifying glass of moderate power be taken, one can readily see the minute yet perfect flowers of which they are composed. One frail little fluffy ball, so tender that it wilts at once and is readily blown about by a gentle breeze, is an aggregate of flowers each as perfect as that of a buttercup; and the calyx with its component sepals, the corolla with its constituent petals, the many stamens, and the incipient pod are all there. This floral wonder is best seen when the wattle is not perfectly full.

Wattles vary greatly in size. We have some which hardly raise themselves above the ground, so that we have to brush aside the grass to get a view of them. On the other hand we have wattles, in certain well-watered districts, which are large forest trees, of ascertained heights of more than 100 feet.

The colour of wattle-blossoms varies from pure white to deep yellow and, rarely, orange. It has been called a golden flower, and it is beautiful to the true Australian, gladdening his heart like the precious metal; but with this difference, that it is the most democratic of all flowers, abundant and free to rich and poor alike.

The value of the plant-lore of the aborigines has been probably exaggerated, but we do know that they used (and still do in remote parts of this continent) to employ wattle-buds as calendars. They would decide on starting certain journeys or undertaking other periodical businesses on the stage of development of the wattle-buds; for the opening of the first flowers of some species in certain localities takes place with hardly a day's variation from year to year.

And then, have we ever thought of the universality of the precious wattle? It encounters the spray of the ocean, and unites the sand to offer resistance to the encroaching waves. If we go to the torrid saline sands of the interior it is still there, defiant alike to heat and drought. It adorns every geological formation, softening the hard outlines of the ancient rocks, for we see its beauteous plumes gracing the sandstone, the granite, the basalt with charming impartiality. It is the natural ornament of the black tablelands, of the well-drained hillsides, of the boggy alluvial lands, and defines and gilds the margin of the running stream. Give it soil, and it will gratefully rear its head to the sky; if an anchoring place and nutriment be not available, it will diminish its size and accommodate itself to its altered conditions. Afford it plenty of water, and the happy response is broad, luxurious foliage with very cascades of brilliant posies. In the desert its branchlets are reduced to spines, a very embodiment of the defensive attitude necessitated by its severe environment.



M. Flockton. del. et lith.

BURKITT'S WATTLE.

(*Acacia Burkittii* F.v.M.)

It is found in every Australian State, and abundantly. Dear little Tasmania is ablaze with it. From Sydney to Perth, from Adelaide to Port Darwin, right across the continent from Brisbane to Adelaide, thence to the Kimberleys, and so on to the Gulf of Carpentaria and back again, it is one of the few flowers that everyone knows, the gum tree being perhaps the only other.

This is the flower we ask you to think about, and, if you will, wear and cherish on 1st September, our Wattle Day. The wattle stands for sunshine, for purity, for beauty, for goodwill throughout Australia, for a united happy people—Australians first, and then citizens of our respective States next.

Some friends love the wattle so much that they think that the development of our movement will mean destruction to it. I do not think so. For over a quarter of a century I have, in season and out of season, been extolling the beauties of our native flowers, and have been doing what I can to diffuse a knowledge of them. And I have helped to found the Wattle Day League because I think that it will help people to think more about the flower; and increased knowledge will result in greater love of it.—*The Lone Hand*, 1st September, 1910.

EXPLANATION OF PLATE 224.

A. Flowering twig from Lake Gillies, S.A.

B. Flower, 4-merous.

C. Pistil.

D. Bract found at the base of the flower.

E. Pods from Lake Gillies, showing the seeds pendulous.

F. Seed.

G. and *g*1. Portions of phyllode, *g*1 showing the fringe of hairs on either side. The phyllodes are sometimes terete, but more generally sub-terete or even quite flattened at the tips.

No. 220.

Weinmannia rubifolia Benth.

The Bramble-leaved Weinmannia.

(Family CUNONIACEÆ.)

Botanical description.—Genus, *Weinmannia* L. in *Systema Naturæ*, Edition X, 1005 (1759).

The particular edition from which the following has been copied is Vol. iii, p. 274, of the 1770 Edition:—

488. *Weinmannia.* Cal. 4-phyllus. Cor. 4-petala. Caps. 2-locularis, birostris.

pinnata. Weinmannia. Arbuscula ramis oppositis: vitimis subpubescentibus. Folia opposita, pinnata cum impari: Petiolo communi alato, articulis subovatis: Foliola 11–13, parva, nuda, obtusa, opposita, sessilia, obovata, latere interiore versus basin angustiora, serraturis utrinque. Stipulae ovatæ, magnitudine foliorum, deciduae, inter paria petiolorum solitariae. Racemi terminales, solitarii, pedunculati, foliis longiores, erecti, simplices.

Floribus numerosis, albis, magnitudine Tiarellae. Pedicellis unifloris, e singulis punctis pedunculi pluribus. Calyx foliolis oblongis, quatuor, patentibus, albis. Petala 4, lanceolata, calyce triplo longiora. Stamina capillaria. Corolla duplo longiora. Germen ovatum, bisulcum. Styli 2, albi, filiformes. Stigmata capitata. Copiose in Insula S. Crucis a D. Browne.

It may be translated as follows, and it will be observed that the original species is *D. pinnata* (a West Indian one).

488. *Weinmannia.*—Calyx 4-lobed, corolla 4-petalled. Capsule 2-celled; birostrate.

Species pinnata (*Weinmannia*).—A small tree, branches opposite; the ultimate branches somewhat pubescent. Leaves opposite, imparipinnate; the common petiole winged, the joints almost ovate. Leaflets 11–13, small, naked, obtuse, opposite, sessile, obovate, the inner side somewhat narrower towards the base, serrulate on both sides. Stipules ovate, of the size of the leaves, deciduous, interpetiolar, solitary. Racemes terminal, solitary, pedunculate, longer than the leaves, erect, simple. Flowers numerous, white, of the size of *Tiarella*. Pedicels uni-flowered, many coming from each point of the peduncle. Calyx with 4 oblong, spreading white leaflets (sepals). Petals 4, lanceolate, three times as long as the calyx. Stamens hair-like, twice as long as the corolla. Ovary ovate, bisulcate. Styles 2, white, filiform. Stigmas capitate. Very abundant in the island of St. Croix (West Indies), D. Browne.

Bentham defines the genus and the Australian species *rubifolia*, in the following words :—

Calyx divided almost to the base into 4 or 5 more or less imbricate segments.

Petals as many as calyx-segments.

Stamens twice as many as petals, inserted round the disk ; anthers small.

Ovary free, 2- or rarely 3-celled, with several pendulous ovules in each cell ; styles distinct, each with a terminal or decurrent stigma.

Capsule oblong or ovoid, septicidally dehiscent.

Seeds oblong reniform or nearly globular, usually (but not always) hairy ; embryo in the axis of a fleshy albumen.

Trees or shrubs.

Leaves opposite, simple, or digitately or pinnately compound, with 3 or more leaflets.

Flowers in simple racemes, terminal or axillary, solitary or clustered. (B.Fl. ii, 444.)

Botanical description.—Species, *W. rubifolia* Benth., in *Flora Australiensis* ii, 445 (1864), so Mueller in his Second Census, but Bentham *loc. cit.* credits it to Mueller in the following words :—

"F. Mucll. (under *Geissois*)."

A small tree, the young branches, inflorescence and veins of the leaflets more or less clothed with long fine hairs.

Leaflets 3 or 5, digitate, ovate-elliptical, acuminate, sharply serrate, much narrowed into a petiolule, rigid but not thick, the primary parallel veins very prominent underneath, with transverse reticulations, the terminal one usually 2 to 3 inches long, or rarely more, the lateral ones smaller.

Stipules large, hairy, deciduous. (These must be floral bracts ; there are no stipules.—J.H.M.)

Racemes axillary, usually several together on a very short common peduncle, 1½ to 3 inches long when in fruit.

Flowers not seen. (The floral bracts are large and persistent ; the petals are 3 in number, and there are 6 stamens ; the anthers have a connective.—J.H.M.)

Pedicels very short or scarcely any.

Sepals shorter than the fruit.

Capsules reflexed, 1½ to nearly 2 lines long, narrow, hairy, with 2, rarely 3, recurved styles, the stigmas shortly decurrent.

Seeds two or three in each carpel, narrow-oblong, the testa more or less extended into a loose wing at one or both ends, or in some seeds the nucleus appears to extend nearly the whole length. (B.Fl. ii, 445.)

This species certainly bears a superficial resemblance to *Ackama Muelleri*, See Part LV, page 91.

To summarise some of the chief points, *W. rubifolia* has:—

Leaves in 3's or 5's (digitate). Our one *Weinmannia* is therefore digitate, not pinnate as the original species is.

Stamens 6 (anthers have connective). According to Bentham and Hooker the genus requires 6–10.

Petals 3. According to Bentham and Hooker the genus requires 4–10.

Stipules none.

Floral bracts large and persistent. (There has been some confusion with stipules.)

Botanical Name.—*Weinmannia*, in honour of Johann Wilhelm Weinmann, apotheker (pharmacist), Regensburg, Bavaria, Germany. He was the author of the works enumerated at 10139 and 10140 of Pritzel, viz.—"Thesaurus rei herbariæ" (1787), and "Phytanthozaiconographia" &c., an illustrated work in four volumes, folio (1737–45); *rubifolia*, Latin *rubus*, a bramble or blackberry-bush, *folium*, a leaf.

Vernacular Name.—I know of none that can with certainty be applied to it. I have known it to be called "Corkwood" and "Marrara," but probably through some confusion with other trees. I have therefore no alternative but to propose the cumbrous name "Bramble-leaved Weinmannia" until such time as the public invent one for themselves.

Aboriginal Name.—I know of none.

Synonym.—*Geissois rubifolia* F.v.M., as already indicated.

Timber.—Timber close-grained, tough, and easily wrought; considered to be an excellent timber, but not much used.

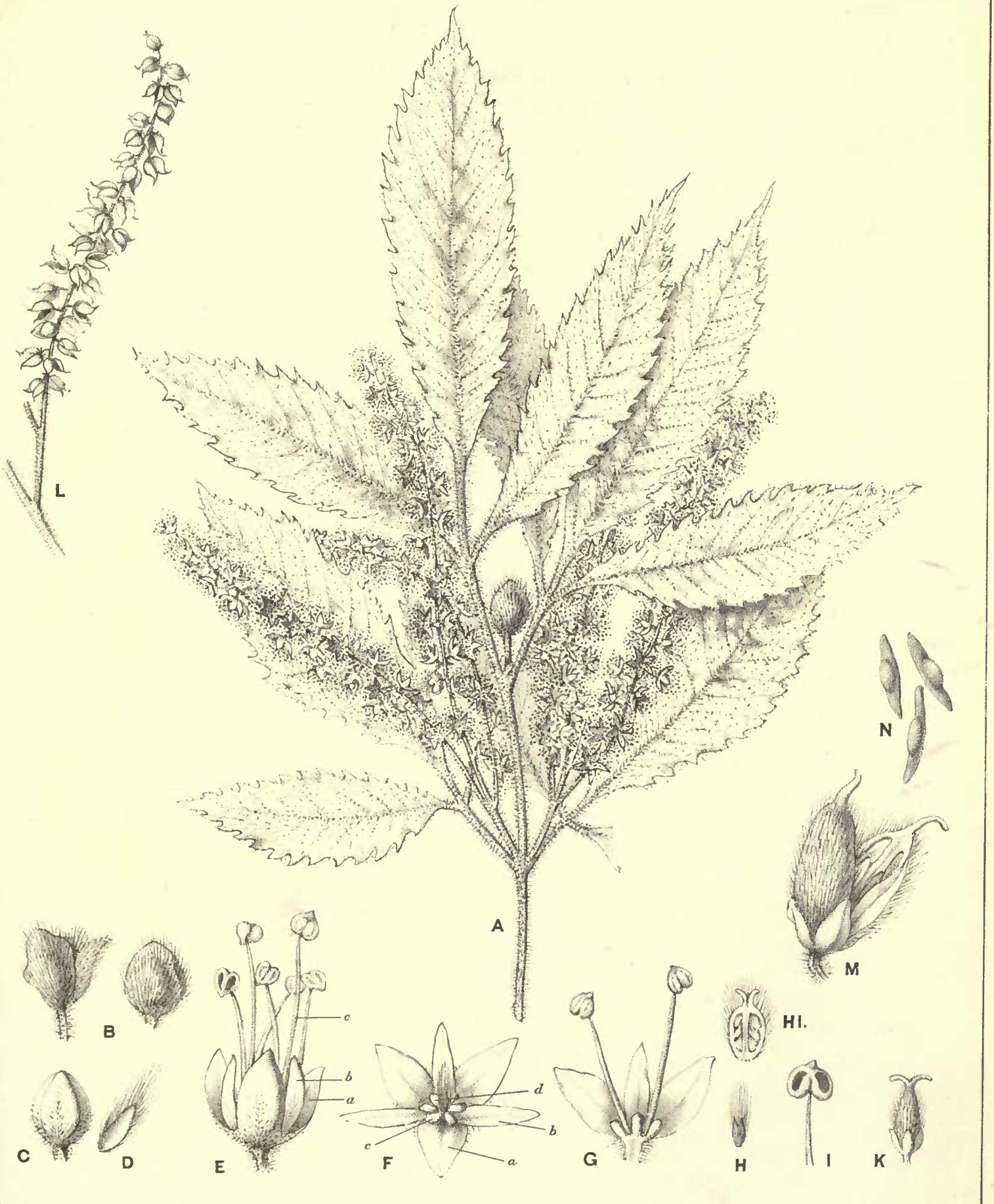
Size.—Particulars as to the size of this tree are discrepant. Personally I have not seen it larger than a small tree of, say, 20 feet, with a stem diameter of a few inches, but the late Mr. Augustus Rudder, a man of great experience, once sent me twigs of it with the note that the tree attained a height of 120 feet and a trunk diameter of 2 feet 6 inches. I think this is a mistake. I shall be glad of correspondence on the subject.

Habitat.—The type came from Cloud's Creek, a tributary of Clarence River, New South Wales (Beckler), from which it extends to southern Queensland. Its known southern limit is the Upper Hunter. Following are some specimens represented in the National Herbarium, Sydney:—

6–8 feet. On the fringe of the scrubs on the way up from bottom to top of Barrington Tops, 5,100 feet (J. L. Boorman.)

Piri Brush, Upper Hunter (Dr. Leichhardt, January, 1843); Upper Gloucester, 120 feet high, 2 feet 6 inches in diameter (A. Rudder); Comboyne Brush, *viâ* Taree; Ellenborough Falls (J.H.M.); Dorrigo (W. Heron, J. L. Boorman); 6 to 12 feet, Meldrum (Guy Fawkes Falls) (J. L. Boorman).

It is a brush tree, a denizen of localities well watered and with deep soil.



M. Flockton. del. et lith.

THE BRAMBLE-LEAVED WEINMANNIA.

(*Weinmannia rubifolia* BENTH.)

EXPLANATION OF PLATE 225.

A. Flowering twig.

B. Stipules enclosing young flowers.

C. Bud, valvate.

D. Floral bract.

E. Flower showing :—

(*a*) Three broad calyx-lobes.

(*b*) Narrow petals.

(*c*) Six stamens.

F. Flower (stamens removed) showing (*a*) calyx-lobes, (*b*) petals, (*c*) lobed disk, (*d*) pistil.

G. Part of flower showing the stamens a little behind the disk, and alternate with the lobes of it.

H. Pistil.

H1. Pistil more advanced.

I. Stamen.

K. Young fruit, with persistent styles.

L. Fruits, natural size.

M. Fruit capsule enlarged, showing the imbricate seeds.

N. Winged seeds.

Drawn from specimens from Murwillumbah, Tweed River, N.S.W.

APPENDIX

[Following is a brief original paper by Mr. Hedley. Will my readers help him to clear up the confusion which has gathered around our Australian form?—J.H M.]

MARINE WOOD-BORERS.

By Charles Hedley, F.L.S., Assistant Curator, Australian Museum, Sydney.

On land, timber is destroyed by a variety of noxious animals, for it may be riddled by white ants, bored by the larvæ of beetles, moths, or other insects, or gnawed by rats. In the water it is beyond the reach of these creatures, but their business is carried on quite as efficiently by another series of pests. No matter whether the water is cold or warm, whether fresh, brackish or salt, we find that some organism or another is there to take its food or shelter in the wood.

The part that insects play on land is accepted in the water-world by *mollusca* and *crustacea* or the shell-fish and the crayfish kinds. More than a century has elapsed since European science sent her first missionaries to the realm of Australian zoology, but so few are the labourers, so great is the field, that the more obscure of these creatures have not yet been fully studied and named.

The first to claim our attention is *Sphaeroma quoyana* (Fig. 1), a *crustacean* half an inch long, somewhat of the form of a wood-louse, but longer and broader, and with a hard shell. With its strong jaws this gnaws holes and furrows in the wood and ranges from low to half tide level. Not only does it consume soft and hard woods alike, but it even carves out burrows in the sandstone rock. Abroad, some kinds of *Sphaeroma* are known to live in fresh water, so that in tropical or sub-tropical Australian rivers, this pest may be expected to extend beyond the influence of the sea.

A specimen of the ravages of *Sphaeroma* is illustrated in Fig. 2. This shows part of the rib of a vessel left as a wreck on the beach at Mosman's Bay, Sydney. At the upper end, the timber has been eaten right through by a process of gouging and boring.

Apparently introduced from Europe is a far smaller wood borer, about the size of a grain of rice, the Gribble or *Limnoria lignorum*. This drills small holes close together like those in the lid of a pepper pot; it has been found in wharves and vessels in Sydney Harbour.* How far from this centre of infection it has spread is uncertain.

By far the largest and most destructive of the wood borers is the ship-worm, which may be roughly described as a modified cockle drawn out to worm shape, an example of which is *Nausitoria thoracites* (Fig. 3). About half a dozen indigenous species have been found in Australia. To these, recent writers have

* Whitelegge—Rec. Austr. Mus. iv, 1901, p 113.

added three European species as infesting submerged timber in Victoria.* But as an Australian ship-worm, twice as large and with a different shell, is identified with a foreign species, these records may require confirmation.

The Australian species are among the largest in the world, for they reach a length of almost 6 feet, and a diameter of more than an inch.† A fossil ship-worm from the Cretaceous beds of Queensland is described by Mr. R. Etheridge as reaching a breadth of an inch and a half.‡

A rudimentary pair of valves at that end of the worm which is sunk deepest into the wood, have long ceased to fulfil their original purpose of protecting the soft body. Assuming a quite different function, they have become clamps to grip the wall of the burrow, and thus afford a fulcrum to the foot when scraping at the mine face.

Whereas the crustacean pests already mentioned, actually eat the wood for food, the ship-worms feed by suction on silt or animalculæ floating in the water, and bore into the wood as they might into some inorganic substance for shelter only. Sometimes, indeed, the burrow is sealed at the end and lined for its length with a shell wall, thus excluding the animal from the wood.

The process of excavation has been a subject of much debate: the following conflicting explanations have been suggested:—(1) That the wood is destroyed by some chemical agent secreted by the worm; but no such acid has been observed, and the clean even cut is not like the rough surface half-consumed by a chemical mordant. (2) That the hole was rasped out by the blade or the back of the shell; but the delicate surface of the shell shows under the microscope no sign of wear. (3) That the fleshy foot of the ship-worm, shaped like a pestle and roughened with lime spicules, has been the instrument of perforation. This latter appears to be the correct explanation. The drill is equally efficient against the hardest or the softest wood. A specimen of the boring is shown in Fig. 4.

