

## Five new species of *Eucalyptus* from Western Australia

By M. I. H. Brooker\* and D. F. Blaxell†

### Abstract

Five new species of eucalypt are described—*Eucalyptus beardiana* and *E. gittinsii* from the Kalbarri-Shark Bay region, *E. johnsoniana* from the Eneabba sand-plain, and *E. georgei* and *E. cerasiformis* from east of Hyden. Their distribution and natural affinity are discussed.

***Eucalyptus beardiana* Brooker et Blaxell, sp. nov.** (Figures 1, 6). Pryor and Johnson code SIVAB.‡

*Frutex* 'mallee' ad 4 m altus, caulibus laevibus.

*Folia juvenilia* petiolata, non-opposita, lanceolata, 2-9 x 0.5-3.5 cm. *Folia adulta* petiolata, non-opposita, lanceolata, ad 15 x 1.5 cm.

*Inflorescentiae* axillares, 11-florae. *Pedunculus* c. 3 cm longus, recurvus, teretus. *Alabastra* 3-4 x 1 cm. *Hypanthium* hemisphaericum vel cupulatum, c. 1 cm longum. *Operculum* conicum attenuatum, c. 2 cm longum. *Filamenta* staminum connata in dimidio inferiore et androecium in totum deciduum. *Pedicelli* c. 1 cm longi. *Loculi* 5. *Ovula* 4-seriata.

*Fructus* pedicellati, hemisphaerici, 12-14 x 10-12 mm. *Valvae* exsertae. *Discus* latus, albidus, planus, leviter depressus.

*Type*: Northwest of 'Coburn' HS, south of Shark Bay, Western Australia (26° 42'S, 114° 08'E) 8 Oct. 1975, D. F. Blaxell W75/105 (holo: NSW; iso: K, FRI, PERTH).

A mallee to 4 m tall with smooth, grey bark.

*Cotyledons* bisected, petiole 4-5 mm, arms 5-7 mm. *Juvenile leaves* petiolate, not opposite, broadly lanceolate, 2-9 x 0.5-3.5 cm, green, slightly paler below. *Adult leaves* petiolate (1-2 cm long), not opposite, lanceolate, to 15 cm x 1.5 cm, lateral and intra-marginal veins not prominent. *Glands* obscure in dried material.

*Inflorescences* axillary, 11-flowered. *Peduncle* c. 3 cm long, terete, recurved. *Buds* 3-4 x 1 cm, hypanthium hemispherical to cup-shaped, c. 1 cm long, operculum conical-attenuate, c. 2 cm long. *Pedicel* c. 1 cm long. *Filaments* basally connate for about half their length, at first erect, and most finally inflected with anthers pendent in bud. *Androecium* deciduous as a whole. *Anthers* dorsifixed, oblong, opening in longitudinal slits. *Style* long, deeply inserted in tube formed by beak of operculum. *Locules* 5. *Ovules* in four vertical rows.

*Fruit* pedicellate, hemispherical, flaring at the top, 12-14 mm x 10-12 mm. *Disc* broad, whitish, flat, just below rim level. *Operculum* scars and *staminophore* c. 2 mm wide, horizontal. *Valves* exserted.

*Seed* irregular, light grey-brown, dorsal side rounded and shallowly and finely reticulate, ventral side with shallow ribbing and inconspicuous hilum. *Chaff* cuboid or subulate, reddish brown.

*Distribution*: Western Australia: northwest and south of Wannoo (South of Shark Bay on NW Coastal Highway).

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‡ Codes have been derived from the Pryor and Johnson classification (1971).

