Handbooks of the
FLORA OF
PAPUA NEW GUINEA

Volume II

Edited by

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Acknowledgements

With the appearance of this second volume of the Flora Handbooks, it is appropriate to recognize again the contributions made by workers overseas to the understanding of the Papuasian flora. In particular, direct contributions to this volume have come from Dr Brian Barlow, of Adelaide, and Dr Andrew Kanis, of Canberra. Dr Kanis also contributed to the first volume, and took part in the original planning of the project.

Some contributors, formerly attached to the Herbarium here, have moved on; their current addresses are given, for the convenience of interested persons.

Illustrations in this volume are the work of Faye Owner, Terry Nolan, Semeri Hitingnuc, Taikika Iwagu and Bore Doviong.

Those readers who are unfamiliar with botanical terms will find a glossary, the work of Dr N. M. U. Clunie, in Vol. I.

Abbreviations, Latin Words, Symbols

auct. non . . .	(*auctoris non* . . .) of a single author not . . .
c.	(*circa, circiter*) about
ed.	edition
ex	from
f.	figure
ic.	(icon) illustration
nom. cons.	(*nomen conservandum*) the name is conserved, according to the International Code of Botanical Nomenclature, against all names of the same rank, based on the same type.
nom. illeg.	(*nomen illegitimum*) illegitimate name
nom. nud.	(*nomen nudum*) a name published without a supporting description of the plant, or citation of a type specimen; it is not legitimate.
non	not
pl.	plate
p.p.	(*pro parte*) in part
sens. lat. (or s.l.)	(*sensu lato*) in the broad sense
sens. str. (or s.s.)	(*sensu stricto*) in the narrow sense
ser.	series
sp.	species (singular)
spp.	species (plural)
ssp.	subspecies
syn.	synonym: a name which has been used for the given taxon, but which is not legitimate.
t.	(*tabula*) plate
T.S.	transverse section
var.	variety
§	section
×	by; e.g. 5 × 4 cm: measuring 5 cm long and 4 cm wide
±	(*plus minusve*) more or less

BIXACEAE

J. Croft

Evergreen lepidote-glabrescent shrubs or trees. Leaves simple, alternate, spirally arranged, venation palmate; stipulate. Flowers bisexual, actinomorphic, in terminal bracteate corymbs or panicles, large and showy. Sepals (4–)5, free, imbricate. Stamens numerous, inserted on an annular disk; filaments free, filiform; anthers 2-locular, inverted U-shaped, passing over tops of filaments and closely applied to them, dehiscing by a short apical slit at the middle of each loculus. Ovary superior, free, usually bristly, unilocular with 2 opposite intruding placentas bearing numerous ovules. Style solitary, simple, sinuous, thickened upwards; stigma 2-dentate. Fruit a compressed, 2-valved, loculicidal capsule, mostly armed with long bristles; seeds numerous, obovoid, angular, testa with numerous red sessile glands.

Distribution: A monogeneric family native to South America, but introduced to many parts of the tropical world.

Literature: C. A. Backer (1951), Bixaceae, *Fl. Males.* ser 1, **4**(3): 239–41, f. 1–2. J. Hutchinson (1967), Bixaceae, *The Genera of Flowering Plants,* **2**, 197–8.

BIXA L.

Characters of the family.

Distribution: A genus of 1–4 species depending on the species concepts of different authors. *Bixa orellana* is the sole species in Papuasia and has been introduced by man in relatively recent times.

Bixa orellana L. *Sp. Pl.* 512 (1753). **Fig. 1.**

Shrub or small tree 2–10 m tall. Young twigs, inflorescences and leaves finely lepidote and ± glabrescent. Twigs rusty lepidote, glabrescent, terete, smooth, 4–5 mm diameter. Leaves remote, 3–5 cm apart, alternate, spirally arranged, simple, chartaceous, ovate to broadly so, (6–) 10–15(–16) cm, base cordate, rarely truncate, apex attenuate, margin entire; 5 main veins radiating from insertion of petiole, central vein with 4–7 pairs of looping lateral veins, flat or slightly raised above, strongly prominent below; petiole terete, glabrescent, 1–1·5 mm diameter, thickened at apex and base, 4–12 cm long; stipules lepidote, 5–8 mm long, narrowly triangular, soon caducous, leaving a pair of prominent almost annular scars at each node. Flowers bisexual, actinomorphic, in terminal several- to many-flowered bracteate panicles or corymbs, 6–15 cm long; bracts 5–10 mm long, soon caducous. Pedicels ± terete, densely

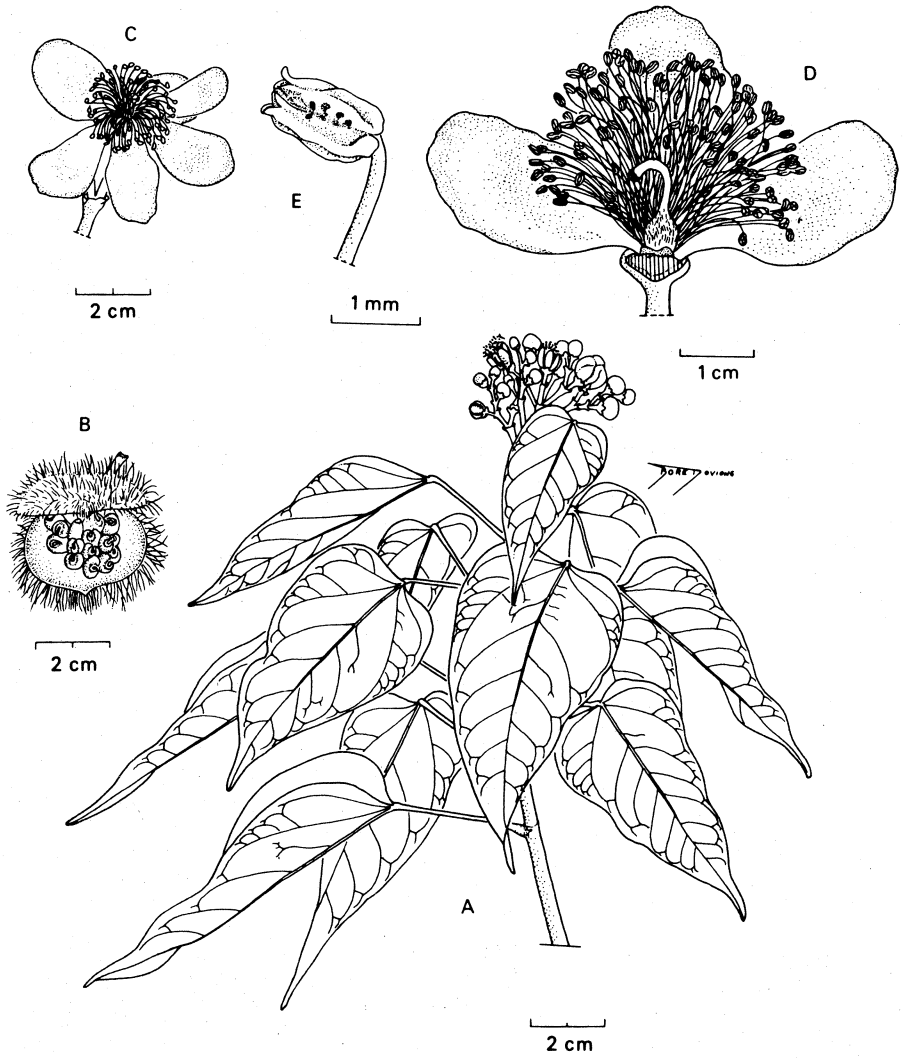

Fig. 1 **Bixa orellana** L. (A) twig with inflorescene (B) open fruit showing seed (C) flower (D) flower with nearer parts removed (E) stamen

reddish squamulose, 1–1·5 mm diameter, 5–8 mm long, swollen apically with 5(–6) large sessile glands, alternating with the sepals. Sepals (4–)5, free, imbricate, caducous, ovate to orbicular, spoon-shaped, 9–12 mm long, apex rounded, densely finely lepidote outside, sparsely so inside. Petals glabrous, (4–)5(–7), free, imbricate, ± unequal, thin papery, obovate, 2–3 × 1–2 cm, apex rounded or retuse, white, pink, lavender or mauve. Stamens numerous, filaments filiform, free, 10–15 mm long; anthers 1 mm long. Ovary ± globose, 2–3 mm high, with a dense covering of fleshy bristles, 1-locular with 2 parietal placentas bearing many ovules; style 10–15 mm long, thickened upwards curved in bud, stigma with 2 obscure teeth. Fruit a 2-valved loculicidal capsule, ovate to broadly so, 2–4 × 2–3·5 cm, with rounded, acute or acuminate apex, densely covered with bristles to 8 mm long; seeds numerous, obovoid, angular, 4–5 mm long, the seed coat producing a strong red dye.

Field characters: Crown open and spreading. Bark smooth, light grey to brown, often with lighter spots; inner bark straw with clear orange exudate. Wood straw. No odours recorded.

Distribution: A native of tropical America, introduced and naturalized throughout Papuasia.

Ecology: In gardens and secondary regrowth or disturbed forest to 2000 m altitude, on well-drained areas or margins of *Metroxylon* swamps. It is unquestionably naturalized in Papuasia but certainly owes its distribution to man. It can be expected in flower and fruit throughout the year, often on the same plant.

Uses: The seed coat produces a strong dye, annatto, that was previously used in the colouring of fabric, and is still used to colour butter and cheese. In Papuasia the dye is used for colouring bowls, grass skirts and string bags. It is also used for skin painting. The leaves are sometimes used to treat fever in children. The plant is also an attractive ornamental.

BOMBACACEAE

J. R. Croft

Trees, rarely shrubs, sometimes buttressed, sometimes armed (and sometimes, outside Papuasia, with bulging stems adapted to water storage). Leaves petiolate, alternate, distichous or spiral, simple or digitately compound, often lepidote or tomentose, stipules soon caducous. Flowers bisexual, generally large and showy, solitary or clustered, or in axillary or terminal umbels or panicles. Calyx cupular, campanulate or tubular, closed in bud, rupturing at anthesis to become truncate or irregularly lobed, often subtended by a ± persistent epicalyx or by 3 caducous bracteoles. Petals 5 (rarely, outside Papuasia, more or absent), often large, free, contorted (or induplicate outside Papuasia), adnate to the base of the staminal tube. Stamens mostly numerous (-5, outside Papuasia), united in varying degrees into a tube (or outside Papuasia, free); anthers 1-2-locular, free or adnate, reniform to linear, often twisted, medifixed, dehiscing by a longitudinal slit; pollen ± smooth or muricate. Ovary superior, sessile, 2-5-locular, ovules 1-many on the inner angle of each loculus; style subentire or with as many lobes as the ovary loculi; stigma capitate or not. Fruit a loculicidal capsule (rarely, outside Papuasia, a drupe); seeds often embedded in pairs in the inner wall of the fruit, naked or with a pappus of stiff or floccose hairs; aril sometimes present; endosperm little or lacking; cotyledons flat or contorted or plicate.

Distribution: About 30 genera with about 225 species, scattered throughout the tropics of both hemispheres. In Papuasia, 2 genera are native (*Bombax* and *Camptostemon*) and 3 have been introduced recently by man; *Ochroma* and *Durio* have been introduced within the last century and *Ceiba* was probably introduced before the arrival of Europeans.

Notes: The generic and familial limits of this diverse group are not at all satisfactorily resolved as yet. As construed by such authors as Bakhuizen van den Brink (1924) and Hutchinson (1967), the Bombacaceae is very difficult to separate from the Malvaceae, and in fact authors in the past have treated them as a single family, the Malvaceae.

Literature: R. C. Bakhuizen van den Brink (1924), Revisio Bombacacearum, *Bull. Jard. Bot. Btzg* ser.3, **6**: 161-232. A. J. G. H. Kostermans (1958), The genus *Durio, Reinwardtia* **4**: 47-150; (1960), Misc. Bot. Notes pt 1, *Papuodendron, Reinwardtia* **5**: 234-6. A. Robyns (1961), *Taxon* **10**(6): 156. J.S. Womersley (1963), The nomenclature of the Balsa tree, *P. & N.G. Agric. J.* **15**: 133-35. J. van Borssum Waalkes (1966), Malesian Malvaceae revised, *Blumea* **14**: 1-213. W. A. van Heel (1966), Morphology of the androecium in Malvales, *Blumea* **13**: 177-394. J. Hutchinson (1967), Bombacaceae, *The Genera of Flowering Plants* **2**: 522-35. W.S. Gruezo (1976), Javanese Bom-

bacaceae: morpho-anatomy of the bark, *Kalikasan* **5**: 357–74.

KEY TO GENERA

1. Leaves digitately compound, trunks often armed. Calyx with 3 caducous bracteoles only, no epicalyx. Deciduous.
2. Flowers larger than 5 cm diameter, with petals stellate-tomentose externally; solitary or in few-flowered lateral clusters; pedicels short and stout. Leaves 5–7-foliolate; petiolule 10–30 mm long, flattened above ..... BOMBAX
2. Flowers less than 3 cm diameter with petals woolly externally; in lateral or axillary clusters; pedicels filiform. Leaves 7–9-foliolate; petiolule 4–8 mm long, distinctly winged above. Introduced ..... CEIBA
1. Leaves simple, trunks unarmed. Calyx with 3 caducous bracteoles or with a lobed or truncate epicalyx. Evergreen.
3. Leaves ± cordate and sometimes angular-lobed, petiole swollen apically, venation at the base of the leaf 5–7-palmate. Calyx with 3 caducous bracteoles. Staminal tube densely covered from the middle to the apex with long sinuous sessile anthers. Introduced ..... OCHROMA
3. Leaves ovate to lanceolate, base rounded or cuneate, venation pinnate. Calyx subtended by lobed or truncate epicalyx. Staminal tube bearing free anthers on filaments.
4. Capsule woody, aculeate; seeds surrounded by a fleshy foetid/sweet smelling aril. Pollen smooth. Introduced cultivated trees ..... DURIO
4. Capsule smooth, densely lepidote; seeds with a pappus. Pollen echinate. Native trees in mangrove ..... CAMPTOSTEMON

BOMBAX L.

Deciduous, often buttressed trees, trunk often armed. Leaves spirally arranged, digitately 3–9-foliolate, leaflets entire, glabrous or with stellate hairs or sparingly lepidote. Flowers solitary or clustered, on young twigs, pedunculate; bracteoles 3, caducous. Calyx closed in bud, cupular to campanulate, truncate to deeply lobed, finally circumscissile at the base and falling with petals and stamens. Petals 5, oblong to obovate imbricate, adnate to the base of the staminal tube, tomentose or stellate-tomentose externally. Stamens numerous, arising in 5 bundles opposite the petals, connate basally into a tube, with or without an inner whorl of stamens around the style; anthers unilocular, strongly recurved, dehiscing along a peripheral slit; pollen ± smooth. Ovary sessile, 5-locular; ovules numerous, axile; style filiform, stigma 4–5-lobed. Fruit a ± woody loculicidal 5-valved capsule, axis winged, persistent; seeds small, numerous, densely floccose.

Distribution: A genus of about 8 species, native to the Old World tropics. The wild kapok tree, *Bombax ceiba* L., is the sole representative in Papuasia.

Bombax ceiba L. *Sp. Pl.* 511 (1753). **Fig. 2.**

B. malabaricum DC. (1824); *Salmalia malabarica* (DC.) Schott and Engl. (1832); *Gossampinus malabarica* (DC.) Merr (1927).

Deciduous trees to 45 m tall, although flowering as low as 10 m tall; buttresses to 3 m high often present; trunk often armed, especially in young trees. Twigs thick and woody, ± 1 cm diameter, pustular, bearing prominent leaf scars and clusters of horizontal rings marking the end of each growth period. Young leaves densely stellate-hairy, glabrescent, spirally arranged in apical clusters, the twig elongating rapidly 5–15 cm, spreading out the leaves. Mature leaves digitately 5–7-foliolate, petiole ± terete, striate, 10–28 cm long, 2 mm

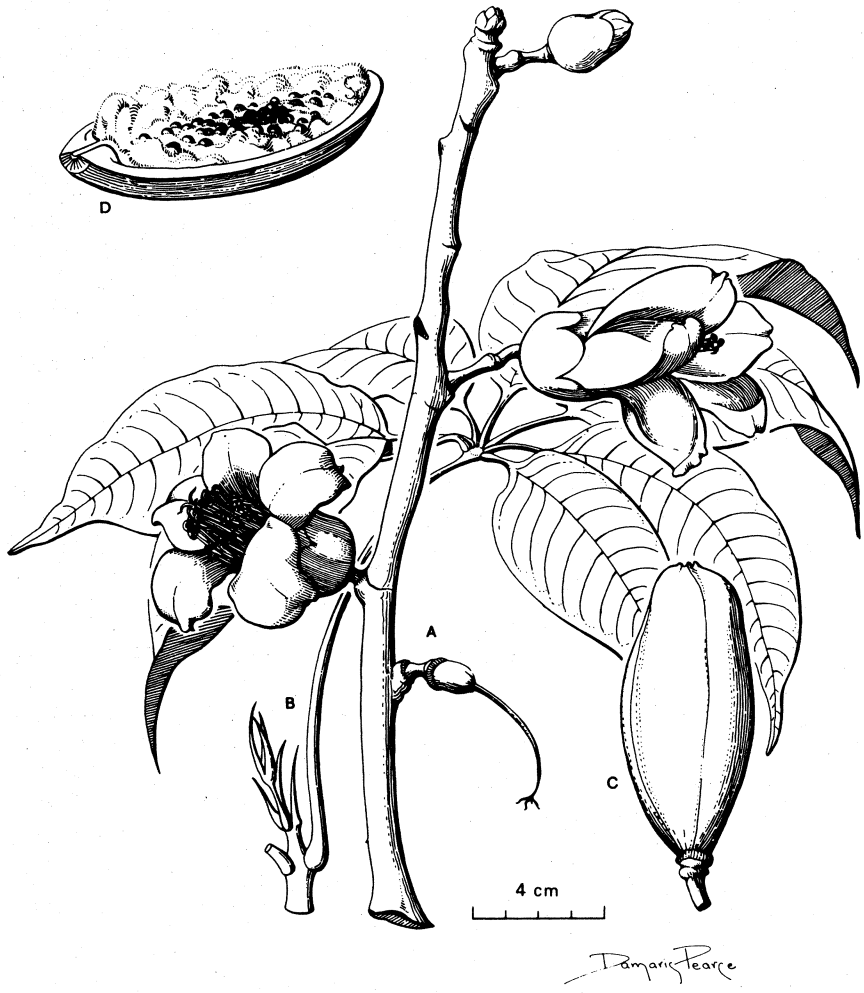

Fig. 2 **Bombax ceiba** L. (A) flowering twig (B) twig tip and leaf (C) fruit (D) opened pod showing seeds and fibre

diameter; leaflets chartaceous to thin-coriaceous, entire, elliptic to broad-elliptic, to 17 × 8 cm, glabrous, but a few scattered stellate hairs may persist along midrib and lateral veins; apex acute, rarely obtuse, mostly acuminate, base acute or obtuse, shortly decurrent into petiolule; midrib and lateral veins prominent below, less so above; lateral veins 11–22 pairs, looping towards the apex, tertiary venation a very fine tight reticulum, prominent on the lower surface; petiolule flattened above, 1–3 cm long, 1 mm diameter; stipules early caducous, deltoid, pilose or glabrous, ± 8 mm long. Flowers solitary, in defoliate leaf axils, towards the ends of leafless branches. Buds broadly ovoid, 2 × 2·5 cm prior to anthesis. Pedicel 1–2 cm long, 2–3 mm wide, ± terete, expanded apically bearing 3(–5) caducous bracteoles. Calyx completely closed in bud, tearing apically to become deeply 3–5-lobed and broadly campanulate at anthesis, glabrous externally, densely pilose internally, especially basally, finally circumcissile at the base and falling with the petals and stamens; orange-brown to red or yellow-green when mature. Petals 5, entire, free, imbricate, obovate, 5–9 × 2–4 cm, rounded apically, adnate to the staminal tube, densely stellate-tomentose outside, sparsely so inside, bright red to crimson. Stamens in 3 whorls connate basally into a short stout tube; anthers black, unilocular, strongly revolute, medifixed, ± 2 mm long, dehiscing along a peripheral slit; pollen ± smooth; filaments yellow, 1·5–5 mm long. Ovary glabrous, or with a tuft of stiff hairs at the base of the style or densely stellate-tomentose, ± conical, ± 5 mm long; style filiform, glabrous, 4–7 mm long; stigma with 5 acute lobes ± 5 mm long. Capsule pendulous, 5-valved, loculicidal, ± woody, ellipsoid, 7–12 × 4 cm, each valve ± 2·5 cm wide, shedding seeds while on the tree; seeds numerous, dark, broadly ovoid, ± 3 mm long, densely floccose.

Field characters: Bole straight and slender to 25 m long, and 1·2 m diameter. Plank buttresses to 3 m high and 1·5 m wide may be present. Short stout spines or thorns are often present on the trunks of younger trees, but these vanish as the trees age. Crown open, conical or later broad and spreading, branches whorled, horizontal. Bark smooth and rippled to rough with irregular vertical fissures or cracks, pustules or corrugations, often peeling in coarse angular flakes, green-grey to brown. Underbark red, red-brown, green or marbled red-cream-yellow-green. Inner bark to 2 cm thick, soft and fibrous, red to orange, or pink or straw with orange or red flames. No odours or exudates have been reported. Sapwood is not differentiated from heartwood, soft and light, pale brown to straw.

Distribution: India and Ceylon through Malesia to Guadalcanal in the Solomon Islands. On mainland New Guinea most collections are from the Port Moresby and Lae areas and the Markham and Bulolo Valleys.

Ecology: From sea level to 700 m altitude, mostly on alluvial and coastal plains, often in disturbed or regrowth forest associated with *Octomeles, Terminalia, Alstonia* and *Dysoxylum* or with *Dracontomelon* and *Celtis.* The tree is completely leafless when in flower, new growth commencing after the fruit is mature. It is sometimes locally dominant and when leafless gives the forest an unhealthy appearance. It is reported as being deciduous in the dry season (Port Moresby area), flowering specimens being available from

June to September; fruit can be expected from October to January and leafy trees from October to May. The spectacular red flowers are reported to be attractive to butterflies and several species of birds, which presumably act as pollinators.

Uses: The timber is not usually sawn but would be suitable for form work and cases. Large logs in the past have been peeled for veneers. The woolly covering of the seeds ('wild kapok') can be used for stuffing pillows, mattresses, life belts, etc. The fibre of this species is not as resilient as the commercial kapok, *Ceiba pentandra.*

CAMPTOSTEMON Mast.

Lepidote evergreen mangrove trees or shrubs, often with plank pneumatophores. Leaves spirally arranged, simple, entire, narrow-elliptic or obovate, densely lepidote below. Flowers small, in axillary umbels, densely lepidote externally. Calyx and epicalyx cupular, completely closed in bud, splitting at anthesis to give an irregular or 3-lobed lip; persistent in fruit. Petals 5, lepidote externally, oblong, adnate to base of staminal tube. Staminal tube terminating in numerous short filaments each bearing a unilocular reniform anther dehiscing by a peripheral split; pollen echinate. Ovary lepidote, sessile, 2-locular, 1 ovule in each loculus; style columnar, divided apically into 2 lobes, each lobe with 2 or 3 lobed stigmas. Fruit a loculicidal capsule containing 1 or 2 floccose seeds.

Distribution: A genus of 2 or 3 species from northern Australia and southern New Guinea to Borneo and the Philippines. *Camptostemon schultzii* Mast. is the only species in Papuasia.

Camptostemon schultzii Mast. in Hook. *Icon. Pl.* **12**: 18 (1872), f. 1119. **Fig. 3.**
C. aruense Becc. (1889); *C. philippinensis* auct. non (Vidal) Becc.: Steenis.

Evergreen tree 8–33 m tall, generally unbuttressed, pneumatophores may be present. Innovations densely lepidote. Twigs ± terete, 3–5 mm diameter, irregularly pustular, lepidote, slowly glabrescent. Leaves spirally arranged, often tending to be loosely clustered towards the ends of twigs, simple, entire, elliptic to lanceolate-elliptic, 2–5 × 6–16 cm, apex mostly acute and slightly apiculate, sometimes rounded and even retuse, base obtuse-cuneate or attenuate, persistently densely lepidote below, soon glabrescent above; midrib flat to slightly sulcate above, strongly prominent below, 8–12 pairs of looping lateral veins slightly prominent on both surfaces on dried material; petiole ± terete or slightly grooved above, ± 1·5 mm diameter, ± 2 cm long dilated apically; stipules early caducous, densely lepidote, linear-lanceolate, ± 1 cm long. Inflorescences axillary umbels of 3–7 flowers, peduncle ± terete, 1.5 mm diameter, 4–6 mm long. Buds densely lepidote, globular, ± 5 mm diameter, ± completely enclosed by epicalyx. Calyx completely closed in bud, breaking apically and becoming cupular with an irregular rim at anthesis, 3 mm long, densely lepidote externally, internally pilose, especially basally; subtended by a cupular epicalyx 2 mm long with an irregular rim, lepidote externally, glabrous internally. Petals 5, free, imbricate, adnate to staminal tube, obovate-oblong, 5–6 mm long, golden-lepidote externally, white inter-

Fig. 3 **Camptostemon schultzii** Mast. (A) twig with flower buds (B) twig with fruit

nally and glabrous but for a basal tuft of white hairs. Staminal tube 5 mm long, terminating in ± 20 anthers on filaments 2 mm long, glabrous but for tufts of white hairs at the junction with the petals; anthers unilocular, reniform, medifixed, ± 1 mm long, dehiscing by a circumferential slit; pollen echinate. Ovary broadly ovoid, 1·5–2 mm long, style columnar, 3 mm long, apically 2-lobed, each short lobe bearing 2 or 3 irregular stigmatic lobes, subtended by fine white hairs. Capsule obovoid, lepidote, loculicidal, 2-locular, 1–1.5 cm long, containing 1 or 2 light brown seeds ± 1 cm long with an irregular floccose pappus; calyx and epicalyx persistent.

Field characters: The trunk can be fluted or flanged to about 3 m and can be up to 12 m long, usually straight; low wide buttresses may be present, or numerous knobby flattened pneumatophores to 30 cm high and 20 cm wide. The crown is deep, but moderately sparse and open. The leaves have a tendency to be 'dished'. Bark smooth to scaly, often with interwoven longitudinal fissures; vertical lines of pustules may be present. Outer bark light to dark grey; underbark red (but reported to be green on young trees); inner bark pale straw to pink to reddish-brown or red with a 'pleasant vegetable-like smell' reported. There are no records of exudates. Wood white to pale straw, soft, with no differentiation between sapwood and heartwood.

Distribution: The coastal regions of northern Australia and southern New Guinea south of the Fly River and in the Gulf district in the Purari River delta.

Ecology: Common or scattered in mangrove forests, sometimes forming almost pure stands, often associated with *Bruguiera* and *Rhizophora.* Prefers brackish conditions rather than marine. In spite of the strong seasonality of rainfall in its area of distribution, there appears to be no seasonality of flowering or fruiting.

Uses: A light-coloured soft timber suitable for moulding and interior finish.

Notes: C. schultzii could possibly be confused with *C. philippinensis* of Borneo, Celebes and the Philippines, but *C. philippinensis* has leaves that are obovate to broadly so and persistently scaly on the upper surface.

CEIBA Plum. ex Mill.

Deciduous trees, trunks with spines or unarmed. Leaves alternate, digitately 3–7-foliolate, leaflets entire, glabrous; stipules soon caducous. Flowers solitary or clustered, axillary or subterminal. Calyx cupular, truncate or irregularly 3–5-lobed, persistent. Petals oblong, externally pubescent or woolly, adnate to the base of the staminal column. Staminal column naked, short, conical or cylindrical, divided apically into 5 branches each bearing 1–3 anthers, loculi adnate, linear or wavy, in each branch stimulating a single stamen; pollen ± smooth. Ovary sessile, 5-locular, each loculus with many ovules; style filiform; stigma capitate or clavate or shortly 5-lobed. Fruit a woody or coriaceous capsule, loculicidal, 5-valved, internally densely woolly; seeds numerous, obovoid or globose, encircled by the wool of the endocarp; testa crustaceous, smooth; endosperm very thin or absent.

Distribution: A genus of about 10 species native to tropical and subtropical America. The commercial kapok (*Ceiba pentandra* Gaertn.) has been introduced into areas of Africa and Asia and may be found in inhabited coastal areas of mainland New Guinea, the Bismarck Archipelago and the Solomon Islands.

Ceiba pentandra (L.) Gaertn. *Fruct.* **2**: 244 (1791). **Fig. 4.**

Bombax pentandra L. (1753); *Eriodendron anfractuosum* DC. (1824); *Bombax ceiba* auct. non L.: Warb.

Evergreen tree to 25 m tall; trunk often with stout spines; branches whorled, horizontal or ascending. Twigs ± terete, with leaf scars exhibiting regular phases of growth. Leaves spirally arranged, towards the ends of the branchlets, digitately 7–9-foliolate; petiole terete, 10–20 cm long, 1·5–2·5 mm diameter; leaflets chartaceous to thin coriaceous, entire, elliptic to obovate-elliptic, to 15 × 14 cm, glabrous, apex acute or acuminate, narrowly apiculate, base acute, decurrent into petiolule; midrib and 8–10 pairs of looping lateral veins prominent on both surfaces; petiolule rounded or 2-angled below, narrowly winged above; stipules soon caducous leaving 2 prominent lateral scars on either side of the insertion of the petiole. Flowers in lateral or axillary clusters of 4–15; pedicels filiform, 2–4 cm long, ± 1 mm diameter, with 3 distal bracteole scars. Calyx leathery, completely closed in bud, ± 8 mm diameter, rupturing apically to become irregularly 5-lobed and ± campanulate, glabrous externally, sparsely hirsute internally but for a basal pilose band ± 5 mm wide, gradually decurrent into pedicel. Petals white, free, imbricate, entire, obovate, 1 × 1·5 cm, hirsute externally, internally less so apically and glabrous basally; adnate to the base of the staminal tube. Staminal tube conical and slightly longer than the ovary, divided distally into 5 lobes 8–10 mm long, opposite the petals, each bearing 2–3 contorted unilocular ± united anthers, the whole unit thus resembling a stamen. Ovary sessile, conical, glabrous, ± 2·5 mm long, 5-locular, each locule bearing many ovules; style filiform, obscurely 5-ribbed, constricted above the ovary; stigma clavate, minutely 5-lobed. Fruit a ± woody 5-valved loculicidal capsule, sometimes incompletely so, the inner surface of each valve densely floccose and enveloping the seeds.

Field characters: The bark is green to greenish-grey externally and the trunk may be armed with prickles. The crown is open and thinly foliaged, pagoda-like in form, i.e. branches horizontal and ± layered, although certain strains have ascending branches.

Distribution: A species native to tropical America, cultivated throughout the tropics. In Papuasia it can be found in such areas as old gardens or village sites by the coast; widely established, although not often collected.