In some species the eggs are extruded into the water, and there fertilised, but in other ovo-viviparous species the larvæ are hatched in the gills of the parent. These eggs are extremely small, having a diameter of not more than one five-hundredth of an inch. So prolific are they, that Professor Sigerfoos estimated that a large ship-worm might produce 100,000,000 eggs.§

Having hatched, the larvæ exist for probably a few weeks as a free-swimming organism, they then settle down on some wooden structure, moult their larval features, and commence to burrow. A month later the animal has grown from microscopic dimensions to a length of a few inches, and probably attains its full size within a year.

While the crustacea work at or near the surface of the sea, the ship-worms may descend to any depth. One was found boring a deep sea cable, and another was dredged by the Challenger Expedition from a depth of 1,400 fathoms.

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* Gatliff and Gabriel—Proc. Roy. Soc. Vict. xxviii, 1915, p. 171.
† Hedley—Proc. Austr. Assoc. Adv. Sci., 1901, p. 251.
‡ Etheridge—Rec. Austr. Mus. iv, 1901, pp. 201-204, pls. 34-35.
§ Sigerfoos—Bull. U. S. Bur. Fish, xxvii, 1907, p. 196.

Few creatures are so well sheltered against their natural enemies as the ship-worm, but a small predaceous annelid worm, *Lycoris fucata*, gains admission to the burrows of European species and devours its host alive. Artificial protection against ship-worms' ravages has been sought by various methods. In the first place the destruction of the animals has been attempted, and in the second efforts were made to preserve the wood from their depredation.

A strong poison, such as corrosive sublimate, has been poured into the water round infected piles. But in the open sea, the poison becomes too diluted to injure the molluscs beyond a short radius.

If a pile be enclosed in a cylinder of pipes or canvas, and the space between the cover and the wood be filled with mud or sand, the ship-worms will soon die from suffocation.

By discharge of electricity in the water near infected piles, the worms may be poisoned by the volumes of chlorine gas thus produced.

In saving the wood from the worm, it must be remembered that an opening the size of a pinhole is all that the pest needs to gain admission to the timber. A primitive and effective way to exclude the ship-worm is to scorch the wood with fire till a complete crust of charcoal is obtained. An improvement on this treatment is to follow with an application of hot tar, and then a coat of sand. A variation of the same idea is to wrap round the piles a mat of canvas and bitumen, or a composition of asphalt and netting, or to sheath the piles with metal plates.

A method of filling the pores of the wood with creosote has not been successful. This process spoilt the timber, making it too weak and brittle to be hammered by the pile-driver. The dense Australian hardwoods do not admit of saturation as do the lighter European pines.

The whole subject of the destruction of wood by ship-worms is worthy of more study than it has hitherto received in Australia. Since conditions are so different, it does not follow that observations and deductions made in Europe upon northern species are applicable here. It would be useful to record depredations made on a timber botanically determined, by a ship-worm conchologically determined, whose length and breadth is stated, within certain dates accurately noted, in water whose temperature and salinity is known. For lack of such details, most observations published on the subject are of slight value, and apparently conflicting.

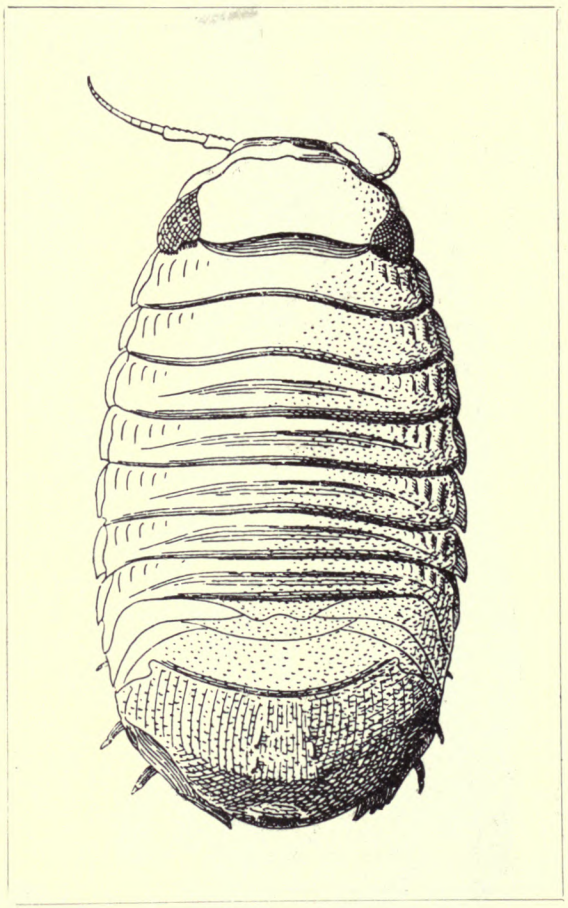
ILLUSTRATIONS.

Animal of *Sphaeroma quoyana*. Original.

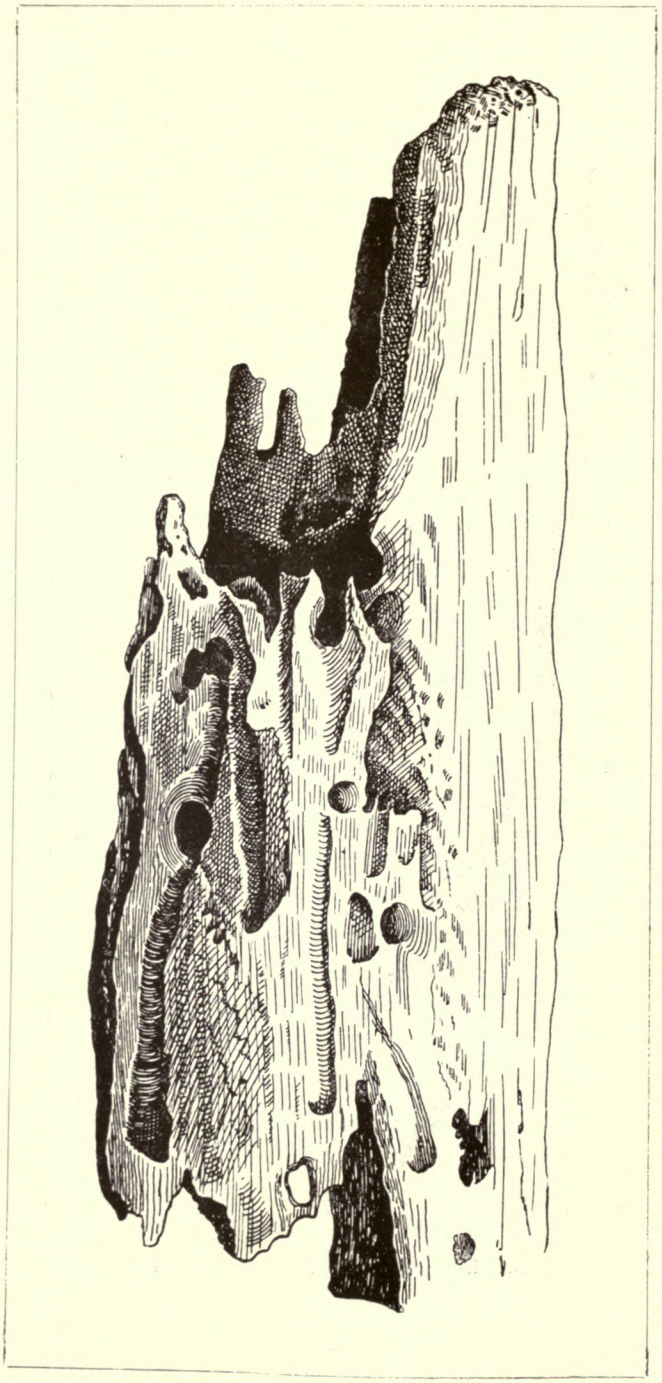
Wood bored by *Sphaeroma quoyana*. Original.

Animal of *Nausitoria thoracites*. After Wright.

Wood bored by *Nausitoria edax*. Original.

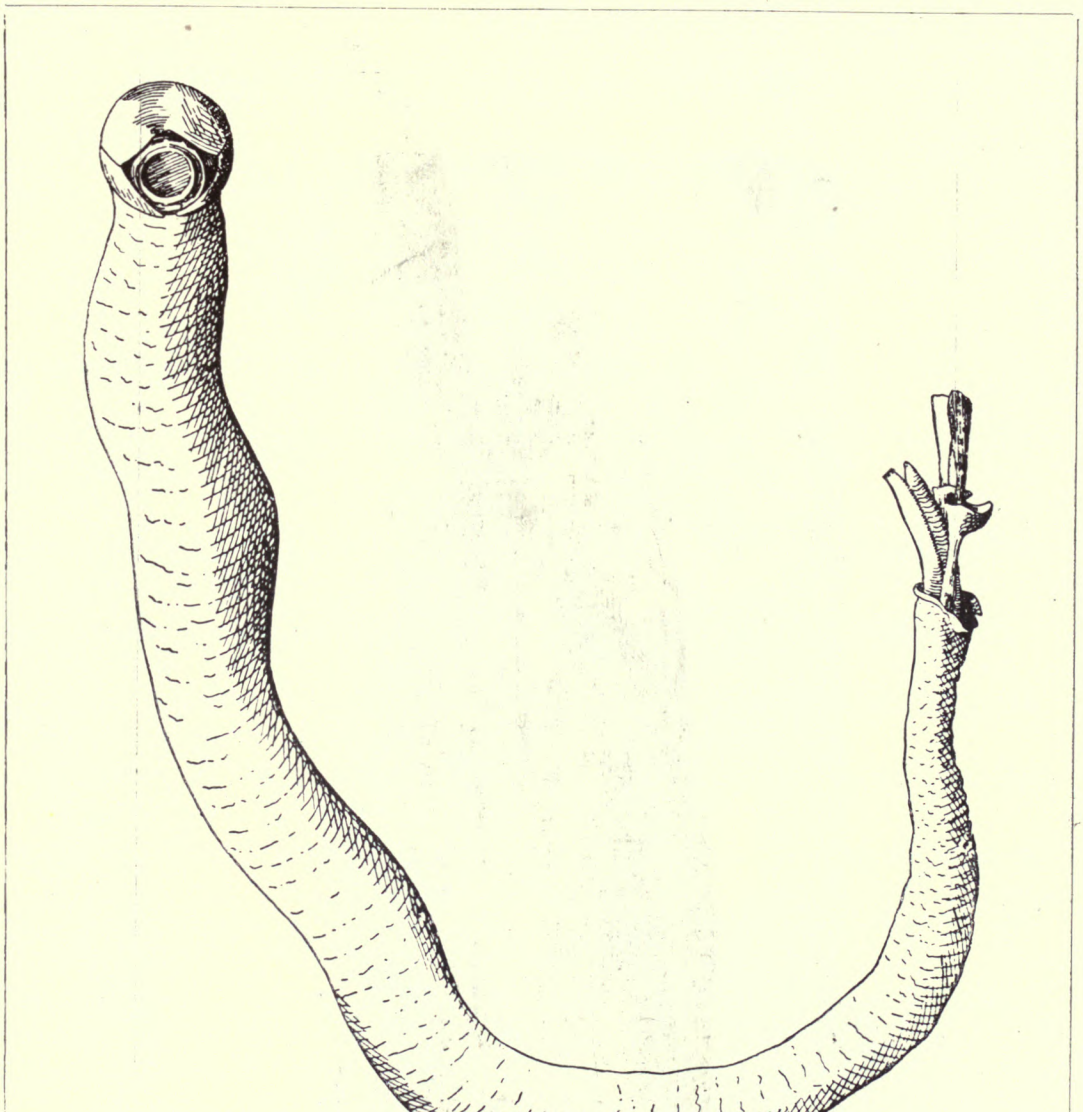


ANIMAL OF SPHAEROMA QUOYANA.

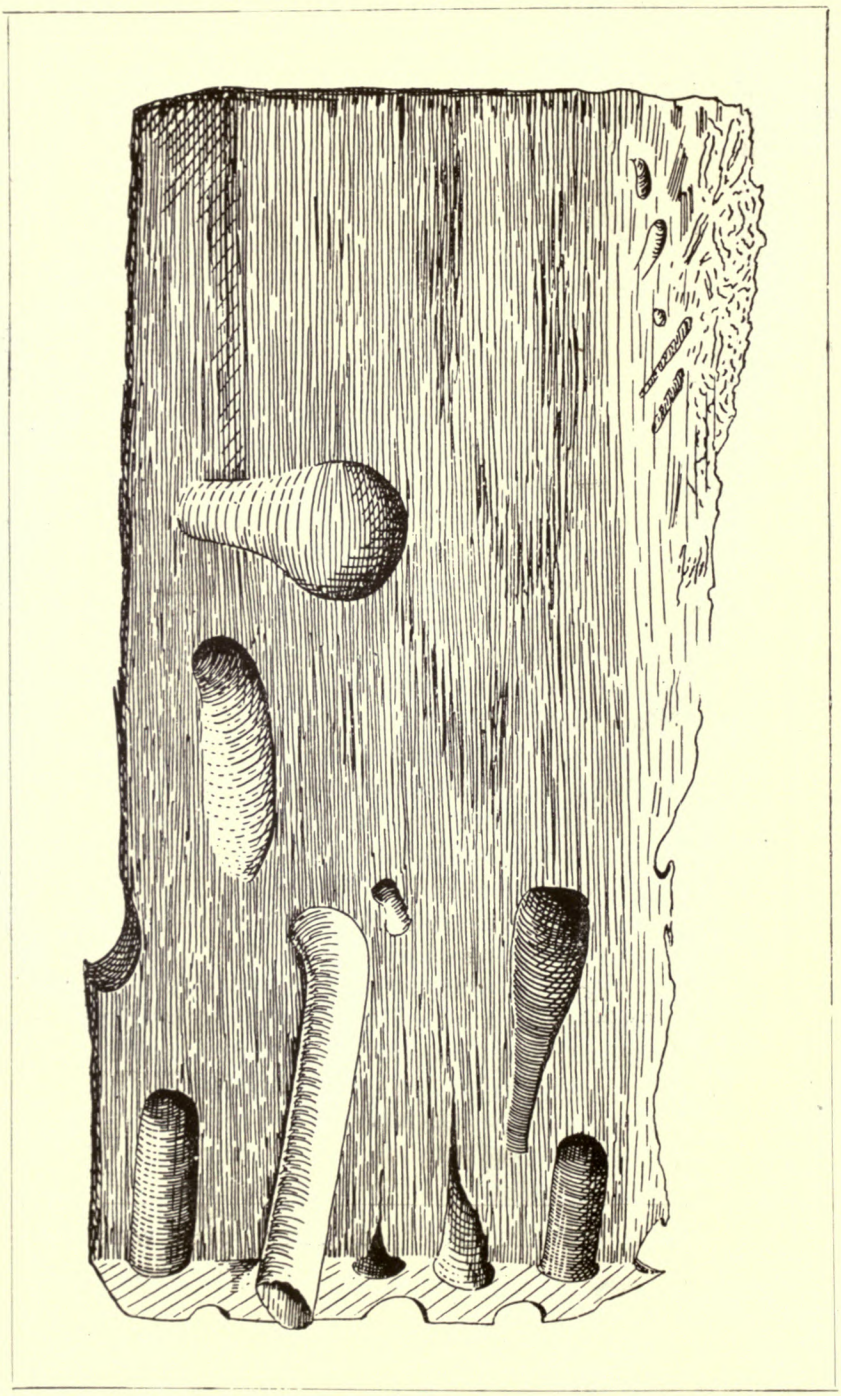


WOOD BORED BY SPHAEROMA QUOYANA. ORIGINAL.

266²



ANIMAL OF NAUSITORIA THORACITES. AFTER WRIGHT.



WOOD BORED BY NAUSITORIA EDAX. ORIGINAL.

No. 221.

Eucalyptus oleosa F.v.M.

Red Mallee.

(Family MYRTACEÆ.)

Botanical description.—Genus, *Eucalyptus*. (See Part II, p. 33.)

Botanical description.—Species, *E. oleosa* F.v.M., in Miquel's paper in *Ned. Kruidk. Arch.* iv, 128 (1856).

The above description is not quite satisfactory, since it refers to mixed material. The following is by Bentham :—

A shrub or small tree, the bark of the trunk rough and persistent, that of the branches smooth. (*F. Mueller.*)

Leaves mostly lanceolate, obtuse or acuminate, under 4 inches long, thick and smooth, the oblique and rather numerous veins scarcely conspicuous.

Peduncles axillary or lateral, terete or slightly angular, each with about 4 to 8 more or less pedicellate flowers.

Calyx-tube obovoid, more or less contracted at the base, and sometimes at the top, 2 to 2½ inches long.

Operculum obtusely conical or shortly acuminate, usually exceeding the calyx-tube, and sometimes much longer and not very thick.

Stamens 2 to 3 lines long, inflected in the bud, but without the acute angle of *E. uncinata*; anthers small, ovate, with parallel distinct cells.

Ovary short, convex or conical in the centre.

Fruit ovoid or globose, truncate, contracted at the orifice, about 3 lines long, the rim flat or concave, the capsule sunk, but the slender points of the valves formed by the split base of the style often protruding. (B.Fl. iii, 248.)

It is figured and described by Mueller in the "Eucalyptographia."

Varieties.—There are two fairly well marked varieties :—

1. Var. *longicornis* F.v.M.
2. Var. *glauca* Maiden.

Neither of them occurs in New South Wales so far as we know at present. Var. *longicornis* is only known from Western Australia, and var. *glauca* chiefly occurs in that State, but it extends into South Australia, and may yet be found in western New South Wales.

These two varieties are figured and fully described in Part xv of my "Critical Revision of the genus Eucalyptus," to which my readers are referred for further information in regard to a somewhat protean species.

Affinities.—This is dealt with at some length, though not finally, at page 173, Part xv, of the same work.

Botanical Name.—*Eucalyptus*, already explained (see Part II, p. 34); *oleosa*, Latin, oil-bearing. In spite of its name, it is not an important source of Eucalyptus oil. For further particulars see "A Research on the Eucalypts" (Baker and Smith).

Vernacular Names.—"Red Mallee" because of the colour of the timber. Sometimes called "Smooth-barked Mallee," but this is by no means sufficiently characteristic; indeed I have sometimes known it to be called "Rough-barked Mallee," but it is usually smooth rather than rough.

The variety *glauca* Maiden, is on the sand-hills at Ooldea, S.A., stated by Mr. Henry Deane to be called "Water Mallee," because its roots yield water to the blacks (compare Part LI, p. 14). It is, with other trees, known as "Blackbutt" on the Eastern Gold-fields of Western Australia.

The variety *longicornis* F.v.M. is known in Western Australia as "Morrel," and in some districts as "Poot."

Aboriginal Names.—I know of none which can be certainly attributed to this species.

Synonyms.—*E. socialis* F.v.M., *E. laurifolia* Behr, *E. turbinata* Behr et F.v.M. These are forms found in South Australia. For details, which need not be repeated here, see my "Critical Revision of the genus Eucalyptus," Part xv.

Leaves.—Normally the juvenile leaves are broad or broadish, but they vary in width, so that in some exceptional instances they may be narrower.

Flowers.—The operculum is usually pointed-tapering, but sometimes rounded and even almost hemispherical. Occasionally the buds almost assume the "egg-in-egg-cup" shape, reminding one of *E. salubris* (the Gimlet gum of Western Australia) and a few other species, in this respect.