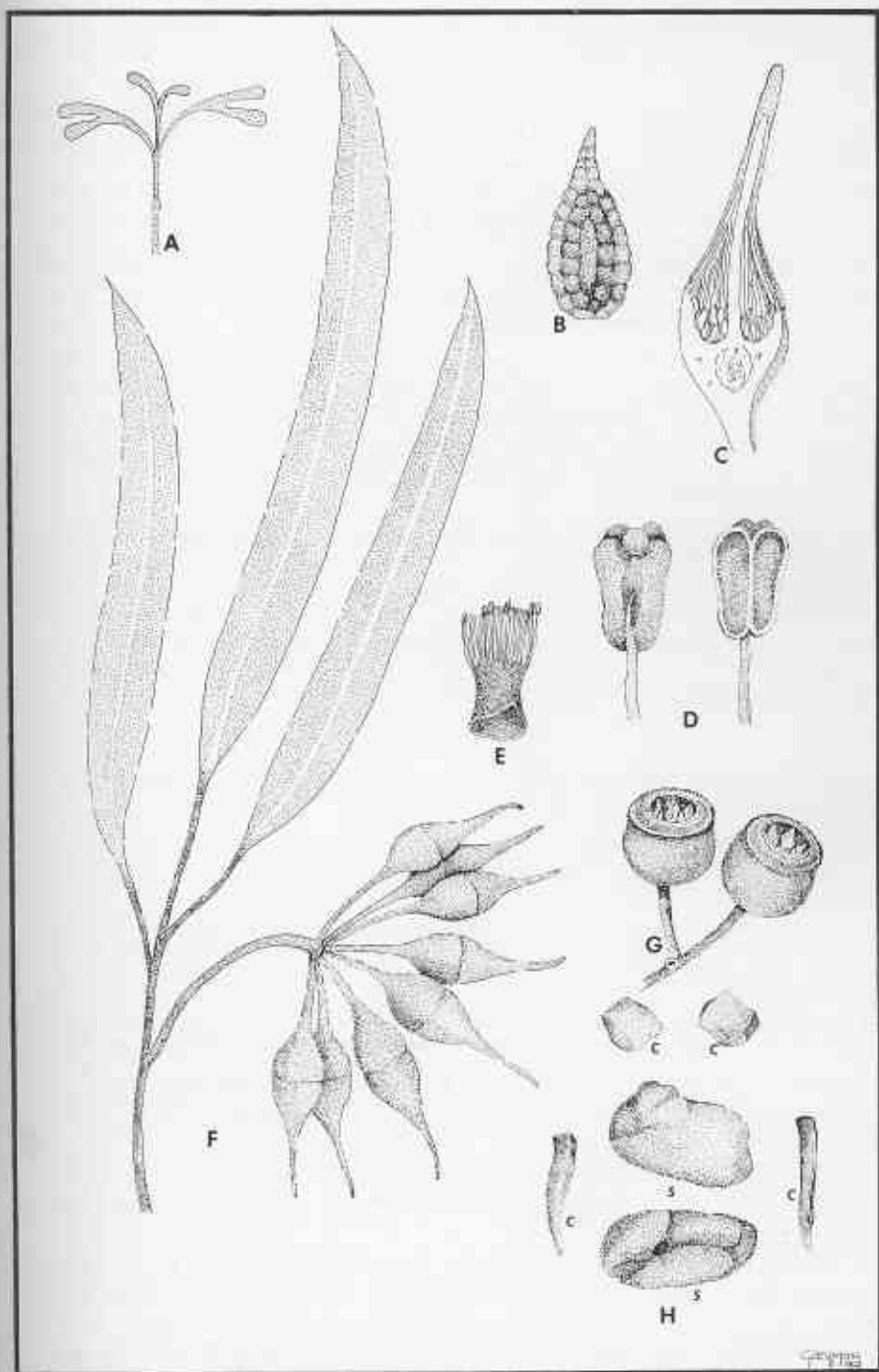


Figure 1—*Eucalyptus beardiana* sp. nov. A—Cotyledons, x 1. B—Ovules, x 30. C—Bud section, x 3. D—Anthers, x 25. E—Androecium (after falling whole), x 2. F—Adult leaves and buds, x 1. G—Fruit, x 1. H—Seed (s) and chaff (c), x 9. From J. S. Beard 7391 except for androecium and seed (MIHB 5014) and seedling grown from MIHB 5014.

*Other collections:* along a survey line  $\pm$  15 miles west of Coburn Station, 8 April 1975, *J. S. Beard* 7391 (FRI, PERTH); 71 km south of Wannoo (158 km north of Geraldton) (27° 30' S, 114° 45' E), 9 Oct. 1975, *D. F. Blaxell* W75/117A (NSW), *M. I. H. Brooker* 5023 (FRI, PERTH, NSW, AD, MEL) and *M. I. H. Brooker* 5024 (FRI, PERTH, NSW, AD, MEL).

Only two populations of this species are known to us at present; the Type locality and that 71 km south of the Billabong Roadhouse at Wannoo on the NW Coastal Highway. At the Type locality the site consists of low, red, sand dunes supporting a 'unique community, to be mapped as "Tree heath"' (J. S. Beard pers. comm.). Associated species here are *Eucalyptus roycei*, *Banksia ashbyi*, *Hakea stenophylla*, *Acacia longispina* and *Plectrachne danthonioides*. The southern population occurs in tall open-shrubland on yellow sand with occasional sand ridges supporting *Actinostrobus arenarius*, *Banksia sceptrum* and *Xylomelum angustifolium*.

*E. beardiana* belongs in the series MACROCARPAE of Pryor & Johnson. It appears to occupy a position near *E. leptopoda* Benth., one population of which (near Queen Victoria Spring) also has the character (almost unique in *Eucalyptus*) of connate filaments. It differs from *E. leptopoda* in the broader leaves, the larger buds and the larger fruit with the sunken though still broad and prominent disc.

The species is named after its collector, Dr. John Beard, formerly Director of Kings Park Botanic Garden, Perth and of the Royal Botanic Gardens, Sydney, who is currently mapping the vegetation of Western Australia. During the course of his travels into remote parts of the State he has discovered several new taxa of *Eucalyptus*, some of which have yet to be published. We consider it appropriate that his long association with the botany of Western Australia should be perpetuated by a species endemic to the State.

***Eucalyptus johnsoniana* Brooker et Blaxell, sp. nov. (Figs 2, 6). Pryor and Johnson code MADEJ.**

*Frutex* 'mallee' ad 2 m altus.

*Folia juvenilia* petiolata, opposita, ovata, 3-7 x 1-3 cm. *Folia adulta* petiolata, non-opposita, lanceolata, 5-12 x 1-1.5 cm.

*Inflorescentiae* axillares, 7-florae. *Pedunculus* c. 1 cm longus, complanatus vel teretus. *Alabastra* c. 10 x 5 mm. *Hypanthium* campanulatum. *Operculum* hemisphaericum interdum umbone parvo. *Pedicellus* c. 5 mm longus. *Antherae* dorsifixae oblongae. *Loculi* 3-4. *Ovula* 2-seriata.

*Fructus* pedicellati, hemisphaerici vel globosi, c. 1 x 1 cm. *Discus* verticaliter depressus. *Valvae* deltoideae, interdum leviter protrusae. *Semina* pyramidalia, alis prominentibus.

*Type:* 6 km south of Coorow-Green Head intersection on Highway 1, south of Dongara, Western Australia (30° 06' S, 115° 24' E) 7 Oct. 1975, *D. F. Blaxell* W75/89 (holo: NSW; iso: K, FRI, PERTH).

A mallee to 2 m high, forming dense and broad clumps up to several metres across. Bark slightly rough, grey-brown, peeling in strips from the stems.

*Cotyledons* orbicular to reniform, 8 x 6 mm. *Juvenile leaves* petiolate, opposite for c. 9 pairs, ovate, 3-7 x 1-3 cm. *Adult leaves* petiolate, not opposite, lanceolate, 5-12 x 1-1.5 cm, yellow-green, concolorous, with the midrib and leaf edges pale yellow-green. *Glands* obscure in dried material.

*Inflorescences* axillary, 7-flowered. *Peduncle* c. 1 cm long, terete or slightly flattened. *Mature buds* c. 10 x 5 mm, hypanthium campanulate, operculum hemispherical and sometimes with a small umbo, pedicel c. 5 mm long. *Stamens* inflexed in bud. *Anthers* dorsifixed, oblong. *Style* short. *Locules* 3-4. *Ovules* in 2 vertical rows.