Ecology: A tree of the lowland and coastal regions rarely seen away from human settlement. The leaves tend to fall as the drier season starts and the flowers mature; by the time new leaves are developing the fruit is reaching maturity. Probably pollinated by bats that have been seen to visit the flowers at dawn and dusk.

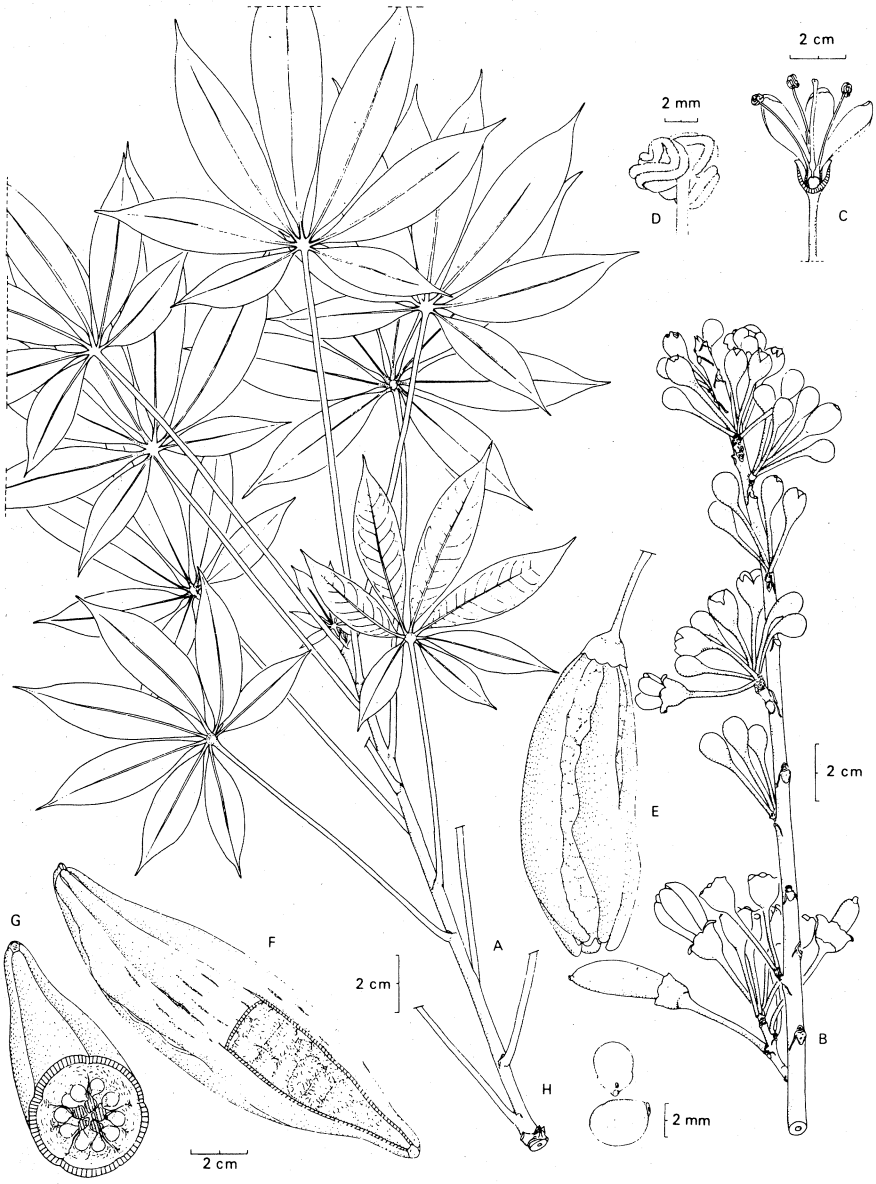

Fig. 4 **Ceiba pentandra** (L.) Gaertn. (A) leafy twig (B) leafless flowering twig (C) flower at anthesis, part of calyx and corolla removed (D) anther (E) mature fruit (F) mature fruit with part of valve removed (G) transverse section of mature fruit showing seeds, septae and hairs (H) seeds

Uses: The timber is not used at all in Papuasia. The woolly covering of the seeds is the kapok of commerce. The fibres are too smooth to be spun in usable yarn or thread but are used in the padding of certain garments, and stuffing of lifejackets, pillows and mattresses. As yet there is no industry based on kapok in Papuasia. It is superior to *Bombax,* as the fibres are longer and more resilient, and the pods do not split as early, remaining for some time on the tree with the valves partially fused, which enables the fruit to be harvested without scattering the kapok fibres; in *Bombax* the pods split *in situ,* scattering the seeds and fibre. The fibre is very effective as a thermal insulator and as a sound absorber. The seeds contain 20–25% edible oil similar to cottonseed oil and the remaining presscake contains about 20% protein and is suitable for livestock fodder. The young seed pods are eaten in Java and the seeds are roasted and eaten in West Africa. The tree is easily propagated from cuttings, and branches stuck in the ground readily become 'live' fence posts.

DURIO Adans.

Evergreen often buttressed trees. Leaves simple, alternate, entire, chartaceous to coriaceous, ovate or oblong elliptic, glabrous above, lepidote and stellate hairy below. Flowers solitary, or in cymes or bundles, ramiflorous, sometimes at the base of the main stem, densely lepidote and subtended by lepidote bracts. Calyx 3–5-lobed or -patite, closed in bud, urceolate or campanulate, densely lepidote externally, caducous; subtended by an irregularly 2–3-lobed epicalyx, cupular, closed in bud, often caducous. Petals (4–)5(–6), linear to spathulate, contorted, caducous. Stamens 5 or numerous, free or united into 5 bundles, or some free and the remainder in 5 bundles; bundles free or partly connate, opposite the petals; anthers unilocular, opening by a longitudinal slit; pollen ± smooth. Ovary sessile, ovoid, lepidote or stellate-hairy, usually (3–)5(–6)-locular with 2 or more ovules in each loculus, placentation axile; style terete, filiform, with capitate or dilated stigmas. Fruit a woody capsule, densely covered externally with thick or slender spines, globose to ellipsoid, usually 5-locular, splitting to the base; seeds ovoid or oblong, glabrous, in 2 rows, usually arillate.

Distribution: A genus of about 25 species, native to Burma, Malaya and the Philippines. In Papuasia the durian, *Durio zibethinus* Murr., is cultivated.

Durio zibethinus Murr. *Syst. Veg.* ed. 13; 581 (1774). **Fig. 5.**

Evergreen unarmed trees to 30 m tall, although flowering as low as 8 m tall. Twigs terete, 4–5 mm diameter, densely lepidote; scales overlapping, orbicular, peltate, 0·5–0·7 mm diameter, golden brown with dark brown central points. Innovations densely golden orbicular-lepidote; stipules lanceolate, 1–1.5 m long, densely lepidote abaxially, 1-ribbed and very finely stellate-tomentose adaxially. Leaves distichous, petiole terete, ± 2 cm long, 1·5–2 mm wide in basal half, swollen 3–4 mm wide in apical half, appearing wrinkled in dried material, continuous with midrib abaxially; leaves chartaceous, glabrous above, golden-brown lepidote below, scales 0·5–0·4 mm diameter, touching or just overlapping, covering a layer of fine silvery stellate hairs ±

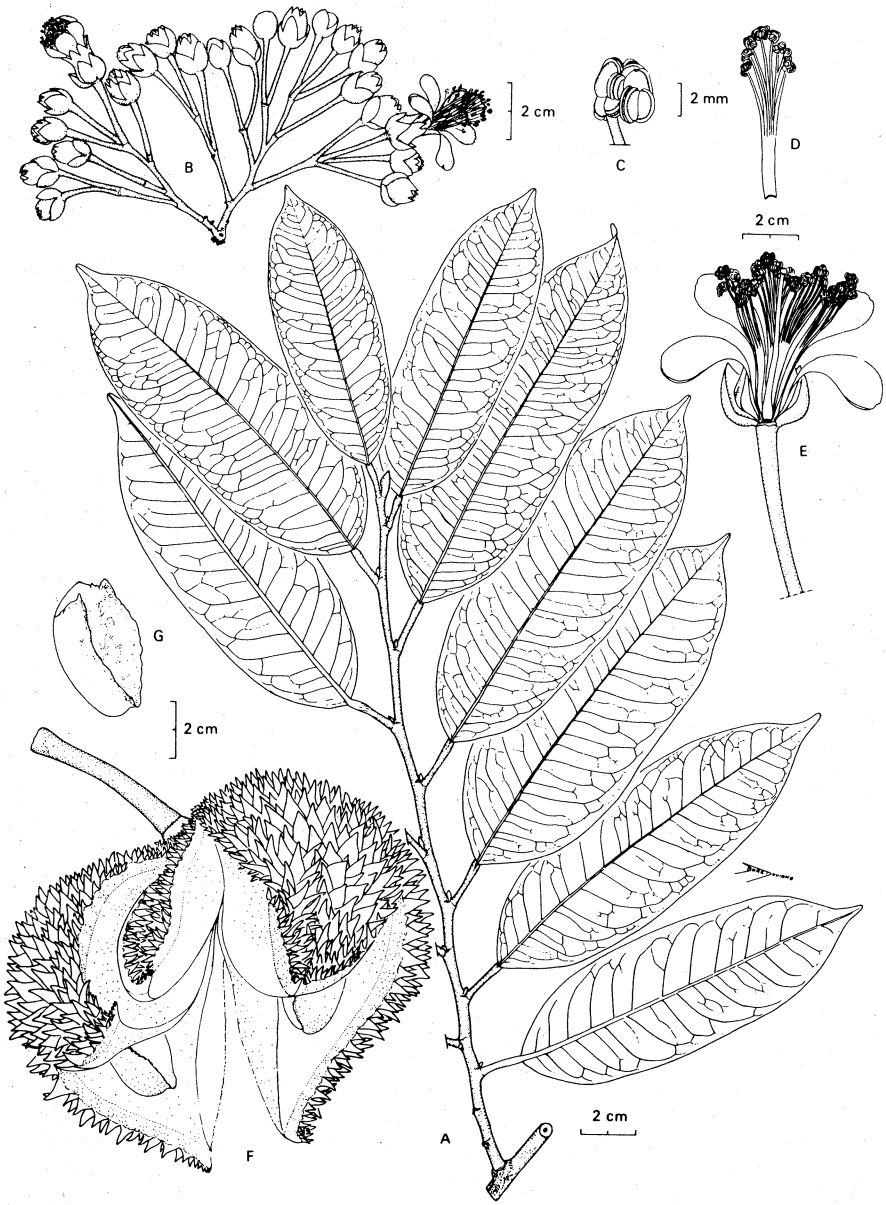

Fig. 5 **Durio zibethinus** Murr. (A) leafy twig (B) inflorescence (C) anther (D) group of stamens (E) flower with nearer parts removed (F) open fruit (G) seed

0·5 mm diameter, lamina oblong to oblong elliptic, 4–5·5 × 13–18 cm, apex ± 1 cm acuminate, base rounded, union with petiole abrupt, margin flat, entire; midrib slightly raised above, strongly prominent below, lateral veins 12–15 pairs, prominent on both surfaces. Inflorescence ramiflorous, ± pendulous, cymose, corymbiform, ± 20 cm long, ± 10–25 flowers, axes densely lepidote, 3·4 mm diameter, conspicuously wrinkled in dried material, terete when fresh. Flowers large and showy, pedicels 3–4 cm long; epicalyx 2 cm long, closed and ovoid in bud, rupturing irregularly into 2–4 ± acute lobes, densely golden lepidote externally, scales overlapping 0·5–0·7 mm diameter, very finely densely tomentose internally. Calyx closed and ovoid in bud, rupturing ± regularly into 5 lobes ± 1 cm deep after the epicalyx opens, expanding to 3 cm long, the basal 1 cm thickening to 2·5 cm across and becoming fleshy; yellow lepidote externally with overlapping scales, 1 mm diameter, glabrous internally with swollen basal portion densely glandular. Petals 5, cream to pink, contorted in bud, broadly spathulate at anthesis, glabrous externally, finely silver stellate-tomentose internally, 5–6 cm long, 2·5–3 cm wide, apex broadly rounded and slightly emarginate. Stamens ± 35, in 5 free flat bundles of 7(–8), free from and opposite the petals, 4–6 cm long, united for the basal ± 2 cm, the central stamens of each bundle ± 2 cm longer than the outer ones, anthers unilocular, medifixed and strongly recurved and twisted, appearing peltate, dehiscing by a longitudinal slit. Ovary superior, ovoid, ± 1 cm long, continuous with the thick style, papillose, densely golden lepidote, scales overlapping, ± 1 mm diameter with dark central points; locules 5, each containing 4–6 ovules; style terete, 4–5 cm long, 3 mm wide basally, 1 mm wide apically, glabrous but for a few fine silvery stellate hairs basally, stigma capitate, 3 mm diameter, with 5 distinct shallow lobes. Capsule pendulous, broadly ovoid, 15–20 cm diameter, yellowish-green when mature, with numerous contiguous hard lepidote spines ± 1 cm wide and high; wall of capsule ± 1 cm thick, loculicidal, 5-valved, each loculus with 2–4 large ± reniform seeds to 5 cm long surrounded by a thick fleshy aril.

Field characters: Large trees to 30m tall, with a moderately dense rounded crown. Trunk unarmed, diameter up to 1 m; steep buttresses sometimes present. Outer bark flaky, brown to mauve-brown, inner bark reddish to crimson. Sapwood white to pinkish grading gradually to reddish or brown heartwood. Bark and wood have a slight odour. No exudate.

Distribution: Malaya, Indonesia and the Philippines. In most places it is cultivated, rarely occurring spontaneously. In Papua New Guinea it is rarely grown, most people finding its smell repugnant.

Ecology: Warm humid tropical lowland regions. It rarely occurs in the undisturbed forests, the seeds being generally propagated by man. The first flowers are borne after about 7 years; the fruit matures about 3 months after the onset of flowering and falls to the ground when ripe before splitting open. 1 or 2 crops can be expected a year. Bats and bees are suspected of being the pollinating agents. The seeds lose viability very quickly.

Uses: In Indonesia, Malaya and surrounding areas the fruit is highly prized. The fleshy aril has a rich foetid smell reminiscent of onion and garlic-flavoured

bananas and is eaten by itself or used to flavour other foods. It is reputed to be a stimulant and an aphrodisiac. The seeds may be boiled and roasted and eaten. The wood is soft, shrinks on drying and is not at all durable; it is of little use.

There are alkaloids present in the fruit which react with alcohol and a feeling of morbidity often follows the consumption of alcohol too soon after eating durian.

OCHROMA Sw.

Evergreen trees, with very light wood. Leaves simple, alternate, petiolate, cordate, 3–5–7-angular-lobate, coriaceous, pubescent beneath; petiole swollen at the apex; stipules ovate-lanceolate, caducous. Flowers large, pedunculate, terminal, white. Calyx 5-lobed, tubular to almost funnel-shaped, lobes dilated, imbricate or induplicate; bracteoles 3. Petals 5, imbricate in bud, puberulous externally. Staminal tube ± tubular, distally shortly 5-lobed, densely covered from the middle to the apex with long wavy anthers; pollen ± smooth. Ovary sessile, oblong, 5-locular, locules with numerous ovules; style stigmatose-cylindric apically, entire, spirally 5-grooved. Fruit a loculicidal 5-valved capsule, very densely woolly-villose internally; seeds oblong or obovoid, enveloped by the woolly sericeous endocarp; aril lacking, endosperm fleshy.

Distribution: A genus of 1–11 species depending on the species concepts of the various authors, native to tropical South America. The balsa tree, *Ochroma lagopus* Sw., has been introduced to Papuasia. It seeds freely and is establishing itself in areas around Lae and Madang.

Ochroma lagopus Sw. *Prodr. Veg. Ind. Occ.* 98 (1788). **Fig. 6.**

Monoecious evergreen trees to 30 m or more tall. Innovations densely stellate-hairy. Twigs terete, rapidly glabrescent, 7–10 mm diameter, smooth but for petiole and stipule scars. Leaves simple, spirally arranged towards the ends of the twigs; lamina broadly cordate, 10–26 × 14–30 cm, thin coriaceous ± entire or angularly lobed, apex obtuse to acuminate, base rounded to cordate, persistently densely stellate-tomentose below, glabrescent above, midrib and main veins slightly raised to sulcate above, strongly prominent below; venation 5–7-palmate at the base, midvein with 4–6 lateral veins; petiole ± terete, 2–4 mm diameter, 12–20 cm long, moderately stellate-tomentose even on mature leaves, ± dilated apically; stipules ± deltoid, to 10 mm long, densely tomentose, caducous. Flowers solitary, lateral or axillary, on a stout ± fleshy pedicel 7 mm diameter and ± 10 cm long. Calyx tubular to funnel-shaped, to 7 cm long, apically with 5 dilated lobes 1·5–2 cm long, appearing deeply carinate externally in dried material, externally stellate-tomentose, internally woolly, decurrent with pedicel and subtended by 3 caducous bracteoles that leave prominent scars. Petals 5, contorted in bud, orange-yellow, clavate, 13 × 5 cm, externally stellate-tomentose, glabrescent basally, internally glabrous. Stamens connate into a glabrous tube 11 cm long, the distal half being slightly dilated and densely covered with sessile long wavy anthers. Ovary sessile, glabrous, conical, ± 8 cm high, 5-locular; style 15 cm long with an apical twisted cylindrical stigmatic

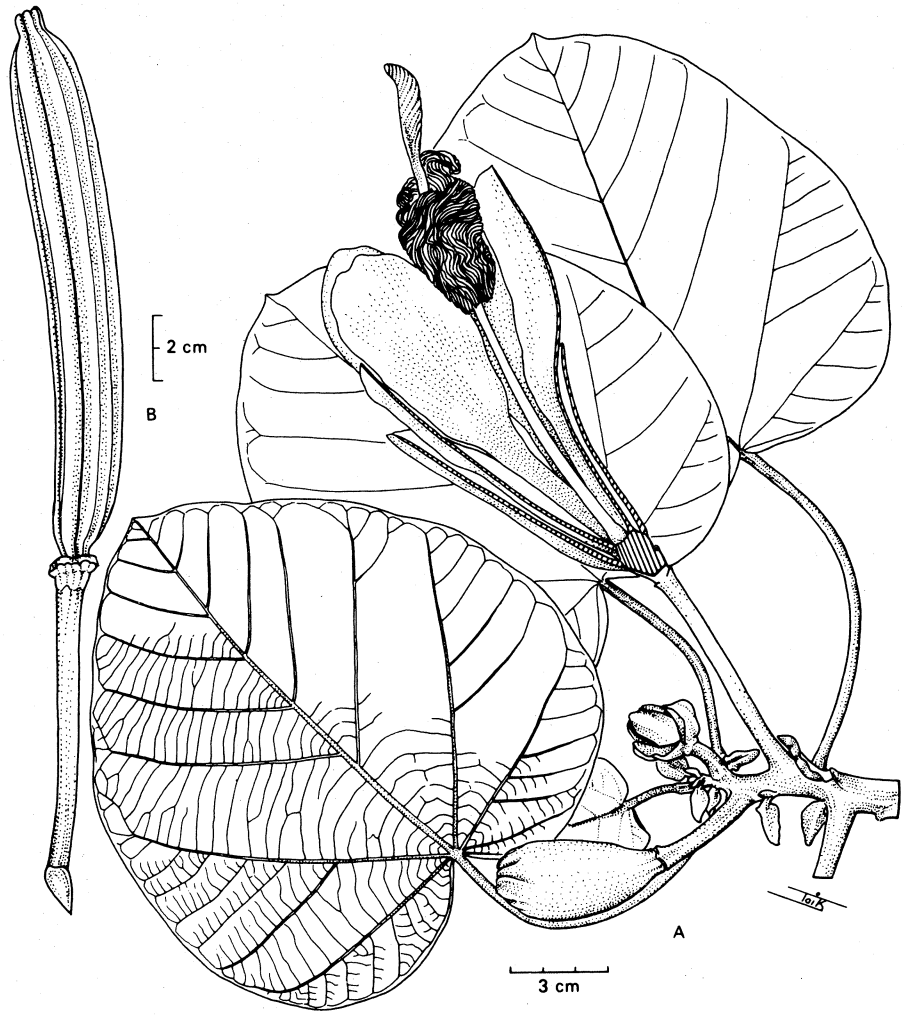

Fig. 6 **Ochroma lagopus** Sw. (A) leafy twig with buds and flower at anthesis, with part of calyx and corolla removed (B) mature fruit

mass 3 cm long and 8 mm wide. Capsule ± cylindrical, ellipsoid, slightly curved, longitudinally sulcate, loculicidal, 15 cm long and 8 mm wide; seeds black, embedded in a mass of woolly hairs.

Field characters: Buttresses are generally lacking, but the bole may be fluted or spurred and the roots may spread above the ground like flattened snakes. The branches are long and spreading. The bark is grey, smooth, or shallowly fissured with brown lenticels; underbark brownish-green; inner bark light pink or straw turning reddish on exposure. Wood soft and light, white or pinkish. The flowers have a foetid smell.

Distribution: A native of tropical South America, this tree has been introduced in cultivation to many parts of the tropics.

Ecology: A lowland species that seeds freely and has established itself in areas near Lae and Madang. However, its spread is likely to be restricted to areas where it is introduced as a plantation species.

Uses: The timber 'balsa' is unique in its extremely low density and in the past has found specialist uses, such as for the frames of fabric-covered aeroplanes. It is widely used in the manufacture of functional models of aeroplanes, boats, etc. It has been used as a thermal insulation for cold stores and is commonly used in boat construction, making a very rigid and strong hull when sandwiched between layers of fibreglass-reinforced plastic.

EXCLUDED SPECIES

Papuodendron C. T. White = *Hibiscus* L. (Malvaceae).
P. hooglandianum (Kosterm.) Borss. *Blumea* **14**: 84 (1966) = *Hibiscus hooglandianus* Kosterm. *Reinwardtia* **5**: 235 (1960); *P. lepidotum* C. T. White *J. Arnold Arbor.* **27**: 272 (1946) = *Hibiscus papuodendron* Kosterm. loc. cit.

The only character separating *Papuodendron* from *Hibiscus* is that the anthers are closely packed in the former and rather spaced in the latter (Kostermans, loc. cit.).

CHENOPODIACEAE

A. Kanis *

Herbs or shrubs. Leaves alternate or opposite, without stipules, simple. Inflorescences simple, racemose or paniculate, of single flowers or cymose flower clusters, with persistent bracts. Flowers bisexual or unisexual, with 2 bracteoles or none; tepals 2 or (4–)5, usually ± joined at base; stamens 1–5, opposite tepals, filaments free or ± joined at base, anthers 2-celled; staminodes absent; ovary superior, 1-celled, 1-ovulate; ovule basal, erect or pendent from erect funicle. Fruit usually a nut, sometimes a capsule or berry.

Distribution: About 100 genera with about 1400 species throughout the world, chiefly in the subtropics; 3 genera with 6 species are known from Papuasia, of which 1 genus with 4 species has been introduced.

Note: The genera *Arthrocnemum* Moq. and *Suaeda* Scop. are not (yet) known from Papuasia, but single species of each genus are known from northern Australia as well as southern Malesia. The genera concerned have been included in the key below but have not been treated further.

Literature: C. A. Backer (1949), Chenopodiaceae, *Fl. Males.* ser. 1, **4**: 99–106, 594–5; C. G. G. J. van Steenis (1972), Chenopodiaceae, ibid. **6**: 932; A. Kanis (1976), A review of the Chenopodiaceae in Papuasia, *Contr. Herb. Aust.* **20**: 1–6.

KEY TO GENERA

1. Branches apparently jointed, ± succulent, with opposite very reduced leaves; inflorescences of sessile cymes of 3–5 flowers ± concealed between bracts, combined into compound compactly ovoid or cylindrical structures
2. Inflorescences terminal, sometimes with 1 or 2 sessile lateral ones at base; bracts ± free, half-circular, with thick outer rim ..... TECTICORNIA
2. Inflorescences terminal and lateral (or terminal on short side branches), not sessile; bracts of opposite pairs joined into faintly 2-lobed cup-shaped structures with thin outer rim ..... ARTHROCNEMUM
1. Branches not jointed, slender, with alternate clearly developed leaves (lowest leaves sometimes opposite); inflorescences of single flowers or open flower clusters, sometimes combined into compound but rather lax structures
3. Plants shortly hairy, often with glandular hairs or ± mealy because of vesicular hairs; leaves ovate to narrowly lanceolate, flat, mostly with distinct petioles; flowers without bracteoles ..... CHENOPODIUM
3. Plants glabrous or almost so, without glandular hairs; leaves linear, ± succulent, sessile; flowers with bracteoles
4. Leaves pungent; bracteoles similar to bracts, longer than perianth; tepals thickened across middle, in fruit usually with horizontally extending wing ..... SALSOLA
4. Leaves not pungent; bracteoles transparent, shorter than perianth; tepals not thickened across middle only, in fruit ± succulent without wing ..... SUAEDA

* Herbarium Australiense, CSIRO, Canberra, ACT, Australia.

CHENOPODIUM L.

Annual herbs (elsewhere also perennial herbs or shrubs); stem and branches ± terete, usually ± hairy. Leaves mostly alternate, lowest ones sometimes opposite, ± distinctly petiolate. Inflorescences of lateral cymose flower clusters, often forming lateral and/or terminal compound inflorescences; bracts free; bracteoles absent. Flowers bisexual or female, sessile; tepals (4–5), ± free, often appressed against fruit; stamens 1(–2) or (4–)5, filaments free or ± joined at base; ovary depressed globose; style short with 2(–5) filiform stigmas. Fruit a thin-walled nut.

Distribution: A genus with about 120 species, almost of worldwide occurrence but predominantly in the temperate and warmer zones; 4 species have been introduced into Papuasia.

Ecology: Several species of this genus have become widespread and gregarious agricultural weeds.

KEY TO SPECIES

1. Flower clusters combining into leafy thyrses as well as partly into terminal panicles; leaves usually with hairs or sessile glands but without glandular hairs; stamens in bisexual flowers (1–)4–5; fruit at maturity concealed in tepals
2. Leaves mealy because of whitish vesicular hairs especially at lower surface, ± scentless; tepals mealy when young, keeled by a strong midrib; ovary without glands; stigmas 2 ..... **C. album**
2. Leaves subglabrous, covered with yellow sessile glands below, malodorous; tepals glabrous, concave but not keeled; ovary with yellow glands in upper half; stigmas (2–)3–5 ..... **C. ambrosioides**
1. Flower clusters not combining into distinct compound inflorescences; leaves with short hairs, at least some tipped with yellow glands, aromatic; stamens in bisexual flowers 1(–2); fruit at maturity not concealed in tepals
3. Tepals distinctly keeled with truncated triangular crest, giving perianth star-like appearance; seed distinctly keeled along most of circumference ..... **C. carinatum**
3. Tepals concave but not keeled; seed keeled along half of circumference only ..... **C. pumilio**

Chenopodium album L. *Sp. Pl.* 219 (1753)

Erect annual herb, 5–15 (elsewhere up to 150) cm high (elsewhere often much branched); stem and branches ± angularly ribbed, with white vesicular hairs giving a mealy appearance, particularly on young parts. Leaves rather variable, ± mealy especially below; lower stem leaves with relatively long petioles, lamina ± rhombic ovate (elsewhere often ± 3-lobed), up to 4·5 × 2·5 cm (elsewhere larger), with acute to obtuse apex, ± cuneate base and irregularly dentate margin; higher leaves smaller, grading to linear-lanceolate with entire margin and ± decurrent into relatively shorter petiole. Inflorescence of clustered flowers arranged in leafy thyrses, higher ones combined into terminal panicles. Tepals (4–)5, ovate, 1·5–2 mm long, concave, keeled outside by strong midrib, joined at base, herbaceous, often with pale margin, mealy outside; stamens (4–)5; ovary with 2 stigmas. Fruit concealed in tepals; seed lens-shaped, horizontal, 1·2–1·8 mm diameter, rather smooth, shiny brown-black.

Distribution: A species of almost worldwide occurrence, but predominantly

in the temperate zones; in Papuasia only once collected from the Western Highlands district (Pumas near Laiagam at **c.** 2500 m, in 1978).

Ecology: A nitrophilous and usually gregarious weed of cultivation; reported from Papuasia as germinating among carrot seed and probably not persisting, at least at lower altitudes.

Note: This taxon is usually treated as a species complex, divided into a number of (micro-)species and/or infraspecific taxa. As mature seeds are not yet available from Papuasia, it has not been possible to determine the taxonomic position of the relevant material more precisely.

Chenopodium ambrosioides L. *Sp. Pl.* 219 (1753). **Fig. 7.**

Erect or ascending annual(?) herb up to 100(–120) cm high, much branched; stem and branches ± angularly ribbed towards tips, thinly white-hairy. Leaves ± narrowly lanceolate, 1·5–10(–15) × 0·5–3·5(–5) cm, with acute apex and narrowly cuneate or ± decurrent base, subglabrous, densely covered with sessile yellow glands below, malodorous, lower ones distinctly petioled, with ± coarsely dentate margin (lamina sometimes shallowly and acutely lobed), higher ones not distinctly petioled, entire, ± bract-like. Inflorescence of clusters of 3–many flowers, laxly arranged in leafy thyrses, higher ones combined into terminal panicles. Tepals 4–5, acutely ovate, concave (but not keeled), joined at base, light green, paler at base, becoming dry-membranous and up to 1·5 mm long; stamens (1–)4–5; ovary with (2–)3–5 stigmas. Fruit concealed in tepals, with yellow glands in upper half; seed compressed globose, usually horizontal, sometimes vertical, 0·6–0·8 mm diameter, rather smooth, shiny brown-black.

Distribution: Originally a neotropical species, introduced into many other parts of the world, tropical as well as temperate; in Papuasia so far restricted to the northwestern part of the Central district (Kairuku and Goilala subdistricts) and the adjacent part of the Morobe district (near Garaina village).

Ecology: A weed of open places, along village tracks and river banks, on sandy or rocky soils, at 0–2000 m altitude.

Chenopodium carinatum R. Br. *Prodr.* **1**: 407 (1810).

Prostrate or ascending (elsewhere also ± erect) annual herb, 15–35 (elsewhere up to 100) cm long, much branched; stem and branches with short hairs, at least some tipped with yellow glands. Leaves ± distinctly petioled, elliptic-ovate, 0·5–1·5 × 0·3–0·5 (elsewhere up to 7·5 × 5) cm, with obtuse to acute apex and ± decurrent base, dentate or ± deeply lobed, hairy like branches especially on petiole and nerves. Inflorescence of clusters of many flowers, not combining into distinct thyrses or panicles. Tepals 5, narrowly oblanceolate, about 1·2 mm long, joined in lower half, concave and conspicuously keeled in upper half with truncately triangular crest, hairy, green, turning white and dry-membranous, spreading like vertical wing; stamen 1; ovary with short style and 2 filamentous stigmas. Fruit enveloped in tepals but not concealed at maturity, whitish, glandless; seed compressed globose and distinctly keeled along most of circumference, vertical or diagonal, about 0·6 mm diameter, shiny dark red-brown.