Fruit.—A common character is the awl-shaped tips of the valves, which are well exsert as a rule.

Bark.—Its trunk has roughish bark at the butt, but the upper portion and the branches are smooth.

Timber.—Colour of a reddish brown, with the reddish colour predominating more or less. It is durable, but it is usually so small that it is but of limited use except for such local purposes as posts and rails and fuel.



W. Gill, photo.

Eucalyptus oleosa, PARILLA FOREST, PINNAROO DISTRICT, SOUTH AUSTRALIA.



E. B. Docker, photo.

GROUP OF MALLEE *(Eucalyptus oleosa)*, GUNBAR, N.S.W.



W. Gill, photo.

RED MALLEE *(Eucalyptus oleosa)*, BLACK MALLEE *(Eucalyptus odorata)*, AND PINES, NACKARA FOREST RESERVE, SOUTH AUSTRALIA.



M. Flockton del. et lith.

RED MALLEE.

(*Eucalyptus oleosa* F.v.M.)

Size.—It is a Mallee, but it may attain the dignity of a small or medium-sized tree, rarely, however, attaining a height of 25 to 30 feet.

Habitat.—The co-types come from South Australia, and, as was often the case in the old days, the pernicious method of giving more than one locality for the type (*e.g.*, Marble Range and the Murray Scrub in the present case) was followed.

It is a dry country species, occurring sparsely in Western and South Australia (both States of comparatively low rainfall), in Victoria near the Murray, and in the western or drier portion of our own State. In Queensland it has recently (*Proc. Roy. Soc. N.S.W.*, xlvii, 1913) been recorded for the Jericho district. It is a species that should be further searched for.

I have it from the following New South Wales localities:—Abbott's Tank, near Balranald (C. J. McMaster); Lower Lachlan River, two specimens, respectively labelled "Smooth-barked tree," "Rough-barked tree" (correspondents of H. Deane); Condobolin (R. H. Cambage); Wyalong (H. Deane, J. G. Postlethwaite); Coolabah and Girilambone, with moderately narrow juvenile leaves (R. W. Peacock, J. L. Boorman, J.H.M.); Cobar (Rev. Dr. Woolls, R. H. Cambage, L. Abrahams, J. L. Boorman); Wittagoona, near Cobar (L. Abrahams); Nymagee (Dr. J. Wharton Cox, J. L. Boorman); Mount Boppy (J. L. Boorman).

I shall be glad to receive specimens from other localities.

EXPLANATION OF PLATE 226.

A. Juvenile leaves from Coolabah, N.S.W.

B. Flowering twig from Mount Boppy, N.S.W.

C. Fruits from Mount Boppy.

D. Buds from Murat and Denial Bays, South Australia.

E. Fruits from Venus Harbour, South Australia.

F. Anthers.

PHOTOGRAPHIC ILLUSTRATIONS.

Group of Mallee (*E. oleosa*). Gunbar, N.S.W. (E. B. Docker, photo.)

Eucalyptus oleosa. Parilla Forest, Pinnaroo District, South Australia. (W. Gill, photo.)

View showing Red Mallee (*E. oleosa*), Black Mallee (*E. odorata*) and Pines (*Callitris*). Naekara Forest Reserve, South Australia. (W. Gill, photo.)

No. 222.

Acacia cyperophylla F.v.M.

The Red Mulga.

(Family LEGUMINOSÆ : MIMOSÆ.)

Botanical description.—Genus, *Acacia*. (See Part XV, p. 103.)

Botanical description.—Species, *A. cyperophylla*, F. Muell. Herb. (in B.Fl. ii. 400, 1864).

Tall, with curly bark and dark wood, branchlets terete.

Phyllodia linear-subulate with a fine, usually curved point, 6 to 10 inches long, terete or very slightly compressed, striate with numerous exceedingly fine parallel nerves only visible under a lens, hoary with a very minute loose pubescence.

Spikes sessile or nearly so, oblong, not ½ inch long.

Flowers mostly 5-merous or 6-merous.

Calyx turbinate, about half as long as the corolla, at first shortly toothed but often dividing nearly to the base.

Petals smooth, glabrous.

Pod unknown.

In the course of time some confusion has arisen in regard to this species, Mueller himself sometimes forgetting what he had originally described under that name, oftenest substituting *A. Burkittii* F.v.M. for it.

I accordingly requested Professor Ewart to kindly favour me with all the material in the Melbourne Herbarium attributed to *A. cyperophylla*, which he promptly did. None of the material received was authentic, except the Leichhardt and Gregory specimens.

The Gregory specimen, which is evidently the type, bears the following very old label, in Mueller's handwriting :—

" Acacia cyperophylla, F.v.M. inedit

" A aneura affinis (sepalis diversa). . . Stony ground, Cooper's Creek.

" Tall stem with curly bark and dark wood."

It is in flower only, and is the comparatively coarse twig in the middle of the plate of *Acacia cyperophylla*, as depicted by Mueller in his " Iconography of Australian Acacias."

The twig to the left is probably *A. Burkittii* F.v.M. The twig to the right is *A. Currani* Maiden (*Proc. Roy. Soc. N.S.W.*, xlix, 492, 1915). So that the plate pourtrays no less than three species of Acacia!

Most of the enlarged drawings of Mueller's plate are those of *A. Burkittii*. The type may be re-described as follows:—

Phyllode, terete or somewhat flattened, finely striate with a hoary tomentum, seen under a lens; the base somewhat constricted and wrinkled for a few mm. with almost annular very shallow protuberances, the whole more or less hoary.

Flowers in nearly sessile spikes, glabrous, 5-merous.

Calyx turbinate-truncate, slightly lobed at the apex, with a ragged, irregular edge, hoary on surface. About half as long as the corolla.

Petals glabrous (too young to show recurving), united not quite half-way up.

Pistil smooth and shiny or hoary (very small).

Pod absent.

The following specimens, probably *A. cyperophylla*, were seen by both Mueller and Bentham. They are only inferior in importance to the type.

A specimen from Flinders River (No. 141) is smaller in all its parts, but appears to be structurally similar to the type. If the pods turn out different, the matter can be reconsidered.

There is a second specimen labelled "No. 10," Flinders River, which is apparently the same as the above, but I do not know the name of the collector, although the handwriting was at one time familiar to me. I suggest it may be Henne.

The specimen of Leichhardt's simply bears the words "Acacia" and "Leichhardt" in Bentham's handwriting in pencil.

W. V. Fitzgerald writes as follows of this species:—

A. cyperophylla F.v.M. Calyx usually lobed to the middle; lobes ciliate. Petals connate to or above the middle. Pod long, linear, slightly constricted between the seeds, 4–6 inches long; valves convex, pubescent. Seeds oblique oblong; funicle rather long and much folded from the base, hardly thickened into a linear basilar arillus. (*Journ. W.A. Nat. Hist. Soc.*, Vol. 2, Part i, p. 51 [1904?]).

I doubt whether Mr. Fitzgerald saw the pods of *A. cyperophylla*. The linear pod 4–6 inches long, and convex, pubescent valves, constricted between the seeds, points to something different to what I recognise as *A. cyperophylla*. The most careful search here and in Perth has failed to find the specimens described.

The following is a description (see also Fig. G. Plate 227) of a pod *in situ*, on a branchlet whose phyllodes are typical. It was collected by Captain S. A. White as stated below.

Stipitate, pod flat, valves pointed at each extremity, 5 cm. long, 5 mm. broad, brownish, slightly scaly, thickened margins.

Seeds thin, compressed, pale brown (evidently not perfectly ripe), of irregular quadrangular outline, funicle uniformly thread-like, once folded, arillus or cap very small.

This, in my view, is the first time the pods of *A. cyperophylla* have been described.

Affinities.—It may be distinguished from *A. Burkittii* and *A. brachystachya* in the following way :—

A. CYPEROPHYLLA.	A. BURKITTII.	A. BRACHYSTACHYA.
Flower 5-merous, glabrous ...	*Flower* 4-merous	*Flower* 5-merous.
Calyx semi-truncate	*Calyx* irregularly divided, hairy ...	*Calyx* narrow, thin, no central nerve, or very slight, a few hairs at the tips.
Pistil hoary	*Pistil* hairy	*Pistil* hoary.
Pod figured *infra*, and described *supra*	*Pods* figured and described in Part 59.	.....

Botanical Name.—*Acacia*, already explained (see Part XV, p. 104); *cyperophylla*, from two Greek words, kupeiros, a marsh plant or sedge, and *phullon*, a leaf, the foliage reminding one of a sedgy or rushy plant.

Vernacular Name.—"Red Mulga." The term "Mulga" is applied to several species of Acacia forming tallish shrubs or small trees, and somewhat erect in habit, though not invariably so.

Aboriginal Name.—I know of none.

Leaves.—Of the rush-like or needle bushes, the leaves (phyllodes) of this species are relatively coarse.

Fruit.—Note that the pod has been now described for the first time.

Bark.—Most writers draw attention to the bark, which appears to be characteristic. Reference is invited to what has been quoted from Ernest Giles and Baldwin Spencer, below. Its characteristic appears to be its curliness; it is red in colour.

Timber.—It is so small and so distant from large towns that it can only be used locally. It is remarkably tough, and hence, although I have no direct evidence, it is probably used by the aborigines in the manufacture of weapons.

Size.—A tall shrub or small tree.

Habitat.—It is a denizen of dry country. Mueller, in his "Second Census of Australian Plants," 1889, states that this species is found in South Australia, New South Wales and Queensland.

As regards South Australia, the type comes from there, and I have referred to some specimens with thinner phyllodes, from Queensland, which, in the present state of our knowledge, are referable to *A. cyperophylla*. I will also show (I believe satisfactorily) that it is found in Western Australia, but I cannot find any evidence that it occurs in New South Wales. I have, however, deliberately inserted it in the present work because every writer who refers to *A. cyperophylla* follows Mueller in recording

it from New South Wales, and I think that it is probable that it may be, later on, found in the north-western extremity of this State. I trust that the drawing I submit may lead to its re-discovery, for it is to some extent a "lost" species as, until the present publication, it had not been re-discovered since it was originally described in 1864 from "Stony Ground, Cooper's Creek, *A. C. Gregory*." The native name of Cooper's Creek is Barcoo, and its course is not perfectly defined, as, in many parts of its length, it frequently does not run. It rises in the Warrego district of Queensland, flows through sandy desert country into South Australia, debouching into Lake Eyre.

It is noteworthy that most writers who have collected this Acacia speak of its local rarity. It is evidently never found gregariously. I give a number of references to South Australian localities; it is found in the vicinity of the Macdonell Ranges.

1. I have not seen the specimens referred to in Ernest Giles' "Geographic Travels in Central Australia, from 1872 to 1874," 8vo. pp. iii, 223, Melbourne, 1875.

Giles gives a slightly fuller account of this Acacia in his "Australia twice Traversed," i, 62. He speaks of his arrival on the 24th September, 1872, at an elevation he calls Mount Udor, in the western part of the Macdonell Ranges. He says: "We had to encamp in the midst of a thicket of a kind of willow acacia, with pink bark all in little curls, with a small and pretty (mimosa-like, these two words are not in the 1875 version.—J.H.M.) leaf. The bush is of the most tenacious nature, you may bend it, but break it won't."

I think Tate's determination of this as *A. cyperophylla* is correct in spite of the fact that it is not a "Willow Acacia . . . . with pretty mimosa-like leaf." But the curly bark seems a character.

2. It is stated to have been collected by Tietkens at the Warman Rocks (S.E. of Lake Macdonald), see his *Journal of Cent. Aust. Exped.* 1889, p. 74 (1891); see also *Trans. Roy. Soc. S.A.*, xiii, 101 (1890).

3. In the *Journ. Horn Scientific Exp.* 1894, by C. Winnecke, p. 7, under date 9th May; we have "Camped at Red Mulga Creek, ... the name of the creek is derived from a peculiar and rare species of Mulga, supposed to be *Acacia cyperophylla*, which we first beheld here, and which is possibly confined to this region."

4. "The lines of the watercourses are marked with *Acacia cyperophylla*, the red Mulga, a very local tree extending across a narrow belt of country from east to west, a little way to the north of the old Macumba Station." (*Horn Expedition, Narrative*, by Baldwin Spencer, p. 13.)

5. "A little to the north of Dalhousie we crossed a narrow belt of country characterised by the growth along the creek sides of Red Mulga. This is an Acacia (*A. cyperophylla*) reaching perhaps a height of twenty feet, the bark of which, alone amongst Acacias, is deciduous and peels off, forming little deep-red coloured flakes. It is evidently very local in its distribution, and we met it nowhere else except in this district." (*Ib.*, p. 16.)

6. See also a reference in Spencer and Gillen's "Across Australia" (i, 72, 1912).

7. In the Larapintine Region (Tate, *Horn Expedition*, p. 156) we have recorded under *A. cyperophylla*:—

"Warman Rocks (Tietkens), Mount Udor (E. Giles), from description, 'Geogr. Travels,' p. 32; also by margins of creeks flowing on scarped face of Stanley Tableland to the Stevenson River, and on the east slope on Red Mulga Creek."

8. The *A. cyperophylla* F.v.M. of the "Report on the Botany of the Elder Exploring Expedition," by Mueller and Tate, *Proc. Roy. Soc. S.A.*, xvi, 352 (1896), is, as at least as regards the Warrina, S.A., specimen, *A. brachystachya*, Benth. I have not seen the Arkaringa Valley specimen.

9. "Red Mulga," between Dalhousie and Blood's Creek (in say 26° 30′ S. Lat. and say 135° 20′ E. Long.), S.A., August, 1913 (Capt. S. A. White, through J. M. Black). Only found in very limited areas on one or two creeks. It is recorded by Mr. Black in *Trans. Roy. Soc. S.A.*, xxxviii, 465. The specimen consists of phyllodes, with one pod containing ripe seeds *in situ*.

As regards Queensland we have a specimen referred to by Bentham which was collected by Leichhardt, and which may or may not have come from that State, although it probably did. The Flinders River specimen, also seen by Bentham, of course came from Queensland.

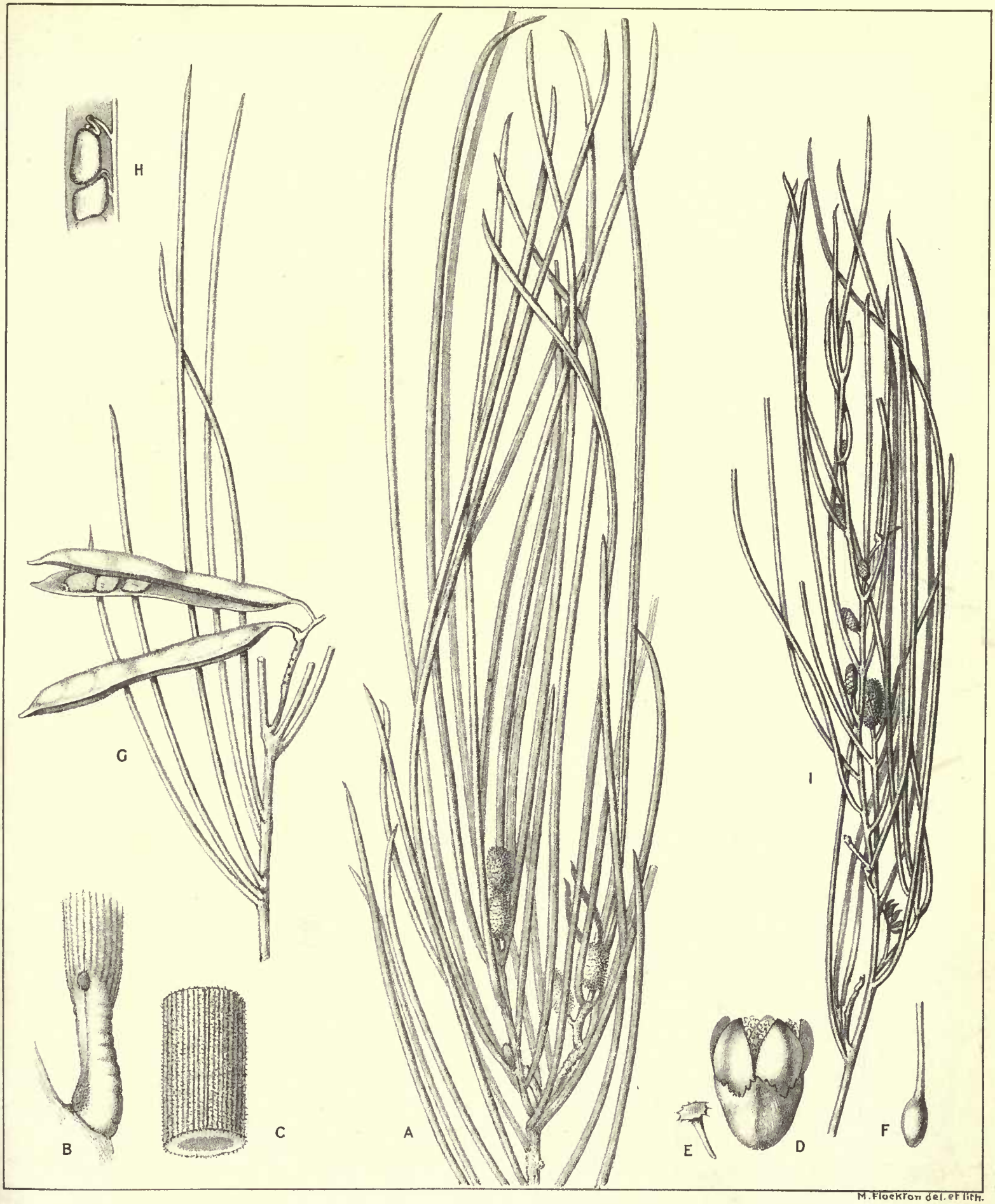
Bailey (*Queensland Flora*, 505) merely says "Southern inland localities" and gives nothing definite.

As regards Western Australia, it is in the late Dr. A. Morrison's list of Extra-tropic Western Australian plants published in the *Western Australian Year-book for* 1900–01, but without a specific locality. It is not in the collection of the Government Botanist at Perth.

Following is a translation of some remarks under *A. cyperophylla*, by Messrs. Diels and Pritzel in Engler's *Bot. Jahrb.* XXXV, 307, 1905. With reference to the "figures and types of Mueller," the only figure I know, is the centre oneof *A. cyperophylla* in Mueller's 'Iconography of Acacias,' and the only type is that already described. I am inclined to doubt the correctness of the determinations of Messrs. Diels and Pritzel in regard to this particular species, which is not to be surprised at, and the specimens quoted by them are not available, with the exception of a specimen by Mr. W. V. Fitzgerald which I have commented upon, p. 273.

"We have got numerous specimens from the interior regions which agree entirely with the figures and types of Mueller.

"Habitat in the Austin district near Cue in open muddy gravelly shrublands; flowered and fruited in the month of June. A shrub 3 m. high, remarkable for its somewhat terete phyllodes (d. 3275); near Mount Malcolm (W. V. Fitzgerald); in the Coolgardie district near Coolgardie (Webster, 1898). A form resinous in the young parts, 2 m. high, had fruit in the month of November in the open muddy forest near Dundas (D. 5844)."



THE RED MULGA.

(*Acacia cyperophylla* F.v.M.)

The following specimen, in the absence of pods, appears to be *A. cyperophylla*:—

Comet Vale, 62 miles north of Kalgoorlie, W.A., September, 1900 (J.H.M.). A rigid tough shrub of 10–12 feet growing in slight depressions in sandy land.