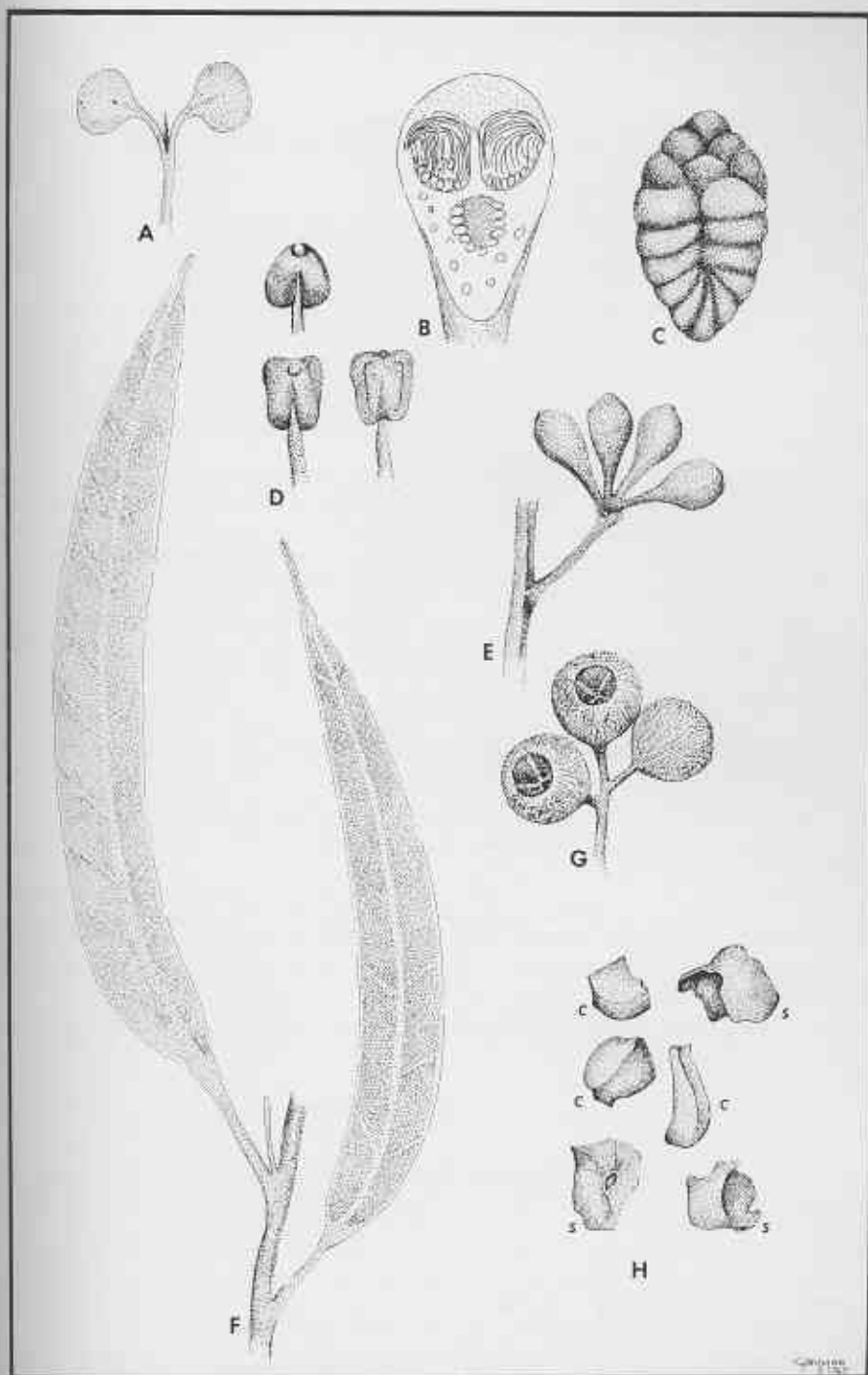


Figure 2—*Eucalyptus johnsoniana* sp. nov. A—Cotyledons, x 1. B—Bud section, x 6. C—Ovules, x 25. D—Anthers, x 25. E—Buds, x 1.5. F—Adult leaves, x 1.5. G—Fruit, x 1.5. H—Seed (s) and chaff (c), x 3.

From MIHB 5002 except for fruit and seed (MIHB 5033) and seedling grown from MIHB 5033.

*Fruit* pedicellate, hemispherical to globose, c. 1 x 1 cm. *Disc* vertically depressed inside the orifice. *Valves* deltoid, the tips occasionally protruding from the orifice.

*Seed* pyramidal, with conspicuous wings, brown, smooth on dorsal side, ribbed on ventral side. *Chaff* cuboid, yellow and brown.

*Distribution*: Western Australia: south of Eneabba, east of Jurien Bay.

*Other Collections*: 11·8 km south of the Coorow—Green Head road intersection with Highway 1, at the turn-off to Lara Downs (30° 09'S, 115° 26'E) 7 Oct. 1975, *D. F. Blaxell* W75/88 (NSW) and *M. I. H. Brooker* 5002 (FRI, PERTH, NSW, AD, K); Type locality, *M. I. H. Brooker* 5003 (FRI, PERTH, AD, MEL).

Only three small populations of this species are known to us, all along a 10 km stretch of Highway 1 south of Eneabba, and within a few metres of the road. The soil is white sand over laterite with little relief to the topography. The vegetation is closed-heath with isolated patches of *E. johnsoniana* and mallee forms of *E. todtiana* barely emergent amongst dense sclerophyllous shrubbery.

The affinities of this species are not clear, but we here tentatively erect a monotypic sub-series (Johnsonianinae) to be placed between Buprestinae and Marginatinae of the Pryor and Johnson classification (a re-coding of the five series, Preissianae to Acmenoideae, is required to accommodate the dozen or so new taxa of *Monocalyptus* which have been discovered in recent years).

The species is named after Dr. Lawrie Johnson, Director of the Royal Botanic Gardens, Sydney, who has contributed so much over the years to the knowledge of the genus, in particular his enlightening publications of recent years on classification and morphology.

