THE IDENTIFICATION OF THE PRINCIPAL IRONBARKS AND ALLIED WOODS.

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(With Plates XV-XVI and Text Figures.)

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Certain Eucalypts possessing a hard, rough, deeply furrowed bark are called Ironbarks. The timbers of some species possess great strength and durability, and are undoubtedly among our most valuable hardwoods for constructional purposes. Altogether about twenty species fall into the class Schizophrloide or Ironbarks, but of these the most important are *E. paniculata*, Sm., Grey or White Ironbark; *E. crebra*, F.v.M., Narrow-leaved Ironbark; *E. siderophloioa*, Benth., Broad-leaved Ironbark; *E. sideroxylylon*, A. Cunn., Red-flowering Ironbark or Mugga.

Two species of which the wood is frequently confused with that of the Ironbarks are *E. punctata*, D.C., and *E. propinqua*, Deane & Maiden; both trees have smooth barks and are known as Grey Gum. It is often a very difficult matter to identify the woods of these two groups with certainty, and it is, therefore, proposed to describe their structure in some detail.

R. T. Baker* described the anatomical characters of four Ironbarks, namely, *E. paniculata*, Sm.; *E. Fergusoni*, R.T.B.; *E. Nanglei*, R.T.B.; *E. Beyeri*, R.T.B.; the latter three being species allied to, and often mistaken for, *E. paniculata.*

It is very difficult to separate the woods on general external characters, although those constantly handling the timbers undoubtedly become very expert at their identification. A very useful list of tests which can be used to discriminate between the Grey Gum and Ironbark groups is given in a bulletin issued by the New South Wales' Forestry Department. Owing to variation which undoubtedly occurs in the weight, hardness, closeness of texture, and even to some extent in the colour, exceptions often occur to the general rules, which make the problem by no means an easy one. One test often quoted is the tenacity in breaking of a sliver of the wood, Grey Gum being said to be more brittle than the Ironbarks. This does not always hold, however (although *E. paniculata* is in general tougher than the other woods), and is quite unreliable. Similarly "interlocked grain" is not a constant character, although some woods are more prone to this feature than others. One of the most reliable indications is probably the presence of concentric "gum veins" in the wood of the Grey Gums, whereas they apparently do not occur in the wood of the Ironbarks. Although gum pockets may occur in the latter group, kino is usually confined to the bark, in this respect differing from practically all other Eucalypts. It should be noted, however, that gum veins are frequently absent from the timber of Grey Gum. The end checking of logs is often a useful indication, since Grey Gum normally splits radially, whereas Ironbark usually has small radial and concentric checks, breaking up the end surface into irregular squares.

A method of separation of the two groups which is sometimes mentioned depends on a supposed constant variation

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in their densities; thus a chip of Grey Gum is said to float, whereas the Ironbark sinks. The variation of the specific gravity in any one species renders such methods absolutely unreliable, and also misleading.

The principal macroscopic and microscopic features of the woods are given in the following descriptions:

E. PANICULATA, Sm.

White or Grey Ironbark.

A large forest tree found in the coast districts of New South Wales and Queensland. The wood is pale to brownish in colour, sometimes pinkish, moderately open textured, very heavy; weight per cubic foot 62-72 lbs. Hardness = Very hard.

Macroscopical characters.—Pores of medium size, easily seen with the naked eye, usually in oblique rows, more crowded at intervals, this constituting the only indication of growth rings. Soft tissue not apparent. Rays invisible on end section without pocket lens, more prominent on a radial face, being somewhat darker than the ground tissue.

Microscopical characters.—Pores usually single, often in oblique rows of 2–4; single pores elliptical; radial diameter 75–180μ; mean 130μ; tangential diameter 35–95μ, mean 80μ; vessel segments 100–400μ in length; walls 5–7μ; lateral pits not crowded, slit like, border often indistinct, circular or almost so, pits in contact with ray cells larger, irregular in shape, simple; end perforation simple; end wall transverse or slightly oblique; tyloses invariably present; average number per sq. mm., 16.

Wood fibres very thick walled, in radial rows, average diameter 15μ; lumen often reduced to 1μ; length 600–1,500μ; pitting slit like, definitely bordered and therefore corresponding to fibre-tracheids. Gradations occur from the fibre-tracheids to moderately thin walled
tracheids, which are irregular in shape, often blunt ended and measuring up to 700\(\mu\) in length by 15\(\mu\) in diameter; pitting crowded, bordered. Tracheids usually occur only in close proximity to the vessels.