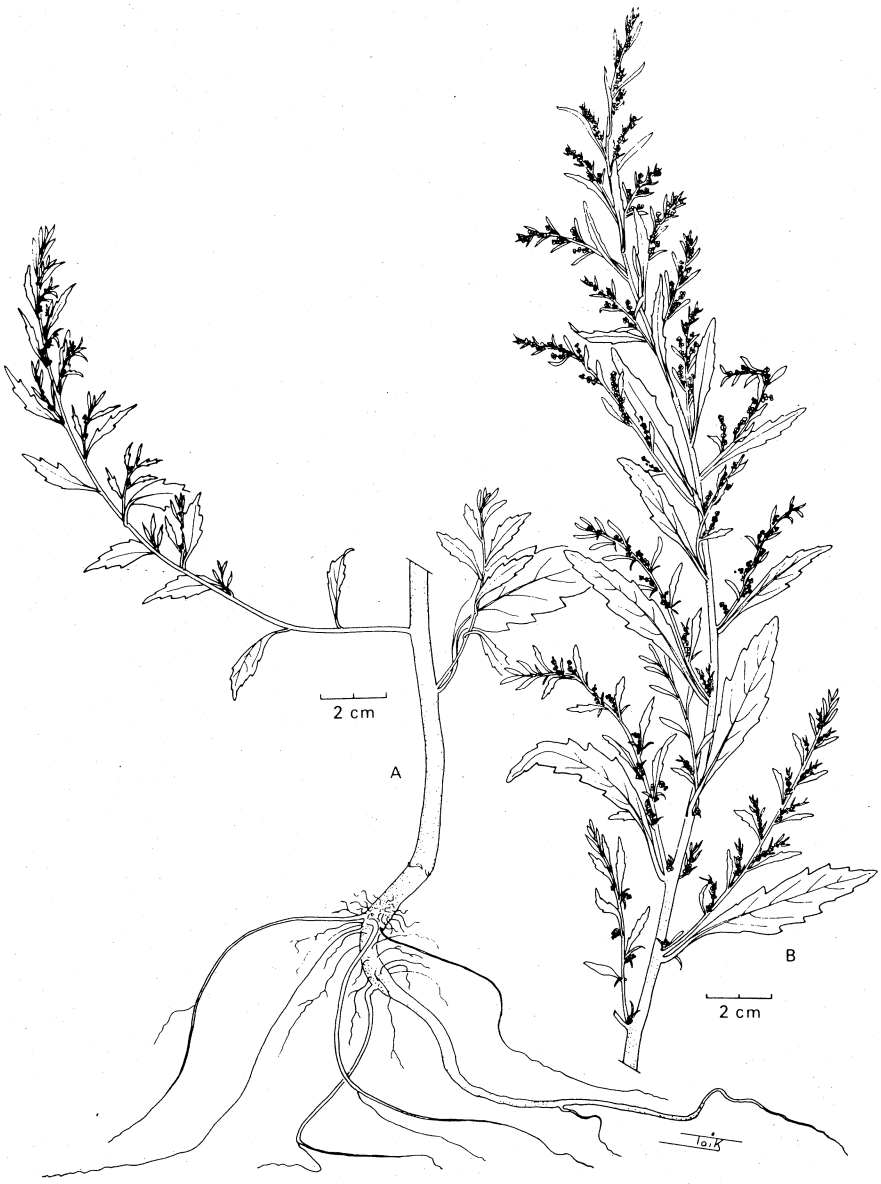

Fig. 7 **Chenopodium ambrosiodies** L.

Distribution: Originally an Australian species, occasionally introduced into other parts of the world, usually with wool; in Papuasia only once collected from the Morobe district (near Kaiapit Mission in 1939).

Ecology: Reported as a weed from an open village space at 500 m altitude and from tobacco cultivation in the Markham Valley.

Chenopodium pumilio R. Br. *Prodr.* **1**: 407 (1810).

Prostrate or ascending (elsewhere also ± erect) annual herb, 5–15 (elsewhere up to 80) cm long, much branched near base; stem and branches with glandular hairs. Leaves distinctly petioled, ± narrowly rhombic to ovate, 0·5–1 × 0·2–0·4 (elsewhere up to 4 × 2) cm, with shortly acuminate apex and ± decurrent base, dentate or ± deeply lobed, hairy like branches especially on petiole and nerves. Inflorescence of clusters of many flowers, not combining into distinct thyrses or panicles. Tepals (4–)5, acutely oblanceolate, about 1 mm long, joined in basal quarter, very concave (but not keeled), hairy, green, turning white and dry-membranous; stamens 1–2; ovary with short style and 2 filamentous stigmas. Fruit enveloped in tepals but not concealed, whitish, glandless; seed compressed globose and keeled along half of circumference, horizontal, about 0·5 mm diameter, shiny dark brown.

Distribution: Originally an Australian species, occasionally introduced into other parts of the world, usually with wool; in Papuasia only once collected from the Morobe district (Leron Cattle Station in 1963).

Ecology: Reported as a weed from bare patches in grazed grassland at 150 m altitude.

SALSOLA L.

Annual herbs (elsewhere also perennial herbs or shrubs); stem and branches ± terete, glabrous. Leaves mostly alternate, lowest ones sometimes opposite, sessile. Inflorescences lateral, of single flowers or shortened branches with few flowers clustered together; bracts and bracteoles free. Flowers bisexual, sessile; tepals (4–)5, ± free, enclosing ripe fruit, thickened across middle, often ultimately with horizontally extending wing; stamens (4–)5, filaments connate at base; ovary depressed globose; style slender with 2 filiform stigmas. Fruit a thin-walled 1-seeded ultimately circumscissile capsule, falling with perianth or flower cluster.

Distribution: A genus of 100–120 species throughout most of Eurasia and Africa, but especially in the more arid areas of the northern subtropical zone; 1 species extends into Papuasia (and Australia).

Ecology: Plants and fruits develop during the wet season, withering away during the dry season.

Salsola kali L. *Sp. Pl.* 222 (1753). **Fig. 8.**

Erect annual herb up to 60 cm high, often woody and branched at base; lower branches often ascending. Leaves succulent, glaucous, ± pungent, basal ones narrowly linear, ± flaccid, up to 3·5(–5) cm long, higher ones

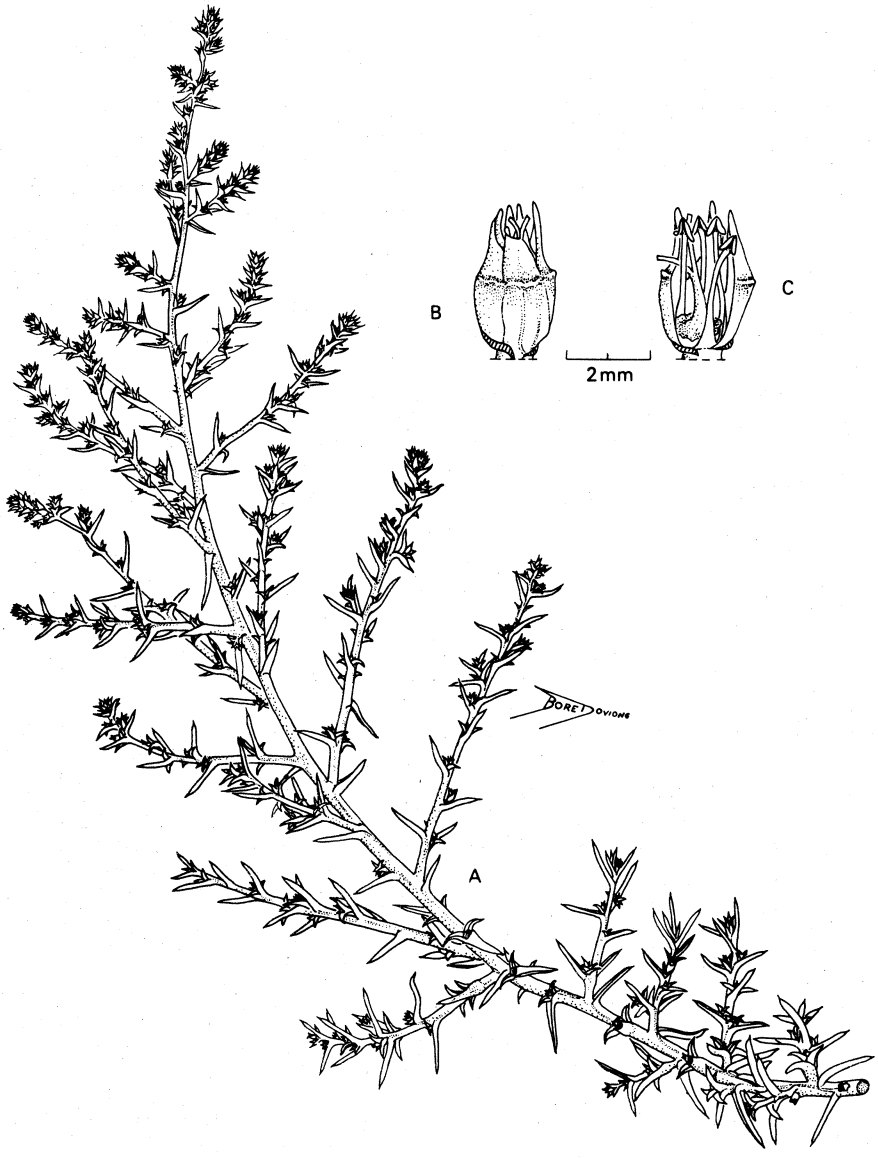

Fig. 8 **Salsola kali** L. (A) part of plant (B) flower (C) flower with nearer tepals removed

gradually shorter and broader, apical ones and bracts ± narrowly triangular, rigidly recurved, with ± amplexicaul base. Flowers with bracteoles similar to bracts, about 5 mm long; tepals ovate, 3–3·5 mm long, acuminate, upper part dry-membranous, lower part thicker, wings ± tinged pink, variable in size, up to 2 mm wide, those of 2 inner tepals usually smaller; stamens with linear filament, anther obcordate, about 1·5 mm long. Fruit ± obovoid, about 2 mm long, tipped by style base; seed depressed-globose, shining black.

Distribution: Originally a Eurasian and North African species, probably also indigenous in Malesia and Australia, introduced into North America; in Papuasia known from the Digul, Central and Milne Bay districts, also recorded from the Aru Islands and 'islands in Torres Strait'.

Ecology: In Papuasia probably restricted to sandy beaches in areas with a pronounced dry season.

Note: The name *Salsola kali* L. is applied here in a wide sense as is still customary in the Southwest Pacific area. Elsewhere several (infra-)specific taxa are recognized within this species complex. The position and relationships within this complex of the material from Papuasia and adjacent areas has yet to be determined.

TECTICORNIA Hook f.

Annual herbs (elsewhere also perennial herbs or undershrubs); branches terete, glabrous, apparently jointed and succulent. Leaves opposite, very reduced. Inflorescences terminal, sometimes also lateral, very compact, of sessile cymes of 3–5 flowers ± perpendicular to the main axis and concealed between bracts; bracts opposite, ± free, closely imbricate, with fleshy upturned margin; bracteoles absent. Flowers bisexual, sessile, ± free; tepals 2, lateral, succulent, ± pressed together, ± joined at base, becoming free and dry in fruit; stamen 1, abaxial, with versatile introrse anther; ovary obovoid; style slender with 2 filiform stigmas. Fruit a thin-walled nut, falling with the inflorescence.

Distribution: An essentially Australian genus with 3 species; 1 species extends into Papuasia (and southern Malesia).

Ecology: Seeds ripen at the beginning of the wet season. They are capable of floating while still enveloped by other parts of the infructescence, being released upon disintegration of those parts.

Literature: P. van Royen (1956), Notes on *Tecticornia cinerea* (F. v. M.) Bailey (Chenopodiaceae), *Nova Guinea* N.S. **7:** 180–6. P.G. Wilson (1972), A taxonomic revision of the genus *Tecticornia* (Chenopodiaceae), *Nuytsia* **1**: 277–88.

Tecticornia australasica (Moq.) P.G. Wilson *Nuytsia* **1**: 280 (1972). **Fig. 9.**

Salicornia cinerea (F. Muell.) F. Muell. (1868); *T. cinerea* (F. Muell.) F.M. Bail. (1887).

Succulent annual herb up to 40 cm high, ± woody at base; lower branches often ascending, with red pigmentation more conspicuous in less developed

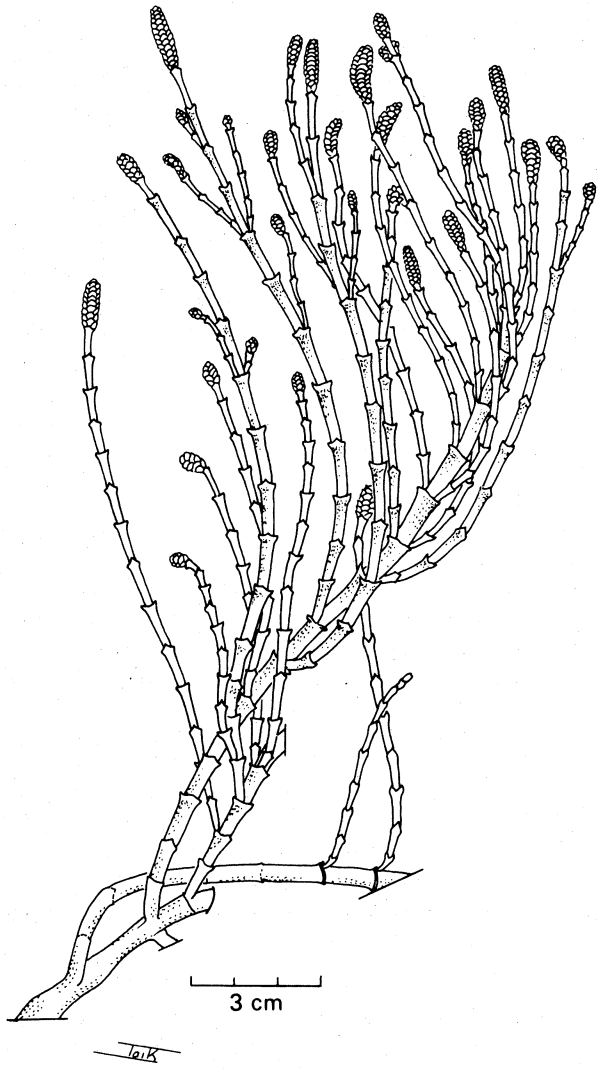

Fig. 9 **Tecticornia australasica** (Moq.) P. G. Wilson

specimens; internodes 7–15 mm long, glaucous. Leaves reduced to small scales with scarious margins. Inflorescences mostly terminal, sessile and perpendicular to stem when lateral, narrowly ovoid to ± cylindrical, 10–40 × 5–10 (–15) mm; bracts half-circular, supporting cymes of 3–5 flowers (outer ones sometimes sterile). Flowers at first fused with upper bract near base, otherwise free; tepals obovoid, about 2 × 1 mm, acute, inner surfaces flat, at first joined below towards base; stamen with about 2 mm long slender filament; anther oblong-cordate, 1–1·5 mm long. Fruit with ± ovoid, laterally compressed, about 1·5 mm long, blackish-brown seed, largely smooth but for ± aculeate margin.

Distribution: Tropical Australia, reported once from East Java; in Papuasia recorded from Digul and Central districts.

Ecology: In coastal areas, probably restricted to those with a pronounced dry season, on moderately saline mudflats, alternately dry and inundated with ± brackish water; often in pure stands.

EXCLUDED TAXA

Salicornia L. has been listed incorrectly from Papuasia, very probably based on a specimen identified as *S. cinerea* (F. Muell.) F. Muell. (= *Tecticornia australasica* (Moq.) P.G. Wilson).

Suaeda nudiflora Moq. has also been recorded erroneously for the region, caused by misidentifications of collections correctly referred to *Batis argillicola* P. Royen (Bataceae).

COCHLOSPERMACEAE

J. R. Croft

Trees or shrubs, often deciduous, gummiferous, puberulous-glabrescent. Leaves simple, palmately lobed; pocket domatia often present in axils of main veins; stipulate, stipules fugacious. Flowers bisexual, actinomorphic, large and showy, in axillary or terminal racemes or panicles. Sepals 5, free, imbricate. Petals 5, free, imbricate or contorted. Stamens numerous, hypogynous, free, equal or subequal; anthers 2-locular, linear or oblong, tapering or not, basifixed, dehiscing by introrse apical often confluent pore-like slits. Ovary superior, free, unilocular with 3–5 laminal parietal placentas projecting into the locules, or perfectly 2–3-locular with axile placentation; ovules numerous; style simple, with a denticulate punctiform stigma. Fruit a 3–5-valved loculicidal capsule; seeds densely floccose or glabrous, straight or spoon-shaped reniform.

Distribution: A family of 2 genera, throughout the tropics and subtropics. In Papuasia *Cochlospermum* is the only genus.

Literature: J. Hutchinson, (1969), Cochlospermaceae, *The Genera of Flowering Plants* **2**:232–4. C.G.G.J. van Steenis, (1933), The Cochlospermaceae of the Netherlands Indies, *Bull. Jard. Bot. Btzg* ser. 3, **13**(4): 519–24, f. 1; (1949); Cochlospermaceae, *Fl. Males.* ser. 1, **4**(2): 61–3, f. 1; H.-H. Poppendieck, (1980), A Monograph of the Cochlospermaceae, *Bot. Jb.* **101**(2): 191–265, f. 1–49.

COCHLOSPERMUM Kunth

Shrubs or trees, often deciduous, producing gum and an orange juice, innovations pubescent. Leaves spirally arranged, digitately lobed; pocket domatia often present in axils of main veins. Petals sometimes emarginate. Anthers basifixed; filaments filiform. Ovary glabrous or pubescent, unilocular with 3–5 parietal placentas projecting into loculus; style curved, with a minute stigmatic tip. Fruit incompletely septate, 3–5-valved; seeds spoon-shaped, reniform, densely covered with floccose hairs. Other characters as for the family.

Distribution: A genus of about 12 species throughout the tropics, most diverse in tropical and subtropical America, rare in Malesia. In Papuasia *Cochlospermum gillivraei* is the sole species.

Cochlospermum gillivraei Benth. ssp. **gillivraei.** *Fl. Aust.* **1:** 106 (1863). **Fig. 10.**
C. gillivraei Benth. var. *papuanum* Bak. f. (1923).

Deciduous shrub or treelet to 8 m tall. Innovations finely pubescent. Twigs terete, glabrous, 3–5 mm diameter, with prominent orbicular leaf scars; scat-

Fig. 10 **Cochlospermum gillivraei** Benth. (A) leafy twig (B) flowering twig (C) flower with nearer parts removed (D) fruit.

tered small pustules may be present on older twigs. Leaves 3–7-digitately lobed to within 1–2 cm of base, 5–14 cm long × 6–14 cm wide, margin serrate, at least apically, apices of lobes acute to acuminate, each lobe with 6–10 arching lateral veins, ± flat or depressed above, strongly prominent beneath; pocket domatia present in axils of main veins; petiole ± terete, glabrous, with several longitudinal grooves in dried material, 1–1·5 mm diameter, 4–14 cm long; stipules 3–5 mm long, narrowly triangular, rapidly caducous. Flowers in terminal and axillary open panicles or racemes to 5 cm long; pedicels 1–1·5 mm. Sepals broadly ovate to rotund, 2 outer 5–6 mm long, 3 inner 8–11 mm long, apex broadly rounded, inside and outside finely pubescent, glabrescent towards the thin margins, especially the inner three. Petals 5, contorted, bright yellow, oblong, 2·5–3·5 × 1·5–2 cm, truncate to ± emarginate, thin, papery. Anthers slightly curved, oblong, 2–3·5 mm long, 2-locular, opening by a solitary, apical, oblique, introrse, pore-like slit; filaments filiform, glabrous, 3–6 mm long. Ovary globular, glabrous, 3–4 mm high, unilocular with 3–5 parietal placentas projecting into loculus bearing many ovules; style glabrous, ± 12 mm long, dilated and curved distally, the ultimate 1 mm tapering and sharply curved towards the base; stigma punctiform and minutely denticulate. Fruit glabrous, 6–9 × 3 cm, septa incomplete and parting along the axis almost to the base in old fruit; seeds spoon-shaped, reniform, 3–4 mm long, densely floccose.

Field characters: Bark ± smooth, grey, sometimes channelled and scaly; inner bark pink and cream striated. Wood soft, pinkish-cream. Leaves glossy, dark green above, lighter below. Petals bright yellow, sepals green, stamens reddish.

Distribution: Northern Territory and Queensland, Thursday Island; in Papuasia, around Daru in the Western district and Port Moresby in the Central district. Infrequently collected; possibly introduced.

Ecology: Open savanna woodland, in monsoonal areas, 20–150 m altitude. Deciduous and bearing flowers in the dry season, July to September.

Uses: This species is of no commercial value, but may prove to be an interesting ornamental.

Note: The specific epithet is sometimes unnecessarily corrected to *gillivrayi*.

CORIARIACEAE

*B.J. Conn**

Shrubs or small trees. Branches glabrous; branchlets laterally compressed to quadrangular. Leaves simple, opposite or whorled, plinerved, exstipulate. Inflorescence racemose. Bracts present. Flowers small, 5-merous. Calyx imbricate, free, persistent. Petals valvate, free, keeled on abaxial surface. Stamens 5 + 5, free, or those opposite the petals adnate; anthers large. Ovary superior; carpels free, 5–10, 1-celled; receptacles conical; styles free, greatly reduced; stigmas elongate. Fruit drupe-like, the petals becoming fleshy after anthesis and enclosing the carpels.

Distribution: Only genus *Coriaria,* with up to 30 species. South and Central America, the Mediterranean, the Himalayas through southern China and the northern Philippines to Japan, Papuasia, New Zealand, and extending into the Pacific as far east as the Society Islands.

Literature: M.M.J. van. Balgooy, (1966), *Coriaria, Blumea* suppl. 5, **2:** 122–3, map 67.

CORIARIA L.

Characters of the family.

Coriaria papuana Warb. *Bot. Jb.* **16:** 22 (1893). **Fig. 11.**

Shrub or small tree, erect or spreading, 1·5–5 m high. Leaves sessile or petiole to 0·5 mm; lamina ovate to ovate-lanceolate, 2–3·5 × 1–2 cm, glabrous, subcoriaceous; base rounded to obtuse, often subcordate; margins entire, sometimes becoming undulate; apex tapering-acute; (3–)5(–9)-plinerved; leaves at base of branchlets ovate, 1–1·5 mm long, glabrous, base of lamina stem-clasping. Inflorescence displaced-axillary, 10–20 cm long, spreading or ascending, 60–90-flowered; peduncles slender, ribbed, hirsute on ribs; bracts linear-ovate, 1·5–4 mm long, tending to enclose pedicel in a sheath, margin irregularly toothed, or sometimes entire, apex acuminate; pedicels 2–3.5 mm long, hirsute. Sepals ovate, 1·4–1·8 × 0·6–0·9 mm, glabrous, purple; point of attachment at base 0·2–0·3 × 0·4 mm; margin membranous, sinuate; apex acute. Petals broadly ovate, 0·7–0·8 × 0·6–0·7 mm, glabrous, yellow-green, apex acute to shortly and broadly acuminate; filaments slender, 0·6 mm long, glabrous, yellow-green, anthers 0·8–0·9 mm, light brown; pistil glabrous; carpels 5, diameter 0·6 mm; style 0·1–0·16 mm long, glabrous, yellow-green; stigma linear-oblong, 1·8 mm long, bright red; ovules parietal. Fruit

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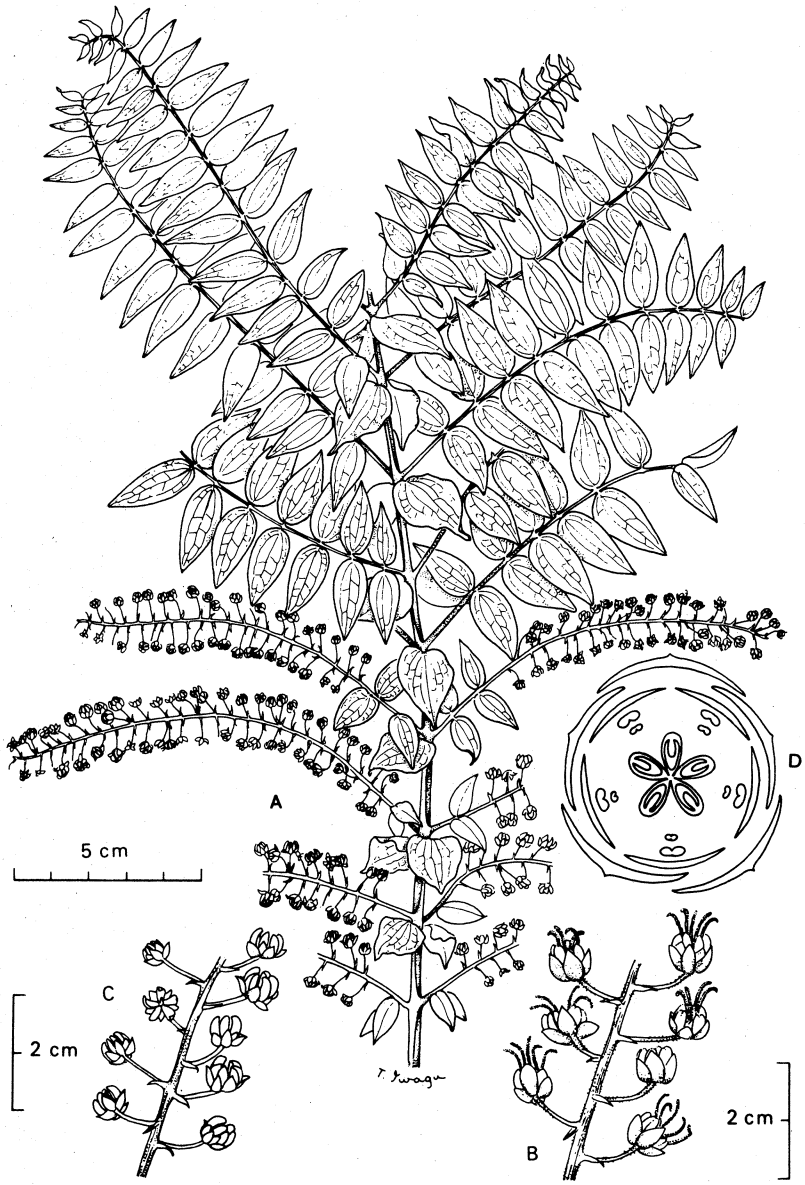

Fig. 11 **Coriaria papuana** Warb. (A) branch with inflorescences (B) flowers at anthesis (C) flowers after anthesis with thickened petals around maturing fruit (D) floral diagram

black-purple, *c.* 3 mm across in dried specimens; carpels with exocarp usually longitudinally 5-ribbed on abaxial surface; endocarp thin, hard, bony. Seed ellipsoid, slightly flattened, *c.* 1 × 0·7 × 0·4 mm, 1-ribbed on longest circumference.

Distribution: Endemic in Papuasia; collected from the Western Highlands, Southern Highlands, Eastern Highlands, Madang, Morobe and New Ireland districts.

Ecology: Generally associated with the more open vegetation of exposed ridges, secondary vegetation, landslip communities, montane and upper montane forests, at altitudes of 1200–3500 m; commonly on rocky stream banks.

Uses: Used in traditional medicine as an emetic.

Note: This species is hardly distinct from the closely related *C. ruscifolia* L., which is widespread throughout the Pacific.

DAPHNIPHYLLACEAE

*W. R. Barker**

Glabrous trees or shrubs, usually dioecious, rarely monoecious or (extra-Papuasia) polygamodioecious. Leaves simple, spirally arranged, entire; stipules absent. Flowers small, unisexual, in usually axillary, rarely (extra-Papuasia) terminal, racemes subtended by 1–several whorls of deciduous bracts; perianth absent (extra-Papuasia) or present as a single whorl of 3–6 tepals, free (in Papuasia) or fused, deciduous (in Papuasia) or persistent. Male flowers: stamens 5–12 in single whorl, free or (extra-Papuasia) fused at apex; anthers 2-celled, loculicidally dehiscent; pistillode rarely present. Female flowers: single whorl of small staminodia present or (extra-Papuasia) absent; ovary superior, imperfectly 2(–4)-celled, each cell with (1–)2 pendulous ovules; style erect, with 1–2(–4) recurved lobes, stigmatic on upper surfaces. Fruit a drupe; seeds 1(–2) with fleshy endosperm and small apical dicotyledonous embryo.

Distribution: A single genus with 9 species, confined to east Asia and Malaysia; a single species in Papuasia.

Literature: K. Rosenthal (1919), Daphniphyllaceae, in Engler *Pfl. R.* **68**(4, 147a): 1–16. T. C. Huang (1965), Monograph of *Daphniphyllum, Taiwania* **11**: 57–98; (1966), *Taiwania* **12**:132–234.

DAPHNIPHYLLUM Bl.

Characters and distribution as for family.

Daphniphyllum gracile Gage *Nova Guinea* Ser. 1, **12**: 480 (1918). **Fig. 12.**
D. papuanum Hallier (1918); non *D. gracile* Rosenthal (1919).