***Eucalyptus georgei* Brooker et Blaxell, sp. nov.** (Figs 3, 6). Pryor and Johnson code SLE:B.

*Frutex* 'mallee' ad 3 m altus, caulibus laevibus, albis. *Medulla* ramulorum glandulifera.

*Folia juvenilia* petiolata, non-opposita, ovata ad lanceolata, 6–8 x 2–5 cm. *Folia adulta* petiolata, lanceolata, ad 15 x 6 cm, crassa.

*Inflorescentiae* axillares, 7-florae. *Pedunculus* ad 3 cm longus, crassus, glaucus. *Alabastra* 11–14 x 6 mm. *Hypanthium* obconicum, c. 7 mm longum. *Operculum* hemisphaericum, 3–4 mm longum. *Filamenta* primum erecta, demum deflexa. *Loculi* 5. *Ovula* 4-seriata.

*Fructus* campanulati, 12–15 x 9–11 mm, glauci. *Discus* latus, albidus, intro declivis. *Valvae* leviter exsertae. *Semina* rufa, nitentia.

*Type*: 159 km east of Hyden along the track to Norseman, Western Australia (32° 15'S, 120° 23'E) 3 Oct. 1975, *D. F. Blaxell* W75/45 (holo: NSW; iso: K, FRI, PERTH).

A whipstick *mallee* to 3 m high with smooth, whitish bark. Pith of branchlets glandular.

*Cotyledons* reniform. *Juvenile leaves* petiolate, not opposite, ovate to lanceolate, 6–8 x 2–5 cm, becoming intensely glaucous at about the 10th seedling leaf pair. *Adult leaves* petiolate, broadly lanceolate, thick and rigid, to 15 x 6 cm, pale yellow-green, concolorous. *Petioles* and proximal section of midrib densely glaucous. *Lateral venation* obscure. *Glands* prominent only on upper surface in dried material. *Young twigs* angular, densely glaucous, reddish brown beneath the waxy coating. *Pith* glandular.

*Inflorescences* axillary, 7-flowered. *Peduncle* thick, glaucous, up to 3 cm long, 2–3 mm diameter. *Mature buds* 11–14 x 6 mm, glaucous, sessile or with a short, thick pedicel. *Hypanthium* obconical, c. 7 mm long, *Operculum* hemispherical, 3–4 mm long with a short and obscure umbo. *Filaments* at first erect then inflexed. *Anthers* dorsifixed to sub-basifixed, oblong to obovate. *Locules* 5. *Ovules* in 4 vertical rows.

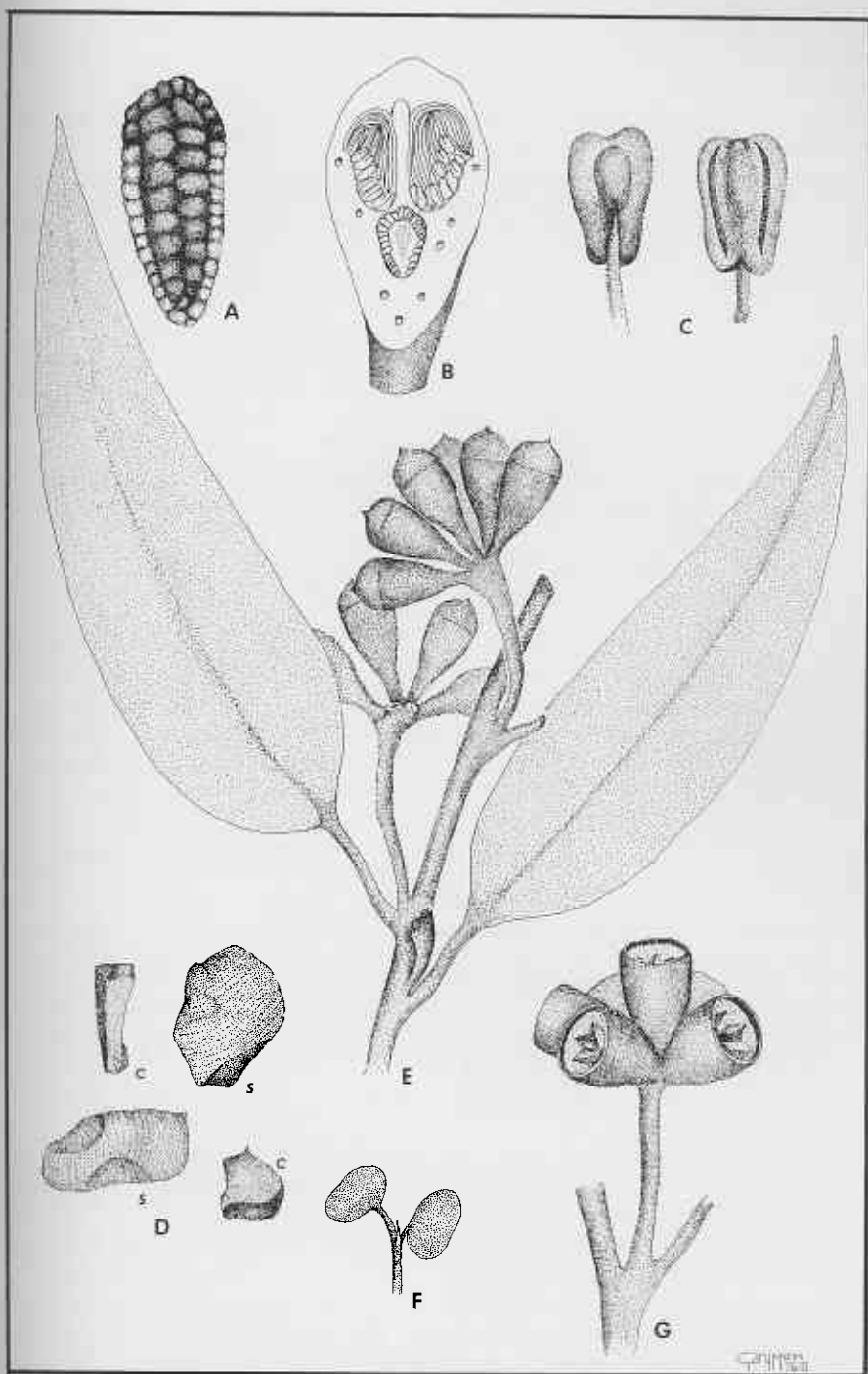


Figure 3—*Eucalyptus georgei* sp. nov. A—Ovules, x 10. B—Bud section, x 4. C—Anthers x 25. D—Seed (s) and chaff (c), x 10. E—Adult leaves and buds, x 1. F—Cotyledons, x 2. G—Fruit, x 1.