Wood parenchyma diffuse or principally vasicentric, not abundant and less than in any other species, cells usually with dark contents. Chambered crystal parenchyma present.

Rays usually uniseriate, 1–14 cells in height; very rarely biseriate, and measuring up to 275\(\mu\) in height and 12\(\mu\) in width; cells moderately thick walled; usually with light greenish coloured amorphous contents, often with a tendency to become heterogeneous; 10–13 per mm. of transverse section. Smoulders to fawn-coloured ash, with little unburnt carbon*. Alcoholic extract pale yellow to yellow, no turbidity on adding water, no fluorescence. Aqueous extract yellow to brown, clear; bluish colouration with ferrous sulphate; slight precipitate with lead acetate.

**E. crebra, F.v.M.**

Narrow-leaved Ironbark.

A large forest tree found in the coast and part of the western districts of New South Wales, extending into Queensland and the Northern Territory. The wood is red in colour, often interlocked in grain, often moderately close in texture; very heavy, weight per cubic foot = 63–70 lbs. Hardness = Very hard.

*Macroscopical characters.*—Pores of small to medium size, easily seen with the naked eye, usually single, sometimes occurring in oblique rows; growth rings defined by

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*It is interesting to note that *E. Beyeri*, *E. Fergusoni* and *E. Nanglei* smoulder to a fawn ash, but leave a certain amount of unburnt carbon, especially in the latter case.*
the crowding of the pores in concentric unevenly spaced zones. Soft tissue not visible. Rays very fine, only visible on end section with lens, but easily visible on a radial surface, of very little difference in colour to surrounding tissue, not seen on a tangential section.

Microscopical characters.—Pores usually single, often in pairs, obliquely or radially arranged, single pores elliptical; radial diameter 35–200μ; mean 120μ; tangential diameter 25–125μ, mean 90μ; vessel segments 200–500μ; walls 5–7μ; lateral pits narrow, elliptical or slit-like, borders circular or elliptical, ray pits irregularly elliptical, simple; end walls almost transverse or slightly oblique; end perforation always simple; tyloses practically always present in heartwood, not in sapwood; pores often filled with dark amorphous phlobaphene-like body; number per sq. mm., 13–24. Wood fibres thick walled, in radial rows; average diameter 15μ, lumen very small, often reduced to 1μ; length 600–1,350μ, pits slit-like, bordered. Gradations occur between the fibre-tracheids which constitute the bulk of the wood and tracheids, the latter measuring up to 600μ in length and 30μ in diameter, with numerous bordered pits, or simple in contact with ray cells. Wood parenchyma not abundant, diffuse or vasicentric, cells usually with dark contents. Rays uniseriate or biseriate; uniseriate rays 2–14 cells in height, biseriate rays up to 450μ in height and 25μ in width; outer cells often somewhat irregular in shape, and deeper than middle cells; 11–14 per mm. of transverse section. Usually does not smoulder, all unburnt carbon, or sometimes with little ash. Alcoholic extract orange yellow; slight turbidity on adding water, no fluorescence. Aqueous extract yellow to brown, turbid; blue with ferrous sulphate; slight to heavy precipitate with lead acetate.
E. siderophloia, Benth.
Broad-leaved Ironbark.

A large forest tree found on the coast and portion of the interior of New South Wales and Queensland. Wood, red in colour, often somewhat open in texture; grain often interlocked; very heavy, weight per cubic foot = 65-73 lbs. Hardness = Very hard.

Macroscopical characters.—Pores small to medium in size, easily seen with the naked eye, usually single, often in irregularly oblique rows, crowded into lighter coloured concentric zones corresponding to growth rings. No soft tissue apparent. Rays very fine, not visible on end or tangential sections without lens, visible radially without difficulty, being darker than ground tissue.