Usually dioecious, rarely monoecious, glabrous shrub 1·5–5(–8) m tall, or tree to 12 (–23) m tall, much-branched or with slender unbuttressed bole to 8 m long and to 45 cm diameter at breast height. Leaves usually densely packed at end of branches and mainly in spaced clusters along them, sometimes ± evenly spaced; petioles long, slender, (1–)2–4·5(–8) cm long, deep pink to red, channelled above, rounded and striate beneath when dry; blade leathery, usually lanceolate to broad elliptic-oblong, rarely broadly obovate, (3–)5–14 (–19) cm long, (1·5–)2·5–5(–7·5) cm broad, glabrous, dark to mid green, shiny or glossy above, usually covered by minute dense papillae, sometimes glabrous, usually glaucous to silver-white, rarely mid to light green, dull beneath; base rounded to obtuse, finally shortly attenuate into petiole; margin entire, narrowly recurved (at least in dried material); apex abruptly mucronu-

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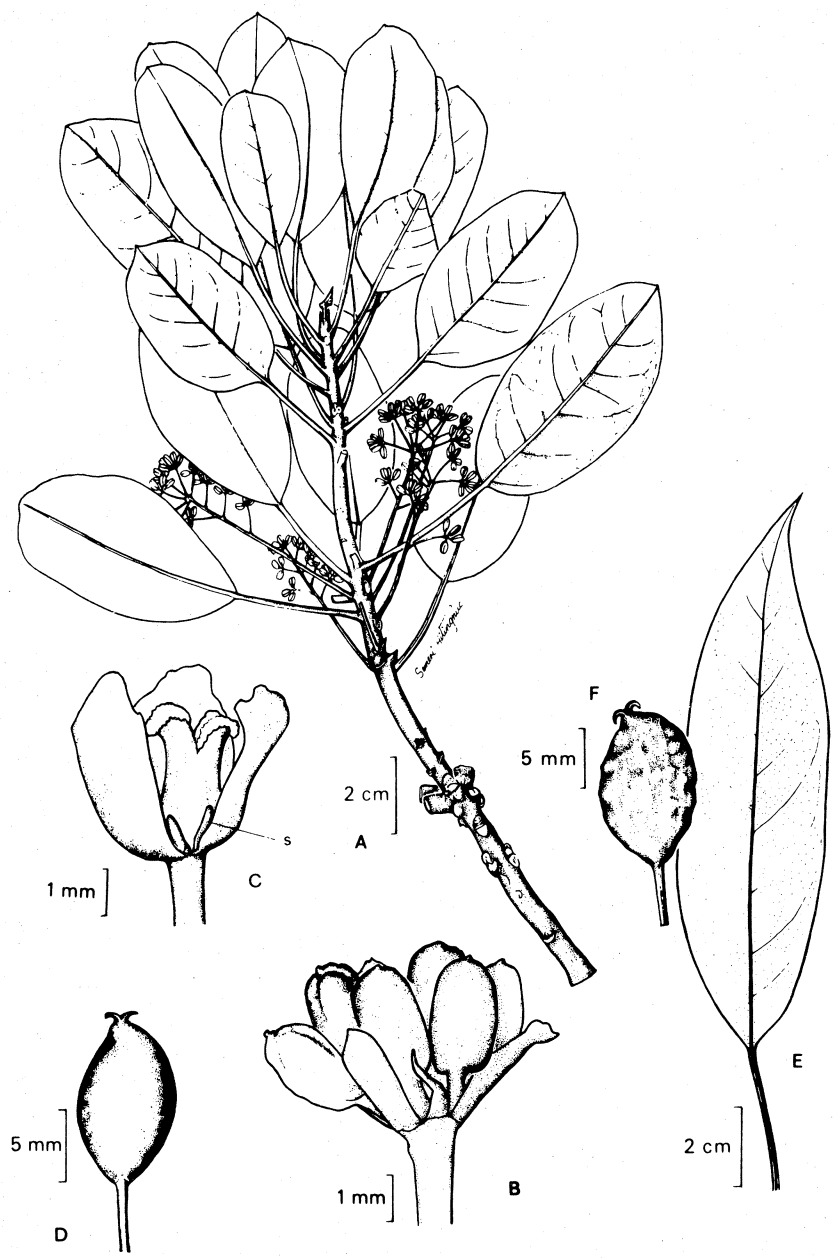

Fig. 12 **Daphniphyllum gracile** Gage var. **gracile** (A) flowering twig (B) male flower (C) female flower showing staminode (s) (D) fruit; var. **tuberculatum** Huang (E) leaf (F) fruit

late or very short to very long acuminate; midrib and main lateral veins channelled above, prominent beneath, the midrib towards the base often reddened; young leaves bright green, yellow-green or red. Inflorescences unisexual racemes with (10–) 20–30 flowers, those at apex in a dense umbel, those along rachis scattered and subtended by broad ovate-acuminate bracts protecting undeveloped inflorescence but quickly caducous leaving crescent-shaped scars; peduncle slender, *c.* 2–7 cm long; pedicels slender, 3–12 mm long; tepals (4–)5(–6), free, rarely 2 adjacent ones joined, narrow linear-triangular, narrow linear or truncate-spathulate, entire except for sometimes erose apex, somewhat unequal, 1–5 mm long, 0·3–1 mm broad, pale green, greenish-yellow or cream, quickly caducous. Male flowers: stamens 5–9, free, brown, red or purple; filaments terete, almost absent to just over half length of anthers; anthers narrow to broad oblong, 1·5–3·5 mm long, 0·5–1·8 mm broad, base rounded to slightly cordate, apex rounded to truncate, often apiculate. Female flowers: staminodes *c.* 6–9, narrowly linear-triangular, minute or as high as the ovary, caducous; gynoecium green to purple or glaucous, 2–3·5 mm long, with globular ovary one-half to two-thirds its length, slightly contracted at the base, tapering into short, stout, erect style; stigmas 2, stout, as long to twice as long as style. Fruit obliquely globular to broad ellipsoid, 8–15 mm long excluding persistent style; pericarp fleshy, smooth or covered by rounded tubercles (at least when dry), green when immature, turning blue, purple or black.

Field characters: Usually shrub or small tree, rarely a medium-sized tree. Outer bark grey, light or dark brown, or greenish-white, ± smooth but often with scattered pustules and/or vertical fissures and/or horizontal ridges. Under bark green, orange or brown. Inner bark from light straw to pinkish or brown, or mottled. Sapwood usually white to straw, rarely light brown. Heartwood (observed once) yellowish-brown. Leaves dense, spirally arranged, usually in spaced clusters, sometimes ± evenly spaced, leathery, glaucous or with prominent venation on underside, with long pink to red petioles.

Distribution: Common in the mountains throughout mainland Papuasia; in the Bismarck Archipelago recorded from New Britain and New Ireland (Hans Meyer Range). Elsewhere in Malesia it is known only from the Celebes.

2 varieties, which are distributed throughout the range of the species, can be distinguished.

Ecology: From (850–) 1000 to 3500 m altitude, in primary and secondary lower mountain to subalpine rainforest, on margins of subalpine grasslands and in exposed summit shrubberies; common.

Notes: It is very doubtful whether *D. gracile* warrants distinction at the species level from the highly polymorphic *D. glaucescens* Bl., a species widespread from Malesia (excluding Papuasia) to India, South China and Japan. In his revision of *Daphniphyllum,* Huang separated *D. glaucescens* by its tepals being shorter than the stamens and generally persistent, but caducous in two subspecies from areas neighbouring Papuasia. *D. gracile* he characterized as having tepals always longer than the stamens and caducous. From study of greatly increased Papuasian collections now available the latter

character is constant throughout Papuasia, but specimens with tepals shorter than the stamens are relatively common.

KEY TO VARIETIES

1. Mature fruit smooth (at least in dried specimens). Leaves with short acumen to 1(–2·5) mm long, obtuse to rounded or subtruncate behind, usually glaucous, rarely green beneath ....var. **gracile**
1. Mature fruit tuberculate (at least dried specimens). Leaves with long, often slender acumen (1·5–)3–25 mm long, acute to obtuse behind, usually green, sometimes glaucous beneath ....var. **tuberculatum**

var. **gracile Fig. 12A–D.**

Ecology: Usually occupying upper mountain rainforest, shrubberies or grassland margins, rarely in middle mountain rainforest.

var. **tuberculatum** Huang *Taiwania* **12**: 159 (1966). **Fig. 12E, F.**

Ecology: Usually occupying lower to middle mountain rainforest, rarely in upper mountain rainforest or shrubberies.

Notes: The length of the leaf acumen (see key) is measured from the point where the leaf apex begins to attenuate.

The 2 varieties may represent the extremes of clines in the characters of fruit surface and leaf apex and surface in the region between subalpine and lower and middle mountain rainforest habitats.

EXCLUDED SPECIES

Daphniphyllum? conglutinosum Hemsl. (1895) = *Pimeleodendron* (Euphorbiaceae).

ELAEOCARPACEAE

M. J. E. Coode

Shrubs or trees, without exudate in the bark. Leaves stipulate or not, simple when mature, alternate, spirally arranged or opposite, usually with dentate (see *Notes* below) or serrate margin. Inflorescence a raceme or panicle, terminal, axillary amongst the leaves or borne behind the leaves; sometimes flowers in fascicles or solitary. Flowers regular, (3–)5-merous, bisexual (in Papuasia). Sepals valvate, free (in Papuasia). Petals present (in Papuasia), usually differing from sepals, usually free, valvate or induplicate-valvate (in Papuasia), sometimes of irregular widths or fused into a tube; lobed, toothed or split into narrow divisions at the tip, or in a few species entire. Disc present. Stamens 8–many, inserted on the disc or between the disc and the ovary, often hairy; anthers basifixed, opening at the tip by 2 pores or a transverse slit, the slits sometimes extending downwards laterally. Ovary superior, with 2–7 loculi, each with 2–20 pendulous axile ovules in two rows; style 1, tapering, no enlarged stigma present. Fruit a capsule, berry or drupe; seeds 1–many, with or without arillodes, rarely pulpy; endosperm copious; embryo straight with broad cotyledons or curved with narrow cotyledons. Germination where known, epigeal.

Distribution: Tropics and subtropics excluding the African mainland; a few species extend to temperate zones. 8 or 9 genera, of which 5 occur in Papuasia.

Notes: Some authorities consider Elaeocarpaceae to be part of Tiliaceae; others treat it separately but include the American genus *Muntingia*. *M. calabura* L. is widely planted in Papuasia, and is known sometimes as 'Javanese cherry' or 'Japanese cherry'. However, it has dorsifixed anthers and distinct stigmas, and the details of the wood structure differ from that of the Elaeocarpaceae. Accordingly *Muntingia* is not dealt with here but will be treated in the account of Tiliaceae.

Throughout this account, the term 'dentate' is used instead of 'coarsely serrate'.

Literature: R. Schlechter (1916), Die Elaeocarpaceae Papuasiens, *Bot. Jb.* **54**: 92–155. A. C. Smith (1944), Studies of Papuasian plants, VI, Elaeocarpaceae, *J. Arnold Arbor.* **25**: 104–21, 222–98. M. J. E. Coode (1978), A Conspectus of Elaeocarpaceae in Papuasia, *Brunonia* **1**: 131–302.

KEY TO GENERA (FLOWERING MATERIAL)

1. Anthers opening by lateral slits, the slits not extending across the tip; stamens inserted upon a flat or rounded unlobed disc (the disc may have 4–5 straight sides corresponding with sepal insertion) ..... SLOANEA
1. Anthers opening across the tip, the slits sometimes also extending downwards laterally; sta-

mens inserted between the disc and the ovary, rarely ± upon the top of the disc, the disc radially lobed or toothed, sometimes inconspicuous
2. Leaves entirely or mostly opposite
3. Filaments longer than anthers; anthers opening by terminal pores surrounded by a group of stiff pale bristles; petals ± joined by means of dense interlocking hairs on the margins of the claw ..... ACERATIUM
3. Filaments not longer than anthers; anthers opening by apical slits not surrounded by bristles; petals not joined by hairs
4. Flowers scattered alternately along the racemes, lacking persistent bracts; petals with 10–12 divisions (*E. sericoloides* only) ..... ELAEOCARPUS
4. Flowers in opposite bracteate pairs along the rachis; petals undivided or with a few blunt lobes ..... SERICOLEA
2. Leaves alternate or spirally arranged
5. Filaments (2·8–)3–4·5 × longer than the anthers which lack awns or bristles at the tip ..... DUBOUZETIA
5. Filaments usually shorter than or equalling anthers; if as much as 2·5 times longer, then clearly awned at the tip (other species may also lack awns but have the shorter filaments) ..... ELAEOCARPUS

KEY TO GENERA (FRUITING MATERIAL)

1. Fruits dehiscent
2. Capsules thick-walled, walls apparently 1-layered; loculicidal ..... SLOANEA
2. Capsules relatively thin-walled, walls of two layers which eventually separate; at first the outer layer splits partially and loculicidally, then the inner layer splits completely and septicidally, often rupturing the outer layer ..... DUBOUZETIA
1. Fruits indehiscent
3. Leaves entirely or mostly opposite (seedlings may have alternate leaves)
4. Fruit a soft berry with 1–4 seeds, up to 5 mm in diameter ..... SERICOLEA
4. Fruit a firm drupe with a single woody stone, usually much bigger
5. Fruit 2-3 cm in diameter, globose, the mesocarp scarcely fibrous, distinct and ± separate from the stone, the stone sculptured (*E. sericoloides* only) ..... ELAEOCARPUS
5. Fruit of various shapes, the mesocarp very fibrous, the fibres radially arranged and firmly attached to the stone, stone not sculptured ..... ACERATIUM
3. Leaves alternate or spirally arranged ..... ELAEOCARPUS

ACERATIUM DC.

Shrubs, small or large trees. Leaves usually exstipulate, opposite, petioles less than 1 cm long. Inflorescence short-stalked, racemose or sub-umbellate, few-flowered, pedicels usually longer than the inflorescence axis. Flowers usually 5-merous. Sepals distinct from petals. Petals (in Papuasia) free, oblong-spathulate, the limb a little wider than the claw and divided at the tip into 5–10 teeth, glabrous on the back, but the claw always with the margins densely hairy, causing neighbouring petals to attach quite firmly to each other. Disc rather indistinctly lobed, (in Papuasia) hairy. Stamens 15–20(–30); filaments straight in young bud becoming sigmoid-flexuous when the flowers open (*A. brassii* has relatively stout filaments which remain straight throughout); anthers oblong, blunt, shorter than the filaments, opening by a pore at the tip surrounded by a group of small stiff bristles, without awns. Ovary densely hairy (in Papuasia), 3–5-locular; ovules 6–14 per loculus. Fruit ± drupoid, the flesh with ± radially arranged fibres attached firmly to the ± woody stone. Seeds ± hairy, at least at the ends, 1–2 per fertile fruit; seedless fruits often found. Embryo flat with broad cotyledons.

Field characters: Usually small straight trees, sometimes with stilt-roots, occasionally larger trees. Branching slender and often drooping. Bark thin; outer bark usually pale greyish, ± smooth, rarely rough; under bark often green; inner orange or straw, brittle to somewhat fibrous. Wood pale, soft to medium-hard. Seedlings may show alternate leaves; only one species observed (*A. oppositifolium*).

Distribution: About 20 species in all, 1 widespread (from Celebes, Moluccas, Kai Islands and throughout Papuasia), 1 endemic to New Hebrides (possibly conspecific with the widespread species), 5 endemic to Queensland and the rest endemic to New Guinea and New Britain.

Ecology: There is very little information on the ecology of the genus. Generally the species are understory forest trees, occasionally part of the forest canopy; they are sometimes found in disturbed vegetation.

Uses: The flesh of some species is edible, and the seeds are often roasted and eaten.

Notes: Aceratium in flower, having petals joined by hairy margins, filaments longer than anthers, anthers without awns but with stiff small bristles surrounding the apical pore, is easy to distinguish from other genera of the family. The red ripe fruit and opposite leaves also distinguish *Aceratium* from the usually blue-fruited *Elaeocarpus,* in which the stone can generally (though not in *E. womersleyi* or *E. blepharoceras*) be separated from the flesh. Hairy seeds are apparently found only in *Aceratium.*

KEY TO SPECIES (FRUITING MATERIAL)

(Fruits described and measured dry unless otherwise stated)

1. Leaves mostly obtuse at the tip. (Leaves densely soft-hairy beneath; fruit ellipsoid-cylindric, 5–8 × 2·5–4 cm; highlands) ..... **A. tomentosum**
1. Leaves mostly acute at the tip
2. Leaves and twigs glabrous (a few minute hairs may be present on the buds); leaf margins ± sinulate-dentate; fruit ellipsoid-cylindric, 3–4·5 × 1·8–2·4 cm when fresh, up to 3·5 × 1·4 cm when dried ..... **A. sinuatum**
2. Leaves and twigs variously hairy when young, often persistently so; leaf margins entire to serrate or dentate, not sinuate-dentate; fruits various
3. Fruits ± globose
4. Leaves up to 8 × 2·5 cm, mostly smaller; twigs slender (fruits *c.* 2 cm in diameter) ..... **A. sphaerocarpum**
4. Leaves (8–)9–18 × (5–)6–10·5 cm; twigs robust
5. Fruits 2·5–5 × 2·2–4·5 cm; leaves entire to ± obscurely serrate ..... **A. breviflorum**
5. Fruits up to 1·7 × 1·5 cm (possibly immature); leaves coarsely and ± irregularly serrate or dentate, especially nearer the tip ..... **A pachypetalum**
3. Fruits ovoid, oblong-cylindric to ellipsoid
6. Fruits oblong-ellipsoid, 15–18 × 6–8(–11) mm, often bluntly (4–)6(–8)-angled in section (leaves 4–6 × 1·5–2 cm) ..... **A. parvifolium**
6. Fruits larger or of a different shape
7. Fruits squat, ± ovoid often with ± parallel sides, 3–4·2 × 2–2·5 cm; flesh 1–4 cm thick, not very fibrous; stone walls and septa thin (1 mm at most) and loculi wide open in section, not obscured ..... **A. muelleranum**
7. Fruits ovoid-conic or ellipsoid-cylindric; flesh thicker; stone walls and septa thicker and seedless loculi generally obscured by seed growth in neighbouring loculi or by outgrowth from the axis in seedless fruits
8. Leaves narrow-ovate, 4·5–7 × 1·8–2·2 cm, conspicuously appressed silky-hairy beneath, particularly when young ..... **A. sericeum**

8. Leaves larger or at least broader, never sericeous though otherwise variously spreading- or appressed-hairy
9. Fruit ovoid or ellipsoid-cylindric, base rounded, in section the stone ± circular to ± 5-sided, the corners not pronounced
10. Fruits ellipsoid-cylindric, 4–6 × 2·5–3 cm ..... **A. brassii**
10. Fruits ovoid, 3–3·5 × 1·4–2 cm ..... **A. archboldianum**
9. Fruit ovoid to conical, often flat-based, in section the stone usually 3(–4)-sided with pronounced projections beyond the septa
11. Leaves (7–)9–14 × 3·5–7 cm; fruits 3–5 × 1·6–2·2 cm ..... **A. ledermannii**
11. Leaves 5–11 × 1·7–4 cm; fruit smaller ..... **A. oppositifolium**

KEY TO SPECIES (FLOWERING MATERIAL)

1. Leaves mostly obtuse at the tip (leaves densely soft-hairy beneath) ..... **A. tomentosum**
1. Leaves mostly acute at the tip
2. Leaves and twigs glabrous (a few minute hairs may be present on the buds); leaf margins ± sinuate-dentate ..... **A. sinuatum**
2. Leaves and twigs variously hairy when young, often persistently so; leaf margins entire, serrate or dentate, not sinuate-dentate
3. Filaments of stamens straight, ± stout (highlands) ..... **A. brassii**
3. Filaments of stamens twisted or curved, slender
4. Leaves 4–8 × 1·5–2·5 cm
5. Leaves densely silky-hairy beneath ..... **A. sericeum**
5. Leaves variously hairy, not densely silky-hairy
6. Plants from 750 to 1800 m altitude range; leaf nerves 10–15 pairs ..... **A. parvifolium**
6. Plants from sea level to 500 m altitude range; leaf nerves generally fewer { **A. oppositifolium** / **A. sphaerocarpum**
4. Leaves larger
7. Leaves mostly 6–10·5 cm broad, thick, ± densely spreading-hairy beneath
8. Leaves with coarse teeth on the margin particularly near the tip ..... **A. pachypetalum**
8. Leaves ± entire, sometimes ± serrate ..... **A. pittosporoides**
7. Leaves mostly 2–4 cm broad, papery, glabrous or appressed-hairy beneath
9. Plants from sea level to 300 m altitude range
10. Leaves (7½*)9–14 × 3·5–7 cm; sepals 15–21 mm long; petals 20–22 mm long ..... **A. ledermannii**
10. Leaves 5–11 × 2–4(–6) cm; sepals 8–13(–15) mm long; petals 9–16(–20) mm long ..... **A. oppositifolium**
9. Plants from (500–)750 to 2350 m altitude range ..... { **A. archboldianum** / **A. muelleranum**

Aceratium archboldianum A. C. Sm. *J. Arnold Arbor.* **25**: 119 (1944).

Shrubs or small trees to 11 m tall. Twigs soft-hairy when young. Leaves ovate to elliptic to elliptic-obovate, 5·5–14 × 2·5–5·5 cm, the tip acute and often acuminate, tapering towards a truncate base or rounded at base, brown-hairy beneath, margins ± entire or very obscurely serrate. Inflorescences brown-hairy throughout, axis up to 12 mm long, bearing (1–)4–5 flowers on pedicels 8–10 mm long. Sepals 13–16(–21) × 2–3(–4·5) mm, brown-hairy outside, hairs much shorter and sparser inside. Petals pale yellow, 16–19(–24) × 3–4(–5·5) mm, the tip divided into 4–6 simple teeth, or 3 ± bifid teeth, claw margin and inner surface densely hairy. Stamens *c.* 15; filaments 5–9 mm; anthers 3·5 mm long. Style 8–12(–18) mm, glabrous towards the tip. Fruit ellipsoid-ovoid, 30–35 × 14–20 mm, acute at the tip, rounded at base, not angled in section; flesh 2–5 mm thick; outline of stone circular or elliptic in section, not angled though sometimes ± irregular, walls *c.* 1 mm thick; sterile loculi completely obscured by growth of seeds in the fertile loculi. Seeds 1–2 per fruit.

Distribution: Known from the Wissel Lakes and from Lake Habbema (Snow Mountains, western New Guinea), from the Oksapmin area of the West Sepik district and from the Western Highlands district of northeastern New Guinea.

Ecology: Mostly in forest, often with Fagaceae. Occasionally in disturbed habitats. 1350–2350 m.

Notes: The upper dimensions for flowers in brackets given above are extracted from Smith's original description and have not been confirmed on the material seen; it seems clear that the eastern specimens are smaller in leaves and flowers.

Aceratium brassii A. C. Sm. *J. Arnold Arbor.* **25**: 114 (1944).

Trees up to 20 m tall. Twigs hairy when young. Leaves ovate to elliptic, 6–11 × 2–4·5 cm, acute at the tip, tapering to rounded at base, with some persistent hairs beneath, margins ± entire to weakly serrate. Inflorescences borne in the axils of leaves or behind them, densely hairy, the axis 2–15 mm long, bearing up to 7 flowers in short racemes or ± umbels on ± robust pedicels 8–22 mm long. Sepals pinkish-white, 12–13 × (3–)4 mm, finally splitting to base, thick, appressed-hairy outside, with dense appressed short hairs inside. Petals creamy to pinkish, oblong-oblanceolate, 21–25 × *c.* 8(–12) mm, the tip divided into 3–7 shallow lobes or teeth, margins and inside of claw densely hairy. Stamens 15–20; filaments straight, 6–9 mm long; anthers 4–6 mm long. Style 13–7 mm long, glabrous towards the tip. Fruits ovoid to ellipsoid-cylindric, 4–6 × 2·5–3 cm, (4–)5-locular, flesh 4–8 mm thick; stone ± circular to ± 5-sided in section, thick-walled, densely ± fibrous, hard but not stony. Seeds 1–2.

Distribution: Known in western New Guinea from the Cycloop Mountains and the Idenburg River both in Jayapura, and from the Star Mountains on the borders of the Jayapura and Digul districts. In northeastern New Guinea it has been found in the East Sepik, Eastern and Western Highlands districts; it is also known from the Southern Highlands district of Papua.

Ecology: In primary and secondary forest, at (800–)1000–2000 m.

Notes: The only *Aceratium* known with straight stamen filaments; these are easily seen in open flowers which thus somewhat resemble those of *Elaeocarpus womersleyi* and, to a certain extent, *Dubouzetia galorei.*

Aceratium ledermannii Schltr *Bot. Jb.* **54**: 103 (1916)

A dolichostylum Schltr (1916).

Small trees to 11 m tall. Twigs softly hairy when young. Leaves elliptic or ovate-elliptic, (7–)9–14 × 3·5–7 cm, acute and often acuminate at the tip, base tapering to rounded, persistently soft-hairy beneath, margins entire to serrate. Inflorescences sessile or with an axis up to 2 cm long (rarely more), hairy, bearing 1–6 flowers on pedicels 1·4–3 cm long. Sepals 15–21 × 2–3·5 (–5) mm, hairy or rarely very sparsely hairy outside, ± sparsely short-hairy inside. Petals cream, oblong-spathulate, 20–22 × 5–8 mm, claw margins and inner surface densely hairy, the tip rounded and divided into *c.* 15 unequal small ± acute teeth. Stamens 15–20; filaments 6–8 mm long; anthers *c.* 4 mm long. Style 7–16 mm, glabrous toward the tip. Fruit red to purplish, ellipsoid,

5 × 3 cm, the tip obtuse, base truncate when fresh; when dried, ellipsoid-conical, 3–5 × 1·5–2·2 cm, often ± 3-sided, the tip pointed, base ± truncate or with a rim round the base; flesh in spirit 7–11 mm thick, when dry 2–4 mm thick; stone strongly 3(–4)-angled, the septa usually produced into prominent ridges, with the centreline of the carpels opposite the loculi often slightly ridged, walls 1–2 mm thick; when seedless the loculi usually completely obscured by seed growth in fertile loculi and by outgrowths from the axis. Seeds sparsely hairy.

Field characters: Stilt-roots to 1 m have been recorded.

Distribution: Known from Manokwari in the Vogelkop and from near Jayapura in western New Guinea; from near Vanimo in the West Sepik district and May River in the East Sepik district, from the Madang and Morobe districts; 1 collection from the Central district of Papua is known. The species is common in New Britain.

Ecology: Primary lowland forest or sometimes in strand vegetation, 0–300 m.

Notes: Differing from *A. oppositifolium* only in size of leaves and fruits; there are some ± intermediate specimens. *A. muelleranum* is also rather similar but differs in fruit type, particularly as seen in cross-section.

Aceratium muelleranum Schltr *Bot. Jb.* **54**: 107 (1916). **Fig. 13D–F.**

A. obtusidens Schltr (1916); *Elaeocarpus ochraceus* Ridley (1916); *A. ochraceum* (Ridley) Schltr (1918).

Generally small trees, once reported large. Twigs densely soft-hairy when young. Leaves ovate to elliptic, broad to narrow, 9–15(–20) × (3·5–)4–8(–10) cm, acute and often acuminate at the tip, tapering to slightly cordate at base, hairy to velvety-hairy beneath, margins ± entire to distantly and shallowly serrate. Inflorescence axillary or terminal, densely hairy, with axis up to 8 mm long, bearing 3–4 flowers on pedicels 12–20 mm long. Sepals 13–17 × 3·5–5 mm, densely hairy outside, ± short-hairy inside. Petals creamy, oblong-oblanceolate, 18–25 × 5–7 mm, claw margin and inner face densely hairy, divided irregularly into 7–10 ± acute teeth at the tip. Stamens (15–) 25–30; filaments 6–8 mm long; anthers 2·5–3·5 mm long. Style 8–14 mm long, densely spreading-hairy for most of its length. Fruits red; when dried ovoid-ellipsoid or broadly oblong-ellipsoid, 3–4 × 2–2·5 cm, rounded or bluntly pointed at the tip, truncate or rounded at base, (3–)4-locular, seedless loculi large, not becoming obscured by growth of seeds in neighbouring fertile loculi; flesh 1–4 mm thick, less pronouncedly fibrous than usual in *Aceratium;* stone with thin walls usually less than 1 mm thick. Seeds 0–2, densely golden-hairy.

Distribution: In western New Guinea, so far known with certainty from only 1 collection, obtained in the foothills of Mt Carstensz in the Mimika district. In northeastern New Guinea it is known from the East Sepik district, from Wagau and near Garaina in the Morobe district, from the Okapa and Kassam areas of the Eastern Highlands, and from Lake Kutubu in the Southern Highlands district of Papua; there are several collections from the Central district of Papua.

Fig. 13 **Aceratium** (A—C) **A. oppositifolium** DC. (A) leafy twig with inflorescence (B) dried fruit (C) cross-section of dried fruit (D—F) **A. muelleranum** Schltr (D) dried fruit (E) cross-section of dried fruit (F) seed from outside and in section (G—H) **A. parvifolium** Schltr (G) dried fruit (H) cross-section of dried fruit

Ecology: Forest or secondary regrowth, from 500 to 1500 m.

Notes: There are some difficulties in typification that are discussed in Coode (1978). It resembles *A. ledermannii* and to a certain extent *A. brassii* and *A. archboldianum*, all differing in fruit type.

Aceratium oppositifolium DC. *Prodr.* **1**: 519 (1824). **Fig. 13A–C.**

Elaeocarpus oppositifolius (DC.) Miq. (1859); *E. edulis* Teysm. & Binn. (1864); *Aceratium branderhorstii* Schltr (1961); *A. versteegii* Schltr (1916); *?A. warenense* Kan. & Hat. (1942); *A. angustifolium A. C. Sm. (1944); A. gracile* A. C. Sm. (1944); *A. insulare* A. C. Sm. (1944).

Trees up to 15 m tall. Twigs ± appressed-hairy when young, often quickly becoming glabrous. Leaves mostly elliptic, sometimes ovate or obovate-elliptic, 5–11 × 2–4(–6) cm, the tip acute and often acuminate, broadly tapering to rounded to slightly cordate at base, ± appressed-hairy (sparse or dense) beneath, margins entire to serrate. Inflorescences very variable, axis 1–10(–18) mm long, bearing (1–)2–5 flowers on pedicels 8–12(–38) mm long;glabrous to distinctly hairy throughout. Sepals (8–)10–13(–15) mm, hairy or glabrous outside or inside, soon falling. Petals cream, white, pink or red, oblong-spathulate, (9–)13–16(–20) × 3–6(–10) mm, short-hairy on the claw margins, hairy inside on the claw, the tip divided into (6–)8–15 teeth. Stamens 11–15; filaments 5–8 mm long; anthers 2–3 mm long. Style 7–13(–18) mm, variously hairy. Fruit: when fresh ovoid, slightly 3-sided, acute at the tip and rounded to slightly flattened at base, 3·2 × 1.8–2 cm; when dried ovoid-conic to conical and 3-sided, 18–34 × 14–22 mm, usually with a pronounced flat base, 3(–4)-locular; flesh 0·5–3 mm thick; stone usually 3(–4)-angled in section, the walls *c.* 1 mm thick, usually with distinct processes at the ends of the septa; seedless loculi not or partially or ± completely obscured by growth of seeds in the fertile loculi. Seed 1, sparsely hairy.

Field characters: Sometimes reported with stilt-roots.

Distribution: From the Celebes, Moluccas, and Kai Islands through Papuasia to the Santa Cruz group. In Papuasia the specimens are widely scattered and it is apparently locally common. There are several specimens from the Vogelkop and Jayapura districts in western New Guinea, and 1 from Fakfak. In north-eastern New Guinea there are specimens from the East Sepik, Morobe and Western Highlands districts, and in Papua there are many from the Western district and a few from all other mainland districts except Gulf. It is known from New Britain and New Ireland, and from all the island groups in the Solomons except Rennell.

Ecology: Forest or secondary regrowth, from sea level to 300 m.

Uses: In the Moluccas the flesh of the fruit is considered edible.

Notes: A species varying exceedingly in single characters (such as sepal and leaf hairiness, pedicel length, leaf glaucousness and base shape), none correlating with any other. One variant with relatively broad leaves and distinct indumentum on leaves and sepals has been named *A. branderhorstii;* it appears to replace the more normal forms of *A. oppositifolium* in the Western district of Papua and in adjacent western New Guinea. There are similar variants

from as far apart as the Vogelkop, Sepik and New Britain. There are also specimens which can be told from *A. sphaerocarpum* and *A. parvifolium* only on fruit shape; others scarcely differ from *A. ledermannii,* which generally can be distinguished by larger leaves, sepals, petals and fruit. The fruit of *A. oppositifolium* also varies; some have much corkier flesh than others, some have much thicker stone walls, some have open seedless loculi and some have the seedless loculi obscured. Until more is known of how the fruit changes with maturity, and how each stage toward maturity dries out in the herbarium, it is impossible to explain or formally recognise these variations.