From MIHB 4989.

Fruit campanulate to almost cylindrical, densely glaucous, 12–15 x 9–11 mm, with a short, thick pedicel *c.* 2 x 2 mm. Disc broad, whitish, sloping inwards. Valves slightly exerted. Seed irregular, shining reddish brown, shallowly reticulate. Chaff cuboid and subulate, yellow and brown.

*Distribution:* Western Australia: between Hyden and Norseman, just north of the Johnston Lakes.

*Other Collections:* east of Mt Holland, July 1930, C. A. Gardner s.n. (PERTH, FRI); 315 mile peg Hyden—Norseman road, 26 Oct. 1964, J. S. Beard 3849 (NSW); Mt Holland area, 16 Aug. 1966, A. Kessell 408 (PERTH, NSW); 315–332 mile peg on Hyden—Norseman track, 16 Aug. 1966, A. Kessell 424 (PERTH, FRI); junction of the Bremer Range road and Hyden track, 4 Feb. 1970, A. Kessell 947 (PERTH, FRI, NSW, K); 159 km east of Hyden on Norseman track, 3 Oct. 1975, M. I. H. Brooker 4989 (FRI, PERTH, NSW, AD); cultivated, Broken Hill, N.S.W., 24 June 1971, R. Gould (NSW).

In the Type locality there are several hundred plants in a relatively small area of *c.* 1 hectare growing on a lateritic rise, a few metres above the extensive, surrounding sand plains. It forms a pure stand, but with an encircling low open-forest of *E. salubris* and *E. transcintentalis*. Growing with *E. georgei* are *Triodia scariosa*, *Casuarina* sp. and *Acacia* spp.

This species has been known as 'Hyden Blue Gum' for some time, and although occurring a long way east of Hyden, it seems appropriate to retain this common name.

The natural affinities of *E. georgei* are clear. It belongs in the Pryor & Johnson series DUMOSAE between *E. woodwardii* Maiden and *E. sheathiana* Maiden. The buds and fruit are intermediate in size between these two species and are always glaucous, whereas in *E. sheathiana* this character is variable. It has white flowers, unlike the lemon-coloured filaments of *E. woodwardii*.

The specific epithet honours A. S. George, a botanist at the Western Australian Herbarium, who has a great knowledge of the Western Australian flora, and who has assisted both of us in many ways. We consider it appropriate that Alex have an endemic western species named after him.

***Eucalyptus cerasiformis*** Brooker *et* Blaxell, sp. nov. (Figs 4, 6). Pryor and Johnson code SIF:G.

*Frutex* 'mallee' ad 3 m altus, caulibus laevibus. *Medulla* ramulorum glandulifera.

*Folia juvenilia* petiolata, non-opposita, lanceolata, 3–5 x 0.6–1.5 cm. *Folia adulta* petiolata, non-opposita, lanceolata, 6–8 cm x 0.5–1.2 cm, concoloria, glandulis prominentibus.

*Inflorescentiae* axillares, 7-florae. *Pedunculus* recurvus, 2–3 cm longus, gracilis, teretus. *Alabastra* *c.* 1 x 0.5 cm. *Hypanthium* urceolatum, 6–7 mm longum. *Operculum* conicum, 3–5 mm longum. *Pedicellus* 10–12 mm longus. *Filamenta* pro parte maxima inflexa. *Loculi* 4–5. *Ovula* ad 8-seriata.

*Fructus* pedicellati, cylindrico-hemisphaerici, 12–15 mm longi. *Discus* oblique depressus. *Valvae* inclusae.

*Type:* 164 km (by road) east of Hyden, on track to Norseman, Western Australia (32° 14'S, 120° 25'E) 3 Oct. 1975, D. F. Blaxell W75/51 (holo: NSW; iso: K, FRI, PERTH).

A mallee to 3 m high, with smooth, mottled, grey bark; young branches brown. Pith of branchlets glandular.

*Cotyledons* bisected. *Juvenile leaves* petiolate, not opposite, lanceolate, 3–5 x 0.6–1.5 cm. *Adult leaves* petiolate, not opposite, narrowly lanceolate, 6–8 cm x 5–12 mm, yellow-green, concolorous, uncinata. *Petiole* *c.* 1 cm long, terete, yellow-brown. *Mid-vein*, intramarginal vein and major lateral veins pale yellow-green. *Glands* prominent on both surfaces.

*Inflorescences* axillary, 7-flowered. *Peduncle* recurved, 2–3 cm long, slender, terete. *Buds* *c.* 1 x 0.5 cm. *Hypanthium* urceolate, 6–7 mm long.