Microscopical characters.—Pores usually single, occasionally in pairs, very variable in size and unevenly distributed; single pores usually elliptical, though often circular; radial diameter 55–180μ, mean110μ; tangential diameter 40–125μ, mean 90μ; vessel segments 300–450μ, walls very thick, 6–10μ; lateral pits in contact with tracheids, wood parenchyma and intravascular pits crowded, elliptical or slit-like, borders circular or elliptical, ray pits large, irregular rounded, simple; end perforation always simple; end wall transverse or slightly oblique; end projection short; tyloses usually present, cells often with brownish clear amorphous contents; number per sq. mm., 12–18. Wood fibres very thick walled in radial rows; mean diameter 15μ, lumen often reduced to 2μ; length 650–1,300μ; pits usually slit-like, very definitely bordered. Transition stages occur from these fibre-tracheids to irregularly shaped, often blunt ended tracheids with numerous bordered pits, simple in contact with rays; measuring up to 750μ in length and 18–35μ in diameter.
Wood parenchyma not abundant, diffuse or vasicentric; cells often with amorphous brown contents. Rays uniseriate or biseriate; uniseriate rays 2–18 cells in height; biseriate rays up to 25μ in width and 350μ in height, with a tendency to become heterogeneous, outer cells usually deeper; cells with reddish brown amorphous or granular contents.

Burns without smouldering, all unburnt carbon.

Alcoholic extract orange yellow; turbidity on adding water, no fluorescence. Aqueous extract yellow to light brown, turbid; bluish colouration with ferrous sulphate; very slight precipitate with lead acetate.

_E. sideroxylon_, A. Cunn.
Mugga, Red-flowering Ironbark.

A large forest tree with an exceptionally furrowed bark, found over a large area of New South Wales, Victoria and Queensland. Wood, reddish in colour, moderately open in texture, often with an interlocked grain; very heavy; weight per cubic foot, 60–70 lbs. Hardness = Very hard.

**Macroscopical characters.**—Pores small to medium in size, easily visible with the naked eye, single or often in oblique irregular rows, more crowded in portion of growth ring. No soft tissue apparent. Rays not visible on end or tangential section without lens, but easily seen on a radial surface, being darker in colour than the surrounding tissue.

**Microscopical characters.**—Pores usually single, rarely in pairs, obliquely or radially distributed; very variable in size and unevenly distributed; single pores elliptical, rarely circular; radial diameter 55–190μ, mean 125μ; tangential diameter 40–150μ, mean 110μ; vessel segments 150–350μ, walls 6–8μ; lateral pits crowded, more or less slit-like in contact with vertical wood elements, with circular or elliptical borders; large and simple in contact with ray cells;
end perforation simple; end walls transverse or slightly oblique; end projection wanting or small; tyloses abundant; number per sq. mm. 11–16. Wood fibres in radial rows, very thick walled; average diameter $14\mu$, lumen often reduced to $2\mu$; length 600–1,400$\mu$. Transition stages occur to heavily pitted tracheids measuring up to $700\mu$ in length and $18\mu$ in diameter. Wood parenchyma with tendency to form zones, diffuse or vasicentric; cells with dark amorphous contents. Rays mostly biseriate, up to $350\mu$ in height and $37\mu$ in width, but rarely exceeding $25\mu$; uniseriate rays 1–6 cells in height; cells with brown amorphous contents; rays often tend to become heterogeneous; 11–15 per mm. of transverse section.

Burns without smouldering, all unburnt carbon.

Alcoholic extract orange red; slight turbidity on adding water, no fluorescence. Aqueous extract brown, turbid; bluish colouration with ferrous sulphate; slight precipitate with lead acetate.

E. PUNCTATA, DC.

Grey Gum.

A large forest tree found in the coastal districts of New South Wales and Southern Queensland. The wood is reddish in colour, moderately close in texture, often interlocked in grain and very heavy. Weight per cubic foot, 61–65 lbs. Hardness = Hard.

Macroscopical characters.—Pores usually medium in size, easily seen with the naked eye, more crowded at intervals, often in oblique rows. Soft tissue not visible. Rays on end section often visible with naked eye as very fine lines, visible with difficulty on a tangential surface, readily seen on radial sections; darker in colour than ground tissue.

Microscopical characters.—Pores usually single, very rarely in pairs, very variable in size and uneven in distri-
bution; single pores usually elliptical; radial diameter 50–270 µ, mean 180 µ; tangential diameter 50–155 µ, mean 120 µ; vessel segments 240–500 µ; walls 4–6 µ; lateral pitting in contact with vertical elements crowded, slit-like; borders

Fig. 1.

a = Vessel segment, *E. propinqua*, showing a few simple and bordered pits × 140.  
b = vessel segment, *E. siderophloia*, pitting not shown, × 140.  
c = vessel segment *E. crebra*, showing a few of the pits, × 140. The vessels show the simple end perforation and the oblique or almost transverse end walls.