Aceratium pachypetalum Schltr *Bot. Jb.* **54**: 107 (1916) amplified by A. C. Sm. *J. Arnold Arbor.* **25**: 120 (1944). **Fig. 14A–C.**

Shrubs to small trees. Twigs soft-hairy when young. Leaves ovate to ovate-elliptic, 9–12(–17) × 6–7(–9) cm, acute and usually acuminate at the tip, broadly tapering to rounded at base, persistently soft-hairy beneath, margins distantly and very coarsely serrate, the teeth ± apiculate. Inflorescence axis 6–10 mm long, bearing 4–6 flowers on pedicels 10–15 mm long, densely brown-hairy throughout. Sepals 11–13 × 2.5–3.5 mm, hairy outside like the pedicels, inside with shorter sparser hairs. Petals oblong-spathulate, 14–16 × 4–5 mm, the margins and the inside of the claw hairy, divided at the tip into 4–6 teeth. Stamens *c.* 19; filaments 4–6 mm long; anthers 3–3.5 mm long. Style 7–8 mm long, glabrous for most of its length. Fruits globose when dried, up to 17 × 15 mm (possibly not mature); style often persistent; 3–4-locular; the flesh 1–2 mm thick; stone walls *c.* 1 mm thick; seedless loculi remaining open unless a seed develops in a neighbouring loculus, when they become partially obscured.

Distribution: Known from only 3 collections, all from near Jayapura in western New Guinea.

Ecology: Secondary forest, 40–100 m.

Notes: Possibly not distinct from *A. pittosporoides* but currently kept separate on the basis of much smaller fruits and coarsely sinuate-serrate leaf margins. More material is needed to check the constancy of these characters.

Aceratium parvifolium Schltr *Bot. Jb.* **54**: 102 (1916) amplified by A. C. Sm. *J. Arnold Arbor.* **25**: 111 (1944). **Fig. 13 G,H.**

A. clemensiae A. C. Sm. (1944).

Small trees up to 17 m tall. Twigs slender, appressed-hairy when young. Leaves narrowly ovate to elliptic, 4–6 × 1.5–2 cm, acute and acuminate at the tip, broadly tapering to rounded at base, ± papery, appressed-hairy beneath, main nerves ± prominent beneath and rather crowded (10–15 pairs), margins finely serrate. Inflorescences borne in leaf axils, axis up to 15 mm long, bearing 3–5 flowers on hairy, often slender, pedicels 8–16 mm long. Sepals 10–15 ± 2 mm, ± densely short-hairy outside, equally or more so inside. Petals oblanceolate-spathulate, 13–15(–20) × 3 mm, hairy on claw margins and inner surface toward the base, the tip divided into 5–8 irregular blunt teeth. Stamens *c.* 15; filaments 5–6 mm long; anthers 2–2.5 mm long. Style 9–12 mm long, glabrous near the tip. Fruit oblong-ellipsoid at least

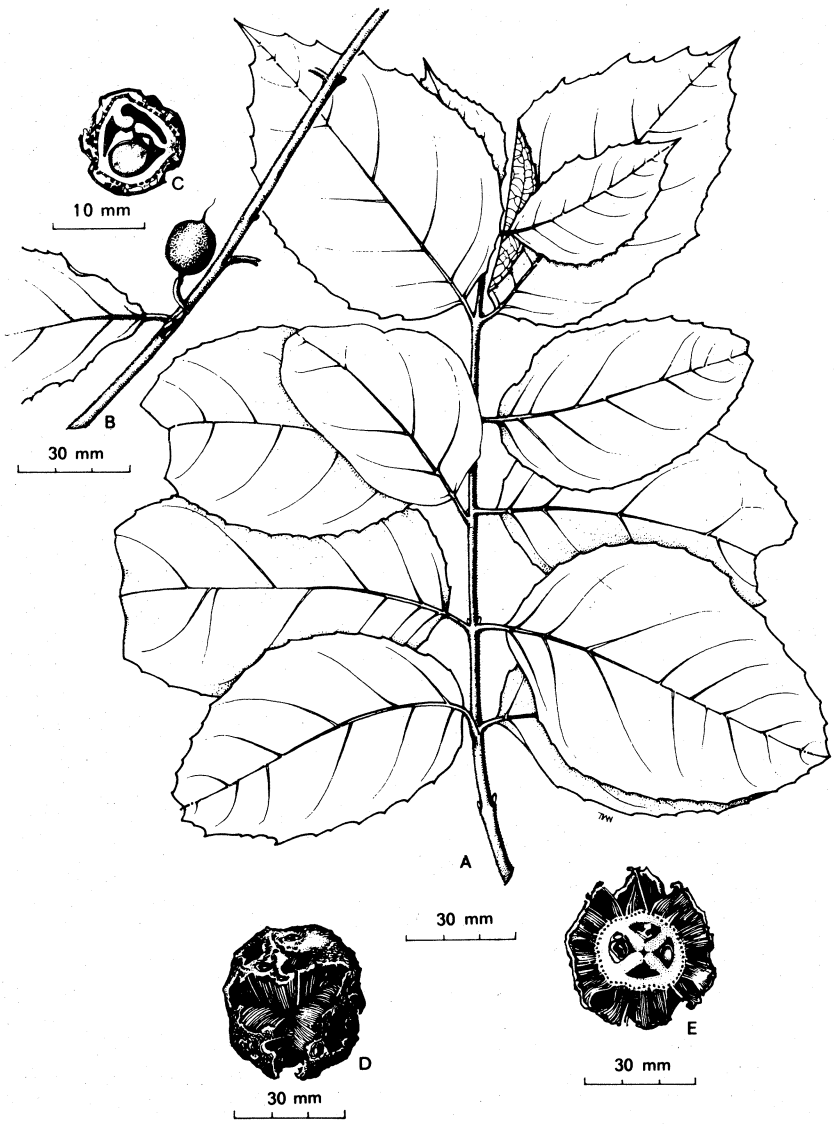

Fig. 14 **Aceratium** (A—C) **A. pachypetalum** Schltr (A) leafy twig (B) ?young fruit, dried (C) cross-section of mature fruit (D—E) **A. pittosporoides** Schltr (D) dried fruit (E) cross-section of dried fruit

when dry, (4–)6(–8)-angled, 15–18 × 6–8(–11) mm, the tip acute to obtuse, style often persistent, base rounded, often with irregular pustules, obscurely hairy, (2–)3(–4)-locular; flesh 1–2 mm thick; stone walls *c.* 1 mm thick; seedless loculi only obscured when seeds present in neighbouring loculi. Seed 1 per fruit at most, often not developed, golden-hairy.

Distribution: Very scattered, apparently nowhere common. Known from 3 specimens from the borders of the Snow Mountains, Mimika and Digul districts in western New Guinea; from the Telefomin area of the West Sepik district and from the Morobe, Eastern and Western Highlands districts of northeastern New Guinea. There is also 1 specimen from the north of the Western district of Papua.

Ecology: Castanopsis-forest, secondary forest, beside streams etc., 750-1800 m.

Notes: The small, oblong, often 6- or 8-sided fruit and small leaves with rather crowded nerves are distinct. In flower it would not be easy to tell from some forms of *A. oppositifolium* or *A. sphaerocarpum.*

Aceratium pittosporoides Schltr *Bot. Jb.* **54**: 105 (1916), f. 2, H–J. **Fig. 14D, E.**

A. breviflorum Schltr (1916); *?A. cryptocariifolium* Kan. & Hat. (1942).

Small trees 9–13 m tall. Young parts densely velvety-hairy. Stipules often present, very narrow, to *c.* 5 mm long. Leaves ovate, (8–)11–18 × (5–)7–10 cm, acute at the tip, broadly tapered, rounded, truncate or slightly cordate at base, with dense short velvety hairs beneath, venation prominent beneath, undersurface sometimes slightly glaucous, margins usually ± entire, sometimes serrate or even sinuate-serrate. Inflorescences axillary, with dense velvety brown hairs, condensed and bearing up to 10 flowers on robust pedicels 8–13 mm long. Sepals falling quickly, not known. Petals ± oblong-spathulate, 18–20 × 3–4 mm, short-hairy on claw margins and inner surface near the base, with 6–8 short somewhat blunt teeth at the tip. Stamens *c.* 18; filaments 7–8 mm long; anthers 3–4 mm long. Style *c.* 13 mm long, glabrous for most of its length. Fruits red, broad-ellipsoid and rounded at the tip when fresh; when dry, ± spherical or globose-ellipsoid, 2.5–5 × 2.2–4 cm, splitting deeply on drying, 4–10 mm thick, stone walls relatively thin (1–2 mm); loculi (3–)4, seedless loculi or only a little obscured by growth of seeds in neighbouring loculi. Seeds 0–2.

Field characters: Buttresses to 50 cm have been recorded.

Distribution: Scattered. Known from near Sarmi in the Jayapura district of western New Guinea, from Oksapmin in the south of the West Sepik district, from near Ambunti in the East Sepik district, from the Madang district, from Gurakor in the Morobe district, from near Lake Kopiago in the Western Highlands district, and Arau in the Eastern Highlands.

Ecology: Primary forest, sea level to 1400 m, often with *Nothofagus.*

Notes: The flower description is based on specimens which lack confirmatory fruit characters, and thus must be taken cautiously. It is possible that *A. pittosporoides* and *A. pachypetalum* may in the future be considered con-

specific; here they are considered separate on the basis of fruit size and leaf margin, although one specimen of *A. pittosporoides* tends to the leaf margins of *A. pachypetalum.*

Aceratium sericeum A. C. Sm. *J. Arnold Arbor.* **25**: 113 (1944).

Trees up to 23 m tall. Twigs slender, appressed-hairy when young. Leaves narrow-ovate, 4·5–7 × 1·8–2·2 cm, acute and acuminate at the tip, tapering to rounded at base, fairly tough, main veins slightly prominent beneath and rather crowded (10–13 pairs), shining-appressed-hairy beneath, margins finely serrate. Inflorescences borne in the axils of leaves, appressed-hairy, axis 10–25(–32) mm long, bearing 2–3(–7) flowers on slender pedicels 10–12 mm long. Sepals 11–13 × 1.5–2·5 mm, ± appressed-hairy outside, sparsely short-hairy inside. Petals red, oblong-oblanceolate, 15–20 ± 5–6·5 mm, claw margins and inner face short-hairy, the tip divided into 4–7 irregular teeth. Stamens *c.* 15; filaments 6–7 mm long; anthers 2·5–3 mm long. Style 11–12 mm, hairy almost to the tip. Ripe fruit unknown; unripe fruit conical, acuminate.

Distribution: So far known definitely only from the Idenburg River in the Jayapura district of western New Guinea.

Ecology: Primary and secondary forest, 1100–1200 m.

Notes: A fruiting specimen from the Eastern Highlands district of north-eastern New Guinea may belong here; it has nearly mature fruit which are narrow-ovoid, 30–35 × 9 × 8 mm, ± acuminate, 3-angled, borne on slender pedicels *c.* 2 mm long. Sterile specimens could perhaps be confused with *Sericolea;* the generally shiny leaf hairs are characteristic of *A. sericeum* and several species of *Sericolea.*

Aceratium sinuatum Coode *Brunonia* **1**: 145 (1978).

Trees up to 27 m tall. Twigs slender, glabrous (buds may be minutely appressed-hairy), twig bark remaining smooth and greenish for some time. Leaves elliptic or broadly elliptic, 7·5–10 × 3·5–6 cm, acute and acuminate at the tip, base tapering or broadly tapering, ± papery, glabrous, main veins rather few (5–7(–9) pairs) and only a little prominent beneath, margins obscurely sinuate-crenate. Inflorescences borne in the axils of leaves, axis to 1 cm long, bearing probably *c.* 4–5 flowers; pedicels in fruit very sparsely hairy, 17–22 mm long. Flowers unknown. Fruits when fresh oblong-cylindric to cylindric-ovoid, 3–4·5 × 1·8–2·4 cm, depressed at base, tapering a little to an obtuse to minutely depressed tip, very sparsely appressed-hairy or ± glabrous, styles not persistent; when dry the flesh contracts and forms an irregular rim at base, the tip becoming more pointed, up to 3·5 × 1·4 cm. Seed 1 per fruit at most, hairy; well developed seed not seen.

Distribution: Only known from 2 collections from near Kiunga in the Western district of Papua.

Ecology: Riverbank forest, periodically flooded, and sago swamp, 20–30 m.

Notes: A. sinuatum is easily distinguished from the other species in Papuasia by the virtual absence of any hairs on the twigs and leaves and in the sinuate-crenate to almost entire leaf margins.

Aceratium sphaerocarpum Kan. & Hat. *Bot. Mag. Tokyo* **56**: 311 (1942).
A. erythrocarpum A. C. Sm. (1944).

Trees up to 27 m tall (generally less). Twigs slender, ± appressed-hairy when young. Leaves ovate-elliptic or oblong, (4–)5–8 × 2–2·5 cm, the tip acute and usually acuminate, tapering to rounded at base, papery; main nerves slightly prominent beneath (7–10 pairs), appressed-hairy on nerves and often glaucous beneath, margins obscurely serrate. Inflorescences borne in the axils of leaves, almost umbellate, conspicuously hairy, axis up to 10 mm long, bearing 2–5 flowers on pedicels 5–7 mm long. Sepals 7–9 × 1–2 mm, hairy like the inflorescence outside, ± glabrous inside. Petals ± oblanceolate, 14–16 × *c.* 3 mm, claw densely hairy on margins and inside towards the base, the tip divided into 10–15 irregular teeth. Stamens *c.* 15; filaments 5–7 mm long; anthers 1·5 mm long. Style *c.* 11 mm long, hairy in basal half only. Fruit globose or depressed-globose when dried, *c.* 2 cm in diameter, flesh 1–4 mm thick, stone relatively solid, walls 1–3 mm thick, seedless loculi ± obscured. Ripe seed not seen; seedcoat evidently sparsely hairy.

Field characters: Sometimes stilt-rooted.

Distribution: Mostly in the south of New Guinea. 1 specimen is known from each of the Geelvink Bay and Digul districts of western New Guinea. From Papua there are specimens from the Western, Gulf and Central districts.

Ecology: Forest; usually primary, occasionally secondary; sea level to 500 m.

Notes: The only Papuasian species with small leaves and globose fruit. In flower, difficult to separate from some forms of *A. oppositifolium* or *A. parvifolium.*

Aceratium tomentosum Coode *Brunonia* **1**: 148 (1978).

Trees from 7 m tall to large forest trees. Twigs robust, densely hairy at least when young. Leaves mostly elliptic, occasionally ovate, obovate or broadly elliptic, (5–)6.5–8(–12) × 4–6 cm, the tip obtuse or rarely ± acute, the base broadly tapered, rounded or truncate, tough, persistently and densely soft-hairy, main veins (7–10 pairs) prominent beneath, margins very finely and obscurely serrulate or entire. Inflorescences borne in the axils of leaves, hairy; in fruit with the axis robust, 1–4 cm long; fruits borne on pedicels 15–25 mm long. Flowers unknown. Fruits ± cylindric-ellipsoid, 5–8 × 2·5–4 cm, red and firm-fleshy when ripe, soft-hairy at first, later glabrous, flesh 5–10 mm thick, stone with 4–5 loculi, seedless loculi obscured or not, the 1 fertile fruit seen with 2 seeds and 3 obscured loculi. Seeds hairy, particularly towards the ends.

Field characters: Occasionally stilt-rooted.

Distribution: Known only from the Morobe and Western Highlands districts of northeastern New Guinea, and the Southern Highlands of Papua.

Ecology: Primary forest, 2000–2800 m.

Notes: The only species of *Aceratium* with the majority of leaf apices obtuse or rounded. More material is needed especially in flower.

NAMES NOT ACCOUNTED FOR

A. hypoleucum Kan. & Hat. *Bot. Mag. Tokyo* **56**: 310 (1942), described from inland of Nabire in the Geelvink Bay district of Western New Guinea. This was considered to be related to *A. branderhorstii* but with larger leaves. The illustration shows the fruit to have a rounded, not flattened, base. There is insufficient information to place it among the species described above, although the petals are described as 1 cm long, indicating that it may be part of *A. oppositifolium*. The specimens presumably exist but could not be obtained for study.

A. molle Schltr *Bot. Jb.* **54**: 107 (1916), described from near Malu (Ambunti area) in the East Sepik district. Schlechter considered this to differ from *A. pachypetalum* in the blunt almost entire leaves and longer petals; without seeing an isotype, and lacking a fruit description, it is impossible to judge whether it may be a distinct species or part of *A. pachypetalum*. No specimen is known to have survived.

DUBOUZETIA Pancher ex Brongn. & Gris

Small or large trees. Leaves alternate or spirally arranged, exstipulate, or stipules minute and falling quickly. Inflorescence fasciculate to short-racemose, axillary, rarely terminal. Flowers 4–5-merous. Sepals distinct from the petals. Petals free, undivided at the tip or with a few obscure teeth or lobes. Disc lobed, lobes as many as petals, ± bifid. Stamens 25–35, inserted between the disc and ovary; filaments slender, much exceeding anthers; anthers oblong, dehiscing at the tip between two short recurved teeth, without awns or bristles at the tip. Ovary hairy, 3–5-locular, loculi 4–6-ovulate. Fruit a globose or 3–5-angled capsule, of complex structure with the walls relatively thin and bony and composed of two layers which usually separate on drying, the outer layer splitting first, partially and loculicidally; later the inner layer, which is organised in discrete cocci enclosing the seeds, breaks open septicidally between the cocci, often rupturing the outer layer; finally the various parts (at least in *D. dentata, D. novoguineensis* and the New Caledonian species) twist back and detach, either connected in a ring or individually, leaving the axis persistent. Seeds ± angular, strophiolate (the strophiole spiral or reduced) or without a strophiole and the seed coat developing into a thick spongy sarcotesta surrounding a small stony sclerotesta. Embryo flat with broad cotyledons.

Field characters: The larger species may have fissured bark, and buttresses. The wood is hard and heavy for the family. The flowers are relatively showy.

Distribution: About 11 species, 1 in Moluccas, 4 in New Guinea and 7 in New Caledonia.

Notes: Very like *Peripentadenia* L. S. Smith from Queensland, which differs in its consistently 1-seeded capsule and solitary flowers. In flower, *Dubouzetia* can be distinguished from *Elaeocarpus, Sericolea* and *Sloanea* by having filaments much longer than the anthers, which lack awns; from *Aceratium* and *Sericolea* in its alternate or spirally arranged leaves. In fruit the curious dry capsule with 2-layered walls is distinct.

D. galorei and *D. kairoi* are relatively distinct species, but the variation in *D. novoguineensis* is very great. Observations on fresh or spirit material of seeds, strophioles and whole fruits are needed.

KEY TO SPECIES

1. Leaves glabrous beneath or with a few scattered hairs on midrib at most
   2. Leaves lanceolate or narrow-elliptic ..... **D. dentata**
   2. Leaves obovate to elliptic ..... **D. novoguineensis**
1. Leaves hairy beneath
   3. Petals thin ± glabrous; capsules ± globose, 1–1·5 cm in diameter ..... **D. kairoi**
   3. Petals thick, velvety-hairy; capsules polygonal (3–5-sided), 4·5–5·5 × 3–4 cm in diameter ..... **D. galorei**

Dubouzetia dentata A. C. Sm. *J. Arnold Arbor.* **25**: 272 (1944).

Differs from *D. novoguineensis* in leaf length, being 8–12·5 cm long, and leaf shape, being relatively narrower; the anthers are also reported to be shorter.

Distribution: Known only from the type and a specimen from Ceram in the Moluccas.

Notes: A flowering specimen from the Western Highlands district has leaves which match well but has stamens like those of *D. novoguineensis* and its flowers clustered at the twig tips in a terminal ± leafless inflorescence. Such variation suggests that *D. dentata* and *D. novoguineensis* are part of the same variable species, but more material is needed before any formal decision can be made. Smith's published fruit distinction does not hold in the new material.

Dubouzetia galorei Coode *Brunonia* **1**: 154 (1978).

Trees 20–40 m tall. Twigs densely velvety-hairy to sparsely hairy, persistent at least for a time. Petioles 10–23 mm long, robust, with hairs like the twigs. Leaves mostly obovate to broad-elliptic, (9–)11–27 × 5·5–14 cm, round or acute at the tip, broadly tapering to subcordate at base, sparsely short-hairy to velvety-hairy beneath at least on nerves, margins coarsely crenate to ± entire. Inflorescences with a short woody axis, few-flowered; pedicels *c.* 12 mm long, short-hairy. Sepals 13–14 × 2·5–4 mm, thick, ± velvety-hairy on both sides. Petals oblong-obovate when flattened out, 23–24 × 8 mm, velvety-hairy, normally with lateral infoldings near the tip, the base forming 2 small pouches inside, the tip rounded. Stamens *c.* 25; filaments 9–10 mm long; anthers 2·5–3·5 mm long. Style *c.* 10 mm long. Fruit obovoid, 4·5–5·5 × 3–4 cm, strongly 3–4-sided (sides occasionally concave), apex depressed around an acuminate tip, 3–4-locular. Dehisced ripe fruit unknown; undehisced fruits and fruit fragments from ground known. Seeds 1–2 per loculus, when fresh soft and bright pink or red, 15–20 × 13–18 mm, filling the loculi and therefore angular-globose, contracting irregularly on drying; seed coat thin, tough, flexible, containing dryish white pulp surrounding a ± conical sclerotesta or 'stone' containing the endosperm and the embedded embryo.

Field characters: Spurred or buttressed bole; bark apparently very fibrous inside; collectors have reported that the capsule has not been seen open and with peeled-back valves, only with slits at the tip; in this state the fruits will

not prize open. Capsules rotting on the ground have usually been unopened. The bright red pulpy seeds are unique in the family at least as found in Papuasia. The whole seed floats buoyantly when fresh but the 'stone' sinks if removed from the pulp. Possibly the seeds are distributed by fish, as happens in Amazonian swamp-forests.

Distribution: Endemic to New Guinea. So far known only from northeastern New Guinea, near Amanab and near the Frieda River both in the West Sepik district, near Bulolo in the Morobe district, and from Kiunga, Lake Daviumbu and Weam in the Western district of Papua.

Ecology: Primary forest; sometimes savannah subject to periodic flooding; common in the forests along the Fly River; from 30 to 1200 m.

Notes: The flower description is based on material from the Morobe district. The type is from the Western district from where flowers are not known. Fruit or fruit fragments are known from all areas and are very similar. There is considerable variation in leaf hairiness and in ecology; it is possible that more than one species is involved, and more material is needed. When in fruit *D. galorei* is quite unmistakable for anything else, although in leaf alone it could resemble *Elaeocarpus,* or *Vavaea* in Meliaceae.

Dubouzetia kairoi Coode *Brunonia* **1**: 157 (1978).

Trees up to 40 m tall, though sometimes flowering when very much smaller, twigs persistently hairy. Petioles 10–15 mm, hairy. Leaves broadly obovate or broadly elliptic, 8–11 × 6–8 cm, the tip obtuse to ± acute, tapering at base, densely hairy beneath, with widely spaced obscure teeth on the margin. Inflorescences axillary, fasciculate or short-stalked, densely hairy, bearing 3–5 flowers on pedicels 12–17 mm long. Sepals falling quickly, 7–8 × 2–3 mm, hairy outside, short-hairy inside. Petals white, ± oblong, 17–19 × 5–6(–8) mm, flat, thin, with few hairs in the basal half, entire or emarginate (rarely obscurely toothed) at the tip. Stamens 28–33; filaments 12–14 mm long; anthers 3–4 mm long. Styles 17–18 mm long, glabrous near the tip. Ripe fruit unknown; unripe fruits, possibly full-sized, ± globose with persistent style, 10–15 mm in diameter, appressed-hairy, usually 3-locular; seeds small, brown, at least sometimes with a spiral strophiole.

Field characters: Reported with buttresses, flaky and fissured bark, and hard heavy wood. The flowers are showy.

Distribution: Endemic to new Guinea. 6 collections are known, all from the Morobe district of northeastern New Guinea.

Ecology: Forest often on ridges and in association with *Nothofagus;* 1600–2300 m.

Notes: Differs from *D. novoguineensis* in the hairy leaves, and from *D. galorei* in the size of the fruit and in thin petals with only a few hairs.

Dubouzetia novoguineensis A. C. Sm. *J. Arnold Arbor.* **25**: 271 (1944). **Fig. 15.**

Trees 8–20 m tall. Twigs appressed-hairy when young, soon glabrous.

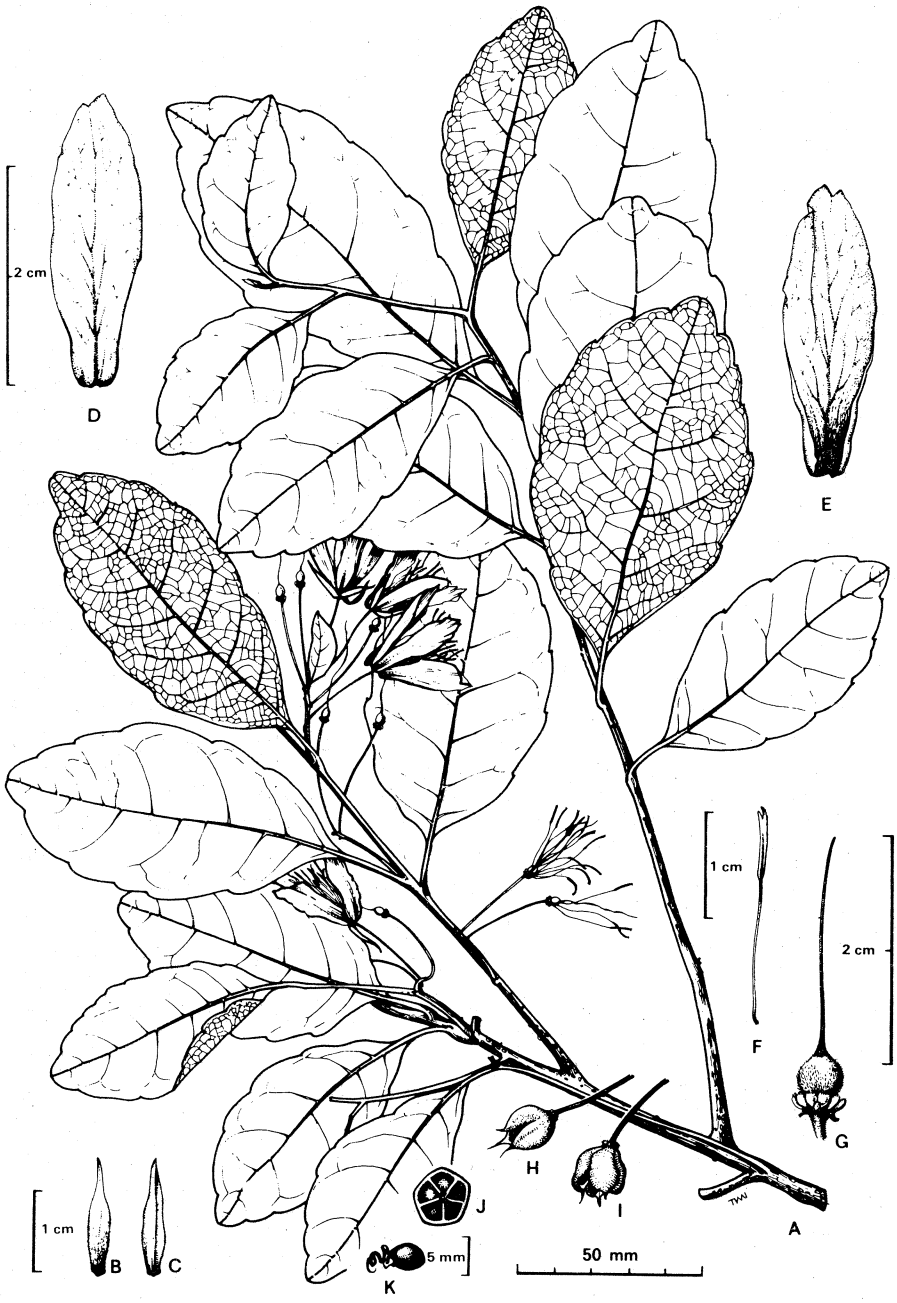

Fig. 15 **Dubouzetia novoguineensis** A. C. Sm (A) leafy twig with inflorescences (B) sepal outside (C) sepal inside (D) petal outside (E) petal inside (F) stamen (G) ovary and style surmounting disc (H—I) fruits (J) cross-section of fruit (K) seed, with strophiole

Petioles 5–8(–10) mm long. Leaves elliptic to obovate, 4–7(–11) × 2–3(–6·5) cm, the tip acute or obtuse or rounded, base tapering, glabrous or with a little appressed indumentum on the midrib beneath, margins often slightly rolled under, variously crenate or serrate, occasionally entire. Inflorescence a short-stalked axillary raceme, ± sparsely hairy, bearing 3–6 flowers on pedicels 12–20 mm long. Sepals soon falling, *c.* 10 × 3 mm, short-hairy on both sides. Petals white or cream, oblong-obovate, 20–23 × 5–7 mm, thin, flat, sparsely hairy in the lower half or ± glabrous, the tip entire or slightly notched. Stamens *c.* 25; filaments 11–15 mm long; anthers 3–4 mm long. Styles 14–19 mm long, glabrous near the tip. Fruit generally 3-locular, broad-obovoid or ± globose, *c.* 15 mm long just before dehiscence; style base persistent and splitting on dehiscence; valves twisted and curved back, finally detaching, leaving the axis persisting. Seeds 2–3 per loculus, smooth, purplish-black, often with yellow strophiole, *c.* 4 mm long.

Field characters: The flowers are showy.

Distribution: Known from 1 specimen from the Arfak Mountains of the Vogelkop, western New Guinea, and from the Morobe and Western Highlands districts of northeastern New Guinea. In Papua it is known from the Central and Milne Bay districts.

Ecology: Nothofagus forest, moss forest, secondary regrowth, 2200–2700 m.

Notes: A species very variable in leaf shape, size and tip, and in the degree of hairiness of the petals. More collections are needed. Differs from *D. kairoi* in the glabrous leaves and from *D. galorei* in fruit size and petal hairiness. One variant is very similar to New Caledonian *D. elegans* Brongn. & Gris.

Dubouzetia sp.? nov. 1.

Differs from *D. kairoi* in the much smaller flowers, with petals *c.* 11 mm long, filaments 4 mm long, anthers 1 mm long.

Distribution: 1 scrappy specimen known from Lake Kutubu, Southern Highlands district of Papua.

Ecology: Riverside vegetation, *c.* 700 m.

Notes: The material of this apparent new species of *Dubouzetia* is inadequate for formal description and naming.

ELAEOCARPUS L.