EXPLANATION OF PLATE 227.

A. Flowering twig from Cooper's Creek, on stony ground.
B. Base of phyllode, showing attachment and gland.
C. Portion of phyllode much enlarged to show the fine striation.
D. Flower, 5-merous.
E. Floral bract.
F. Pistil.
G. Fruits from Blood's Creek, South Australia.
H. Seeds.
I. Flowering twig from Flinders River.

SUPPLEMENTARY NOTES.

No. 3. Part I. See also vols. ii, p. 185; iii, p. 161; iv, p. 157.

Syncarpia laurifolia Ten.

THE TURPENTINE TREE.

(Family MYRTACEÆ.)

PHOTOGRAPHIC ILLUSTRATION.

Syncarpia laurifolia. Bulladelah District, N.S.W. (Photo, A. Murphy, Junior).

No. 9. Part III. See also vols. ii, p. 188; iv, p. 159; v, p. 187.

Cedrela australis F.v.M.

THE RED CEDAR.

(Family MELIACEÆ.)

PHOTOGRAPHIC ILLUSTRATIONS.

Young Cedar Trees, Dorrigo scrubs, N.S.W.

Old butt of a Red Cedar Tree, cut down in 1860, and wood still solid in 1910. Dorrigo Scrubs, N.S.W. (Both photos by S. W. Jackson.)

No. 16. Part V. See also vols. ii, p. 195; iii, p. 164; iv, p. 161.

Tristania conferta R.Br.

THE BRUSH BOX.

(Family MYRTACEÆ.)

PHOTOGRAPHIC ILLUSTRATION.

Tristania conferta. Bulladelah District, N.S.W. (Photo, A. Murphy, Junior).

No. 21. Part VI. See also vols. ii, p. 197; iv, p. 162.

Eucalyptus hemiphloia F.v.M.

THE WHITE OR GREY BOX.

(Family MYRTACEÆ.)

PHOTOGRAPHIC ILLUSTRATION.

Natural grove of *E. hemiphloia.* Greendale, near Bent's Basin, N.S.W. (Photo, R. H. Cambage).

For a fuller botanical account of this species see my *Crit. Rev. genus Eucalyptus*, Part xi,

No. 25. Part VII. See also vols. ii, p. 198; iv, p. 163; v, p. 188.

Eucalyptus maculata Hook.

THE SPOTTED GUM.

(Family MYRTACEÆ.)

PHOTOGRAPHIC ILLUSTRATION.

Spotted Gum Tree in the vicinity of the Richmond Range.

The District Forester, Casino, Mr. F. S. Boyd, in presenting this photo, says that the tree is the largest of its species known in the district; at 2 feet from the ground it is quite 40 feet in circumference.

No. 31. Part IX. See also vols. ii, p. 199; iv, p. 164.

Gmelina Leichhardtii F.v.M.

THE WHITE BEECH.

(Family VERBENACEÆ.)

PHOTOGRAPHIC ILLUSTRATION.

Typical scrub on Richmond Range, showing stump of large Beech Tree (*Gmelina Leichhardtii*). Photo forwarded by C. A. Ballard, Forest Guard, Mallanganee, N.S.W.

No. 37. Part X. See also vols. ii, p. 201; iii, p. 165; iv. p. 164.

Flindersia maculosa F.v.M.

THE LEOPARD WOOD.

(Family MELIACEÆ.)

PHOTOGRAPHIC ILLUSTRATION.

An interesting photograph by Mr. S. Jackson, at Cambo Cambo, Collarenebri District, N.S.W., showing the three stages of growth of the Leopard Wood Trees. Mr. Jackson adds the note:—"The middle tree is full grown, though they grow much larger, and it contains two different species of *Loranthus* flowering on separate limbs, the top clusters are *Loranthus Quandong* Lindl., and the thin-stemmed hanging and lowest cluster is *Loranthus linearifolius* Hook. f."

No. 46. Part XII. See also vol. iii, p. 166.

Callitris robusta R.Br.

(Family CONIFERÆ.)

PHOTOGRAPHIC ILLUSTRATION.

Callitris robusta. Weilmoringle, N.S.W. (Photo, C. J. McMaster).

No. 54. Part XIII. See also vols. ii, p. 206; iii, p. 167; iv, p. 165.

Casuarina lepidophloia F.v.M.

THE BELAH.

(Family CASUARINEÆ.)

False spellings of "She-Oak" (*Casuarina*). See vol. ii, p. 75.

Thus we have:—Shiack, *e.g.*, vol. i, p. 11; and Shioc, *e.g.*, vol. i, p. 27, indiscriminately used for She-Oak (*Casuarina*) in Howitt's "Land of Labour and Gold" (1855).

We have also the spelling "Sheoke," by people who cannot think that anything so simple as "She Oak" can be correct. And yet She Oak, and nothing else, is the correct thing, as already explained in Part xiii, p. 75, of the present work.

The following notes on "Belah" are by Mr. Gordon Burrow, acting District Forester, Narrabri:—

Foremost among the timbers of the north-west I would place Belah (*Casuarina lepidophloia*). Its range in the drier north-west and west is very extensive, though the quantity, unfortunately, diminishes from year to year from various causes as I shall show.

Belah chooses generally a low-lying swampy ground, frequently land subject to periodical inundation and covered with depressions known as "gilgais" or "melon-holes," and on the edges of plains. This is not invariably the case, however, as it is also to be found growing in sandy and even hilly or mountainous country, in close conjunction with pine, ironbark and other timbers. Where pine and ironbark are plentiful, it is considered, and perhaps reasonably so, an inferior species, and meets with no consideration at the hands of the ring-barker, but as one gets further out, it assumes a value proportionate to the scarcity of timber for fencing, building and other purposes. Its uses are varied; mature, it is extensively utilised for fencing posts, well slabs, for building, and even sawn into flooring and weather-boards. The saplings are used for rough building and for drop fences, usually with buddha (*Eremophila Mitchelli*) or coolibah (*Eucalyptus microtheca*, see Part lii), posts, for immature belah will not stand in the ground.

In time of drought the foliage is invaluable as fodder for starving stock, and the dry wood burns freely, leaving nothing but an ash. Belah is practically the only timber out west that can be split into posts. The bark is left on for preference, and the posts have a fairly long life when split from mature trees. I have seen fences still in use that have been erected for over twenty-five years. Alternately round posts of buddha, coolibah, box (various species) and, in some localities, yarran (*Acacia homalophylla*) are used for fencing posts.

Under cover, for slabs, belah is practically everlasting; with the bark left on, the effect is not unpleasing, but after a few years, it falls off and creates a nuisance. An additional disadvantage is its liability to shrink. It is largely used for well slabs, for which purpose it is admirably adapted. When a well is unused for some time, an unpleasant odour and taste is imparted to the water, which disappears as the well is used.

Belah is not generally milled, but I have had the opportunity of observing its use also in this capacity. Some twenty or twenty-five years ago, my uncles, then owners of Bunna Bunna Station, some 60 miles north-west of Narrabri, put in a sawing plant and sawed all the timber necessary for a large wool-shed and men's huts. Belah was the timber used. It was sawn green and the timber went straight into the buildings; it was at once painted. It warped and cracked a little when first put up, but to have allowed it to have seasoned would have been fatal.

Belah is a moderately soft timber and easily worked whilst it is green, but it becomes as hard as iron and as brittle as glass if it is allowed to dry. A nail would bend or break before it had been driven half an inch into a belah board, and a bit or auger used on dry belah has but a short life; fencing posts are invariably bored whilst green for that reason.

Buildings were also erected on an adjoining property then owned by Mr. A. S. O. Reid, now known as Eurimbla.

About two years ago, in 1913, I was in the locality and took the opportunity of inspecting the Bunna Bunna sheds. They are still in use and good repair, and look as solid as when first erected. The shed is fitted with (I think sixteen) sheep-shearing machines, but the vibration was practically nil. The manager of the station assured me that the sheds were as good as they looked. I was also informed that some of the buildings at Eurimbla are still in use and good order, though others had been pulled down to make room for alterations. So much for the lasting qualities of this timber.

As a fodder in drought time, belah is invaluable. I note that you quote Mr. R. W. Peacock—"If fed to stock for any length of time the results are disastrous." (See p. 81, Part xiii.) Quite true; but the same is true with respect to almost any scrub. The best of them will only serve to keep stock alive for a limited period—a strictly limited period unless there is at least a little grass or herbage to eke out the supply.

Also—"Stock will eat belah in time of drought if hard pushed, but the settler does not fall belah for fodder when he has Mulga, Leopardwood, Rosewood, Kurrajong, Supplejack, &c., of a more nutritious character." (H. V. Jackson.)

Again granted, though I must acknowledge that I know little of Mulga. The supply of the other timbers, however, on the average holding, large or small, is limited, and is usually found scattered throughout the belah scrubs on the sand-ridges, and is fallen as fodder in conjunction with belah and wilga. I have had, unfortunately, some considerable experience in the use of belah as fodder for starving stock in time of drought, and do not speak of a matter of which I know nothing. I may also quote the opinion of Mr. Robert Cameron, of Pidgee, who has had twenty-five years or more experience in the north-west. He told me that when he first went on to his property, "Pidgee," he proceeded to ring out the belah to increase the pasture land. He let a contract to ring some thick belah country. At that time he was very busy and could not give the work as strict supervision as he could have wished. After the contract was completed and the men paid off, in going through the country, he found that the work had not been faithfully done, and in many of the trees ringbarked the bark was growing over the cut. "I considered," said Mr. Cameron, "that I had been defrauded, but it was too late, and I could only make the best of it, resolving to have it gone through again at a later stage. Then the drought set in and I was compelled to fall scrub to keep my sheep alive. The trees which had escaped the ringbarker were worth five shillings each to me." Mr. Cameron, in the light of his extensive experience, strongly deprecates the wholesale ringbarking of belah, and contends that even if it were valueless from every other point of view, its value as a fodder tree would warrant its protection, in which opinion I quite agree. Unfortunately, the average settler lacks either the foresight or the experience to take this view. Belah country on the plains, when ringbarked and cleared, after a few years usually develops into excellent herbage country, though, as Mr. Cameron remarks, it is always tender country and the first to feel the effect of dry weather conditions.

Belah is very easily killed by ringbarking and rarely or never suckers; also, when dry, it is easily burnt. A log when lit will burn out to the smallest branches, and if a fire once gets into a standing forest of dry belah, there is no knowing where or when it will stop.

Regrowth of belah on stocked country is exceptionally unusual. All stock will eat the young seedlings as soon as they make their appearance above the ground. In addition, the bigger trees are trimmed up as high as the animals can reach; this also in seasons when there is an abundance of herbage and grass. So that, at any rate, in the more closely settled country, it appears that it can only be a question of time before belah must become practically extinct, unless means are taken to protect it. In my opinion, the only way to do this is to reserve suitable areas, and to either prohibit or carefully regulate grazing thereon, so as to give the young growths a chance to become established.

PHOTOGRAPHIC ILLUSTRATION.

"Belah," Collarenebri District, N.S.W. The dead trees alongside are White Pine (*Callitris robusta*). (Photo, S. W. Jackson.)

No. 55. Part XIII. See also vol. iii, p. 168.

Heterodendron oleæfolium Desf.

THE WESTERN ROSEWOOD.

(Family SAPINDACEÆ.)

PHOTOGRAPHIC ILLUSTRATIONS.

"Bunary Tree" (*Heterodendron oleæfolium*). Cambo Cambo, Collarenebri District, N.S.W. (Photo, S. W. Jackson.)

Heterodendron oleæfolium. (Photo, H. Billington, Moree, N.S.W.)

No. 63. Part XV. See also vols. ii, p. 211; iii, p. 169; iv, p. 166.

Atalaya hemiglauca F.v.M.

THE WESTERN WHITEWOOD.

(Family SAPINDACEÆ.)

PHOTOGRAPHIC ILLUSTRATIONS.

"Whitewood" tree laden with clusters of the peculiar winged fruits. Collarenebri District, N.S.W. (Photo, S. W. Jackson.)

"Whitewood" tree, showing clump of Mistletoe (*Loranthus Quandang* Lindl.). Collarenebri District, N.S.W. (Photo, S. W. Jackson.)

No. 64. Part XVI. See also vols. ii, p. 212; iii, p. 169; iv, p. 167.

Acacia pendula A. Cunn.

THE WEEPING MYALL.

(Family LEGUMINOSÆ: MIMOSÆ.)

PHOTOGRAPHIC ILLUSTRATION.

"Myall" (*Acacia pendula*). (Photo by H. Billington, Moree, N.S.W.)

No. 68. Part XVII. See also vols. ii, p. 213; iii, p. 170; iv, p. 167.

Casuarina stricta Ait.

THE DROOPING SHE-OAK.

Family CASUARINEÆ.)

Leaves (Branchlets). See vol. ii, p. 143.

Mr. J. Feld, "Silverton," Upper Burragorang, wrote recently to the Minister for Agriculture:—

Seeing you have decided to do something towards cultivating the useful fodder trees, I have plenty of Kurrajong (*Brachychiton populneum*) and Swamp Oak (*Casuarina Cunninghamiana*. See Part xv). I do not use either. I have another dwarf tree growing here on my place which I call Forest Oak. Some have cut theirs down many years ago. I never cut mine down, I lop them. I have fed my stock on all

sorts of fodder and Kurrajong and Swamp Oak. I use nothing else only the Forest Oak. I have proved beyond all doubt it is far before any. I have never lost any sheep or cattle that I put on it. Those that could not stand up I fed on it for some days till they got up themselves without assistance. In 1902 I fed all my stock for months on this Oak and lost none; in fact, every short drought I lop it for my stock. To prove what I say about this Oak, I would like you to send a man from the Department within the next month or so and it can be proved at once. I let my country to starving stock last spring for nine months, and sold almost all my cattle. I knew when the drought broke that stock would be a high price, so I bought about three months ago 145 head of low condition cattle; having no grass, I put those cattle on the Forest Oak. They have improved wonderfully well; six died before I got them on the Oak, and I have not lost one since. I have 97 in one mob; they average over half-grown cattle. I thin them out about ten or twelve of this Oak once a day. Where I feed them to-day they are waiting there till I go the next day. I estimate that I have six or seven thousand trees of this Oak. It grows on the poorest land on the place and hugs the sandstone measures. Having brought this Oak under your notice I will give you every assistance to prove its high value as a fodder tree. By to-morrow's mail I will send you a parcel of the different kinds, seeds and blossoms, bark and wood. You can give stock as much as they can eat and it will never blow them. Wet Kurrajong will kill cattle. The Oak is right, wet or dry, and stock will chase you all over the place when they get a taste of it. We have fed our milking cows on the Oaks for months and they milked well. Hoping you will give this oak every consideration.

This "Forest Oak" so valuable for stock is *Casuarina stricta*. The usual "Forest Oak" of New South Wales is *C. torulosa* (see Part XVI of the present work), and of very little value as fodder.

No. 92. Part XXV. See also vols. iii, p. 173; v, p. 190.

Melia Azedarach L. Var. *australasica* C. DC.

THE WHITE CEDAR.

(Family MELIACEÆ.)

Fruits.—See also vol. ii, p. 94. The following telegram from Gilgandra appeared in the Sydney newspapers of the 25th June, 1914:—"An infant boy, Gilbert Hitchen, has died from poisoning, caused by eating cedar berries."

This specifically states that the cause of death was poisoning, but very few "infants" could eat large, indigestible fruits like those of the White Cedar without serious consequences. I trust that medical men will publish full information in all cases in which poisoning is attributed to these fruits. They are certainly poisonous to pigs, but such animals crunch the hard seeds, which children do not.

No. 98. Part XXVII. See also vol. iii, p. 173; iv, p. 169.

Eucalyptus macrorrhyncha F.v.M.

RED STRINGYBARK.

(Family MYRTACEÆ.)

Bark and Timber.—See also vol. iii, p. 119. Following is one of the earliest references to the Stringybark of Victoria (1853):—

In fact, the stringybark is the most useful tree conceivable, for the diggers as well as for squatters. Its bark easily peels off, and forms large sheets, which become hard as boards, from half an inch to an inch thick. These make sides and roofs of huts. They make also floors for them, and for tents. They make

seats and tables, one of which we have laid on two trestles in our tent. It forms boats, and spouts and shoots for water. You see large shoots of it to convey the water from the diggers' holes, or to their washing places. A few sheets of canvas, or a few blankets, eked out by sheets of stringy-bark, form numbers of temporary abodes at the diggings. You see numbers of stringy-bark trees standing with the bark stripped off for six or eight feet high, and others felled, and completely stripped. The wood is not less useful. It has the property of easily cleaving, and splits up readily into posts and rails, into slabs for the walls of huts, or into anything that you want. Therefore, there is a great destruction of this tree, and fortunately there is no lack of it. It burns very well quite green, so that it supplies fuel at hand. (Howitt's *Two Years in Victoria*, vol. 1, p. 177.)

For a further botanical account of this species see my *Crit. Rev. genus Eucalyptus*, Part viii.

No. 117. Part XXXII. See also vol. iv, p. 171.

Acacia Cambagei R. T. Baker.

THE GIDGEE.

(Family LEGUMINOSÆ: MIMOSÆ.)

PHOTOGRAPHIC ILLUSTRATION.

Group of Gidgee. Cowan Downs, 120 miles south of Normanton, N. Qld. (Photo, R. H. Cambage).

No. 127. Part XXXV. See also vol. iv, p. 171.

Araucaria Cunninghamii Ait.

RICHMOND RIVER OR HOOP PINE.

(Family CONIFERÆ.)

PHOTOGRAPHIC ILLUSTRATIONS.

Bark of Hoop Pine Tree. Dorrigo Scrubs, N.S.W. (Photo, S. W. Jackson.)

Hoop Pine. Richmond Range, near Casino. Girth, 21 ft. 3 in., measured at 2 feet from ground, 18 ft. 6 in. at 5 feet from the ground. Length of barrel about 50 feet to where tree forks. (Photo received from District Forester F. S. Boyd, Casino, N.S.W.)

No. 140. Part XXXVIII. See also vol. iv, p. 172.

Eucalyptus microcorys F.v.M.

THE TALLOW-WOOD.

(Family MYRTACEÆ.)

PHOTOGRAPHIC ILLUSTRATION.

Tallow-wood Tree, 42 feet girth. Hill Bros. Estate, Comboyne, N.S.W. (Photo by E. Kent, and presented by Mr. G. S. Hill, Bungay, Wingham.)

For a further botanical account of this species, see my *Crit. Rev. genus Eucalyptus*, Part ix.

No. 145. Part XXXIX.

Acacia salicina Lindl.

THE COOBA.

(Family LEGUMINOSÆ: MIMOSÆ.)

PHOTOGRAPHIC ILLUSTRATION.

"Motherumbung" (*Acacia salicina*). (Photo by H. Billington, Moree, N.S.W.)

No. 168. Part XLVI.

Eucalyptus Behriana F.v.M.

THE BROAD LEAF MALLEE.

(Family MYRTACEÆ.)

PHOTOGRAPHIC ILLUSTRATION.

Eucalyptus Behriana. Warunda, Hundred of Mortlock, South Australia. (Photo, W. Gill.)

For a fuller botanical account of this species, see my *Crit. Rev. genus Eucalyptus*, Part x.

No. 172. Part XLVII.

Eucalyptus populifolia Hook.

THE BIMBLE BOX.