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circular or elliptical; ray pits rounded, simple; end perforation simple; end walls slightly oblique or transverse; end projection small or wanting; tyloses usually present; 10–20 per sq. mm. Wood fibres thick walled, in radial rows; mean diameter 14μ, lumen often reduced to 2μ; length 750–1,400μ; pits slit-like, bordered. Transitions occur to tracheids with numerous pits, usually bordered, except in contact with rays, and measuring up to 900μ in length and 30μ in diameter. Wood parenchyma abundant, diffuse or vasicentric, often crowded into zones; cells usually with dark contents. Rays usually biseriate, often triseriate, up to 375μ in height and 45μ in width; uniseriate rays 1–15 cells in height, cells with brown amorphous or granular contents; 8–12 per mm. of transverse section.

Burns without smouldering, all unburnt carbon.

Alcoholic extract orange to orange red; no turbidity on adding water, no fluorescence. Aqueous extract yellow to reddish brown, turbid; bluish green to green with ferrous sulphate, heavy precipitate with lead acetate.

**E. PROPINQUA, Deane & Maiden.**

Small-fruitied Grey Gum.

A very large forest tree found on the coastal district of northern New South Wales and Queensland. The wood is reddish in colour, moderately close in texture, often interlocked in grain and very heavy. Weight per cubic foot, 61–70 lbs. Hardness = Hard.

**Macroscopic characters.**—Pores small to medium in size, easily seen with the naked eye, more crowded at intervals, corresponding to growth rings, often in oblique rows. Soft tissue not visible. Rays not seen on end or tangential sections without the assistance of a lens, but easily seen on a radial surface, being darker than the ground tissue.
Microscopical characters.—Pores usually single, but often in pairs obliquely or radially arranged, very variable in size, distribution uneven; single pores elliptical; radial diameter 35–320μ, mean 160μ; tangential

Fig. 2.

diameter 37–200μ, mean 125μ; vessel segments 300–650μ; walls 4–6μ; lateral pits in contact with vertical elements crowded, border elliptical or circular; simple, rounded in contact with ray cells; end perforation simple; end walls transverse or slightly oblique, end projection small or wanting; tyloses abundant; number per sq. mm. 6–18. Wood fibres in radial rows, thick walled, average diameter 15μ, lumen reduced to 2μ; length 750–1,650μ; pits slit-like, borders elliptical or almost circular. Transition stages occur to irregularly shaped, often blunt ended tracheids measuring up to 800μ in length, and 26μ in diameter. Wood parenchyma abundant, principally vasicentric or diffuse; cells often with dark contents. Rays commonly biseriate, more rarely triseriate, up to 700μ in height and 33μ in width; uniseriate rays 2–16 cells in height; cells often with brownish amorphous contents, 11–14 per mm. of transverse section.

Smoulders without burning, all unburnt carbon.

Alcoholic extract orange yellow; sometimes turbid on adding water, no fluorescence. Aqueous solution yellow-brown, turbid; bluish green with ferrous sulphate, heavy precipitate with lead acetate.

From an examination of the microscopic structure of the woods it is evident that there are few features which appear to be of value for diagnostic purposes. The majority of the structures, for example wood fibres (fibre tracheids), tracheids and vessels do not exhibit any marked constant variation, one from another. Thus in a specimen of E. crebra from Dubbo the maximum radial pore diameter was 130μ, whereas in a piece of the same wood from Thirlmere, a region of higher rainfall, the maximum radial
diameter was 200\(\mu\). The variation in pore size in different parts of the same log has been mentioned in a previous paper.*

In every case the ground mass of the wood consists of wood fibres with more or less prominently bordered pits, the so-called fibre tracheids, which have not been found to exceed 1,700\(\mu\) in length. The fibres in the Eucalypts are

![Fig. 3.](image)

Portions of fibre ends showing typical interlocking serrations commonly found in *Eucalyptus* timbers. \(a = E.\) *paniculata* \(\times 560\). \(b = E.\) *paniculata* \(\times 640\). \(c\) and \(d = E.\) *crebra*, \(\times 130\).

by no means remarkable for their length, the toughness of certain species, e.g., *E. paniculata*, etc., seeming to depend on the development of interlocking serrations near the fibre ends. The development of bordered pits on the fibre cells is especially prominent in *E. siderophloia*. The tracheids are usually irregular in shape, often blunt ended with numerous bordered pits, where they are in contact with

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other tracheids or vessels, or with simple pits in contact with the ray cells. It is possible to find every gradation from prosenchymatous fibre-tracheids with comparatively few pits to spindle-shaped cells with more numerous bordered pits, and finally to the irregularly shaped, comparatively thin walled tracheids.