Shrubs, small or large trees. Leaves usually exstipulate, alternate or spirally arranged (opposite or subopposite in Papuasia only in *E. sericoloides*). Inflorescence usually a simple raceme with equispaced flowers borne in the axils of leaves or on the twigs behind them, rarely otherwise. Flowers (4–)5-merous, from very small to large and showy. Petals distinct from sepals, free (though sometimes coherent along margins by dense short hairs), usually clearly toothed or incised at the tip, sometimes contracted at the tip and teeth very small or absent, rarely without divisions or merely emarginate even though expanded at apex, glabrous or hairy. Disc usually hairy, lobed; the

disc lobes often persist at the base of the fruit and together resemble a cogwheel. Stamens 10–many, inserted between the disc and the ovary or rarely on top of the disc; filaments usually shorter than anthers, in a few species equalling or exceeding them, straight or rarely sharply flexed; anthers opening by transverse slits at the tip, the slit sometimes extending downwards laterally occasionally to the base, the tip blunt or toothed or with a group of bristles or awned at the tip. Ovary hairy or glabrous, with 2–7 loculi; loculi with 2–12 ovules. Fruit drupoid, very small to large, not dehiscent, usually with a blue skin and with succulent or fibrous flesh and a rugose or sculptured stone often with the sutures visible on the stone surface and in transverse section (T. S.). Seeds 1, or 1 per locule at most, containing either a straight embryo with broad flat cotyledons or a curved embryo with narrow cotyledons; no arillode present and seedcoat apparently never succulent nor hairy.

Field characters: Probably most, if not all, of our species of *Elaeocarpus* have leaves which die scarlet while still on the tree; in *E. sphaericus* at least, groups of leaves die together, becoming as brilliant a red as any flower. While the high-altitude shrubby species often lack a distinctive facies, many of the lower-altitude species have a *Terminalia*-like branching habit when young and eventually become ± flat-topped, at least when part of the forest canopy. The bark is usually smooth and light grey with yellow-orange or brownish underbark and slightly paler, fairly hard, granular, or granular and fibrous, inner bark. Mostly the wood is white or creamy and fairly soft, but *E. womersleyi* has exceedingly hard wood, and *E. blepharoceras* has not only reddish wood but also deeply fissured dark grey or brown outer bark, with pink and strongly fibrous inner bark. There are often buttresses, particularly in lowland species, and some species have stilt-roots. The characteristic fringed petals can be seen on the forest floor beneath a tree in flower, and the stones of the larger fruits may also persist for some time in the litter. In some species the flowers and fruits are held just above the canopy; in others the flowers hang down and are invisible from outside the canopy.

Distribution: The genus is widespread throughout Southeast Asia, and extends west to India, Madagascar and Mauritius, north to Japan, east to Hawaii and Polynesia (as far as Rarotonga) and south to Australia and New Zealand. The largest number of species is found in New Guinea, Philippines, Borneo, Sumatra and adjacent mainland regions; there are probably about 250 or 300 species in all.

Ecology: Not much is known of the ecology of the genus. There are representatives from sea level to 3500 m, most species being restricted to lowlands or mid-altitudes or highlands, but some have a wider range. Many of the species, particularly those commonly collected, occur in secondary vegetation; the dispersal is helped by the smallish blue fruits which are evidently attractive to birds. Others, often with larger fruits, are less common and are found in undisturbed forest. Some species dominate mid- to higher-altitude forests in certain places; there seems to be speciation, or hybridization, at the present time on the lower slopes of Mt Albert Edward, in the Central District of Papua, where the genus is particularly common and where some individual variants have been collected that cannot be fitted into the system presented

here. The species are not mutually exclusive; on Mt Kaindi (2300 m near Wau) alone there are 10 species known from a very small area, together with 1 *Dubouzetia,* 2 *Sericolea* and 2 *Sloanea.*

Notes: Elaeocarpus is the largest genus of the family in Papuasia. While generally distinct enough, with its usually fringed petals and alternate leaves, there are strong similarities between the flowers of certain species of *Elaeocarpus* and those of *Dubouzetia,* being distinguished only by the presence of awns; the flowers of *E. bilobatus* resemble those of *Sericolea* but are not borne in opposite pairs.

68 species or species complexes are keyed out and described here; there are at least 7 new species, that are suspected, but the material is not good enough for formal description. In addition there are 21 published names in the literature whose types have been destroyed or are unavailable to us in Lae and whose descriptions are inadequate for their interpretation. These names are listed at the end of the genus (p. 151) where possible under the group or subgroup to wnich they belong.

The two keys that follow are artificial. The key to the groups given in Coode (1978) is omitted here, since it requires floral dissection to find out the number of ovules per loculus and the number of ovary loculi in the flowering stage. Here, the species are arranged alphabetically within these groups so that those species which seem most similar will be found close together, for easier comparison of descriptions. The species are numbered (1 — 68) in the order in which their descriptions occur, and these numbers are also given in the keys for easy location of descriptions. The descriptions have been kept as brief as is possible in a genus as complicated in its specific relationships as *Elaeocarpus.* Some characters may vary in a few species only, but are essential for diagnosing those species; these characters have been described throughout in order that each species description may be compared with any other.

As in other genera with ± succulent fruits, spirit material and dried material from each collection is valuable; in *Elaeocarpus* the half-rotten fruits or bare stones picked up from the forest floor are also very informative.

Several species accepted here are not yet known in fruit. These are listed below with suggestions, where possible, on the probable fruit type that will be found. All seem likely to have straight embryos: *E. badius,* impossible to predict, possibly flattened; *E. bakaianus,* probably over 2 cm long — see p. 90; *E. coodei,* flattened-ovoid like *E. coloides; E. fairchildii,* flattened-ovoid like *E. coloides; E. finisterrae,* either like *E. amplifolius* or like *E. schlechteranus; E. heptadactyloides,* long and tapering like *E. dolichodactylus; E. homalioides,* like *E. multisectus* ?but see p. 73; *E. myrmecophilus,* like *E. dolichodactylus; E. orohensis,* probably like *E. densiflorus; E. schoddei,* probably small.

Fruits of *Elaeocarpus* often fail to set seed even though the fruit looks normal from the outside. Such failure is often accompanied by differences in the stone structure. The key based on fruiting material (p. 63) can only cope with fruits containing viable seed, although empty fruits *may* key out correctly.

All species of *Elaeocarpus* described here are endemic to Papuasia except

the following: *E. sphaericus* (India to Fiji), *E. arnhemicus* (also in Australia), *E. dolichodactylus, E. dolichostylus, E. fairchildii* and perhaps *E. nouhuysii* (the last 4 also occur in islands to the west of New Guinea).

KEY TO SPECIES (FLOWERING MATERIAL)

1. All or most leaves 1–8 cm long
 2. Ovary glabrous
  3. Petals (7–)10–17 mm long, glabrous or sparsely hairy only on the back, with lower margins densely short-hairy; most petioles 2 cm long or more ..... **48. E. culminicola**
  3. Petals up to 7·5 mm long at most, glabrous throughout or hairy on the back, not with densely short-hairy lower margins; petioles less than 2 cm long
   4. Leaves opposite to subopposite ..... **28. E. sericoloides**
   4. Leaves alternate or spirally arranged
    5. Petals entire to emarginate to bilobed, 1·5–2 mm long..... **1. E. bilobatus**
    5. Petals with at least 4 narrow divisions at the tip, more than 2 mm long
     6. Inflorescences 1–3-flowered; leaves not more than 2 cm long ..... **29. E. crenulatus**
     6. Inflorescences 6- or more-flowered; leaves more than 2 cm long
      7. Petals glabrous
       8. Petals 2·5–3 mm long; leaves ± elliptic, acute and usually acuminate ..... **23. E. arnhemicus**
       8. Petals *c.* 5 mm long; leaves ± obovate, obtuse ..... **46. E. miegei**
      7. Petals hairy on the back ..... **55. E. habbemensis**
 2. Ovary hairy
  9. Petals up to 8 mm long
   10. Inflorescences 1–3-flowered; leaves up to 2–3(–4·6) cm long; petals hairy on the back, with fewer than 10 divisions ..... **29. E. crenulatus**
   10. Inflorescences with 5 or more flowers; leaves usually larger (occasionally as small in *E. polydactylus* or *E. luteolus*); petals various
    11. Petals hairy on the back
     12. Petals with up to 10 divisions
      13. Petals mostly glabrous, with only a few hairs near the base on the back ..... **22. E. arfakensis**
      13. Petals obviously hairy
       14. Leaves densely hairy beneath; petals densely long-hairy on both sides ..... **50. E. trichophyllus**
       14. Leaves sparsely appressed-hairy beneath at most; petals appressed-short-hairy or short-hairy, usually with some glabrous areas inside
        15. Petals tapering towards the tip, 3–5-notched; leaves tightly clustered at twig tips ... **60. E. branderhorstii**
        15. Petals widening towards the tip with 5–10 distinct divisions
         16. Petals obviously appressed-hairy outside, with regular narrow tapering divisions; anthers acute or with short awns at the tip ..... **57. E. luteolus**
         16. Petals inconspicuously hairy outside, with unequal ± triangular tapering divisions; anthers blunt at the tip ..... **68. E. schoddei**
     12. Petals with more than 10 divisions
      17. Petals hairy on the inner surface although the divisions may be glabrous
       18. Petals densely long-hairy, tough and thick, often with a central swollen keel on the inner surface near the base ..... **50. E. trichophyllus**
       18. Petals short-appressed-hairy, not tough, flat with little or no keel within
        19. Leaves obovate ..... **57. E. luteolus**
        19. Leaves ovate or elliptic
         20. Leaves ovate, with brownish hairs on prominent veins beneath
          21. Leaves ± coarsely sharp-serrate, the underside with dense short almost felty hairs throughout ..... **59. E. whartonensis**
          21. Leaves finely serrate, the underside with hairs mainly on the veins, ± sparse between, not felty ..... **58. E. sayeri**
         20. Leaves ovate-elliptic or elliptic with fine appressed-silky hairs beneath at most ... **53. E. altigenus**

17. Petals glabrous inside or with a distinct glabrous area inside above a densely hairy central swollen keel
22. Petals 8 mm long (or more), densely long-hairy with a hairy central swollen keel inside; leaves glabrous; twigs usually with a gummy exudate at the bud ..... **51. E. poculiferus**
22. Petals up to 6 mm long, appressed-short-hairy at most, glabrous throughout inside and without a keel; leaves persistently hairy beneath; twigs without gummy exudate
23. Petals with a few scattered hairs on the back though with margins densely short-hairy near the base ..... **24. E. dasycarpus**
23. Petals densely appressed-hairy on the back ..... **56. E. latescens**

11. Petals glabrous on the back
24. Leaves obviously persistently hairy beneath
25. Leaves with dense velvety hairs beneath, the margins coarsely serrate ..... **22. E. arfakensis**
25. Leaves short-hairy at most, margins obscurely to finely serrate
26. Inflorescences borne on twigs behind the leaves; sepals usually persisting longer than petals or stamens; leaf nerves curving forward towards the tip, looping and joining up inside the margin ..... **6. E. homalioides**
26. Inflorescence borne in leaf axils; sepals generally not persisting longer than petals or stamens; leaf nerves straight at first then often bifurcating before joining up inside the margin
27. Inflorescence bracteate, robust, erect, overtopping the leaves ..... **24. E. dasycarpus**
27. Inflorescence without bracts or bracts falling quickly, slender, spreading to erect and not overtopping the leaves ..... **22. E. arfakensis**

24. Leaves glabrous or sparsely and finely appressed-hairy at most
28. Petals with less than 10 thickened, blunt divisions hooked inwards at the tip; sepals persisting after the petals and stamens have fallen ..... **4. E. marafunganus**
28. Petals with usually more than 10 slender, unthickened, straight divisions, usually acute though sometimes blunt; sepals not persisting longer than petals and stamens
29. Leaf margins crenate-dentate, the teeth widely spaced; leaves acute and often acuminate at the tip; petals 2·5–3 mm long ..... **23. E. arnhemicus**
29. Leaf margins minutely serrulate or obscure; leaf tips acute or obtuse, rarely acuminate; petals 3–5·5 mm long ..... **27. E. polydactylus**

9. Petals more than 8 mm long
30. Petals densely long-hairy on the back and also at least on the keel inside
31. Leaves persistently hairy; twigs not gummy-resinous on the buds; petals hairy inside; flowers scattered along the whole length of the inflorescence ..... **50. E. trichophyllus**
31. Leaves glabrous; twigs gummy-resinous on the buds; petals glabrous inside except for the central hairy keel; flowers grouped together near the end of the inflorescence axis ... . **51. E. poculiferus**
30. Petals glabrous on the back or appressed-hairy only near the base on the back, glabrous or somewhat hairy inside, the margins often densely short-hairy near the base
32. Mature leaves persistently and densely short-hairy beneath ..... **13. E. blepharoceras**
32. Mature leaves glabrous
33. Leaves obovate, margins crenate; inflorescences 6–8-flowered, lax ..... **9. E. millarli**
33. Leaves elliptic, margins finely serrate or obscure; inflorescences bearing more flowers, condensed ..... **16. E. ptilanthus**

1. All or most leaves exceeding 8 cm in length
34. Leaves broad-obovate to orbicular, (11–)15–30 × (9–)12–22 cm, sessile or almost so, glabrous, margins crenate with widely spaced teeth, clustered at the ends of thick, glabrous, scarred, gummy-resinous twigs ..... **47. E. neobritannicus**
34. Not as above
35. Petals up to 8 mm long
36. Ovary glabrous
37. Petals hairy on the back
38. Petioles less than 2 cm long; leaves with pronounced domatia in nerve axils beneath, generally obtuse or rounded at the tip and tapering at the base; petals with narrow tapering divisions 0·5–2 mm long ..... **55. E. habbemensis**
38. Petioles more than 2 cm long; leaves without pronounced domatia, acute and often

acuminate at the tip and usually ± rounded at base; petals with triangular teeth or short narrow divisions less than 1 mm long

39. Petals thick, apparently narrowing towards the tip in dried material, concave, margins inrolled, densely appressed-hairy on both sides, divided into 7–9 narrow teeth ..... **62. E. floridanus**

39. Petals thin, clearly widening towards the tip, flat, mostly glabrous with a few hairs on the back and with densely short-hairy margins near the base, divided into *c.* 20 teeth ..... **48. E. culminicola**

37. Petals glabrous on the back

40. Leaves 23–28 cm long on petioles 6–11 cm long, nerves 15–22 pairs, prominent beneath and unbranched till near the margins ..... **44. E. debruynii**

40. Leaves and petioles smaller, nerves fewer and less pronounced and branching well inside the margin

41. Petals 2.5–3 mm long, divisions ± equal; leaves ovate to elliptic, rarely obovate, acute and usually acuminate at the tip ..... **23. E. arnhemicus**

41. Petals 5 mm long or more, divisions grouped into lobes; leaves usually obovate with a rounded tip, occasionally acute ..... **46. E. miegei**

36. Ovary hairy (the hairs may be very short)

42. Flowers wide-opening, 40–50, on long spreading inflorescences borne behind the leaves; petals 5–6 mm long, about as broad as long, glabrous or sparsely hairy, with many narrow divisions grouped into 5–7 lobes; anthers black or purplish, the tip without awns or bristles, the filaments bent back sharply near the base and up again at the midpoint .. .. **7. E. multisectus**

42. Not as above

43. Petals 5–6 mm long, ± oblong, tough, densely long-hairy on the back and on the central keel inside, but with a glabrous area inside nearer the tip, divided into 9–11 small teeth ..... **52. E. pycnanthus**

43. Not as above

44. Petals hairy on the back (the hairs may be very short)

45. Leaves hairy beneath

46. Petals with fewer than 10 divisions

47. Petals expanded at the tip, the divisions thickened, blunt, and hooked inwards at the tip, the hairs very short and not obvious

48. Leaves densely grey-felty beneath, the hairs obscuring the nerves, broad-elliptic and acute ..... **3. E. heptadactyloides**

48. Leaves short-hairy or sparsely so, the nerves not obscured, obovate, usually ± obtuse ..... **2. E. dolichodactylus**

47. Petals narrowing to the tip, divisions very small and tapering, straight, the hairs usually obvious

49. Petioles longer than 2 cm; inflorescences in leaf axils; petals with a prominent keel inside, densely hairy inside

50. Leaves sparsely appressed-hairy at most beneath ..... **63. E. ledermannii**

50. Leaves densely short-hairy beneath ..... **65. E. pachyanthus**

49. Petioles less than 2 cm long; inflorescences borne on twigs behind the leaves; petals ± flat and glabrous inside ..... **19. E. kaniensis**

46. Petals with more than 10 divisions

51. Petals glabrous inside throughout ..... **42. E. rubescens**

51. Petals hairy inside

52. Leaves persistently and obviously hairy beneath

53. Leaves ovate to ovate-elliptic, acute ..... **49. E. fuscoides**

53. Leaves obovate to obovate-elliptic, obtuse ..... **50. E. trichophyllus**

52. Leaves sparsely appressed-hairy at most ..... **53. E. altigenus**

45. Leaves glabrous beneath

54. Petals clearly expanded at the tip

55. Petal divisions less than 10, thickened, blunt, and hooked in at the tip, hairs very few on the back but dense on the margin in the lower half .. **2. E. dolichodactylus**

55. Petal divisions 15–20, narrow, tapering, straight, hairs on the back obvious ..... **54. E. filiformidentatus**

54. Petals narrowed towards the apex or oblong

56. Anthers with a short but distinct awn at the tip; leaves ± papery 8·5–11·5(–15)

cm long, often with domatia in the axils of the main nerves beneath ..... **63. E. ledermannii**

56. Anthers pointed but without awns; leaves usually leathery or larger or both, domatia usually absent

57. Petals oblong, 7–9 mm long with 5–7(–9) divisions at the tip ..... **66. E. sarcanthus**

57. Petals ovate, incurved, 5–6·5(–7·5) mm long with 2–3 minute teeth at the tip

58. Leaves papery ..... **61. E. elatus**

58. Leaves leathery

59. Petals tough, massive; leaves 15–25 cm long; sepals hairy inside ..... **64. E. lingualis**

59. Petals thick but not tough and massive; leaves 9–16 cm long; sepals glabrous inside ..... **67. E. sepikanus**

44. Petals glabrous on the back (there may be a tuft of hairs at the base on the back)

60. Stamens fewer than 20

61. Petals with fewer than 10 divisions, the divisions thickened, blunt, and hooked in at the tip

62. Leaves sessile or nearly so ..... **5. E. myrmecophilus**

62. Leaves clearly petiolate

63. Leaves densely felty-hairy beneath, broad-elliptic ..... **3. E. heptadactyloides**

63. Leaves glabrous beneath, obovate ..... **2. E. dolichodactylus**

61. Petals usually with more than 10 divisions, sometimes fewer, the divisions tapering or linear, never thickened and hooked inwards at the tip

64. Petals 2·5–3 mm long; leaves acute and usually acuminate, margins sinuate or crenate-dentate; petioles mostly less than 2 cm long; hairs rather obscure throughout ..... **23. E. arnhemicus**

64. Petals longer than 3 mm; other characters not in the above combination

65. Petioles (1·5–)2·5–6 cm long, straight, unwinged, conspicuously thickened at each end, floccose brown-hairy when young at least ..... **43. E. tariensis**

65. Petioles less than 2·5 cm or if up to 3 cm long then narrowly winged and not thickened at each end

66. Leaves glabrous or appressed-hairy at most, often with conspicuous blisters, or domatia in the nerve axils, or both

67. Leaves obovate, rounded at the tip; twigs moderately robust with pronounced winging running down from the petiole margin ..... **26. E. orohensis**

67. Leaves ± elliptic, acute to bluntly pointed at the tip; twigs slender with little or no winging running down from the petiole margin .... **27. E. polydactylus**

66. Leaves short-hairy, usually without blisters or domatia ..... **25. E. densiflorus**

60. Stamens more than 20

68. Petals deeply trilobed, the lobes subdivided into long tapering divisions, fewer than 10 in all

70. Leaves 15–19(–23) cm long ..... **15. E. dolichostylus**

70. Leaves 9–11 cm long ..... **18. E. altisectus**

68. Petals divided into more than 10 approximately equal divisions, rarely the divisions grouped into lobes

71. Inflorescences borne in leaf axils, erect, robust, bracteate, the bracts persistent until anthesis at least, boat-shaped to spathulate

72. Leaves glabrous, sessile ..... **20. E. bakaianus**

72. Leaves hairy, petiolate ..... **21. E. murukkai**

71. Inflorescences borne behind the leaves, spreading, ± slender, bracts absent or linear and quickly falling ..... **11. E. prafiensis**

35. Petals more than 8 mm long

73. Ovary glabrous ..... **48. E. culminicola**

73. Ovary hairy

74. Petals less than 5 mm wide, below or at the point of division (some species have petals with the margins folded in, thus appearing less than 5 mm wide but in fact more)

75. Petals hairy on the back

76. Leaves sessile or almost so, blades tapering to a subcordate base ..... **14. E. buderi**

76. Leaves petiolate, not subcordate at base

77. Leaves hairy beneath

78. Petals densely long-hairy; stamens more than 20; anthers each with a single pale awn 2–2·5 mm long
79. Leaves ovate to ovate-elliptic, acute ..... **49. E. fuscoides**
79. Leaves obovate to elliptic-obovate, obtuse ..... **50. E. trichophyllus**
78. Petals short-appressed-hairy or ± sparsely appressed-long-hairy; stamens fewer than 20; anthers each with a group of bristles at the tip ..... **8. E. leucanthus**
77. Leaves glabrous beneath
80. Petals tough and thick, densely long-hairy on both sides, with 5–9 teeth at the tip; stamens more than 20, anthers acute at apex without awns or bristles ..... **66. E. sarcanthus**
80. Petals thin, flat, only the lower half or two-thirds hairy, with 20–25 teeth at the tip; stamens up to 20, anthers bearing a clump of bristles at the tip ..... **10. E. oriomensis**
75. Petals glabrous on the back
81. Leaves hairy beneath
82. Petioles 0–1·5 cm long, leaves 15–27 cm long with linear stipules persisting at least for a time ..... **33. E. badius**
82. Petioles longer or leaves shorter or both, stipules absent or minute and quickly falling
83. Petioles slender or narrowly winged at least near the tips; petals with short-hairy margins
83. Petioles massive, thickened at each end, and unwinged; petals glabrous ..... **34. E. finisterrae**
84. Stamens fewer than 20, filaments about as long as anthers; leaves densely almost felty-hairy beneath; petioles unwinged ..... **13. E. blepharoceras**
84. Stamens more than 20, filaments much shorter than the anthers; leaves appressed-hairy or short-hairy beneath, mainly on the veins; petioles narrowly winged at least near the tip
85. Leaves with 3–4 nerves per 2 cm, usually short-hairy beneath, the hairs easily seen; anthers often very shortly awned, the awn solid ..... **15. E. dolichostylus**
85. Leaves with nerves less densely set, at most with obscure fine appressed hairs; anthers pointed, not awned, but with a group of bristles near the tip ..... **17. E. sphaericus**
81. Leaves glabrous beneath
86. Petioles winged near the tip at least (the wings sometimes narrow), never thickened at the tip, generally less than 2 cm long; petals densely short-hairy on the margins near the base
87. Petals 14–18 × 4–6 mm; leaves 4–10 × 2–4 cm, leathery, shiny above, and with venation network raised above ..... **16. E. ptilanthus**
87. Petals 8–14(–15) × 2–4 mm; leaves 12–19 × 4–9 cm, papery or tough but not shiny above, venation network not raised above
88. Leaves with 3–4 veins per 2 cm; anthers often very shortly awned, the awn solid ..... **15. E. dolichostylus**
88. Leaves with nerves less densely set; anthers pointed, not awned, with a group of bristles near the tip ..... **17. E. sphaericus**
86. Petioles completely unwinged, generally thickened at each end, at least 2 cm long; petals glabrous (except for **E. pullenii**, which has some short hairs on the lower margin)
89. Anthers with a group of bristles at the tip, lacking awns; petals with short hairs on the margins near the base ..... **12. E. pullenii**
89. Anthers awned at the tip; petals glabrous
90. Leaves with very coarse teeth ..... **40. E. coodei**
90. Leaves almost entire
91. Petioles 4–8 cm long; leaves (15–)18–28 cm long ..... **41. E. fairchildii**
91. Petioles 2–4·5 cm long; leaves 10–20(–25) cm long ..... **39. E. coloides**
74. Petals more than 5 mm wide below or at the point of division
92. Leaves glabrous beneath
93. Petals narrowing slightly towards the tip, margin often folded in, divided into 3–9 narrow tapering segments 3–5 mm long; stamens very many, *c.* 150 ..... **30. E. polyandrus**

93. Petals widening towards the tip, margins not or scarcely folded in, segments more numerous or if as few then ± triangular; stamens fewer, usually not more than 60
94. Petals with 3–5 shallow, broad, rounded lobes or teeth; filaments 6–12 mm long ..... **31. E. womersleyi**
94. Petals with 8 or more lobes or teeth; filaments shorter except in **E. nouhuysii** and **E. schlechteranus**
95. Stamen filaments 6–8 mm long
96. Petals densely hairy outside; inflorescence spreading-hairy . **37. E. schlechteranus**
96. Petals ± glabrous; inflorescence appressed-hairy to short-velvety-hairy ..... **35. E. nouhuysii**
95. Stamen filaments up to 2 mm long
97. Petioles less than 2 cm long, ± winged towards the tip; anthers with groups of bristles at the tip, not awned; petal margins densely short-hairy near the base ..... **16. E. ptilanthus**
97. Petioles more than 2 cm long, unwinged, and usually thickened at each end; anthers awned at the tip; petal margins glabrous
98. Petals 15–30 mm long ..... **36. E. piestocarpus**
98. Petals 8–12 mm long ..... **39. E. coloides**
92. Leaves hairy beneath
99. Petals hairy on the back
100. Petals densely hairy on both sides, not more than 10 mm long; leaves up to 10 cm long ..... **50. E. trichophyllus**
100. Petals with some glabrous areas, 9–26 mm long; leaves (8–)11–20 cm long
101. Petals densely hairy outside, 19–26 mm long; filaments 6–8 mm long ..... **37. E. schlechteranus**
101. Petals sparsely hairy outside, 9–12 mm long; filaments *c.* 1 mm long ..... **38. E. undulatus**
99. Petals glabrous on the back
102. Filaments 5–12 mm long; anthers with awns up to 1 mm long
103. Leaves scarcely hairy beneath; petioles scarcely hairy ..... **35. E. nouhuysii**
103. Leaves obviously brown-hairy beneath; petioles hairy ..... **32. E. amplifolius**
102. Filaments *c.* 1 mm long; anthers with awns 2–3 mm long ..... **38. E. undulatus**

KEY TO SPECIES (FRUITING MATERIAL)

To use this key a small fine-toothed saw is necessary to cut T. S.s of the fruit. Measurements are taken from dried material; whereas the stone dimensions will scarcely alter much on drying, the flesh will in many cases contract considerably and allowance should be made if fresh material is being keyed out.

'Sutures' are lines in the stone, as many as and opposite to the loculi; they are often visible in T. S. of the stone and also on the stone surface in those species in which the flesh detaches from the stone. The sutures radiate from the seed cavity, and the stone probably splits along them on germination. In dry fruit of many species the position of the sutures may be shown by the flesh and skin cracking slightly above them.

It is occasionally necessary, and always helpful, to extract the seed and to observe the embryo type. The 2 shapes possible are illustrated in Figs 26 and 30; it is usually sufficient to cut the seed across with razor blades. So far as is known this embryo character is constant and characteristic of the groups, and for this reason those species whose fruits are known but whose embryo type has not been checked because of shrivelling of the seed are keyed out with other members of their group. *E. crenulatus* is an exception, having a mixture of characters of groups with different embryo types.

Certain species are indistinguishable in fruit alone from 1 or more others; where these occur they are bracketed together.