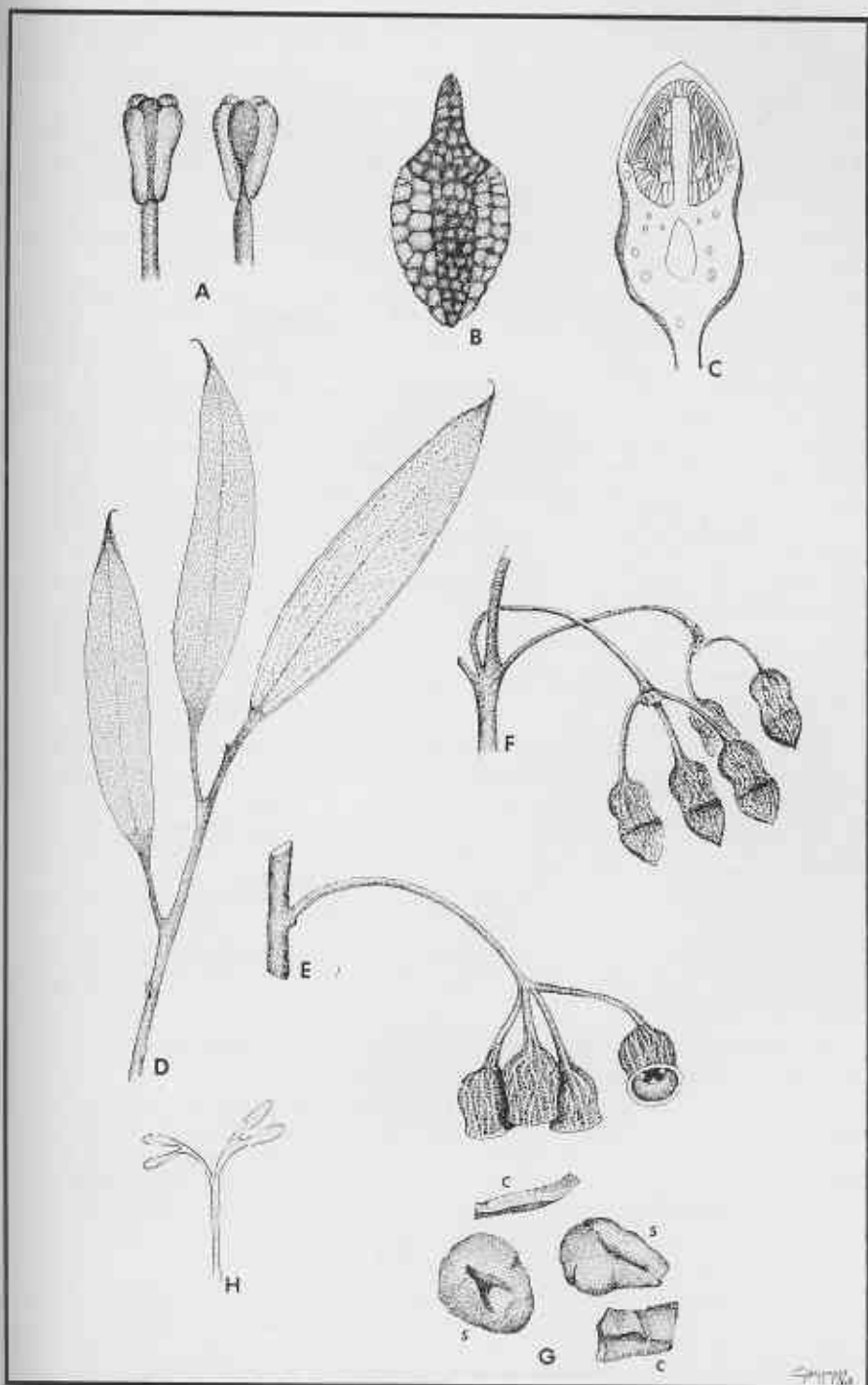


Figure 4—*Eucalyptus cerasiformis* sp. nov. A—Anthers, x 15. B—Ovules, x 10. C—Bud section, x 4. D—Adult leaves, x 1. E—Fruit, x 1. F—Buds, x 1.5. G—Seed (s) and chaff (c), x 20. H—Cotyledons, x 2.

From MIHB 4990.



*Operculum* conical, 3–5 mm long, brown or yellow-brown, contrasting with the green hypanthium. *Pedicel* terete, 10–12 mm long. *Stamens* yellow, most filaments inflexed in bud. *Anthers* dorsifixed, oblong to obovate. *Locules* 4–5. *Ovules* in 6–8 vertical rows.

*Fruit* pedicellate, cylindrical to hemispherical, slightly urceolate when immature, 12–15 mm long. *Disc* obliquely depressed. *Valves* depressed.

*Seed* ovoid, brown, with a shallow reticulum. *Chaff* cuboid, brown.

*Distribution*: Western Australia: between Hyden and Norseman, just north of the Johnston Lakes.

*Other collections*: 318 mile peg on Hyden–Norseman track, 8 Feb. 1967 A. Kessell 545 (PERTH, FRI, NSW, K); same locality, 3 Oct. 1975, D. F. Blaxell W75/51a (NSW), M. I. H. Brooker 4990 (FRI, PERTH, NSW, K, AD), M. I. H. Brooker 4991 (FRI, PERTH, NSW, AD, MEL).

We know of only one population of this species. It occurs in low open-forest on a reddish loamy soil in association with *E. redunca* and *E. salubris*. It does not seem to occur on the yellow or white sands which are more extensive in the region. The specific epithet is derived from 'cerasus' (Latin: cherry) in allusion to the 'bunch of cherries' appearance of the pendent inflorescences.

The affinities of *E. cerasiformis* are clear. It belongs in the series ERY-THRONEMAE of Pryor & Johnson and is close to *E. dielsii* C. A. Gardn. from which it is distinct in the smaller buds and fruit, fruit shape and particularly the absence of a flared rim to the fruit.

***Eucalyptus gittinsii* Brooker et Blaxell, sp. nov.** (Figs 5, 6). Pryor and Johnson code EAAAG.

*Frutex* 'mallee' ad 5 m altus, caulibus laevibus. *Medulla* ramulorum glandulifera.

*Folia juvenilia* petiolata, non-opposita, ovata, 4–8 x 2–4 cm. *Folia adulta* lanceolata, ad 15 x 3 cm.

*Inflorescentiae* axillares 3-florae. *Pedunculus* c. 1 cm longus. *Alabastra* c. 1 x 0.5 cm, quadrangulata. *Operculum* c. 2 mm longum. *Pedicellus* 0.5–1 cm longus. *Filamenta* staminum 4-aggregata. *Loculi* 3 (4).

*Fructus* pedicellati, quadrangulati, 1.5–2 x 1 cm. *Discus* latus, verticaliter depressus. *Valvae* inclusae.

*Type*: 67 km south of 'Billabong Roadhouse', Wannoo, Highway 1, Western Australia (27° 30' S, 114° 45' E) 9 Oct. 1975, D. F. Blaxell W75/113 (holo: NSW; iso: K, FRI, PERTH).