The vessel segments are exclusively with simple end perforation, and in the case of heartwood almost invariably plugged with tyloses (tyloses are absent in the sap-wood). The end walls are transverse or slightly oblique, and the end projection usually small or even wanting. Wood parenchyma is more abundant in the Grey Gums than in the Ironbarks. One feature which appears to be of some value in the identification of the woods is the ray. These are only visible with the naked eye in *E. punctata*, and are often triseriate in that species and in *E. propinqua*. In *E. paniculata* they are almost without exception uniseriate; in *E. siderophloia* and *E. crebra* they are both uniseriate and biseriate, whilst in *E. sideroxylon* they are chiefly biseriate.

It is interesting to note that with only one exception the woods of the species examined did not smoulder, but left a residue consisting practically of unburnt carbon; the exception, *E. paniculata*, smouldered away almost completely to a light coloured ash. This held good in all material tested. The extracts, both alcoholic and aqueous, were disappointing, as too much variation was found in the colour and behaviour of the individual species to make them of much value. One character worthy of note was the greenish colouration obtained by the addition of ferrous sulphate to the aqueous extracts of *E. punctata* and *E. propinqua*; however, exceptions to this might possibly be found.
The following key is based on what appear to be the principal points of difference, and summarises the investigation.

Fig. 4.

\[ a = \text{Wood parenchyma cell showing simple pitting, } E. \textit{siderophloia}, \times 600. \]
\[ b = \text{Wood parenchyma cell with thin cross walls, } E. \textit{paniculata}, \times 600. \]
\[ c = \text{Conjugate parenchyma cell, } E. \textit{siderophloia}, \times 390. \]
\[ d \text{ and } e = \text{Ray cells, } E. \textit{crebra}, \text{ showing simple pitting, } \times 600. \]
Key to the Timbers.

(a) Rays sometimes triseriate.

(b) Rays rarely triseriate, narrow, up to 700μ in height, not visible with naked eye on end section; wood parenchyma cell contents not prominent, chiefly vasicentric.  

E. propinqua.

(b₁) Rays often triseriate, broad elliptical, up to 375μ in height, often visible on end section with naked eye; wood parenchyma cell contents dark in colour, prominent, largely diffuse.  

E. punctata.

(a₁) Rays uniseriate or biseriate.

(c) Rays practically all uniseriate; wood pale to brown or pink in colour, not red, burns to ash.  

E. paniculata.

(e₁) Rays uniseriate or biseriate, wood red in colour, does not burn to ash.

(d) Rays practically all biseriate, short and broad, average width 30μ, uniseriate rays rarely exceeding 6 cells in height.  

E. sideroxylon.

(d₁) Rays uniseriate and biseriate, average width 15μ, uniseriate rays up to 18 cells in height.

(e) Pits on walls of fibre-tracheids prominent; rays darker than ground tissue on a radial surface.  

E. siderophloia.
Fig. 1.—*Eucalyptus paniculata* x 110.

Fig. 2.—*Eucalyptus sideroxylon*. x 110.
Fig. 1.—*Eucalyptus punctata.* x 110.

Fig. 2.—*Eucalyptus crebra.* x 110.
Pits on fibre-tracheid walls not prominent; rays practically same colour as ground tissue on a radial surface.

E. crebra.

EXPLANATION OF PLATES.

PLATE XV.

Fig. 1.—Longitudinal tangential section of wood of E. paniculata, Sm., showing typical uniseriate rays and portion of a vessel partially filled with tyloses. X 110.

Fig. 2.—Longitudinal tangential section of wood of E. sideroxyylon, A. Cunn, showing broad biseriate and a few short uniseriate rays. The pitting on the fibre-tracheid walls is prominent. Portion of a vessel is seen partially filled with tyloses. X 110.

PLATE XVI.

Fig. 1.—Longitudinal tangential section through wood of E. punctata, DC., showing triseriate rays. X 110.

Fig. 2.—Transverse section of sap-wood of E. crebra, F.v.M., showing complete absence of tyloses. The arrangement of the pores and the extreme variability in pore size is typical of the Ironbarks. The pitting in the walls of the vessels and fibre tracheids, etc., can be seen. The wood parenchyma is not abundant, and is vasicentric or diffuse. X 110.

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