1. Fruits 2 cm or more in width or diameter. (Embryo straight; sutures often easily seen in T. S.)
2. Leaves opposite or subopposite. (Fruits globose, stone with long processes into the flesh, seed 1) ..... **28. E. sericoloides**
2. Leaves alternate or spirally arranged
3. Fruits with dense radial fibres in the flesh, firmly and permanently attached to the stone
4. Stone usually with 4 clear sutures; fruit 4–5·5 × 3–5 cm; leaves usually glabrous ..... **31. E. womersleyi**
4. Stone usually with sutures obscured, 2 if visible; fruit up to 3 × 2·5 cm; leaves obviously hairy beneath ..... **13. E. blepharoceras**
3. Fruits with succulent or fibrous flesh, sometimes ± radially fibrous, distinct from and finally detaching from the stone (sometimes detaching on drying and always on rotting)
5. Stones with 4–7 sutures, often with more than one seed
6. Cavity and seed 1, central, symmetrically flattened; stone width 4 cm or more ..... **37. E. schlechteranus**
6. Cavities 4–7, radially arranged, with 1–5 of the cavities bearing seeds ± flattened along the radii, or if cavity single then asymmetrically placed and not flattened; stone diameter usually 3 cm at most
7. Fruit and stone ± globose, occasionally pointed at the tip
8. Leaves sessile or almost so, 27–33 cm long ..... **14. E. buderi** *
8. Leaves clearly petiolate, shorter
9. Leaves (4–)5–10 × 2–4 cm, leathery, shiny and with the fine venation raised above; fruits *c.* 3 cm in diameter; stone surface deeply sculptured ..... **16. E. ptilanthus**
9. Leaves 12–17 × 4–6 cm, papery, not usually shiny and with fine venation not or scarcely raised above; fruits 2–2·5 cm in diameter; stone surface rugose or sculptured but not deeply so ..... **17. E. sphaericus**
{ **18. E. altisectus**
19. E. kaniensis
7. Fruit and stone longer than broad ..... **21. E. murukkai**
5. Stones with 2–3 sutures; seeds and cavities usually 1
10. Leaves sessile or almost so, orbicular to broad-obovate, clumped at twig tips, glabrous, (11–)15–30 × (9–)12–22 cm; twigs massive, scarred, gummy-resinous ..... **47. E. neobritannicus**
10. Not as above
11. Stones usually flattened, with 2 sutures; often winged at lateral margins; seed cavity symmetrical and usually ellipsoid and flattened in T.S., the long axis in the same plane as wings or lateral angles
12. Fruit borne on long curved robust pedicels which enlarge towards the tip; toothed disc at fruit base conspicuous and generally remaining attached to the pedicel after fruit fall; fruit not flattened; stone slightly flattened ..... **30. E. polyandrus**
12. Fruits borne on pedicels of the same thickness throughout; toothed disc remaining attached to fruit base; fruits and stones various
13. Dried fruits unflattened, the flesh shrivelling irregularly; stone slightly flattened, very massive ..... **37. E. schlechteranus**
13. Dried fruits strongly flattened, the flesh often detached from the stone in 2 'plates'; stone strongly flattened, not massive
14. Leaves obviously hairy beneath
15. If stamens persist around the fruit base, as sometimes happens: filaments equalling or longer than anthers ..... **32. E. amplifolius**
15. Filaments shorter than anthers ..... **38. E. undulatus**
14. Leaves glabrous or very sparsely hairy beneath
16. If stamens persist around the fruit base, as sometimes happens: filaments equalling or longer than anthers ..... **35. E. nouhuysii**
16. Filaments shorter than anthers ..... **36. E. piestocarpus**
11. Stones unflattened and without wings, 3-sutured; seed cavity usually not central and symmetrically flattened, or if symmetrically flattened then ± triangular in T. S.
17. Leaves 2–4·5 × 1·2–2 cm, densely short-hairy beneath; petioles 2–3 mm long ..... **24. E. dasycarpus**
17. Leaves and petioles otherwise, mostly much larger

* It is likely that **E. bakaianus** will key out here; see p. 90

18. Leaves and young twigs smooth and glabrous; petioles (2-)4·5-6 cm long; blades up to 15 cm long
19. Mature leaves glabrous
20. Leaves 4·5-8(-11) cm long with conspicuous blisters on the leaves, inflorescences and sepals; highlands ..... **9. E. millarii**
20. Leaves 8-15 cm long, lacking blisters or blisters inconspicuous
21. Leaf bases tapering ..... **11. E. prafiensis**
21. Leaf base broadly tapering to rounded ..... **10. E. oriomensis**
19. Mature leaves hairy beneath ..... **8. E. leucanthus**

1. Fruits less than 2 cm in diameter though they may be more than 2 cm long; embryo straight or curved; sutures often obscured in T. S.
22. Fruits borne on curved robust pedicels thickening towards the tip, the toothed disc conspicuous but remaining attached to the pedicel tip after fruit fall; stones slightly flattened, slightly winged; cavity flattened; embryo straight ..... **30. E. polyandrus**
22. Fruits borne on curved or straight pedicels of even thickness throughout, the disc attached to base of fruit; cavity various; embryo straight or curved
23. Stones and dried fruit somewhat flattened, the stone with small lateral wings or angles in T.S.; embryo straight. Petioles long, straight, glabrous
24. Leaf blades 23-30 cm long with 15-22 pairs of veins rather close together, prominent beneath and unbranched till near the margin ..... **44. E. debruynii**
24. Leaf blades generally smaller, nerves fewer, less prominent, and branching earlier ..... **39. E. coloides**
23. Stones not flattened nor winged nor angled (except sometimes in **E. floridanus**, which has a curved embryo); embryo straight or curved; petioles various
25. Fruits much longer than broad, constricted-tapering at the tip and often at the base, often with sepals persisting; skin and flesh thin and dense, drying blackish; stone ± smooth-surfaced, thick-walled, 3-sutured (Group II); embryo straight
26. Leaves 4-6 × 2-3 cm ..... **4. E. marafunganus**
26. Leaves larger ..... **2. E. dolichodactylus**
25. Fruits not much longer than broad or if so then without tapering tip and base (except perhaps **E. multisectus**, which has a lumpy stone surface, or **E. dolichostylus**, which has 4-5 sutures), sepals not persisting; stones various; embryo straight or curved
27. Stone surface sculptured, the flesh often merging gradually with the stone surface and collapsing considerably on drying; embryo curved; petioles straight, slender, usually more than 2 cm long ..... **48. E. culminicola**
27. Fruit, embryo and petiole characters not in the above combination
28. Fruits with dense radial fibres firmly and permanently attached to the stone, 15-20 mm across, irregularly ± globose; embryo straight ..... **13. E. blepharoceras**
28. Fruits without radial fibres, or if fibrous then the embryo curved and fruits ovoid and smaller; fruits otherwise various; embryo straight or curved
29. Stones dense, thick-walled, with 3-7 sutures; flesh drying blackish, dense, thin; embryo straight
30. Fruits globose to globose-ellipsoid, the tip rounded
31. Leaves over 8 cm long
32. Sutures 3
33. Leaves obviously hairy beneath ..... **25. E. densiflorus**
33. Leaves glabrous ..... **27. E. polydactylus**
32. Sutures 4-7
34. Leaves usually hairy; venation fairly dense, nerves 3-4 per 2 cm and prominent beneath ..... **15. E. dolichostylus**
34. Leaves usually glabrous; venation less densely set and scarcely raised ..... { **27. E. polydactylus** / **17. E. sphaericus**
31. Leaves less than 8 cm long
35. Leaves hairy ..... **22. E. arfakensis**
35. Leaves glabrous ..... **27. E. polydactylus**
30. Fruits ellipsoid, the tip often pointed
36. Sutures (3-)4-5; leaves 15-23 cm long ..... **15. E. dolichostylus**
36. Sutures 3; leaves smaller
37. Fruits *c.* 10 mm long ..... **22. E. arfakensis**

37. Fruits (13–)18–25 mm long ..... **7. E. multisectus**
29. Stones with thin walls or if walls fairly thick then with only 2 sutures; flesh drying shrivelled, sometimes with air spaces, or fibrous, not hard and dense; sutures 2–4 often obscured; embryo straight or curved
38. Fruits solitary or 1–2(–3) borne near the end of the inflorescence axis; leaves 14–30 (–46) × 6–20 mm, obovate to elliptic, not acuminate; embryo unknown ..... **29. E. crenulatus**
38. Fruits always in racemes, more numerous or with scars on inflorescence axis of several other fallen flowers; leaves larger or of a different shape or acuminate
39. Leaves clearly hairy beneath at least on the leaf nerves and on petioles
40. Leaf hairs appressed and silky
41. Fruits (15–)20–25 mm long; embryo straight ..... **42. E. rubescens**
41. Fruits smaller; embryo straight or curved
42. Leaves grouped at the ends of moderately robust twigs; embryo curved
43. Leaves 3·5–5·5 cm wide; lowlands ..... **63. E. ledermannii**
43. Leaves 2–3(–4·5) cm wide; highlands ..... **52. E. pycnanthus**
42. Leaves scattered along slender twigs; embryo straight or curved
44. Fruits ellipsoid, rounded at the tip, up to 6(–7·5) mm long; embryo straight ..... **1. E. bilobatus**
44. Fruits ovoid, pointed at the tip, usually more than (8–)9 mm long; embryo curved
45. Leaves ovate to elliptic
46. Leaves elliptic to ovate-elliptic; hairs fine and colourless ..... **53. E. altigenus**
46. Leaves ovate to ovate-elliptic; hairs brownish and usually rather obvious ..... **58. E. sayeri**
45. Leaves obovate ..... **57. E. luteolus**
40. Leaves spreading-hairy to felty-hairy beneath
47. Leaves ovate to elliptic to ovate-oblong, often acuminate and acute at the tip; embryo straight or curved
48. Leaves closely felty-hairy beneath; embryo curved
49. Leaves elliptic, 11–16 cm long ..... **65. E. pachyanthus**
49. Leaves ovate up to 8 cm long ..... **59. E. whartonensis**
48. Leaves spreading-hairy beneath; embryo straight or curved
50. Fruits 14 mm long or more; embryo straight or curved
51. Leaf nerves close-set in (8–)12–16 pairs, often not branching until near the margin; embryo curved ..... **49. E. fuscoides**
51. Leaf nerves much less dense with fewer pairs, branching earlier; embryo straight ..... **43. E. tariensis**
50. Fruits shorter; embryo curved ..... **58. E. sayeri**
47. Leaves obovate to obovate-elliptic, never acuminate, usually obtuse at the tip; embryo curved
52. Twigs slender; leaves ± scattered, up to 8 cm long..... **56. E. latescens**
52. Twigs robust; leaves rather crowded, sometimes more than 8 cm long ..... **50. E. trichophyllus**
39. Leaves glabrous or very sparsely appressed-hairy beneath
53. Embryo straight
54. Leaves elliptic to ovate, acuminate
55. Fruits 10–15 mm long ..... **23. E. arnhemicus**
55. Fruits 6(–7·5) mm long ..... **1. E. bilobatus**
54. Leaves obovate or oblanceolate, the tip obtuse or rounded, sometimes acute, not acuminate ..... **46. E. miegei**
53. Embryo curved
56. Petioles over 2 cm long; leaves mostly more than 8 cm long
57. Leaves generally clustered towards the tips of robust or moderately robust twigs, usually more than 4 cm wide. At this point a number of species of Group VIII key out, often difficult to separate in fruit:
58. Solomon Islands, rare in Bismarck Archipelago; leaves papery, often ovate; stone with 3–4 sutures, visible on stone surface and sometimes in T. S., often with ridges on the stone surface over the sutures; ovary and young fruits gla-

brous ..... **62. E. floridanus**

58. New Guinea, rare in Bismarck Archipelago (*E. sepikanus, E. elatus* and *E. ledermannii*); leaves usually tougher than papery (except for *E. elatus* and *E. ledermannii*), usually not ovate; stone with 2 sutures (3 in *E. elatus*) without ridges on the surface; ovaries and young fruits hairy
59. Petioles glabrous, young twigs usually glabrous; lowlands or highlands
60. Leaves ± papery with main veins prominent beneath, usually with distinct domatia in their axils; leaves 8·5–11·5(–15) × 3·5–5·5 cm; sea level to 850 m ..... **63. E. ledermannii**
60. Leaves generally ± leathery (± papery in *E. elatus*) with main veins not very prominent beneath, domatia absent or small; leaves 9–18(–25) × (3·5–)6–11 cm, the narrow-leaved species generally highland ..... **61. E. elatus**
64. E. lingualis
66. E. sarcanthus
67. E. sepikanus
59. Petioles and young twigs appressed-hairy; highlands ..... **52. E. pycnanthus**
57. Leaves scattered along slender twigs, 2·4–4·5 cm wide ..... **54. E. filiformidentatus**
56. Petioles less than 2 cm long; leaves mostly less than 8 cm long
61. Leaves tightly clustered at the tips of short shoots with long shoots between them, generally without domatia; leaves obovate ..... **60. E. branderhorstii**
61. Leaves laxer, twigs not arranged in short and long shoots, usually with prominent domatia in the axils of main nerves beneath
62. Leaves acuminate, acute ..... **53. E. altigenus**
62. Leaves obtuse to ± acute, never acuminate
63. Leaves oblong to oblong-obovate; twigs moderately robust, exuding gummy resin at the buds ..... **51. E. poculiferus**
63. Leaves obovate to obovate-elliptic; twigs slender, without gum ..... **55. E. habbemensis**

Group I

Ovules 2 per loculus; loculi 2; ovary glabrous. Embryo straight. Petals entire to 3-notched, very small, minutely hairy on the back. Stamens few, very small; anthers blunt without awns or bristles. Leaves small. Racemes all axillary. Fruits small, ellipsoid; stone thin-walled. Seeds 1.

Notes: 1 species endemic to New Guinea mainland. The group corresponds to section *Lobopetalum* Schltr.

1. Elaeocarpus bilobatus Schltr *Bot. Jb.* **54**: 110 (1916), f. 3.

Epiphytic shrubs or small trees to 10 m tall. Young twigs slender, pubescent, becoming glabrous later. Leaves scattered; petioles 10–14 mm long; blades ovate, long-pointed, 4–7(–8) cm long (of which the point is 1–1.8 cm), 1·7–2·3 cm wide, base tapering, leathery, with sparse short appressed hairs at least when young, main veins often curving towards the tip, close reticulate venation visible throughout; teeth obscure, wide-spaced. Inflorescences axillary, *c.* 3 cm long, sparsely hairy, bearing 4–8 flowers (right to the base) on pedicels 2–3 mm long, curved in flower, ± straight or erect in fruit. Sepals 4, pinkish, *c.* 1·5 × 0·5 mm, incurved, sparsely hairy, persisting longer than the petals. Petals 4(–5), creamy, 1·5–2 mm, thick, inrolled, minutely hairy outside, entire and blunt or 1–3-notched at tip. Disc lobed, short-hairy. Stamens 8–10, overall *c.* 1 mm long; filaments shorter than the anthers; anthers awnless, blunt. Ovary glabrous; loculi 2; ovules 2 per loculus, style *c.* 1 mm long. Fruit almost as many as flowers, bluish-green, ellipsoid, up to 7·5 × 4

mm, mostly blunt at the tip, flesh less than 1 mm thick; stone pale, thin-walled. Seed 1. Embryo straight.

Distribution: So far known from 2 small areas: the Star Mountains and the headwaters of the Ok Denim in western New Guinea, and the Lordberg/Hunstein Spitze area (Sumset) in the Ambunti area of the West Sepik district.

Ecology: Forest or disturbed vegetation, mostly between 850 and 1450 m, occasionally as low as 200 m. Occasionally epiphytic.

Notes: The minute undivided or notched petals should distinguish this species in flower. In fruit it could perhaps be confused with *E. arnhemicus* (from low altitudes usually in grassland; leaves usually larger with lax venation) or with *E. altigenus* or *E. sayeri* (mostly at higher altitudes, usually with ovoid fruit and leaves with sharper serrations and more prominent main veins; furthermore the embryos of *E. altigenus* and *E. sayeri* are curved). Schlechter also described a variety, var. *acutatus,* with longer-pointed leaves and nearly entire margins. We now have new material; the variety is probably no longer worth recognizing.

Group II

Ovules 2 per loculus; loculi 3(–4); ovary minutely hairy. Embryo straight. Petals small, with 5–10(–13) divisions, the divisions blunt, thickened, hooked over inwards at the tip, minutely hairy inside, usually glabrous outside. Stamens few, small; anthers blunt, without awns or bristles. Leaves small or large. Racemes mostly axillary in flower, but in fruit the subtending leaves often fallen. Fruits long, tapering to apex and often to base at least when dry, stone thick-walled with 3, rarely 4, sutures usually visible in T. S., often with persisting sepals at base. Seeds 1.

Notes: Specific limits in this group are very difficult to determine, although the group itself is distinct and easy to recognize in flower or fruit. Mostly New Guinea mainland, also Celebes and Moluccas; the group corresponds to section *Dactylosphaera* Schltr.

2. Elaeocarpus dolichodactylus Schltr *Bot. Jb.* **54**: 112 (1916), f. 4. **Fig. 16.**
E. cephalodactylus Schltr (1916); *E. stenodactylus* Schltr (1916); *E. lamii* O.C.Schm. (1942).

Trees 10–22 m tall. Twigs short-hairy when young. Leaves usually clustered towards twig tips; petioles 1–2·5 cm long, usually jointed at the tip and often at the base, hairy or not; blades obovate, (8–)10–20 × 4–9·5 cm, tip ± acute, tapering at base, papery to fairly tough, generally glabrous, occasionally hairy, main veins prominent beneath, margins obscure to crenate. Inflorescences borne in the axils of leaves or behind the leaves, 6–11 cm long, often erect, short-hairy, bearing 25–35 flowers on curved pedicels 3–4 mm long. Sepals 2·5 × 1 mm, sparsely short-hairy outside, indumentum denser inside, persisting in young fruit. Petals obovate to spathulate, 2–3 × 1 mm, the claw constricted or not, margins of claw and inside hairy, glabrous on the back or rarely with a few hairs, divided at the tip into 5–9 blunt thickened divisions hooked inwards at the tip. Disc lobes 5, free, distinct, short-hairy, *c.* 1 mm

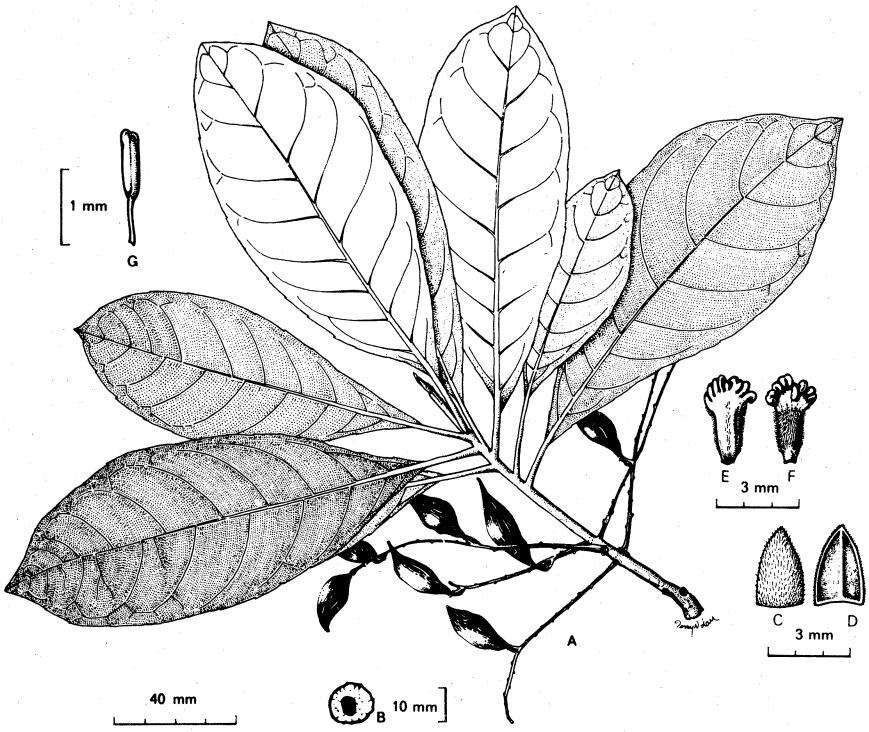

Fig. 16 **Elaeocarpus dolichodactylus** Schltr (A) leafy twig with fruits (B) cross-section of fruit (C) sepal outside (D) sepal inside (E) petal outside (F) petal inside (G) stamen

long, blunt. Stamens 10–15; filaments about as long as anthers; anthers blunt, without awns or bristles; 1–1·5 mm long overall. Ovary densely short-hairy; loculi 3; ovules 2 per loculus; style *c.* 1 mm long, ± glabrous. Fruit ellipsoid, 35–50 × 10–14 mm, tapering at tip (tip sometimes curved), often tapering at base, sepals or sepal bases persisting, flesh evidently fairly hard in life, when dry often cracking over the sutures and usually black and dense, distinct from stone; stone usually brown, thick-walled, 3-sutured, often slightly 3-sided, surface weakly rugose. Seed 1; embryo straight.

Field characters: The twigs are sometimes inhabited by ants.

Distribution: Apparently scattered but widespread throughout the lowlands of the New Guinea mainland, also at high altitudes in a few places, perhaps locally common. In western New Guinea from Vogelkop and Fakfak districts; in northeastern New Guinea from Kilifas in the West Sepik, the Ambunti area of the East Sepik, 1 collection from Madang and from near Lae and near Buso in the Morobe district, and from the Eastern Highlands. In Papua scattered in all districts. A specimen from the Moluccas has also been seen.

Ecology: Mostly collected in forest (alluvial, gallery, or mixed forest on slopes) from sea level to 1200 m; there are a few collections from the Southern and Eastern Highlands from 1500 to 1800 m, also in forest. Twice collected in advanced regrowth.

Notes: The variation is very great, both obviously in leaf size and hairiness, and in technical details of the petals. Schlechter's original distinctions between *E. cephalodactylus, E. stenodactylus* and *E. dolichodactylus* can no longer be used because there are far too many specimens in the new material that will not fit Schlechter's system. In addition the new material shows variations outside Schlechter's species, but none of the variations can be split off at specific level satisfactorily. Originally *E. cephalodactylus* covered specimens with smallish leaves (8–12 cm long) and petals with 8–9 divisions; *E. stenodactylus* and *E. dolichodactylus* had petals with 5 divisions, differing between themselves in relative length of petal divisions. There has never been a name to cover the specimens whose leaves are hairy beneath, so far known from western New Guinea and Papua only, although *E. heptadactylus* had leaves felty-hairy beneath. See discussion in Coode (1978).

3. Elaeocarpus heptadactyloides Weibel *Candollea* **26**: 360 (1971).

Tree. Twigs hairy when young. Leaves clustered towards tips of twigs; petioles 2–4 cm long, minutely hairy when young; blades elliptic, 12–14 × 7–8 cm, the tip rounded or broadly pointed, often short-acuminate, tapering at base, ± glabrous above, with dense short felty hairs beneath, nerves prominent beneath, margins ± entire. Inflorescences in the axils of current or fallen leaves, *c.* 7 cm long, short-hairy, bearing probably 20–30 flowers on hairy pedicels 2–3 mm long. Sepals 2·5 × 1 mm, short-hairy on both sides. Petals obovate, 2·5 × 1·2 mm, ± glabrous on the back, short-hairy inside, divided at the tip into 7 glabrous blunt segments, thickened and hooked in at the tip.

Disc lobes 5, distinct, blunt. Stamens *c.* 16; filaments ± glabrous; anthers about as long as filaments, blunt with a few short hairs at tip; overall *c.* 1·5 mm long. Ovary short-hairy; loculi 3; ovules 2 per loculus; style *c.* 1 mm glabrous. Fruit, seed, and embryo unknown.

Distribution: Known only from the type, at Soegawara in western New Guinea.

Ecology: No information except altitude: 60 m.

Notes: Although resembling Schlechter's description of *E. heptadactylus* in 7-divided petals and felty leaf indumentum, *E. heptadactyloides* differs from it, and all other species of this group, in the elliptic, not obovate, leaves.

4. Elaeocarpus marafunganus Coode *Brunonia* **1**: 172 (1978).

Trees 15–31 m tall. Twigs slender to fairly robust, shortly appressed-hairy at least when young. Leaves rather close-set; petioles 6–10 mm long with 1–3 pairs of hair-like teeth at tip; blades obovate, 4–6 × 2–3 cm, tip obtuse or rounded, seldom acute, base tapering, leathery, glabrous or finely and sparsely appressed-hairy beneath (though often silky-hairy when very young), with prominent venation beneath and usually with domatia at nerve axils, margins often conspicuously crenate, the teeth forward-pointing and blunt (often with a needle point at the tip of each). Inflorescences ± erect, 4–12 cm long, borne in the axils of and often overtopping the leaves, short-hairy, bearing about 20 flowers on recurved pedicels ± 5 mm long. Sepals 2–3 × 1–1·5 mm, appressed-hairy outside and particularly on the keel inside, persistent into young fruit. Petals spathulate, the claw sometimes quite distinct from the limb but more usually gradually widening from base to tip, 2–4 × 1–2 mm, hairy on the margins and on the inside of the claw, ± equally divided into 8–9 lobes, thickened and hooked inward at tip. Disc divided into 5 large flattish blunt velvety-hairy lobes and persistent after the petals and stamens have fallen. Stamens 11–15, quickly falling; filaments 0·5–1 mm, ± glabrous; anthers 1–1·5 mm, blunt, sometimes bearing a few hairs at the tip. Ovary minutely hairy, loculi 3, ovules 2 per loculus. Fruit narrowly ellipsoid, 3·8–4·5 × 1·2–1·5 cm, drying ± smooth and glossy-blackish with thin skin and flesh (*c.* 0·5 mm) and a thick-walled stone (*c.* 5 mm) containing a single ± 3-sided loculus; sutures 3, generally visible in T. S. Seed 1. Embryo straight.

Distribution: Western, Eastern and Southern Highlands districts; 5 localities only. Most specimens come from Marafunga in the Goroka subdistrict in the Eastern Highlands.

Ecology: Montane forest, 2000–2700 m.

Notes: The leaves are distinctive, small, thick, and usually with domatia; the specimens too have a characteristic appearance with erect inflorescences usually overtopping the clustered leaves. There is little variation, and the species is always distinct from *E. dolichodactylus,* although *E. marafunganus* is sometimes considered to be only a variant of *E. cephalodactylus.*

5. Elaeocarpus myrmecophilus A. C. Sm. *J. Arnold Arbor.* **25**: 224 (1944).

Tree 5–6 m tall. Twigs stout, hairy at first, later glabrous. Leaves clustered at twig tips; petioles very short or absent; blade narrowly obovate, (15–)20–30 × 5–8·5 cm, tip obtuse or rounded, gradually narrowed towards the base and at the base itself broadly obtuse or abruptly rounded, glabrous, venation network intricate, prominent on both sides, margin ± crenulate (teeth 1–2 per cm). Inflorescence axillary, erect, 10–20 cm long, rachis puberulous, bearing numerous flowers on curved slender pedicels 3–5 mm long and minutely hairy. Sepals 3·5–4 × 1·5–2 mm, ± acute, minutely hairy on both sides. Petals 5, obovate, 3·5–4 × 1·5–2 mm, minutely hairy inside towards the base and on the margins, divided into 6–8 ± equal segments *c.* 1 mm long, thickened and hooked inwards at tip. Disc lobes 5, free, minutely hairy, *c.* 1 mm long. Stamens 15, ± glabrous; anthers a little longer than the filaments, blunt; 2–2·5 mm long overall. Ovary minutely hairy; loculi 3; ovules 2 per loculus; style slender, *c.* 1·5 mm long. Fruits unknown.

Distribution: Known only from 1 collection, in western New Guinea, Jayapura district, Bernhard Camp, Idenburg River.

Ecology: Forest at 850 m.

Notes: A very distinct species with its narrow-obovate sessile leaves and small flowers typical of group II. The hollow twigs were inhabited by ants. The fruit will probably be long and narrow as in other members of group II. Sterile *E. bakaianus* could be confused with this species; the flowers are clearly of different types, the petal divisions of *E. bakaianus* being unthickened at the tip.

Group III

Ovules 2 per loculus; loculi 3; ovary minutely or obviously hairy. Embryo straight. Petals medium to fairly large, deeply divided into generally more than 10 slender ± linear tapering lobes. Stamens generally over 20, sometimes less, anthers pointed with bristles at the tips or not, never blunt. Leaves small to fairly large. Racemes mostly behind the leaves, sometimes axillary. Fruits generally over 2 cm long, ellipsoid to globose; stone thick-walled, the 3 sutures generally clearly visible in T. S. Seeds 1.

Note: This group is part of the widespread section *Elaeocarpus,* with many species as far west as India.

Group III A

Petals 4–6 mm long. Anthers without bristles. Fruits, where known, 2–2·7 cm long, ellipsoid, perhaps to globose.

Notes: Subgroup A corresponds to section *Chascanthus* Schltr. At the end of the subgroup a brief description is given of an apparent new member of the subgroup. More material is needed to be certain that this is a distinct new species.

6. Elaeocarpus homalioides Schltr *Bot. Jb.* **54**: 115 (1916).

Medium-sized tree. Young twigs hairy. Leaves generally ± clustered at twig tips; petioles *c.* 1 cm long, hairy; blades obovate to elliptic, 3·5–8 × 2·5–4 cm, tip rounded or broadly pointed, tapering at base, texture only fairly tough, short-hairy above on nerves only (sometimes with small blisters), short-hairy beneath, venation prominent beneath, the main veins curving forward and breaking up into reticulation well inside the margin, margins obscure to crenate-serrate. Inflorescences apparently borne behind the leaves, 3–7 cm long, short-hairy, bearing 10–*c.* 30 flowers on slender hairy pedicels 6–7 mm long. Sepals 2·5 × 1 mm, hairy outside, almost glabrous inside. Petals obovate, 3–4 × *c.* 1·5 mm, the claw ± constricted, glabrous, divided into 8–14 narrow tapering segments. Disc with 5 bilobed hairy lobes. Stamens *c.* 10 (not seen); filaments shorter than anthers, anthers apiculate, overall shorter than calyx lobes, falling early. Ovary hairy, 3-locular; ovules 2 per loculus; style short, glabrous. Young fruit ellipsoid; mature fruit perhaps globose, *c.* 2 cm in diameter, with a single symmetrical slightly flattened loculus, and a deeply sculptured stone (see below).

Distribution: Reported by Schlechter as 'manifestly widespread', the original collections, 9 in all, were from 3 different localities in the East Sepik district (near May River, up the April River and on the Hunstein Range). Since then it has apparently been collected only rarely, from near the Kebar Valley in the Vogelkop and from the Jayapura district of western New Guinea. It therefore appears to be scattered and locally common.

Ecology: 'Cloud forest', 1000–1500 m.

Notes: Though distinct enough on minute detail of the flowers, sterile *E. homalioides* could be difficult to separate from *E. arfakensis,* which generally has the inflorescences borne in the axils of current leaves. The fruit description is based on a single recent collection, which may belong here, from Mt Bosavi in the Western district.

7. Elaeocarpus multisectus Schltr *Bot. Jb.* **54**: 116 (1916). **Fig. 17.**

E. salomonensis Knuth (1941); *E. solomonensis* A. C. Sm. (1944).

Trees (7–)15–25 m tall. Twigs slender, short-hairy when young. Leaves scattered along the length of the twigs; petioles 1–3 cm long, slender, straight, usually hairy when young and often with 2 hairlike teeth at the tip; blades elliptic to ovate-elliptic to oblong, 9–13(–16) × (2·5–)4–6(–8) cm, tip acute and often acuminate, base tapering or rounded, papery, glabrous above, glabrous or persistently hairy beneath, main veins slightly prominent beneath, margins with fine but distinct sharp serration. Inflorescences borne behind the leaves, hanging down clear of the foliage, 10–30 cm long, short-hairy when young with up to 50 flowers on pedicels 1–1·3 cm long; pedicels stiffly spreading or slightly reflexed, bent at the tip; flowers opening widely, 11–15 mm across. Sepals 4–5 × *c.* 2 mm, minutely hairy outside, glabrous inside. Petals 5, white, very broadly obovate (broader than long), 5–6 × 7–8 mm, widely flared at the tip, on the back and on margins of the lobes with some straight hairs, ± glabrous inside, divided into 5–7 lobes, each lobe further divided into several fine linear divisions which, when dried, curl up and contort. Disc lobes 5, large, irregularly rounded, velvety-hairy. Stamens 25–35; filaments

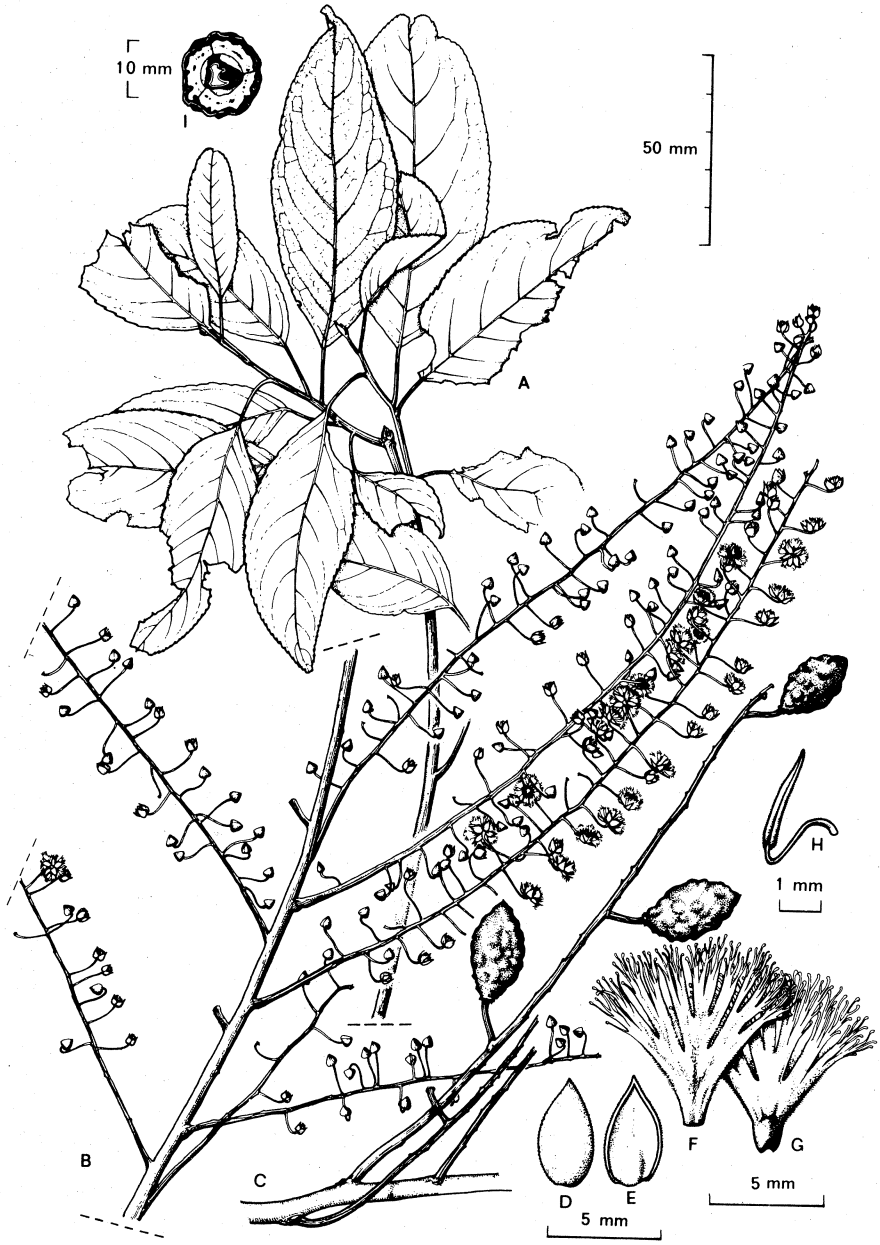

Fig. 17 **Elaeocarpus multisectus** Schltr (A) leafy twig (B) flowering inflorescences (C) fruiting inflorescence (D) sepal outside (E) sepal inside (F) petal outside (G) petal inside (H) stamen (I) cross-section of dried fruit, plane of symmetry drawn ± horizontal

strongly bent back near the base and bent up again near the midpoint, *c.* 1 mm long; anthers black or purplish, 2–2·5 mm long, pointed at the tip but without bristles. Ovary short-hairy, 3-locular; ovules 2 per loculus; style *c.* 1 mm long, glabrous towards the tip. Fruit ± ellipsoid and smooth when fresh, blue when ripe, drying lumpy (1·3–)2–2·7 × 1·3–1·5 cm; when dry flesh rather thin, black and dense; stone thick-walled, sometimes with air spaces, 3-sutured or sutures obscure, surface lumpy or sometimes with processes, loculus often 3-sided. Seed 1. Embryo straight.