(Family MYRTACEÆ.)

PHOTOGRAPHIC ILLUSTRATION.

"Bibble Box" or "Shining-leaf Box" (*Eucalyptus populifolia*). (Photo, H. Billington, Moree, N.S.W).

For a fuller botanical account of this species, see my *Crit. Rev. genus Eucalyptus*, Part x.

Part LI.

Appendix.—Aboriginal Method of obtaining Water.

Following is a letter from the veteran explorer W. H. Tietkens, in reference to Mr. Tietkens' quoted statement at p. 15, vol. vi :—

The tree that the little fellow found was an ordinary Oak (presumably *C. Fraseriana*, Miq.—J.H.M.), not *Casuarina Decaisneana*. It was at least four chains distant as you say; the intervening ground was covered with a dense scrub, and it was quite impossible for the boy to have seen lower than the middle branches of the tree. I examined the ground around, also the tree, but could find nothing different between this one and many others growing around; in fact it was a clump of Oaks.

The little fellow had not been with whites very long, so I was unable to question him as to how he could tell this one from many others growing around and from that distance; there was not an instant of hesitation; he slid down off the tall walking camel and ran straight to the tree, and before I had stopped the camels and arrived at the spot, he had one water root exposed, and in a few minutes we both had a foot long of root 2 inches in diameter upended and having a cool drink. I could understand it had it been a grown man, but for a child of 8 or 10 it seemed rather wonderful,

The Common Oak will yield water in another way: in a fork of the tree there will be a cavity that will give a full drink for two or three people, some more, some less—such trees are perhaps as well known as are the small rock cups and as frequently visited; this cavity may be anywhere, perhaps just beyond the man's reach or higher. The blacks take a coarse straw of grass or spinifex and suck the water up; these and other methods known to them will perhaps account for the fact that blacks are seen in the most arid and desolate parts of the desert in the heat of summer. So they move from one little water to another in small groups or families, and from what has been seen of them in their native habitat it appears they are never reduced to want except perhaps from their own indolence. Upon another occasion I have known water sufficient for five men to be obtained from Oak and plenty to spare, but have never heard of a white man who knew the secret, and have never known it to be found in the Desert Oak. I imagine this tree must send its roots deep down, for it is a handsome shapely tree with very thick rugged bark that protects the tree from the fires made by the blacks when burning spinifex.

The following note is interesting in this connection :—

"We could procure no water except a few drops from the cut end of a climbing plant, which the natives call 'Kalobit' and of which they sometimes form rough cordage, by rending it into long strips. The juice of the plant is intensely bitter, but the water which distilled itself slowly from the cut end was quite pure and tasteless." (Burbidge, "The Gardens of the Sun," p. 84.)

PHOTOGRAPHIC ILLUSTRATION.

Water Vine (*Vitis*) growing round a Hoop Pine Tree (*Araucaria Cunninghamii*), Dorrigo, N.S.W. (Photo, S. W. Jackson.)

No. 191. Part LII.

Eucalyptus microtheca F.v.M.

THE COOLABAH.

(Family MYRTACEÆ.)

Timber.—See also vol. vi, p. 21. "Found in the drier north-west and largely used for fencing purposes. It rarely attains any size, and is so tough and interlocked as to make splitting practically impossible, for which reason it is used almost invariably in the round. The trunks of the small and the branches of the larger trees are thus used, and to one used to the straight, neatly-erected split post fences of the more favoured timber districts, the effect of the line of crooked and even angular posts staggering across the plain is somewhat startling. The same is even more noticeable when, as is sometimes the case, coolibah telephone posts are used, and the observer may be excused if he looks a second time to determine whether his eyes or the telephone poles are at fault, and he views the line stretching across some treeless plain, like nothing so much as a *Bulletin* cartoon of what a man sees after a 'Wee Scotch Nicht.' Coolibah, however, possesses the advantage of lasting well in the ground, and is often the only timber available to the settler, and the fence is at least serviceable, which after all is the chief desideratum" (Gordon Burrow).

For a fuller botanical account of this species, see my *Crit. Rev. genus Eucalyptus*, Part xi.

PHOTOGRAPHIC ILLUSTRATION.

River Box group (*E. microtheca*). Locally called "Coolabah." Paddy's Lagoon, near Flinders River, about 80 miles south of Normanton, North Queensland. (Photo, R. H. Cambage.)

Part LIV.

Appendix.—On some Natural Grafts between Indigenous Trees.

A supposed Natural Graft at the Hawkesbury Agricultural College Farm, Richmond, N.S.W.

This was provisionally described at page 79, Part liv, of the present work, and Mr. C. T. Musson, Lecturer in Botany at the College, reports now on the subject :—

As the tree has been cut down, and the Swamp Gum host has broken open, we have facts now to settle the matter.

"The Apple was a seedling that started in a hollow branch, the roots grew down through the accumulated soil in the gum, which proves to have been a mere shell. We can see no sign of union; only an enlargement above where pressure of the Gum was exerted on the under (or, outer, lower) side of the Apple, just where it emerged from the hollow in the host tree; this enlargement eventually becoming prominent for at least two-fifths of the circumference of the Apple.

The accompanying photographs (not reproduced) show :—

1. The Apple roots still attached to their stem which lies in the hollow broken gum.
2. The gum stump with lower end of the roots still remaining *in situ*.

Therefore, it is not a case of grafting at all."

I would invite the attention of readers to a short article on natural grafts, with some very good illustrations, in the *Missouri Botanical Garden Bulletin*, iv, p. 38 (1916).

PHOTOGRAPHIC ILLUSTRATIONS.

Natural graft of *Eucalyptus tereticornis*. On original Bathurst Road between Sidmouth Valley and Rainville Creek, N.S.W. (Photo, R. H. Cambage.)

Jasminum lineare as a reputed natural graft on White Box (*Eucalyptus hemiphloia* var. *albens*). It is, however, not a graft at all, the hollow stem of the White Box acting as a flower pot. Attunga, near Tamworth, N.S.W. (Photo, H. L. Waterhouse.)

No. 203. Part LV.

Eucalyptus Caleyi Maiden.

CALEY'S IRONBARK.

(Family MYRTACEÆ.)

Range.—See also vol. vi, p. 87. Mr. Gordon Burrow, Acting District Forester at Narrabri, reports :—

E. Caleyi is plentiful in the Counties of Hardinge and Arrawatta, though in the latter county, north of Ashford, the largely predominating ironbarks are *E. crebra* and *E. melanophloia*. In the County of Gough, I do not know of it east of the Waterloo Range and Emmaville. It extends only a very little over the border of the Counties of Burnett, Murchison and Darling. I have also collected it (identified by you) in the Parish of Dungowan, County of Parry, though it is very scarce there, and was told that scattered trees or belts were to be found on the opposite side of the Peel River, on the Goonoo Goonoo Estate. I have also been told that there is a little of it growing near Scone, but cannot vouch for this. It seems to me interesting only as forming a link between the Inverell District and other localities as given in your Forest Flora, *i.e.*, Denman and Rylstone.

Although it is plentiful around Inverell and Howell, it becomes scarcer as one travels north. I found it on the Ashford-Emmaville Road within a mile of three other ironbarks, viz., *E. crebra*, *E. sideroxylon* and *E. melanophloia*. I cannot hear of it across the Queensland border at all. Its range east and west seems very limited; it does not appear to cross the Waterloo Range, nor to grow far (if at all) west of Delungra.

Near Inverell and Howell it is frequently or generally found growing in company with *E. dealbata*, in stony hills, when it has a drooping or "weeping" appearance; when it occurs on more level country it is found with other species, and has a more erect habit.

A very interesting characteristic of this species is the frequency with which it appears to hybridise with White Box (*E. hemiphloia* var. *albens*). Trees are to be found in all stages, some showing very distinct signs of Ironbark parentage, with only a trace of Box, some Box with a trace of Ironbark, and others so evenly distributed that it is difficult to say which parent predominates. Unfortunately, I only noticed this just before I left Inverell, or I should have followed it up. Now I am not in a position to do so.

For a fuller botanical account of this species, see my *Crit. Rev. genus Eucalyptus*, Part x.

No. 205. Part LV.

Ackama Muelleri Benth.

A CORKWOOD.

(Family CUNONIACEÆ.)

PHOTOGRAPHIC ILLUSTRATION.

"Corkwood." Pheasant Creek, viâ Glen Innes. (Photo, N. Stewart.) This block originally appeared in the Annual Report of the Forestry Department, 1906–7.

No. 193. Part LII. See also Part lviii. **Appendix.—Enemies of Trees. iv. Parasites.**

Quintinia Sieberi A.DC.

THE OPOSSUM WOOD.

(Family SAXIFRAGACEÆ.)

Trees starting life on Tree-ferns.—At p. 30, Part lii, of the present work, under *Quintinia Sieberi*, I stated that I had mislaid Allan Cunningham's reference to the above subject. Here it is:—

A remarkable tree, assuming occasionally (like some *Fici* of equinoctial countries) a parasitical growth, as will appear from the following memorandum, made some years ago in one of its native forests. It may be premised, that in the centre of the Blue Mountain chain, directly west from Port Jackson, is a remarkable eminence, called Tomah, the height of which, above the level of the ocean, has been ascertained to exceed 3,500 feet. Before the axe of the colonist was carried to the base of that mountain, in the great chain, viz., prior to 1823, Tomah had its flanks and summits clothed with a dense vegetation consisting of timber trees, loving shade and moisture, laden with orchideous Epiphytes, and borne down heavily by gigantic climbers; and beneath them, in deep shade, flourished many a noble specimen of an arborescent fern (the *Cibotium Billardieri* of Kaulfuss), which was not previously known to exist in New South Wales. On the side of the mountain was then to be observed a remarkable instance of the disposition of the *Quintinia* to attach itself to other plants by means of cauline roots, that may be worthy notice.

A large *Quintinia* (*Sieberi*, A. DC.) grew near to an aged *Cibotium*, full 35 feet high, and having a distinct trunk in the soil. At about 6 feet from the ground, however, the roots which the former had thrown out from its stem had got hold of the fern tree, the caudex of which they enveloped by numerous folds, so as to present but one trunk of great bulk for upwards of 20 feet. Above this, however, was to be perceived the rough bark of the *Quintinia* on one side, and the rugged caudex of the fern on the other, the trunks of both continuing firmly united, as if grafted into each other, until near their summits, where they separated; the *Quintinia* exhibiting a branching umbrageous head, while the *Cibotium* spread forth its noble tufts of fronds, evidently not in the slightest degree inconvenienced by the embrace of the aerial roots of the other, throughout nearly its whole length of caudex.

It may here be added, that all the specimens of *Cibotium*, examined at that period on the Tomah Mountain, had young seedlings of the *Quintinia* growing on their trunks, upon which, being well rooted, they assumed all the habit and aspect of some kinds of wild fig in intratropical regions, that live and grow as well without earth, in the hollow branch or trunk of a tree, as they do when they happen to fall to the ground and there take root. (Memorandum, 2nd Dec., 1823, A.C.)

(Floræ Insularum Novæ Zelandiæ Precursor; or a specimen of the Botany of the Islands of New Zealand. By Allan Cunningham, in *Annals of Natural History*, ii, p. 356.)

The *Cibotium* is the tree-fern now known as *Dicksonia Billardieri*.

In response to my invitation to my readers to favour me with the names of trees which start life on a tree-fern, my good friend Mr. E. E. Pescott, Director of the School of Horticulture at Burnley, Victoria, had the kindness to supply me with the following :—

Dear Mr. Maiden,

In a recent issue of your "Forest Flora of New South Wales" you invite your readers to advise you of their observations of trees, &c., having germinated from seed and growing on the stems of tree-ferns: so I am sending along my small contribution. This, of course, does not include such epiphytal plants as the various species of Polypodium, Trichomanes, Hymenophyllum, Aspidium, and Fieldia australis, &c.

The most common tree growing from the tree-fern is *Acacia melanoxylon* R.Br., and that is to be met with in almost any fern gully. It is rather interesting that Acacia seeds should germinate so frequently in fern trunks, seeing that they are hard-coated seeds.

The next common is *Coprosma Billardieri* J. Hooker, and this is often seen.

I have met four species of *Pomaderris* on the ferns, viz., *P. ligustrina* Sieber, *P. elliptica* Labill., *P. apetala* Labill., and *P. racemosa* Hook.

Others less common were *Eugenia Smithii* Poiret, *Tristania laurina* R.Br., *Fagus Cunninghami* Hooker, and *Prostanthera lasiantha* Labill. Of the latter tree, there is a fine specimen growing from a fern in the Botanic Gardens at Launceston, Tasmania.

Of climbing plants that have germinated in fern trunks, I have observed the following :—*Marsdenia rostrata* R.Br., *Tecoma australis* R.Br., *Passiflora cinnabarina* Lindley, *Celastrus australis* Harvey and F.v.M., and *Vitis hypoglauca* F.v.M.

The germination of Eucalyptus seeds in fern trunks, so far as my observations go, is very rare, and only twice have I noticed our gum trees so growing, and these were *Eucalyptus macrorrhyncha* F.v.M., and *E. botryoides* Smith, and in each case the plants were quite young.—Sincerely yours,

(Signed) ED. E. PESCOTT.

PHOTOGRAPHIC ILLUSTRATION.

Atherosperma moschata growing on tree fern (*Dicksonia antarctica*). Ringarooma, Tasmania. (Photo, K. Kennedy.)

Part LVIII.

Appendix.—Enemies of Trees. (I.) Meteorological. (c) Wind.

PHOTOGRAPHIC ILLUSTRATIONS.

A. A Cypress Pine (*Callitris robusta* R.Br.) tree after the cyclone on 5th January, 1912. This is only one of hundreds smashed down. Cambo Cambo Station, Collarenebri District, N.S.W. (Photo, S. W. Jackson.)

N.B.—The thin trees at the back on the left are sand ridge Honeysuckle (*Canthium oleifolium*). Throws off a vanilla-like perfume from the blossoms in January.

B. Wind-blown trees. Stanley, North-West Coast, Tasmania. (Photo, K. Kennedy.)

TREE PLANTING FOR SHADE AND ORNAMENT IN NEW SOUTH WALES, WITH ESPECIAL REFERENCE TO MUNICIPAL REQUIREMENTS.

THE subject is a vast one, and naturally falls into two divisions :—

1. How to plant and tend a tree.
2. The kind of trees to plant.

The second division just as naturally falls into two sections :—

(*a*) Native Trees.

(*b*) Exotic Trees.

How to Plant and Tend a Tree.

There is an old joke that the mustard manufacturer lives not by the condiment people eat, but by what they leave on their plates. To parody this, the nurseryman lives by the plants that people kill, and far less by those they succeed in growing. Plants are killed by drought, floods, heat, cold and accidents of all kinds, but the primary causes of the deaths of the vast majority of those planted are avoidable, and spring from ignorance and neglect. Where a man raises his own plants the probability is that he has studied the conditions of plant-life, and he usually succeeds with them as they grow older.

The loss of young plant-life is appalling, and let us see if we can do something to reduce it. Let me take a number of suggestions seriatim :—

1. *Employ a skilled tree-planter.*—I am primarily addressing those who have the control of the planting of trees in streets and parks. I am quite aware that some amateurs can arrive at a considerable degree of excellence in gardening operations, but public bodies have not exceptional and gifted amateurs at their disposal, and they should go into the market and secure the best skilled labour available. I have been often shocked to learn of the unskilled and careless men to whom local authorities have entrusted tree-planting. If a man's watch gets out of repair he does not take it to a handy-man. I am quite aware that some local authorities have not work (or rather in these enlightened days I ought to say will not see that there is work) for a skilled gardener the whole year round. In the age of enlightenment it will be found that the gardener of the municipality has more to show for a certain expenditure of money in the adornment of a district than any other kind of workman. But, until wiser counsels prevail, at least let the planting be done by a gardener, and let him have a retaining fee to do any necessary work to the trees, at least during their period of youth. If we neglect some symptom of our own health, that the ignorant may deem trifling, it may become serious and may even result in death. The wise citizen seeks skilled advice in time, and, what is more, he follows it. So, in regard to a tree, a

gardener may often save its life if called in in time. Let us have no more instances of road navvies being interrupted in their good work of roadmaking to attend to the wants of trees.

2. *Plant only healthy young trees.*—This should be an axiom, but I have often seen miserable trees planted out that no professional gardener would ever plant out if he were a free agent. I allude to pot-bound plants, to plants suffering from insect or fungus pests, or indicating debility in some way, perhaps the result of delay or ill-treatment since they left the nursery. Then accidents sometimes happen to the stems or roots of young trees before they are planted out, and the gardener always performs the necessary pruning operations in such cases before planting. Give the plant a good start. It will have the battle of life to fight, and do not let it enter into the contest maimed.

3. *Trees must be planted at the proper time.*—In New South Wales the vast majority of trees are planted out during the months of June, July and August. With deciduous trees, *i.e.*, those which lose their leaves, such as planes, oaks, elms, it is absolutely necessary that the planting should take place when the leaves are all off, and when the tree is quite at rest. This is, of course, in the winter. The vast majority of evergreen trees are also most safely planted during the winter months. As a rule evergreens are sent out in pots, but sometimes the ball of earth is tied up in canvas, such plants having been dug up open root out of the nursery. Plants in pots can usually be planted out with a maximum of safety—that is to say, with ordinary care, there is a minimum of failure in the case of such plants; but, in the desire for good large plants, it must never be forgotten that a very real danger is that the plant may be pot-bound. There the skill of the professional gardener comes in. He would at once advise which of a certain consignment of pot plants are worth planting out.

I have alluded to the fact that some trees may be planted out at seasons other than the winter. For example, during the autumn anything in pots can be planted out. But in this case we must have two plantings, for the deciduous trees can never be planted out except in winter. And, if the plant be in a pot, it may often be transplanted late in the spring, and even in the summer, but this lateness always handicaps the plant, which should get accustomed to its new surroundings before or during the winter months.

In some places there are only two seasons, the wet and dry. In such areas you can only safely plant when the rain comes. But get the ground ready, so that when the time comes to plant, the planting may not be delayed by work that should have been finished previously.

4. *Large holes, with drainage well provided for.*—If you will not arrange for this, do not go any further—abandon tree-planting. If the soil be good and deep, which is very rarely the case in the Sydney district, it is best to plough and subsoil, if a row of trees be desired; the soil is disturbed and the drainage is attended to. But in the vast majority of cases separate holes have to be dug. Holes should be square, and, wherever possible, each side should be 8 feet long. The depth should be not less than

3 feet. If rock be present, it must be gadded or blasted out for as great a depth as funds will allow, for it must be remembered that the presence of rock, especially solid or continuous rock, indicates very adverse conditions to tree life. Then when the proper depth has been reached, give a parting shot to stir up the rock a bit, leave a good depth of rubble at the bottom of the hole, then place a layer of pieces of rock of smaller size, and fill up with the best soil that can be procured.

But before filling up, drainage must be secured. With holes in the solid rock this, of course, means more blasting, for a channel must be made for the water to flow away, since nothing is more deleterious to the fine roots of trees than to let them chill or drown in water.