A *mallee* to 5 m tall with a small stocking of peeling rough bark, smooth grey-brown bark above. *Pith* of branchlets glandular.

*Cotyledons* ovate. *Juvenile leaves* petiolate, not opposite, ovate to elliptical, 4–8 x 2–4 cm, grey-green, densely pilose when young. *Petioles* and *internodes* also densely pilose with trichomes of the 'r(E)' type (Johnson 1972). *Adult leaves* petiolate (1–2 cm long), not opposite, lanceolate, concolorous, to c. 15 x 3 cm; lateral and intra-marginal veins prominent and yellowish in both fresh and dried material. *Glands* not prominent in dried leaves. *Young twigs* and *petioles* markedly angular and also yellowish.

*Inflorescences* axillary, 3-flowered. *Peduncle* c. 1 cm long, angular. *Buds* c. 1 x 0.5 cm, quadrangular; operculum c. 2 mm long, pyramidal. *Pedicel* 0.5–1 cm long, terete-angular, increasing in diameter distally. *Staminal filaments* in four groups, obliquely erect then deflexed radially with most anthers pendent in bud. *Anthers* dorsifixed, oblong to ovoid, opening in longitudinal slits. *Style* short, slender. *Locules* 3 (4). *Ovules* in 4 vertical rows.

*Fruit* pedicellate, markedly quadrangular, 1.5–2 x 1 cm; calyx remnants small, persistent, *Disc* broad, vertically depressed. *Valves* 3, deeply recessed.

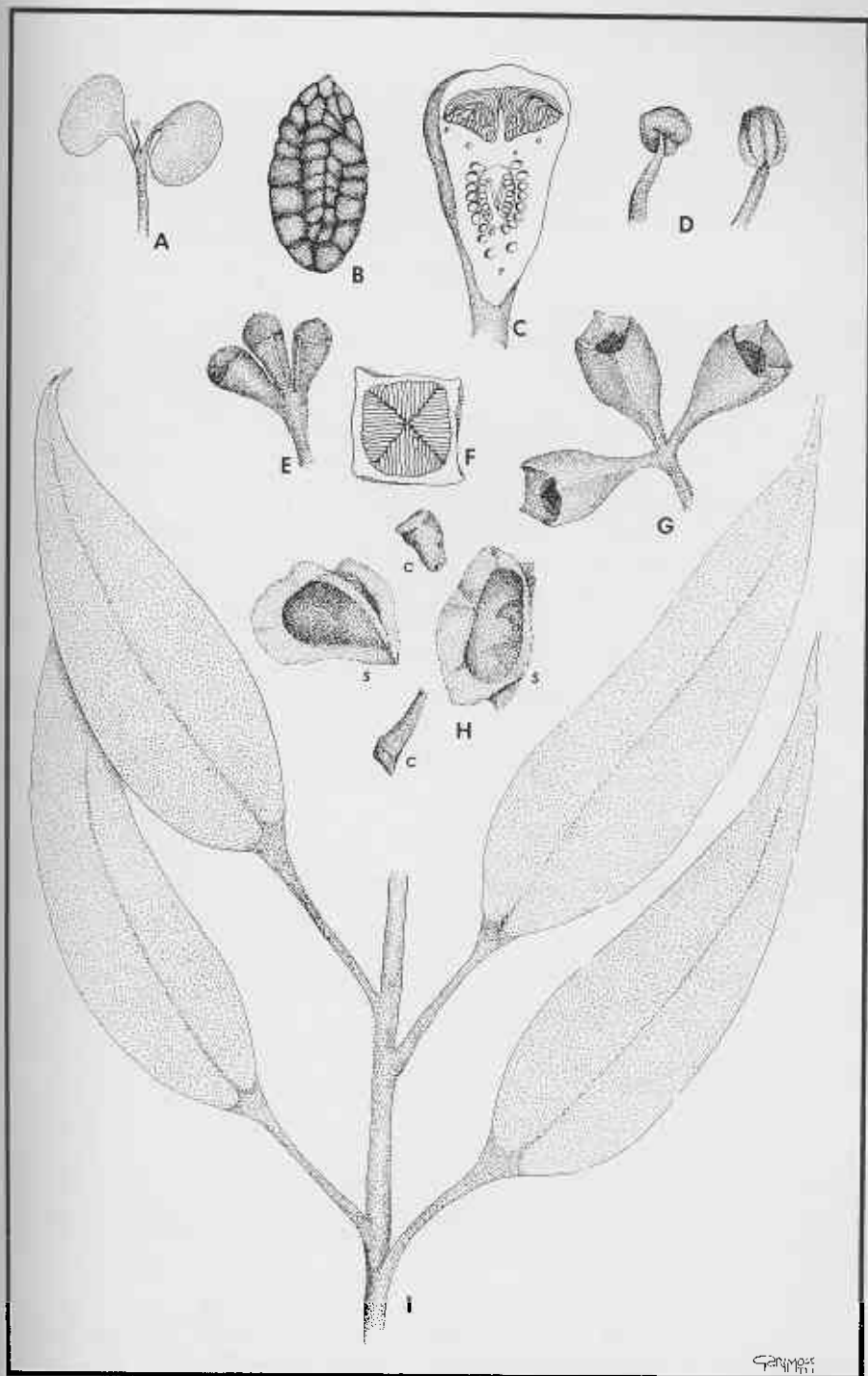


Figure 5—*Eucalyptus gittinsii* sp. nov. A—Cotyledons, x 2. B—Ovules, x 10. C—Bud section, x 4. D—Anthers, x 20. E—Buds, x 1. F—Filament arrangement seen from above with operculum cut away, x 4. G—Fruit, x 1. H—Seed (s) and chaff (c), x 7. I—Adult leaves, x 1.

From MIHB 5022 except buds (MIHB 2391).

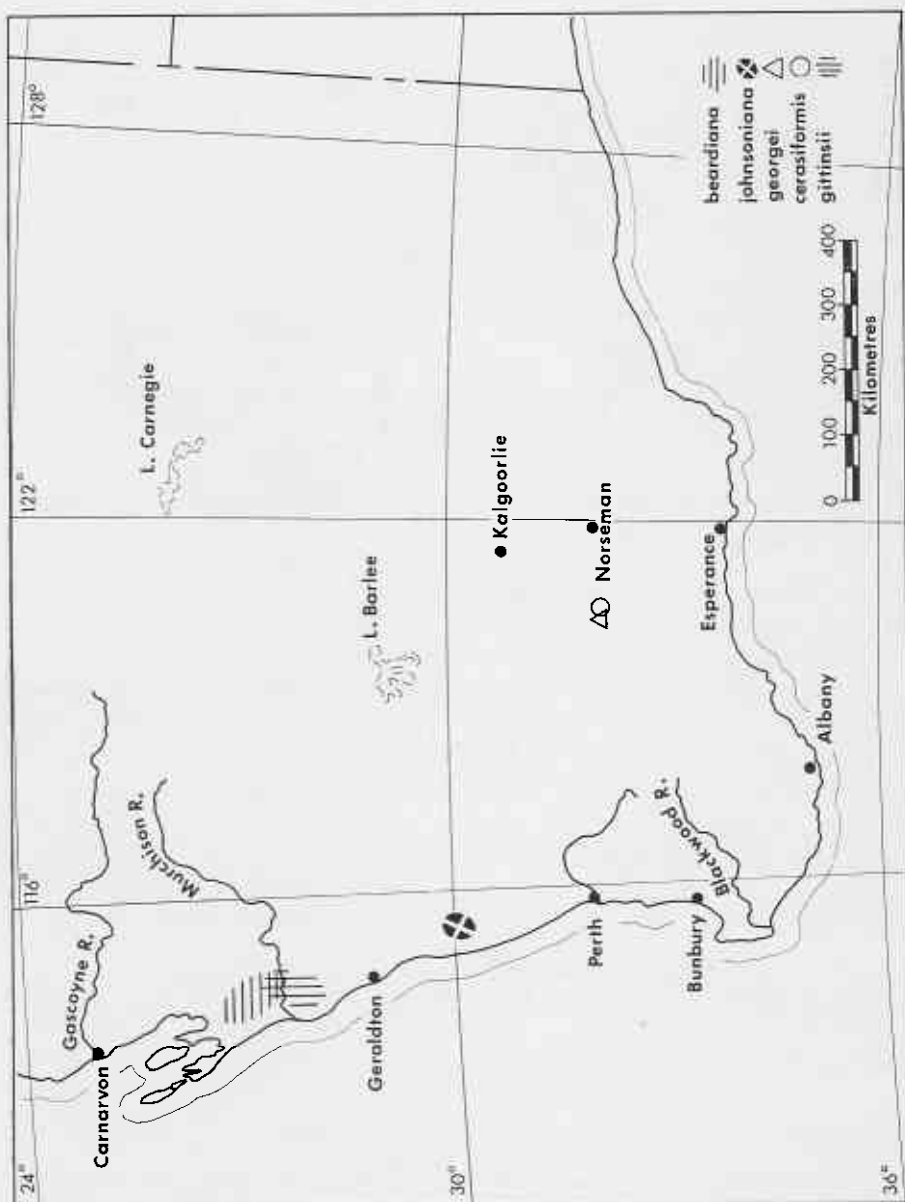


Figure 6—Distribution of *Eucalyptus beardiana* sp. nov., *E. johnsoniana* sp. nov., *E. georgei* sp. nov., *E. cerasiformis* sp. nov. and *E. gittinsii* sp. nov.

*Seed* pyramidal, black, smooth on the dorsal side with ribs ascending to the hilum on the ventral side; prominent hyaline wings around the edge. *Chaff* cuboid, black or red-brown, glistening, shallowly reticulate.

*Distribution*: Western Australia: north of Geraldton (on yellow sand country) and south of Shark Bay.

*Other collections*: 65.6 km (41 miles) south of Wannoo Roadhouse, Aug. 1967, C. H. Gittins 1562 (NSW); 69.6 km (43.5 miles) south of Wannoo, 17 Sept. 1968, M. E. Phillips, CBG 036807 (FRI); c. 40 km (25 miles) from main road on road to Kalbarri township, 9 Jan. 1970,

*M. I. H. Brooker* 2391 (PERTH, NSW, FRI); 413 mile peg on NW Coastal Highway c. 48 km (c. 30 miles) north of Murchison River crossing (27° 24'S, 114° 39'E), 21 Aug. 1973, *M. D. Tindale* 2742 (NSW); 65 km south of Wannoo on Highway 1, 9 Oct. 1975, *M. I. H. Brooker* 5022 (FRI, PERTH, AD); 71 km south of Wannoo, Northwest Coastal Highway, north of Geraldton, 9 Oct. 1975, *D. F. Blaxell* W75/118 (NSW, PERTH).

This is a relatively common species, at least on the yellow sand plain and sand-dune country south of Shark Bay to just south of the Murchison River. The vegetation formation is low open-woodland and associated species are *Eucalyptus jucunda*, *Actinostrobus arenarius* and *Banksia sceptrum*.

The affinities of *E. gittinsii* are clearly with *E. eudesmioides* F. Muell. on seedling characters alone. Adult specimens exhibit some characteristics of *E. odontocarpa* F. Muell., but the presence of 'stellate' trichomes on seedlings of both *E. gittinsii* and *E. eudesmioides* and their absence on *E. odontocarpa* confirms our placement of it next to *E. eudesmioides* in the Pryor and Johnson classification.

The species is named after its first collector (at least, to our knowledge), C. H. Gittins, a retired engineer from Epping in Sydney, who has visited many out-of-the-way regions of Australia over the past ten years or so, and who has carefully and meticulously collected many specimens for the National Herbarium of New South Wales and other institutions.

#### Acknowledgements

We wish to thank Dr J. S. Beard and Mr A. S. George for their help in many ways relating to field collections, checking material etc., Mr G. Moss for the illustrations and map; and Mr J. Turner for growing the seedlings.

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