If we have sandy soil, this must be dug out for as big an area as funds will allow, and where there is a hard-pan a few feet below the surface (which is often the case), this must be removed. Sometimes this hard-pan is only of medium hardness, but it may contain much ferruginous matter in solution, and is sometimes even acid, and deadly to young plants. Now, the expense of providing good soil becomes serious, for usually sandy and sandstone land is at a considerable distance from good soil, and the cost of cartage is therefore very great. There is an old Latin proverb to the effect that you can only get nothing out of nothing, and if you think you can cheat a tree, you will be very much mistaken. You might just as well think that it would not matter to your horse whether you gave him nutritious food or not. Remember that the work of a gardener is largely buried in the earth, and that the plant will explain to the world the condition of affairs below the ground level. When a tree looks sickly or stunted, depend upon it that the fundamental cause, in the vast majority of cases, is bad drainage or poverty of soil.

Trees in paved towns are often planted near the edge of the footpath, and they should be planted as far from it as can be conveniently arranged. But a matter of the greatest importance is to see that the kerbstone nearest the tree is as shallow as the safety of the pavement will permit. You might just as well put the tree in a pot as to force its roots against a deep kerbstone.

5. *Plenty of fairly good soil.*—I have already dealt with this in the preceding section, but it is of such paramount importance that I bring it forward for special reiteration. If you expect a tree to flourish it must have something to feed on in the way of good soil. Only in very rare cases should manure be added to soil at the planting, and when this is deemed to be necessary, the manure should be well rotted. Where a tree is suffering from debility, the digging in of a little bone-dust often gives the necessary stimulus in the direction of health. It is oftenest necessary to give trees a little nutriment in towns, especially where the tree has been planted in a pot-hole in hard or rocky soil. Most town trees are, however, supposed to do without any soil nutriment. In fairly good soil, and where the tree can spread out its roots and live its life, the question of manure is wholly unnecessary, and indeed, it has been shown, as the result of experiment, that the timber crop is the least exhausting to the soil of any crop whatever.

6. *Stake properly.*—Remember that the young tree will not be anchored for many a day. That different situations are of different degrees of shelter. That different soils have varying capacity for anchorage, and facilitate the development of roots in different degrees. Even when there is little danger of the tree being actually blown out of the ground, some trees have a greater tendency than others to heel over or to deflect from that uprightness which is so admired in a tree. In a word, staking is necessary during the early years. Such staking should be adequate, and the best time to do this is *prior* to planting the young trees, in order to avoid possible damage to the roots, a contingency likely to occur when the stakes are driven into the ground *after* the tree is planted. Stakes should be of durable, strong timber, should be driven well into the ground, usually vertically, and the size of the stake should vary with the size of the plant.

Sometimes the stake is changed, two or three times, as growth proceeds. Usually the stake is driven home vertically, but some gardeners prefer the less neat-looking oblique method of staking, where the stem and the stake touch each other at one point only. With vertical staking two or more ties can be attached to the stake, and thus the young tree has support for a large portion of its length, but there is some danger of the stake interfering with the root-system, and also with the base of the stem.

7. *Attend to the state of the stake-ties if necessary.*—The great curse of gardening in New South Wales is what I may term the Micawber system—the "thank-heaven-that's-settled" frame of mind; the neglect to make adequate provision for maintenance. How many men start well with a garden. But they forget that in forming a garden well they have only done one portion of their work. What would one think of a man who had a horse in good condition given him, one which was well bred and altogether desirable, and who would say—he will cost nothing for maintenance? And is not this what thousands of our citizens are doing to-day? They are in charge of trees or own gardens, and expect these living things to flourish and be a source of pleasure to beholders, and all this without further expenditure of labour or money, or both. Let us apply this specifically to stake-ties. I have seen plants securely tied at the time of planting, and death has resulted from these very ties, which should have been an aid and not a torture and danger to the young plant. This has happened in two ways—from insect pests and from throttling. Many insects are constantly on the lookout for shelter to lay their eggs and for other purposes. Tree-loving beetles and moths walk up or fly up the stem, and find comfortable shelter in the stake-ties. These may become a mass of insect eggs or larvæ. Frequently beetles pierce the trunk just at the ties, so that the ties, instead of being a protection, are an absolute detriment. Then by having strong ties, which the tree cannot snap, as its trunk expands, the natural growth of the tree is impeded; it is cinctured, early flowering is induced and the tree, if it lives at all, has a short life. I have known wire to be used for stake-ties, which, of course, cuts into the stem. There is only one remedy for this, and that is the dismissal of the man guilty of it. As regards stake-ties of a more yielding material they should be renewed at least once a year, and the old ones carefully collected and burnt.

Of course, trees are liable to attacks by fungi and insects. In the United States costly and bulky appliances are in use for the purpose of fumigating and spraying big trees. I am not, however, in favour of spraying, as a rule. The best spraying appliances are the axe and mattock, together with a nice warm fire. The continued presence of parasites on a tree spells debility. The tree was sick to begin with, or it has met with accidents, or it is worn out, or in poor or ill-drained land, or is overcrowded. The obvious remedy is to seek the cause of the debility, which enables the parasite to get a hold. If that is not coped with, the parasite will pay more frequent visits until death results. Use spraying and fumigating methods simply as adjuncts to the treatment of the fundamental cause, which is dragging the sick tree down to become a prey to fungus and insect vermin. In the same way the physician uses lotions for skin diseases, only to palliate distressing symptoms. He properly says that to effect a cure we must get at the cause; we must improve the general health, and so he inculcates a course of treatment that he looks upon as getting at the root of things. And that is just the policy of the wise tree-doctor.

Smooth-barked trees are very liable to attack by wood-boring beetles. The stringybark trees of our forest are supplied by nature with a thick blanket which prevents beetles attacking them too easily. The smooth-barked plane is very vulnerable, and hence stake-ties for them are very dangerous things.

They are also liable to attacks by a little curculio beetle, which riddles them. I have seen the trunks of planes girdled with a band of sticky fly-paper to intercept these little beetles. But, obviously, such a method is only capable of application in places where there is very little dust. It certainly could not be applied in city streets.

8. *White Ants.*—Most people have observed an official tapping the wheels of railway carriages of express trains with light hammers, when such trains arrive at a station, and are proceeding to a further stage on their journey. This is a matter of precaution, as a flaw in a wheel might result in disaster. In like manner the staffs of our public parks are constantly inspecting the trees to see if a branch is too top-heavy, or has cracked, or whether a trunk is suffering from white-ant (a very common pest) or decay, or whether it is likely to heel over with the wind after soaking rain. Numbers of branches and not a few trees are annually removed simply because they are a possible source of danger. The writer has no intention of hearing the verdict of a coroner's jury, "The deceased was killed by a limb of a tree which fell upon him, and the dangerous condition of said limb should have been ascertained by the Director of the Botanic Gardens, whom we therefore find guilty of manslaughter." The public may be assured that special precautions are taken on their behalf, and such precautions sometimes necessitate hard pruning and even removal of trees which appear healthy to a superficial observer. Here let me refer my readers to a very useful paper, "Diseases of Shade and Ornamental Trees," by B. T. Galloway and A. F. Woods, in the "Year-book of Agriculture, U.S.A.," for 1896, pp. 237–254.

9. *Attend to the watering, should it be necessary, at the proper time.*—Young trees should have a good sousing at the time of planting, and the settlement of the soil which results should be partly made up by the addition of a little good soil. It is best not to make the level of the soil around the newly planted tree equal to that of the surrounding land, but to leave a little depression, so that moisture may find its way to the roots of the young tree. Bearing in mind that a young tree is a baby tree, it naturally requires a little extra care during its early days. Amongst other requirements it is necessary to see that its roots are kept moist, particularly during a period of westerly winds. When the tree is watered, a good soaking is necessary, for the application of a little drop of water does more harm than good.

Plants breathe by means of their leaves, which have quite a large number of breathing holes. These holes get clogged up by the fine dust common in cities, although most leaves possess contrivances to minimise the danger from choking. This dust should be washed off as frequently as possible, and nothing is better than water, sprayed as finely as possible. No tree can live a vigorous life if choked with dust, and trees in the forest are not subjected to this drawback.

One of the special disabilities under which trees in towns suffer is caused by the fact that the soil around the stem is often trampled hard, or is covered with asphalt or other impervious paving material. How is it possible for the rain to get to the tree and help it to live its life? Broad tree-guards protect the tree in this respect, but the most usual method is to have iron gratings. Usually, however, the gratings are too small; they should be not less than 5 by 4 feet. The pattern of the grating is of very great importance. The holes to admit the rain should be as large as possible, and the lines of the casting should be as narrow as possible at the surface of the pavement. In other words, every drop of rain which falls on the grating should percolate through. Different patterns of gratings are made, but I hope that public bodies will keep the main idea in view, and reject any grating which intercepts much of the rain.

10. *Attend to pruning, if necessary.*—I have already incidentally referred to root-pruning necessary in consequence of injuries in transit. Roots are sometimes pruned because the trees are pot-bound, and for other reasons, but unless the tree is a very valuable one, I would put a tree which requires much root-pruning on to a good hot fire.

Some people think that only roses and fruit trees require pruning, but street and park trees sometimes require this, and the operation should always be entrusted to a first-class man. Sometimes a branch becomes too heavy, and hence in the interests of safety it requires treatment. Then in windy localities trees may get too much of a top, and so they are carefully thinned, so that when that unexpected gale comes along it will simply blow through the branches, and not fell the tree or blow its head off. Then trees require pruning for the removal of puny or diseased branches or to induce symmetry of growth. Sometimes trees are pruned to secure a more compact growth in lieu of spindliness. If a tree be healthy to begin with, and it be planted in good soil, with sufficient moisture and shelter, it can live its life vigorously and healthily. A

healthy, symmetrical tree is a beautiful object, and rarely requires interference. The knife and saw of the pruner are usually to counteract defects, the result of debility at the time of planting, overcrowding, accidents during growth, or uncongenial soil and surroundings. Pruning is a requirement of civilisation amongst tree growths, and is a regrettable necessity. If trees grew naturally they would require no pruning. In the same way, if a man has a healthy constitution and is so fortunate as to escape accidents, he does not require the knife of a surgeon.

Trees, particularly in streets, live an existence almost as artificial as the remainder of the dwellers in towns. To begin with a clean stem is necessary, so as not to interfere with foot and wheeled traffic. To secure this a certain amount of pruning is required.

Some trees, such as figs and many deciduous trees, may be very freely cut without endangering their life, but others, such as the Myrtaceæ, including our gums and Tristania and many other evergreen trees, must be pruned with care, and always when the tree is at rest, *i.e.*, with no flush of new growth at the top.

Noble Approaches to our City Parks.

Every main park entrance should, if possible, be indicated by a plaza as spacious as can be contrived. A plaza is an index to the breadth of view of the citizens.

Let us contemplate the approaches of some of our parks. Some of them remind us of a precious jewel in an unworthy setting. The Centennial Park, for example, is a glorious natural depression with high land all round it and within its area, enabling one in one *coup d'oeil* to view a landscape which is a dream of beauty, a balm to jaded nerves, and inspiration to the æsthete, be he poet or artist.

But the approaches, with one exception, are petty.

We are improving the approaches to the Outer Domain and Inner Domain (Government House Grounds) by plazas, and the above areas and also the Garden Palace Grounds, by an encircling belt of palm-bordered parterres. With these improvements Macquarie-street will, in a few years, be the finest street in Australia.

Let us not further neglect the very important matter of better settings to our parks.

The Policy of Connecting Avenues between our various Parks.

We should have a shady walk or drive from the Circular Quay to Centennial Park and beyond, and back to the starting point by a different route. At the present time we have some dusty road, then some park, then a bit of tree-lined road, then very much more dusty road. When we have the necessary leisure to enjoy it we ought to be able to make long journeys under æsthetic conditions. It is too much to expect that all business premises and residences shall have park-like surroundings, but the *continuity* of our pleasaunces can be more attended to if we set about it.

This matter is akin to the problem of constructing adequate arterial roads of approach to Sydney. Study a map for a moment and see how inadequate and even petty our main roads are. Some of them have the same direction as the track of a perplexed insect. But here I am encroaching on the domain of the professional town-planner, and my work is only a subordinate part.

Trees in Parks.

The planting of a park can only be touched upon at this place, in a general way. In its laying out, the indigenous trees should be conserved if possible. I do not say at any price. Some trees should be cultivated for the purpose, mainly, of giving shelter to the public. The problem of producing beautiful landscape effects is not one suitable for discussion here, except in very general terms, for one cannot go into essential details except with a particular block of land in view. Trees in a public park must have their lower branches removed or children will break them down, and improper characters will use them as places of concealment.

In a private park we see noble specimens of trees, some of them with branches close to the ground. When for public park purposes we prune them, we not only seriously detract from their beauty, but in the case of some trees, particularly conifers, we inflict great injury upon them from a physiological point of view. Trees often require a little judicious pruning, either because of accidents to branches or to prevent branches becoming unduly heavy and tearing themselves away during winds or by their sheer weight. Then we require special precautions in regard to the danger from trees in a public park, particularly in those used by large numbers of people. I have touched upon this subject already.

It is the duty of a park officer to frequently inspect his trees to see if any of them present symptoms which will cause them to be dangerous to the public. Are they getting top-heavy? Are the branches or the trunks becoming unsound? The pruner and the axe-man must be ever on the alert, especially as, with all our care, trees sometimes fall without warning. In such cases examination of the roots or inner portion of the trunk reveals insidious disease, caused either by fungus or by insect pests.

A tree is like a man, in that it progresses to maturity and then commences to decay. Thus we have the active growth of youth, a period of maturity, and a period of senile decay. It would be very desirable if trees could long remain at the period of their best development. But no, they grow out of hand, and have to be cut back, and a common symptom of incipient decay, a dead branch, has to be cut out. I want to emphasise the point that a tree will not remain stationary.

The climbing of trees by boys is a very serious cause of their injury, and even destruction. If a boy intends to climb a tree, one cannot, in practice, prevent him, but he can be hindered by tree guards, and also by loosely twisting barbed wire around the first fork.

While many trees in our genial climate grow more rapidly than they do in Europe, one must not lose sight of the fact that they attain maturity quicker, and then show signs of failure. In applying remedies to unhealthy trees, one must carefully distinguish between those which are suffering from the effects of accident or from a passing ailment, and those in which the real cause is senile decay.

The question of the establishment of *wind-breaks* is a matter of importance to all custodians of parks which are not blessed with a sheltered situation. This is one of the most difficult problems those in charge of parks have to face. The problem is to establish the first line of defence, which in its turn, may protect the second, and so on. Each man must work out the problem for himself, and he, of course, considers the contour of the land, and the direction and force of the prevailing winds. Those interested in the matter may be inclined to study the methods by which wind-breaks are being established at the Centennial Park, a park with the poorest of soils.

In planting we want to look ahead and not overcrowd, as this does not allow the development of good specimens, and people object to the thinning out process. It is born in a man not to like to cut down a tree he has himself planted.

Pavement Gardening.

In Europe the café system is very much in vogue. There people like to take their refreshments in the open air, on the pavement. The pavements are very wide, often wider than the roadway. The greater portion of the width is taken up by the marble-topped or other tables of the café, while pedestrians walk along a comparatively narrow strip immediately adjoining the roadway. The municipality makes considerable revenue through permits to café-keepers to thus encroach on what in English cities would be called foot-paths.

On the pavement at the edge of the line of tables, or just outside the premises where the pavement is narrow, plants in tubs or boxes are commonly employed, either to give shelter to customers, or to ornament the surroundings. The plants used necessarily vary with the locality. For example, in France the *Oleander, Euonymus, tall Privets* (*Ligustrum*) and *Date Palms* are commonly employed. In Hamburg I noticed *Ivy on trellises*, and *Thuya*.

The outdoor café system will be long in establishing itself in Sydney, partly because our citizens, as a rule, have not got into the way of drinking their "soft" and other drinks in view of passers-by, and mainly because the narrow pavements of Sydney have never been designed to lend themselves to the fashion. But in this climate I think that the desire for outdoor life will bring facilities for its realisation in time.

London owes a good deal to the Metropolitan Public Gardens Association, of 83, Lancaster Gate, which supplied poplars and other trees and shrubs in large cubical boxes, painted green, to stand wherever space will admit of their being placed—in front of the Royal Exchange, for example.

What I would like to emphasise is that there must be hundreds, aye, thousands, of places in the city of Sydney where neat boxes or tubs containing nice plants could be placed, and thus the city made a garden city, even in thoroughfares where it would be difficult, and perhaps impossible, to have trees along the foot-path.

Planting on the Surface of Roadways.

On the continent of Europe it is a common practice to plant actually on the top of the road surface. In northern Europe the winters are somewhat severe, and planting takes place in May. During that month the plants that have been sheltered under glass and elsewhere during a long winter are brought out by the cart load. A wide portion of the street is chosen, say the junction of two streets, and on the (say) triangular portion thus available, soil is deposited and the plants planted or plunged in this soil. An edging is put to the bed and this street garden is a thing of beauty and gives great pleasure to passers-by. When October, with its chill winds approaches, the plants have lived their lives or are at all events no longer sightly. The municipal cart then comes and carts away everything, leaving the road bare for the winter, and probably new kinds of plants will be used in the design during the following May.

Roof Gardens.

This is a style of gardening that finds its way into Sydney but slowly, but as skyscrapers increase in number it will become an absolute necessity for roof-cafés, the roof-gardens arranged for employees, the roofs of clubs and other institutions, caretakers' quarters, and so on. The chief trouble is in regard to high winds. When people are seized with the desirability of roof gardens they will make arrangements for a convenient water supply, and as all buildings are fitted with lifts, there will be no difficulty in bringing up soil and other garden requisites after hours. Ornamental boxes, tubs, and fountains will be freely used.

For the taller plants—starers: let us try Palms, Dracænas, Araucaria excelsa, while in a young state, they are bushy; Pandani (Screw pines), the hardy kinds, as the one on our coast or Lord Howe Island.

Shrubs.—These should be fairly large before being tubbed. Laurustinus, Euonymus, Oleander, Coprosma Baueriana (especially the variegated kinds), Eulalia japonica (a beautiful grass, graceful for the summer).

Small Plants.—Arums, Aspidistra, hardy ferns, especially Birds' Nest fern, Stag-horn, &c., Rock-Lily.

Ivy of sorts for trailing and filling up generally. *Asparagus, e.g., plumosus,* will be also valuable in this connection.

Then hanging baskets can be introduced according to requirements.

Of course, these plants will be well planted in tubs or boxes by professional gardeners, who will attend to the soil, drainage, &c. They should be suitably watered and the leaves sponged occasionally. Each winter they will require the attention of a professional gardener who will re-box, if necessary, attend to the soil, prune if necessary, and so forth.

Avenue Trees.

Trees for an avenue, or for a well defined part of it, should be of the same kind. Every celebrated avenue in the world, *e.g.*, the Horse chestnut avenue of Bushey Park, near London, and the Cryptomeria Avenue of Nikko, Japan, are of one kind of tree. The mixed avenue is an abomination, ragged and irregular at the best. If the continuity of an avenue has to be broken, let it be at some well-defined break, such as the junction of an intersecting road, or where the road debouches on to a square.

If you take an expanse of any length in street-planting it is difficult to secure uniform conditions above or below; that is one of the reasons why it is so hard to obtain precision in an avenue, which is one of its merits.

A level plain, with soil, drainage and other conditions uniform, is an ideal as high as we can get, but even then, in say a hundred planted trees some will be found to greatly exceed in vigour or be greatly inferior to the average, and, if this be observed only when the trees are fairly large, it is not easy to rectify matters.

Avenue planting requires careful judgment of a high order.

Roadside Trees in Country.

Much of what has been said is more appropriate, perhaps, to towns of greater or larger size. But the requirements of the resident of the country districts must not be lost sight of. Many a man has lost stock through driving them along a shadeless road, and more still have seen their animals much distressed for the same cause.

Often shadeless roads are caused through the cupidity of the adjacent landowner who begrudges the tree outside his fence the nutriment it gets from his land. The remedy is not to plant his crops so near the edge of the road. In most cases the landowner can be fairly expected to possess sufficient civic spirit to make some sacrifice to enable the trees along the side of the road (probably not planted by the hand of man) continue to render public service. And he should always bear in mind that he himself probably gets more advantage than anybody else from the presence of the trees.

List of Trees.

It is very difficult to make a condensed list of trees suitable for New South Wales. Our State is a very large one, with many soils and climates, and I have, in another place, divided it into five portions. (1) The cold region, consisting of the north and south tablelands—here British trees flourish; (2) the coastal strip; (3) the Northern Rivers, a distinctly sub-tropical belt, forming the north-eastern portion of the State; (4) the Western Slopes and Riverina; (5) the Western Plains.

If I were to attempt an even simpler classification as regards trees, I would say—(*a*) Cool districts with (1) dry, or (2) damp localities; and (*b*) warm districts, with (1) dry, or (2) damp localities. Damp localities are often associated with shelter. Trees which grow in dry situations often do better in moister situations with improved soil. Then again we have light soils, stiff soils, limestone soils, and so on. It is obvious that I can only lightly touch upon our varied conditions and requirements on the present occasion.

The two principal planting problems in New South Wales affect (*a*) the coastal sandy strip; (*b*) the Western Plains. Many special difficulties are involved in regard to plant-life in these areas, and the present does not afford an opportunity for discussion of them.

In forming an idea of the appearance of trees in the Sydney district the Botanic Gardens is full of lessons, but it must be remembered that the soil is, as a rule, very poor, but it possesses many very sheltered situations. Further, in many cases the trees are too crowded together to enable specimen trees to be formed, and so they often have to be severely cut back.

In the Domain, because of its rocky and exposed character, there is but little opportunity for growing trees in variety. In the Centennial Park the conditions are very difficult, and successive Annual Reports show how many trees have been tested there.

Native Trees.—First let me earnestly recommend people to cultivate what is best in their districts; let them grow the native trees. I am not so foolish as to ask people to grow only native plants. Let us grow the best things available, but I feel sure that, in this regard, people often "go farther and fare worse." It may be news to some that in New South Wales we possess nearly six hundred different kinds of native trees, and in this State are some of the most beautiful trees I have seen in any part of the world. Some people do already propagate the native trees, and still more people preserve those already existing; but we want people to do more in this direction. Many parts of New South Wales have special climatic conditions, and the native trees which have become acclimatised throughout the ages are the safest to rely upon in trying times. Tried friends are *Tristania conferta*, the Brush box; *Grevillea robusta*, the Silky oak; *Castanospermum australe*, the Moreton Bay Chestnut; various Eucalypts, such as the Yellow Box (*melliodora*), Black or Swamp Box (*bicolor*), Tallow-wood (*microcorys*), Narrow-leaved ironbark (*crebra*), Peppermint (*amygdalina*); various conifers such as the Cypress pines (*Callitris*) and the plum pine (*Podocarpus elata.*)

Let us never forget that in our Cypress pines (*Callitris*) we have beautiful trees which flourish in the coast districts, in the mountains, and far away into the western plains; the White Cedar (*Melia azedarach*), the She-Oaks (*Casuarina*); and I could run on. Visitors to Sydney often regale me with accounts of the native trees in their districts, and the way in which they respond to a little attention. Native trees are, on the average, just as easy to grow from seed as exotics, so that there is nothing specially difficult in the matter.

Let me offer special notes on Wattles, She-Oaks and Figs.

Wattles are unsuited to street planting, as they mature too quickly. They are peculiarly liable to attacks by beetles, and I suppose that the average life of a wattle as a symmetrical tree in a city is not above five years. In the smoke of a city such as Sydney the delicate grey, fine foliage of such a tree as *Acacia Baileyana* becomes a disgrace in two years.

Certain Melbourne suburbs with wide streets and fairly good soil, had regrettable experience with wattle-planting. The trees never gave satisfaction, and the local councils lost much time, which would have been saved had more permanent trees been planted.

Imported Pines (*Pinus*) are dying out rapidly in the Sydney district, with the exception of the Maritime Pine, for they are very difficult to control, being liable to fatal diseases. I reiterate the opinion that in our She-Oaks, which are very free from disease, we have a class of trees reminiscent of the Pines, and which are destined to replace them in many districts in which the Pines are dying out. Pines give a character of their own to the landscape, but the She-Oaks do not replace them in regard to the delicious health-giving odours they exhale. Another drawback to Pines for park purposes is that they will not, as a general rule, stand cutting.

And now let me turn to the maligned Moreton Bay Fig (*Ficus macrophylla*). To hear some people talk, all Moreton Bay figs should be banished from the Sydney district, but it does not seem to be realised that it is one of the best trees ever introduced to Sydney. It will grow amongst rocks, where scarcely anything else will grow; and it will stand being blown upon by fierce winds and being hacked about and otherwise ill-used. I admit that it can be put in the wrong place (it must not be planted near buildings or pavements), but a Moreton Bay Fig with plenty of room, so that it can live its life, is one of the most beautiful of trees, while its foliage and fruit are nutritious to stock, and its umbrageous head affords a grateful shade.

Then the Port Jackson Fig (*Ficus rubiginosa*) is a most beautiful object. It is far less rampant than the preceding, and takes on an umbrella or mushroom shape, which is very symmetrical. It is nearly an ideal tree for general shelter purposes and picturesqueness, and is hardy in many parts of the State. Amongst deciduous Figs, *Ficus Cunninghamii* and *Ficus Henneana* are two of the best.

We divide trees into two grand groups—evergreens and deciduous. Dependent on locality, there are few trees that are neither quite one nor the other. For example, the silky oak in some districts scarcely loses its leaves in winter.

Evergreen Trees.—We will now take some evergreen trees, and it may be mentioned that in alphabetical order we have:—*Alectryon excelsa*, the New Zealand titoki, a handsome tree suitable for our cold districts.

The carob (*Ceratonia siliqua*) is one of those trees which succeed right from the coast to the western plains. It does best in calcareous soil. It is a beautiful, umbrageous tree, and its pods afford nutritious food for both man and beast.

The camphor tree (*Cinnamomum camphora*) grows best in our coastal districts; it will not flourish on the mountains or tablelands, but it is worthy of experiment in many parts of the State where the soil is not too stiff and the subsoil is moist. It is a beautiful, densely foliaged tree, and is interesting in that camphor is prepared from the wood, though we cannot compete with Japanese and Chinese labour in this industry under existing circumstances.

The karaka, a New Zealand tree, a beautiful dark, glossy-leaved species with orange-coloured fruits, has proved very desirable for the coast districts at no great distance from the sea. Not that it is restricted to such situations by any means, for the New Zealand laurel, as it is often called, has shown itself very tolerant to various soils and climates in New South Wales. It will stand much cold. Its botanical name is *Corynocarpus lævigatus.*

The weeping fig (*Ficus Benjaminea*) is singled out as one of the most beautiful of all figs for the warmer coast strip.

The India-rubber fig (*Ficus elastica*) is a beautiful species, grows fairly in Sydney, but it does not grow as rampantly as it may be confidently expected to do on the Lower Clarence, Richmond, and Tweed. It ought to be grown much more commonly than it is.

The larger white Magnolia (*M. grandiflora*) is as handsome as a fig with its rich polished leaves. Its glory is its very large white, sweetly perfumed flowers. It must have a damp situation and shelter, and given these is tolerant to a fair amount of cold. Of course, it simply revels in the coast districts.

The olive tree (*Olea europea*) I have less to say about, since it flourishes best in calcareous soils, which are an exception in this State. At the same time it does fairly well in our coast districts, and should be more planted. The olive is commonly propagated by thick, longish pieces of the stem, known as truncheons.

Of the evergreen oaks (*Quercus*) we may mention *Q. ægilops*, the Valonia Oak, which by the way, is semi-deciduous with us. It is a beautiful species, best known for the acorn cups, which yield the valuable tanning material called valonia. It flourishes in moist places cooler than Sydney, and every encouragement should be given it.

The holly oak (*Q. ilex*) of South Europe is known to us in more than one variety, and does well in many parts of New South Wales, especially near the coast. It is really very valuable, and can be thoroughly recommended. An allied tree is *Q. virens*, the live or evergreen oak of North America. It and *Q. ilex* are grand trees, and cannot be too much planted. They grow in much the same situation. If it be desired to see in what poor soil accompanied by trying winds it will grow and form a handsome tree, look at the large number of them in Centennial Park, Sydney, and how well they do. The valuable cork oak (*Q. suber*) of South Europe is a handsome tree, and flourishes in the coastal districts. Its bark, of course, yields the cork of commerce.

Another valuable evergreen is the tree we know as pepper tree (*Schinus molle*) a native of North and South America, from Mexico to Chili. It is a graceful umbrageous tree, and a very great merit is that it is hardy in most parts of the State, revelling in the coast districts, standing a good deal of cold, and even advancing far into the interior.

Deciduous Trees.—We now come to the deciduous trees, and the world is divided into two classes of people, the advocates of evergreens and of deciduous trees. There is much to be said for deciduous trees in towns. We have the beautiful spectacle of their unfolding leaf buds, then the abundance of their shady foliage, and finally we have the bare branches at a time when the sun has least power, and the streets require all the light they can obtain.

Acer negundo, the box-elder of North America, is a maple, and *Acer platanoides*, the Norway maple, is another. They have beautiful leaves, and flourish in cold, damp situations. They will stand as much cold as we can give them in New South Wales.

Aesculus californica is the California buckeye or horse chestnut, dwarf in Sydney, but a large tree in moist rich soils in the cooler parts of the State. It has white flowers in trusses, and is one of the most lovely trees in the world. Therefore it is worth taking pains over. The true horse chestnut (*Aesculus hippocastanum*) is also only for the cooler parts of this State, in low-lying localities. Those who have seen it in its best development in Europe recognise it as a beautiful object, and it is well worthy of cultivation, being especially beautiful in the spring. In the summer with hot winds horse chestnuts are apt to be withered looking, but is not this a fault to which many deciduous trees are liable ?

Ailanthus glandulosa is sometimes called the Tree of Heaven. It is a valuable tree, but liable to sucker, and hence should be kept away from cultivated ground, as it behaves like elms and poplars. It is very handsome, in a young state, and is one of the few trees well tested for dry situations, so that it is to be recommended for such trying situations in many parts of the State; it will, however, grow almost anywhere. In Paris, where it is largely and successfully employed for avenue-planting, it is known as Vernix du Japon.

The Cape Chestnut (*Calodendron capense*) is hardy, and is such a specially handsome object when covered all over with its large mauve blossoms that it is worthy of abundant experiment. I believe it will grow in many parts of this State, and that it will stand a fair amount of dryness.

The pecan nut (*Carya oliviformis*) is a handsome tree which yields an excellent edible nut. It requires cool, damp situations.

The same localities are necessary for the proper development of the Spanish Chestnut (*Castanea sativa*), a handsome tree, yielding a nutritious nut which is specially acceptable when roasted. Australians are not a nut-eating people, but when they develop increased tendencies in this direction the Spanish or Sweet Chestnut tree will be very largely planted. At Mount Wilson the tree is perfectly at home.

Then we come to the Catalpas (*bignonioides* and *speciosa*), beautiful American trees which come to us with a great reputation. *C. speciosa* is a hardier and bigger tree than *C. bignonioides*, and they both should be further tested as rapid-growing trees in cold, damp localities. Their reputation in New South Wales has so far come much below their American one, as it is found, so far, that they fail in dry weather, and will not stand our dry winds.

Celtis australis, the lotus tree of South Europe, is a very dense growing, handsome tree. It stands dry and cold as well as hot situations, like silky oaks, and I look upon it as one of the most generally useful trees as yet imported into New South Wales.

Many people know the hardy coral trees which grow from large cuttings, and which shelter the cows and the homesteads on the South Coast when the people have carefully destroyed most of the original vegetation. The commonest one is *Erythrina indica*, and it will stand a considerable amount of cold. *E. speciosa* is very handsome, too, and is a smaller growing tree.

Then we come to the ashes (*Fraxinus*), most valuable trees for low, damp ground and river banks in the colder parts of the State. *F. ornus*, the manna ash, will stand fairly dry situations. The ashes are beautiful trees, and are noted for the toughness of their pale, handsome wood. The principal ashes that we grow in quantity in New South Wales are *F. excelsior*, the common ash of Europe; *F. americana*, the common American or white ash; *F. pennsylvanica* (sometimes known as *pubescens*), the red ash of the United States; *F. nigra* (sometimes known as *sambucifolia*), the black ash of the United States. The honey locust tree (*Gleditschia triacanthos*) of North America is very thorny. It may be recommended for exposed situations where nothing else will grow, and where it will never require to be interfered with. It should not be planted in choice situations where other trees will flourish. If planted closely it will form a hedge that a bull cannot find its way through.

Jacaranda mimosæfolia is a tree with fern-like foliage and beautiful tubular purple blossoms. It is one of the handsomest trees in cultivation. It is semi-deciduous like the silky oak. It is hardy in the coast districts and foothills. It requires shelter.

The walnuts are well-known trees, *Juglans regia* being the common edible walnut of Europe. But the black walnut (*J. nigra*) of the Eastern United States is the most generally useful Juglans for New South Wales. It will stand more exposed situations and drier atmosphere than the others, which revel in low-lying, cold situations, with good soil.

J. cinerea is the butternut tree of the United States, and is a good fast grower near the coast in New South Wales. *J. californica* is a western species. All of them are handsome trees, and are worthy of more persistent experiment than has been accorded to them so far.

Koelreuteria paniculata is a small Chinese tree after the fashion of Robinia. It is well suited for dry climates, and should be well tested on the western slopes. It has large pinnate leaves, with large hanging panicles of yellow flowers.

Liquidambar styraciflua is the sweet gum tree of the United States. It is a beautiful tree, with maple-like leaves, and is one of the few trees which produce lovely autumnal foliage in Sydney. It requires much the same treatment as Juglans, and I believe it is destined to be a valuable acquisition in many parts of the State in damp, sheltered situations.

The tulip tree of North America (*Liriodendron tulipifera*) is a very large tree. It also requires damp, deep soil and cold situations. It has large, handsome foliage, and large flowers of a yellowish red colour, from which bees extract much honey. It should be borne in mind that trees are most valuable to the bee-keeper, and are specially worthy of consideration on that account alone.

Most of us know the white mulberry (*Morus alba*) whose leaves are so useful as food for silkworms. It will stand much drought, and hence is specially valuable on that account.

Morus nigra, the black mulberry tree, the species which yields the luscious fruit, has large coarse foliage, and prefers damp situations. If it gets moisture it is tolerant to both heat and cold. Both mulberry trees should be grown far more extensively than they are.

Paulownia imperialis is one of the gorgeous flowering trees. It bears immense masses of large purple flowers. It comes from Japan, and is intolerant of the heat of Sydney, but is very fond of cold, damp localities.

Then we have the planes, of which we have two principal ones—*Platanus orientalis*, the ordinary or eastern plane, and *P. occidentalis*, the western plane. The one commonly grown in New South Wales is *orientalis*, and it is more generally hardy with us than *occidentalis*. The latter requires damper situations and better soil for its development. Both are, however, when well grown much alike, their differences being chiefly of a botanical character. The planes are very handsome trees, and to be recommended, but like most other trees, are apt to be withered looking after the hot winds of summer and early autumn.

The poplars are deservedly esteemed. They all love damp, cold situations, yet nevertheless, all do fairly well in Sydney. The principal ones are *Populus fastigiata*, the upright or Lombardy poplar; *P. alba*, the white poplar, which has the bad quality of producing a plentiful crop of suckers; *P. angulata*, the Water or Carolina poplar of the United States; *P. betulifolia* and *P. nigra*. The timber of poplars is used for wheel-brakes, and it is tough and will not split. The upright poplar perhaps stands most drought of them all. *P. Bolleana*, the Bollé poplar, is one of the numerous forms of *P. alba*, the White or Silver Poplar, and it is the best of the silvers for our State, as it suckers least.

Here I may say that a great many plants and animals are most estimable, but have perhaps one serious drawback. The perfect man, horse, or tree requires to be discovered. For example, the White poplar is, in my estimation, a charming tree, but it suckers abominably, devastating lawns and flower borders a considerable distance away. Consequently the situation sometimes becomes intolerable, and it may be that the death-warrant of the White Poplar is occasionally signed simply because of its one bad habit.

The Rowan or Mountain Ash (*Pyrus aucuparia*), with its beautiful pinnate foliage and lovely masses of highly-coloured graceful small fruits, will flourish in the coldest localities and is a choice tree.

The deciduous oaks are many, and we can only refer to a few of them. *Quercus bicolor*, the Southern White Oak of the United States, is a useful species which grows fairly well in Sydney, but requires deep rich soil and a cooler situation.

The Turkey Oak (*Q. cerris*) is one of the most distinct of the oaks; it is a shapely, umbrageous tree, with handsome, shiny foliage. It does remarkably well in Sydney, and will flourish in many parts of New South Wales. The Pin or Marsh Oak (*Q. palustris*) of the United States loves swampy localities, as its name denotes. Its autumnal foliage is beautiful. It prefers cooler localities than Sydney. *Q. rubra*, the red oak of the United States, so called because of the splendour of its autumnal foliage, requires similar treatment.

No park should be complete without a specimen of the so-called British Oak (*Q. robur*), which is widely diffused in Europe. Everyone knows it, and it has proved itself remarkably adjustable to circumstances in New South Wales.

The so-called Acacia (*Robinia pseud-acacia*) of North America is one of the most valuable trees imported into New South Wales. It has beautiful pinnate foliage, is umbrageous, and a very great merit consists in the fact that it is one of the most accommodating trees in the States, flourishing in heat and cold, moist and dry places.

We must never forget the willows, so graceful are they for river and lagoon banks and swampy situations. There are very many of them, of which the Weeping Willow (*Salix babylonica*) is best known. The readiness with which they strike from cuttings is proverbial. The Bedford willow (*S. Russelliana*) is more erect than the Weeping one, but it is a good companion for it. It is a large rapid grower, and it furnishes material for basket-work. The Huntingdon willow (*S. alba*) is a valuable species, one of those whose wood is useful for cricket-bats, brake-blocks, and similar purposes, where a light tough wood is required. Some day Australians will make their own cricket-bats, and they use a great many of them. The common Osier (*S. viminalis*) is but a small tree, but it is one of the most valuable of all willows for economic purposes, and the time will come when the cutting and peeling and preparation of Osiers for the making of baskets and trays will be a recognised Australian industry.

The common lime or linden of Europe (*Tilia europea*) is suited for our coldest districts, where damp deep soil is available. It requires precisely the same treatment as the marsh-loving alder (*Alnus glutinosa*), which, by the way, I have omitted to notice in its proper alphabetical order. Both are handsome umbrageous trees.

Just a few words in regard to the elms (*Ulmus*). *U. campestris*, the common elm, is our great standby. It requires deep moist soil for its proper development, and although it will grow in Sydney, it requires much greater winter cold for its proper development. The cork elm is a handsome variety, and so is the Wych elm, though considered a species (*U. montana*) by some. The Wych elm is the fastest grower in Sydney, except the variety known as the Canadian giant, which is a really valuable tree; it is rather more spreading than the common elm. The Huntingdon elm is another useful variety (of *montana*). *U. chinensis*, the Chinese elm, is a beautiful species that should be included in every collection. Elms require cool winters for their best development. I am sorry to hear that many fine elms in New South Wales are doomed. Beautiful to look at, they are becoming a prey to boring beetles. The

summer heat and warm nights appear to induce in these trees debility which renders them a prey to insects. Like so many of the trees mentioned in this article, they require, for healthy development, a fairly hard winter.

Amongst the coniferæ, the pines at once occur to us, and I am sorry that the scope of this article does not allow me to deal with them fully. But no collection of trees is complete without some of these beautiful and deliciously aromatic trees. I have already referred to them in speaking of the She-Oaks. The best of the pines are the heritage of the cold districts, but *Araucaria* and *Agathis* (otherwise *Dammara*) are at their best only in the warmer coast districts. The coniferæ include the cypresses, some of the most lovely members of the vegetable kingdom; *Cryptomeria japonica* and *Sequoia*, also *Abies and Picea*, must be selected for special mention.

In a strict scientific classification the Taxaceæ are kept apart from the true coniferæ, and they include the beautiful maiden-hair tree (*Ginkgo*), *Phyllocladus* and *Dracrydium* (well developed in New Zealand), *Podocarpus elata*, our beautiful and useful she or brown pine; *Prumnopitys*, the plum pines closely allied to Podocarpus, and very beautiful and umbrageous, together with a few others less known.

Just a brief word about Palms. If I am destined to be remembered in Sydney about a particular kind of tree, it will probably be palms. For many years I held the opinion that enough was not made of that feathery-leaved, graceful, tropical-looking plant, the palm. But a very grave responsibility rested on the man who recommended a palm for street planting. The railway station palm (*Washingtonia*) will not do. It grows too rapidly, and presents a long bare stem with a poor top.

My choice fell on the Canary Islands Palm (*Phœnix canariensis*). Time will show what faults it may develop, but it is certainly hardy, and is beautiful at all ages within the tests applied. It is comparatively free from disease, does not mature too rapidly, stands strong winds splendidly and so is an acquisition for the coast belt, even very close to the sea, a very trying situation. A specimen tree of about 35 years of age can be seen in the Botanic Gardens, and I have no doubt it will look well and not be too large for street planting at fifty years. With the inevitable changes in modern cities it is not unreasonable, if necessary, to ask for the street trees to be replanted twice in a century. Those who desire to see this beautiful palm under avenue conditions will see it in the Centennial Park and Macquarie-street. I believe that it may be extensively planted as an avenue tree in the Sydney suburbs and along the coast without any fear of producing monotony, and I am perfectly certain that when private citizens and public bodies see well-grown palms they will desire to plant more of different species and varieties. They will add a graceful decorative note to the vegetation of Sydney that it very much lacks.



A Murphy, junr., photo

THE TURPENTINE TREE *(Syncarpia laurifolia)*,
BULLADELAH DISTRICT, N.S.W.



Sid. W. Jackson, photo.

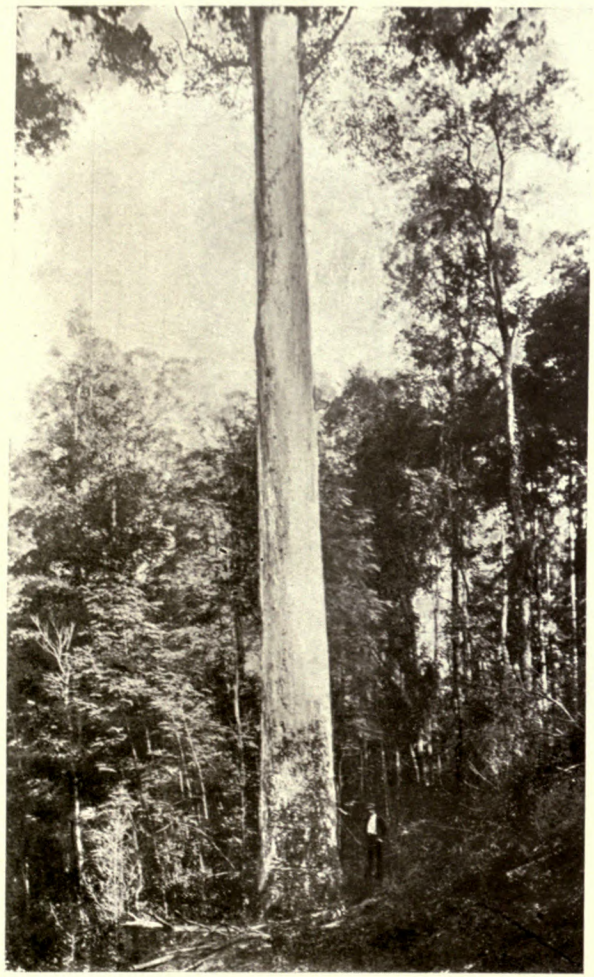
YOUNG CEDAR TREES *(Cedrela australis.)* DORRIGO SCRUBS, N.S.W.



Sid. W. Jackson, photo.

OLD BUTT OF A RED CEDAR TREE *(Cedrela australis.)* DORRIGO SCRUBS, N.S.W.

308 r



A. Murphy, junr., photo

THE BRUSH BOX *(Tristania conferta)*, BULLADELAH DISTRICT, N.S.W.



R. H. Cambage, photo.

NATURAL GROVE OF *Eucalyptus hemiphloia*, GREENDALE, NEAR BENT'S BASIN, N.S.W.



SPOTTED GUM TREE IN THE VICINITY OF THE RICHMOND RANGE.



C. A. Ballard, photo.

TYPICAL SCRUB ON RICHMOND RANGE, SHOWING STUMP OF LARGE BEECH TREE *(Gmelina Leichhardtii)*. F.v.M.



C. J. McMaster, photo.

Callitris robusta. WEILMORINGLE, N.S.W.



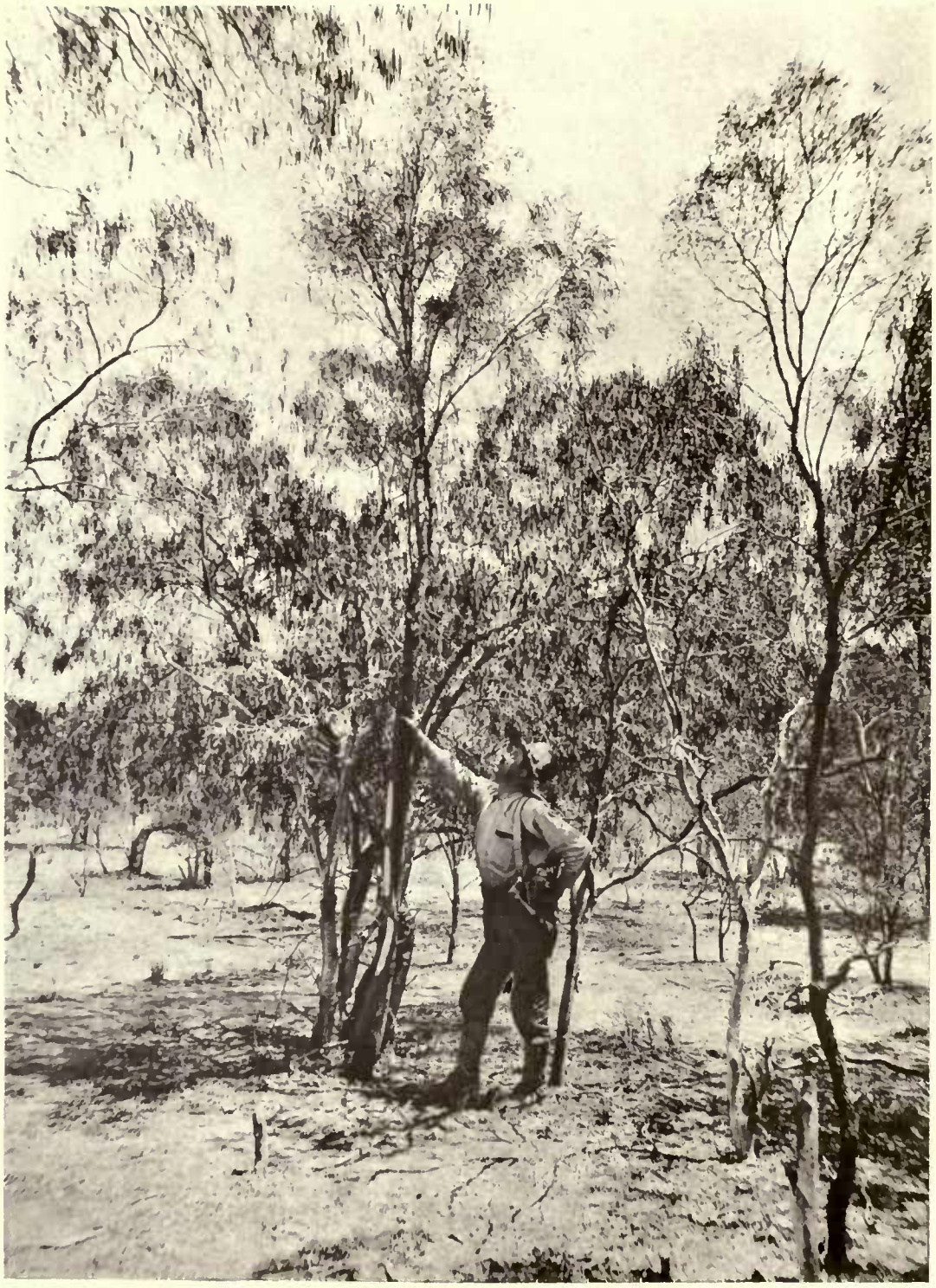
Sid. W. Jackson, photo.

LEOPARD WOOD TREES *(Flindersia maculosa* F.v.M.) CAMBO CAMBO, COLLARENEBRI DISTRICT, N.S.W.



Sid. W. Jackson, photo.

BELAH *(Casuarina lepidophloia)*, COLLARENEBRI DISTRICT, N.S.W.



Sid W Jackson, photo

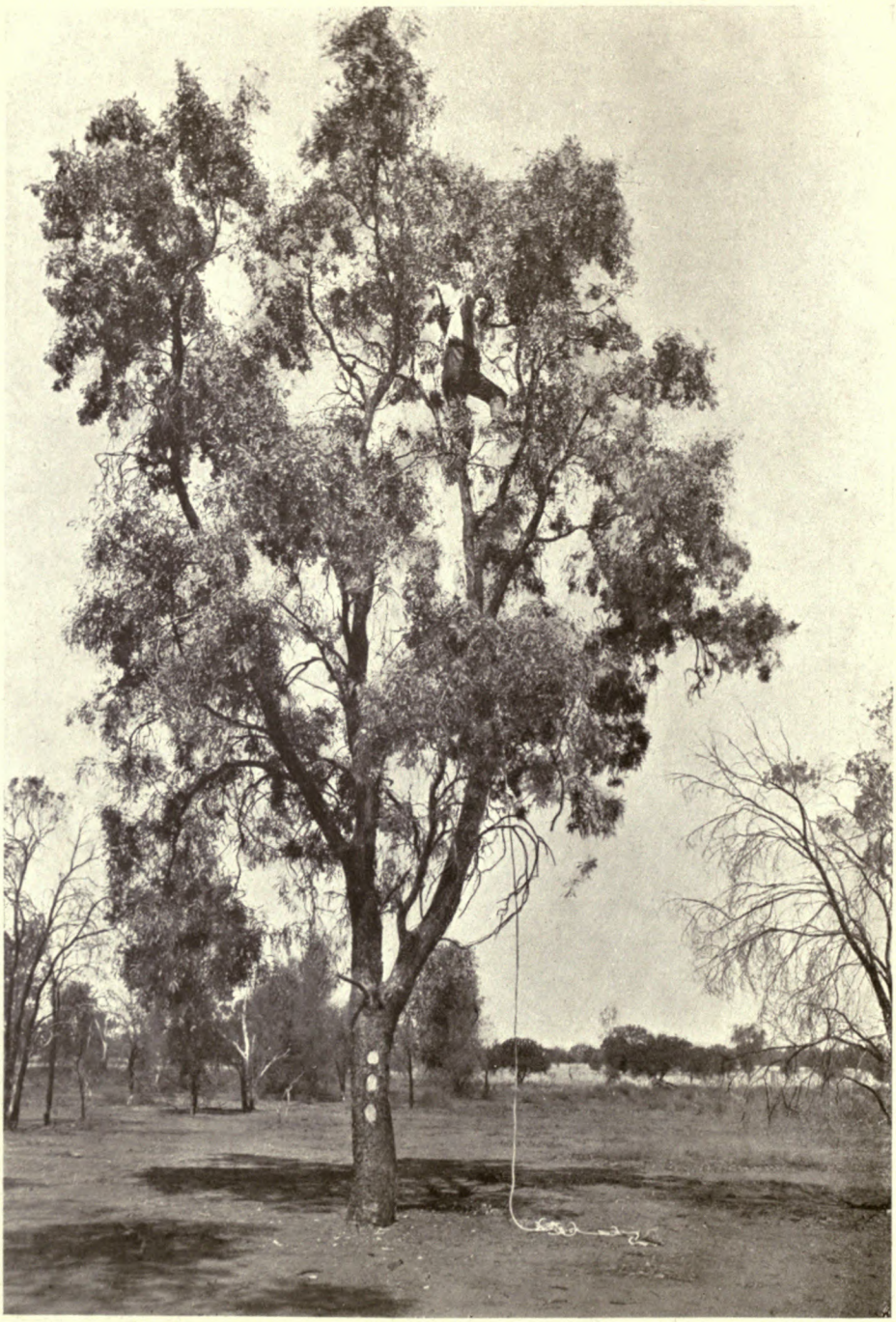
BUNARY TREE *(Heterodendron oleæfolium* DESF.), CAMBO CAMBO- COLLARENEBRI DISTRICT, N.S.W

308.5



H. Billington, photo.

WHITE WOOD *(Heterodendron oleæfolium)*, MOREE N.S.W.



Sid. W. Jackson, photo.

WHITEWOOD TREE *(Atalaya hemiglauca* F.v.M.), COLLARENEBRI DISTRICT, N.S.W.
(WITH CLUSTERS OF WINGED FRUITS.)



Sid W. Jackson, photo.

WHITEWOOD TREE *(Atalaya hemiglauca* F.v.M), COLLARENEBRI DISTRICT, N.S.W.
(WITH MASSES OF MISTLETOE.)



H. Billington, photo.

MYALL *(Acacia pendula* CUNN.), MOREE, N.S.W.



R. H. Cambage, photo.

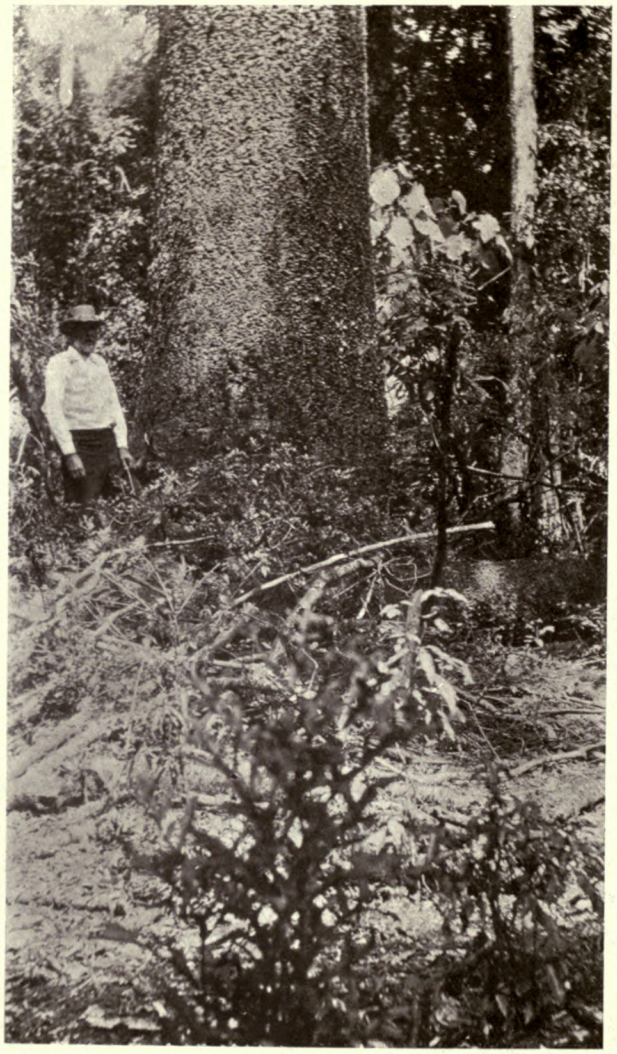
GROUP OF GIDGEE *(Acacia Cambagei)*, COWAN DOWNS, 120 MILES SOUTH OF NORMANTON, NORTH QUEENSLAND.



Std. W. Jackson, photo.

BARK OF HOOP PINE TREE *(Araucaria Cunninghamii)*, DORRIGO SCRUBS, N.S.W.

3087



HOOP PINE (*Araucaria Cunninghamii*). RICHMOND RANGE, NEAR CASINO, N.S.W.



E. Kent, photo.

TALLOW-WOOD TREE, 42 FEET GIRTH, HILL BROS. ESTATE, COMBOYNE, N.S.W.



H. Billington, photo.

MOTHERUMBUNG *(Acacia salicina* LINDL.), MOREE, N.S.W.



W. Gill, photo.

THE BROAD-LEAF MALLEE *(Eucalyptus Behriana)*, WARUNDA, HUNDRED OF MORTLOCK, SOUTH AUSTRALIA.



H. Billington, photo.

BIBBLE-BOX OR SHINING LEAF-BOX *(Eucalyptus populifolia)*, MOREE, N.S.W.

3089



Sid. W. Jackson, photo.

WATER VINE *(Vitis)* GROWING ROUND A HOOP PINE TREE *(Araucaria Cunninghamii)*, DORRIGO, N.S.W.



R. H. Cambage, photo.

NATURAL GRAFT OF *Eucalyptus tereticornis*, ON ORIGINAL BATHURST ROAD, BETWEEN SIDMOUTH VALLEY AND RAINVILLE CREEK, N.S.W.



R. H. Cambage, photo.

RIVER-BOX GROUP *(Eucalyptus microtheca)*, PADDY'S LAGOON, NEAR FLINDERS RIVER, ABOUT 80 MILES SOUTH OF NORMANTON, N. QUEENSLAND.

308 10



N. Stewart, photo

CORKWOOD *(Ackama Muelleri* BENTH.), PHEASANT CREEK,
via GLEN INNES, N.S.W.



H. L. Waterhouse, photo.

Jasminum lineare ON WHITE BOX, ATTUNGA, NEAR TAMWORTH, N.S.W.



K. Kennedy, photo.

Atherosperma moschata GROWING ON TREE FERN *(Dicksonia antarctica)*, RINGAROOMA, TASMANIA.



K. Kennedy, photo.

WIND BLOWN TREES, STANLEY, NORTH-WEST COAST, TASMANIA.



Sid. W. Jackson, photo.

A CYPRESS PINE *(Callitris robusta* R.Br.), AFTER A CYCLONE, CAMBO CAMBO STATION, COLLARENEBRI DISTRICT, N.S.W.

212341

Bot.
Flora
M.

Author Maiden, J. H.

Title The forest flora of New South Wales. Vol.6.

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