Field characters: Often buttressed and stilt-rooted.

Distribution: Now known from scattered localities throughout Papuasia, probably endemic. The collections come from the Vogelkop, Fakfak (Adi Island) and Mimika districts of western New Guinea, from near Madang and from the Lae area of the Morobe district in New Guinea, and from the Southern Highlands Western, Gulf and Northern districts in Papua. Once collected on New Britain (Andru River, near Kandrian), and apparently fairly common in the Solomon Islands, including Bougainville.

Ecology: Primary forest, generally on swampy flat land, or riverine forest, at sea level to 30 m altitude, rarely more (in the Southern Highlands, Lake Kutubu at *c.* 670 m, and in Guadalcanal at 1200 m). It apparently regenerates freely if the swamp forest is cut or disturbed; seedlings grow to 23 m in 10 years. In the Solomon Islands, Whitmore states 'lowland forest, mainly where disturbed or secondary' (Whitmore, 1966, p. 67).

Notes: The bulk of the eastern New Guinea material, together with the New Britain specimen, is all rather similar. However, strikingly hairy-leaved specimens sometimes with larger leaves are known mostly from western New Guinea and the Western district of Papua; there do not seem to be any other differences. The Solomon Island material, until now known as *E. salomonensis.* was said to differ from *E. multisectus* in the glabrous leaves and lack of hairs on the claws of the petals. However, several mainland specimens have virtually glabrous leaves and many Solomon Island specimens have hairy petal claws. It is true that the Solomon Island material has a tendency to narrower smaller leaves that are consistently glabrous at maturity, and the fruits tend to be smaller, 15–22 mm long, but these differences are not reliable enough to maintain *E. salomonensis* as a species.

Elaeocarpus sp.?nov. 1

Differs from *E. multisectus* in smaller flowers (petals 2·5–4 mm long) and in relatively small and narrow leaves (5·5–8·5 × 1·7–2·7 cm).

Distribution: A single specimen from the Digul district of western New Guinea.

Ecology: Riverine forest at 60 m.

Group III B

Petals over 9 mm long except in *E. prafiensis.* Anthers with bristles at apex. Fruits exceeding 3 cm long, massive, ovoid, globose or globose-ellipsoid; flesh not cracking over sutures on drying. Seeds probably edible.

Distribution: Apparently widespread, with species in Borneo, Malaya, Sumatra, Java and the Philippines. In Papuasia, only in New Guinea, where the material has, with a few exceptions, been collected only in the last few years.

Notes: Subgroup B includes *E. leucanthus* which A. C. Smith placed in section *Chascanthus.* At the end of the subgroup descriptions are given of two apparent new members of the subgroup. The material is inadequate for formal description and naming. It is still too early to be sure if the species below will remain as distinct as they seem now, for there are several specimens only in fruit in the Lae Herbarium which either represent further new species or which will considerably alter the circumscription of the already named species if included in them. Some of these species may even have to be merged.

8. Elaeocarpus leucanthus A. C. Sm. *J. Arnold Arbor.* **25**: 227 (1944).

Tree up to 14 m tall. Twigs brown-hairy at first, later glabrous and blackish. Leaves apparently ± scattered; petioles slender, 1·5–3·5 cm long, hairy at first, often thickened at the tip; blades elliptic, 8–14 × 3–6 cm, abruptly pointed at the tip, abruptly tapering at base, medium-textured, glabrous above and short-hairy beneath, main veins and some of the reticulation prominent beneath, margin obscurely serrate-crenulate, the teeth 1–2 per cm. Inflorescences borne in the axils of current or fallen leaves, 5–12 cm long, short-hairy, bearing 5–20 flowers on short-hairy pedicels 12–20 mm long. Sepals 7–8 × 1·5 mm, hairy outside and hairy inside in the upper part. Petals obovate, 9–10 × 3·5–4·5 mm, rather obviously hairy on both sides particularly near the base, divided at tip into 19–21 linear, slightly unequal, divisions. Disc with 5 hairy lobes *c.* 1 mm long. Stamens *c.* 20; filaments *c.* 1 mm long; anthers 2–2·5 mm long, with a small group of conspicuous bristles at the tip up to 1 mm long. Ovary obviously hairy, 3-locular; ovules 2 per loculus; style *c.* 4 mm long, glabrous towards the tip. Immature fruits ellipsoid, 25 × 18 mm. Seed and embryo unknown, but see below.

Distribution: Known with certainly only from the type, from near Bernhard Camp, on the Idenburg River, Jayapura district, western New Guinea.

Ecology: Hillside rainforest, 1600 m.

Notes: There are some specimens collected at lower altitudes from the Western district of Papua near Kiunga. They are all in fruit, but bear some resemblance to *E. leucanthus* in leaf characters. The fruits are large, ovoid, with the massive stone, single seed and straight embryo typical of this subgroup.

9. Elaeocarpus millarii Weibel *Candollea* **26**: 362 (1971).

Trees up to 25 m, but fruiting sometimes when as small as 4 m. Twigs ± slender, quickly developing blisters, often hairy when young, glabrous later. Leaves ± scattered; petioles (1–)2–2·5 cm long, usually glabrous and with a pair of minute hair-like teeth at the tip; blades ± elliptic or obovate, (4·5–)5·5–8(–11) × 3–5(–6) cm, obtuse or bluntly pointed, tapering at base, thick, glabrous except when very young, but covered with blisters, venation slightly prominent beneath, crenation of margins distinct, each tooth with a small hair-like point. Inflorescences borne in the axils of leaves or behind them, 5–8 mm long, with a few scattered hairs, bearing 6–12 flowers; pedicels 8–15

mm long, appressed-hairy, particularly towards the tip. Sepals 9–12 × 2–3 mm, sparsely appressed-hairy outside, blistered particularly outside, densely short-hairy inside. Petals greenish, obovate, *c.* 14 × 9 mm, thin, flat and much expanded at apex, inrolled and thick at base, blistered, the claw appressed-hairy on the back, the entire inner surface more densely hairy, divided at the tip into *c.* 3 lobes, the lobes further divided into 25–43 linear divisions altogether. Disc hairy, indistinctly lobed. Stamens ± 40; filaments 1·5–2 mm long; anthers 4 mm long, with a small group of bristles up to 2 mm long at the tip. Ovary densely hairy, 3-locular; ovules 2 per loculus; style *c.* 8 mm long, glabrous towards the tip. Fruit massive, ± ellipsoid or globose, sometimes irregular, up to 6·5 × 4·5 × 4·0 cm; skin green to brownish (probably still immature) with corky pustules; flesh when dry *c.* 5 mm thick, hard but coarse, eventually detaching from the stone; stone ellipsoid, *c.* 4 × 3 cm, bluntly pointed, thick-walled, dense, hard, with 3 sutures visible in T. S. and on the outside, with 'brain-coral' rugose surface, loculus ± 3-sided. Seed 1. Embryo straight.

Distribution: Known from 3 certain collections, 2 from Marafunga in the Eastern Highlands and 1 from Mt Giluwe in the Southern Highlands district.

Ecology: Montane forest, 2350–2750 m.

Notes: 3 collections in fruit, from the same general area but at lower altitudes (1700–2350 m) probably belong here but have leaves of a slightly different appearance, perhaps due to ageing; the blisters are largely lacking from the leaf blades as if they had been reabsorbed, although they remain on the petioles.

10. Elaeocarpus oriomensis Weibel *Candollea* **26**: 364 (1971).

Large trees, 37 m tall with spreading crown. Twigs moderately robust, ± short-hairy when young but quickly becoming glabrous. Leaves ± grouped towards the tips of the twigs; petioles 1·5–3 cm, robust, minutely hairy when young, glabrous later; blades elliptic or broadly so, 10–15 × 5·5–8 cm, tip obtuse or acute, mostly rounded-truncate at base, though sometimes abruptly tapered, leathery, glabrous, margins obscurely crenulate with the teeth rather far apart. Inflorescences borne below the leaves, 6–8 cm long, hairy, bearing probably 12–20 flowers on flexuous pedicels *c.* 15 mm long. Sepals 10–11 × 1·5 mm, hairy outside, glabrous inside, margins slightly inrolled. Petals oblanceolate, 10–11 × 4 mm, appressed-hairy in the lower half outside and up to the lower two-thirds inside, inrolled and very hairy at base, divided into 20–25 short segments 1–2 mm long. Disc hairy (only damaged material seen). Stamens *c.* 30; filaments 1–1·5 mm long; anthers 4–4·5 mm long with a clump of bristles 1–2 mm long at the tip. Ovary densely hairy, 3-locular; ovules 2 per loculus; style *c.* 9 mm long, hairy for most of its length. Fruit massive, green, 5–5·5 × 4–4·5 cm, ellipsoid; flesh tough and coarsely granular when dry, *c.* 8 mm thick; stone ± ovoid, *c.* 4 × 2·5 cm, tip ± pointed, slightly 3-sided, dense, hard, walls 8–10 mm thick, surface only slightly rugose, loculus ± 3-sided. Seed 1. Embryo straight.

Distribution: Known with certainty only from the type, collected on the Oriomo River near Daru in the Western district of Papua.

Ecology: Riverine forest; altitude *c.* 20 m.

Notes: There are several sterile specimens from widely scattered localities which may belong here. There is also a fruiting specimen which is very similar, from the mouth of the Tami River, Jayapura district, western New Guinea.

11. Elaeocarpus prafiensis Weibel *Candollea* **26**: 365 (1971), f. 1.

Large trees up to 32 m tall, buttressed. Twigs fairly robust, minutely hairy when very young only. Leaves ± scattered; petioles 1–3 cm long, minutely hairy, not or little thickened at the tip; blades broad-elliptic or obovate, 8–12 × 5–7 cm, the tip bluntly pointed or obtuse, sometimes ± short-acuminate, tapering at base, fairly tough, glabrous or minutely and ± sparsely hairy on slightly prominent nerves beneath, margins obscure to crenulate. Inflorescences on the twigs usually behind the leaves, up to 9 cm long, short-hairy, bearing 15–30 flowers; pedicels spreading, *c.* 1 cm long, usually sharply bent near the tip, short-hairy. Sepals 4–5·5 × 1–1·5 mm, short-hairy on both sides. Petals 5, broad-obovate, 4–7 × 3–4·5 mm, short-hairy on the claw margins and with a few longer hairs inside near the base, divided into 5–7 lobes, the lobes subdivided into 2–3 linear divisions. Disc lobes 5, ± subglobose, rugose, velvety-hairy. Stamens 30–35; filaments *c.* 0·5 mm; anthers 1–2 mm long, with a small group of bristles at the tip up to 1 mm long. Ovary short-hairy, 3-locular; ovules 2 per loculus; style 2–3·5 mm long, glabrous toward the tip. Fruit, seed and embryo unknown, but see below.

Distribution: There are only 2 specimens known that are definitely attributable to this species; the type, from the Kwagira river in the Milne Bay district, and from Prafi in the Vogelkop, western New Guinea.

Ecology: Rainforest; 50–150 m.

Notes: The smaller flowers distinguish *E. prafiensis* from others of this subgroup. There are two collections in fruit which may belong here, one from Vanapa in the Central district with fruit said to be large (not seen), and another, less certainly belonging here, from the Oriomo River of the Western district, whose fruits are probably immature but are already 4·5 × 3·5 × 3 cm with pustular skin; they differ from the other members of this subgroup in having much thinner flesh which does not detach ± clearly from the stone, and obscure sutures in the stones (3 in one and 4 in another); seeds are absent, probably too young to have formed. If these fruits are young this may also explain the thin flesh.

12. Elaeocarpus pullenii Weibel *Candollea* **26**: 368 (1971). **Fig. 18.**

Trees up to 30 m tall. Twigs smooth, drying purplish, glabrous throughout. Leaves loosely clustered towards twig tips; petioles (2–)4·5–7 cm long, glabrous; blades ovate or ovate-oblong (11–)18–25 × (6–)8–10 cm, tips acute and acuminate, mostly rounded at base, rather papery, glabrous, main nerves fairly prominent beneath, margins obscurely crenulate. Inflorescences borne in the axils of the lower leaves or behind them, 5–7 cm long, with a few small scattered hairs, bearing 12–20 flowers on curved pedicels 13–15 mm long. Sepals 9–10 × 2–2·5 mm, sparsely short-hairy outside, glabrous inside. Petals

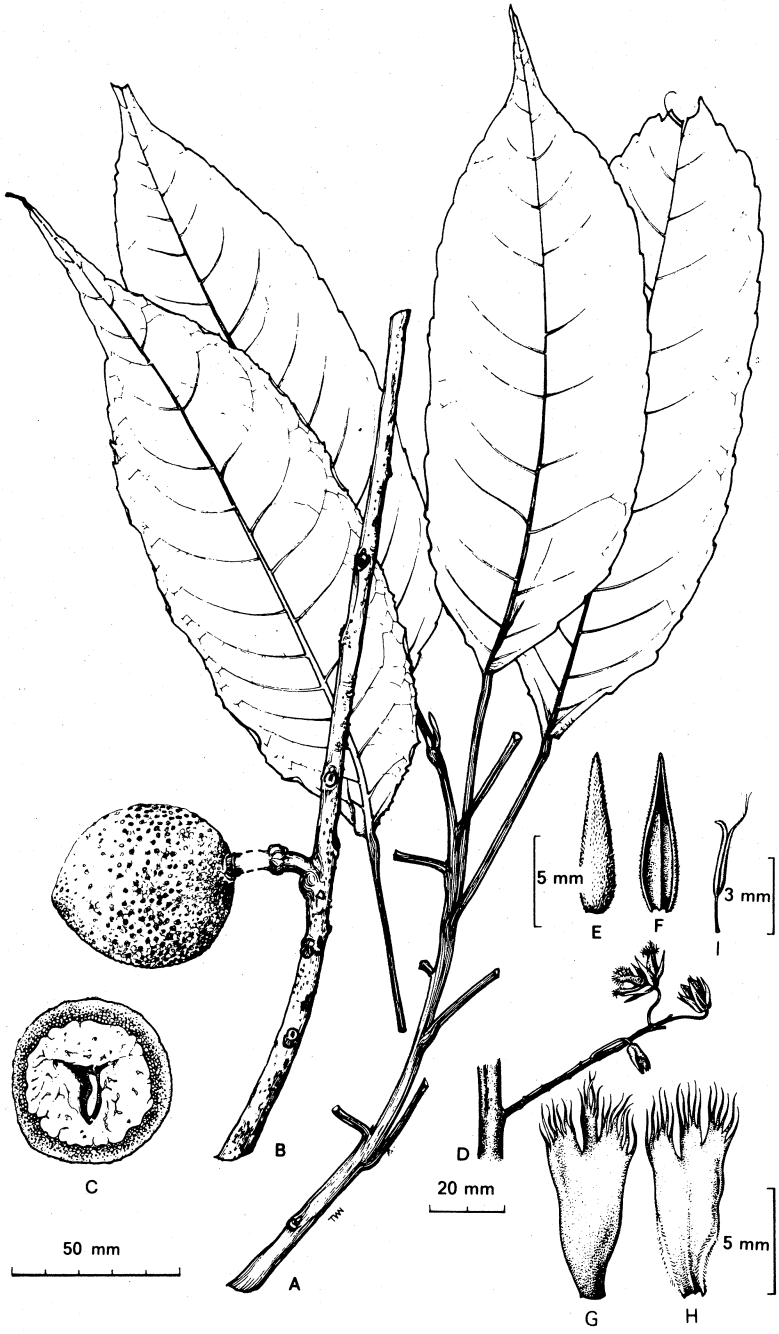

Fig. 18 **Elaeocarpus pullenii** Weibel (A) leafy twig (B) fruiting twig (C) cross-section of fruit (D) flowering inflorescence (E) sepal outside (F) sepal inside (G) petal outside (H) petal inside (I) stamen

5, obovate, 10–13 × 5–7 mm, glabrous except for the margins near the base, divided in 2–4 lobes themselves divided into 20–30 linear segments altogether. Disc velvety-hairy, indistinctly lobed. Stamens 30–45; filaments 1–2 mm long; anthers 3–3·5 mm long, with a small group of bristles at the tip. Ovary short-hairy, 3-locular; ovules 2 per loculus; style 4–5 mm long, glabrous towards the tip. Fruit massive, *c.* 5·5 × 4·5 cm, broadly ovoid-globose; skin bluish-green with pale corky pustules; flesh *c.* 6 mm thick and very hard when dry; stone ellipsoid, *c.* 4·5 × 3·5 cm, walls very thick, hard, and dense, surface slightly rugose, obscurely 3-sutured in T. S., loculus irregularly 3-sided and flattened. Seed 1, flattened. Embryo straight.

Distribution: Known from 2 specimens only; near Mt Turu and in the upper Karawari River area, both in the East Sepik district.

Ecology: Mountain rainforest and riverside; 700–1100 m.

Uses: The seed is recorded as being edible (Karawari River).

Notes: Very distinctive with its long-petioled leaves and glabrous purplish twigs. There are two other specimens both in young fruit, one from near Ialibu in the Southern Highlands and the other form near Aseki in the Morobe district, from higher altitudes, with very similar appearance to *E. pullenii,* but leaf and petiole dimensions are much less. They may represent a high altitude form of *E. pullenii.*

Elaeocarpus sp. ?nov. 2

Differs from the other species in this subgroup in the broad-elliptic, persistently-hairy, rounded leaves, 15–22 × 10·5–14 cm, with petioles 4·5–9 cm long. Fruits are known and are similar to the others described in the subgroup.

Field characters: Buttressed and stilt-rooted.

Distribution: 2 collections are known, both from Papua; 1 from Veimauri River in the Central district and 1 from Sagarai in the Milne Bay district.

Ecology: Lowland forest, 80–100 m. Evidently the kernels are palatable at least to animals; every one of the stones picked up from the ground had the walls (as thick and hard as any in the genus) gnawed through and the seed extracted, presumably by rats.

Elaeocarpus sp. ?nov. 3

Differs from *E. leucanthus* in having the flowers in fascicles, not racemes, and the leaves rather conspicuously blistered. Flower buds and empty aborted fruits are known.

Distribution: Known from a single collection from the foothills of the Star Mountains in the northeast of the Western district of Papua.

Ecology: Forest at 1900 m.

Notes: If new material consistently shows flowers in fascicles or very short-stalked groups it would represent a species distinct in the Group and probably distinct in the genus.

Group IV

Ovules 4(–6) per loculus; loculi usually 2; ovary hairy. Embryo straight. Petals medium-large with many narrow divisions. Stamens less than 20; anthers with pale solid awns. Leaves small to medium. Inflorescences amongst or just behind the leaves. Fruits irregular-ellipsoid, with radial fibres firmly and persistently attached to the stone, sutures not distinct in T .S., not very dense and hard. Seeds 1 or 2.

Notes: It is not known in Lae whether this group extends beyond Papuasia; so far known only from the eastern part of the New Guinea mainland. It corresponds to section *Blepharoceras* Schltr in the narrowest sense; the other species that Schlechter and Smith placed here have been moved to other groups.

13. Elaeocarpus blepharoceras Schltr *Bot. Jb.* **54**: 129 (1916). **Fig. 19.**
E. tafaensis A. C. Sm. (1944).

Trees up to 35 m tall. Twigs hairy at least when young. Leaves in life glossy mid-green above, glaucous beneath, with the nerves showing brown, when dry becoming uniformly brownish; petioles 10–16(–25) mm, hairy; blades obovate, 6–10(–15) × 3·5–5(–8) cm, acute at the tip, occasionally acuminate, tapering at base, densely hairy to felty beneath, nerves ± prominent beneath, margins obscurely serrulate to ± entire. Inflorescences in axils of leaves or a little below them, 5–10 cm long, hairy, bearing 8–12 flowers on hairy pedicels 4–5 mm long. Sepals purplish to pink, 8–10 × *c.* 1·5 mm, with short appressed hairs on both sides. Petals white, pale yellow or pale green, ± oblong and scarcely expanded at apex, 12–13 × 2–3 mm, glabrous outside, cohering at their margins by means of dense interlocking hairs and also ± hairy inside in the lower half, not lobed, but divided into 18–25 very narrow linear divisions. Disc hairy and not deeply lobed. Stamens 13–18; filaments 1·5–2·5 mm long; anthers 2–2·5 mm long with a distinct solid hairy awn at the tip *c.* 1 mm long. Ovary very hairy; loculi 2; ovules 4(–6) per loculus; style 7–11 mm long, mostly glabrous. Fruit irregularly globose, up to 4 × 3·5 cm when fresh, shrinking and cracking irregularly on drying to *c.* 35 × 25 mm, the skin becoming longitudinally striate, green at first, later bluish grey; flesh fibrous, the fibres arranged radially and permanently attached to the stone; stone relatively soft-woody. Seeds 1 or 2, not flattened. Embryo straight.

Field characters: Developing massive upper branches and irregular crown. Bark on old trunks brown, deeply and closely fissured, not separating from underbark; inner bark reddish, paler at cambium, fibrous.

Distribution: Originally collected in the hills south of the Sepik, up the April River; the specimens in Lae all come from the Wau subdistrict of the Morobe district, mostly from Mt Kaindi; the other known locality is Mt Tafa near Woitape in the Central district of Papua.

Ecology: Montane forest, often with *Nothofagus;* 1800–2400 m; the original collection 1000 m.

Notes: The rough furrowed bark with fibrous inner bark is unusual for *Elaeocarpus.* Sterile material has been confused with *Litsea* (Lauraceae), both having glaucous leaf undersides. A very distinct species in flower or fruit.

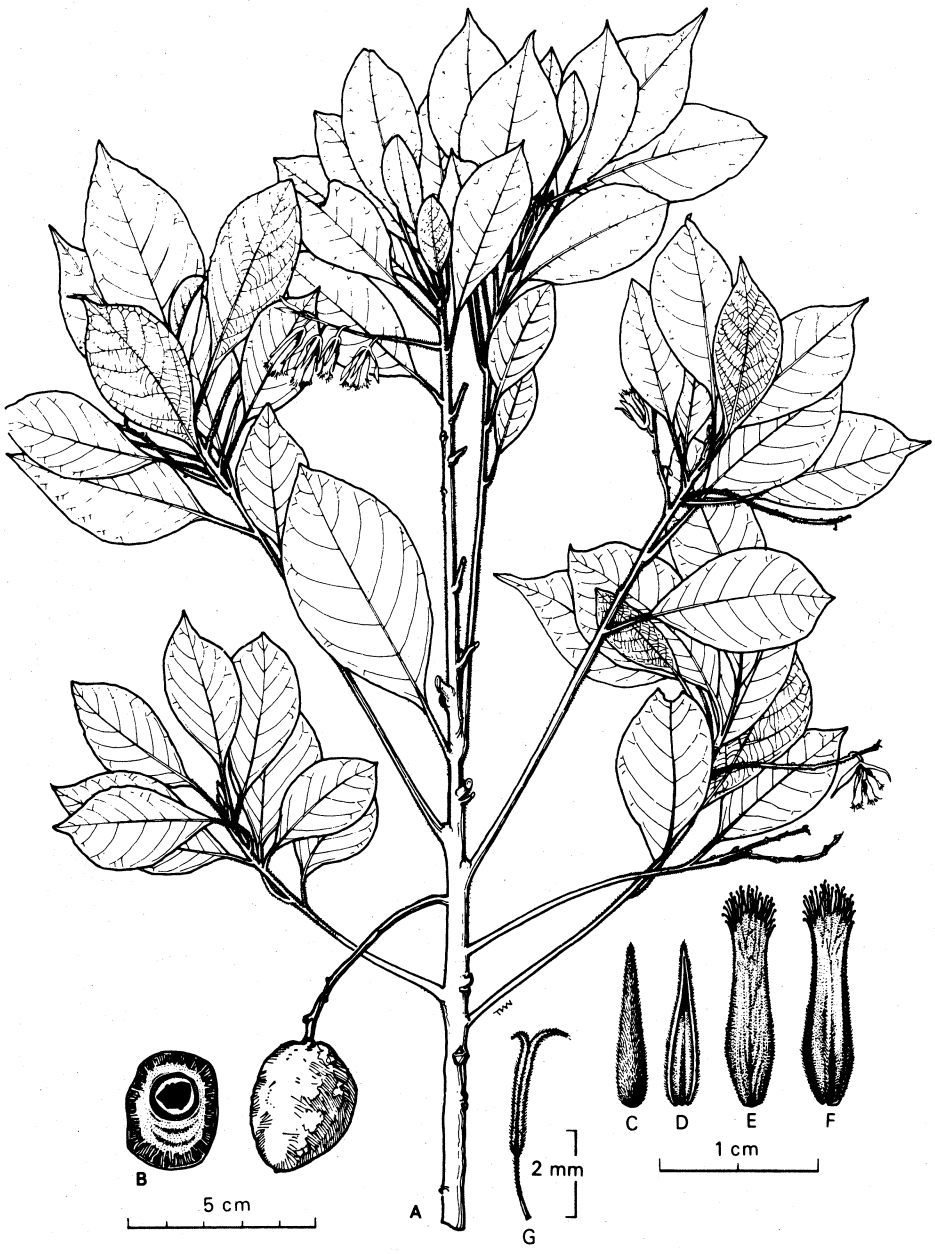

Fig. 19 **Elaeocarpus blepharoceras** Schltr (A) leafy twig with flowering inflorescences and fruit (B) cross-section of fruit (C) sepal outside (D) inside (E) petal outside (F) petal inside (G) stamen

Group V

Ovules (2–)4(–6 or 8) per loculus; loculi 2–7; ovary mostly hairy. Embryo straight. Petals small to medium-large, with many narrow or tapering divisions (less than 10 in only a few species). Stamens various but in most species without awns. Leaves very small to large. Inflorescences amongst or behind the leaves. Fruits (where known) ovoid or ellipsoid or spherical, not flattened, the flesh generally distinct from the stone, the stone dense, thick-walled and hard in all but *E. crenulatus* and sometimes *E. arnhemicus.*

Distribution: Geographically the range is as for the genus.

Notes: This group contains section *Ganitrus* Brongn. & Gris (and thus section *Ptilanthus* Schltr) and section *Fissipetalum* both in Schlechter's original sense and in A. C. Smith's later and wider sense. It is no longer possible to divide the species placed here into these 2 groups; see Coode (1978) for discussion.

Group V A

Loculi (3–)4–7. Petals mostly over 9 mm long, hairy on the margins, otherwise mainly glabrous. Inflorescences spreading, 12–many-flowered, without persistent bracts, usually borne behind the leaves; flowers often apparently borne on one side of the axis. Stamens 30 or more. Flower buds very narrowly ovoid, not acuminate.

Distribution: India to Fiji and Australia; throughout Papuasia.

Notes: This subgroup corresponds to section *Ganitrus* in the strict sense.

14. Elaeocarpus buderi Coode *Brunonia* **1**: 184 (1978).

Trees 12–25 m tall. Twigs stout, finely hairy at first. Leaves ± grouped at the ends of the twigs; petioles 0–5 mm, very stout; blades obovate, 27–33 × 10–12 cm, tip ± acute, often acuminate, subcordate at base, ± appressed-hairy at first, often glabrous at maturity, venation not very prominent; margins obscurely toothed or almost entire. Inflorescences borne below the leaves, 6–9 mm long, appressed-hairy, bearing 7–12 flowers on pedicels 15–20 mm long. Sepals 10–12 × 1–1·5 mm, finely appressed-hairy on both sides. Petals oblanceolate, 17–20 × 4–5 mm, flat and thin, with some very short hairs on the margins, ± glabrous elsewhere, ± 5–7-lobed, the lobes divided into 2–5 linear divisions (*c.* 25 divisions in all) up to 6 mm deep. Disc velvety-hairy. Stamens caducous, (probably about 30?); filaments 1·5–2 mm long; anthers 5 mm long, apparently without awns or setae but deeply split at the tip. Ovary hairy; loculi 4–5; ovules 4 per loculus; styles slender, 23–25 mm long. Fruit blue, globose, 2–2·5 cm in diameter; flesh dense and ± fibrous; stone hard, dense, surface deeply sculptured, sutures obscure in T. S. Seeds *c.* 4, not flattened. Embryo straight.

Field characters: Buttressed, sometimes stilt-rooted as well.

Distribution: Lowland New Britain, only collected 4 times.

Ecology: Forest or disturbed forest, from sea level to 750 m.

Notes: A distinct species with large ± sessile leaves, while clearly resembling *E. sphaericus* in many details of flower and fruit structure. The specimens were previously known as *E. terminalioides*; see below, p.

15. Elaeocarpus dolichostylus Schltr *Bot. Jb.* **54**: 125 (1916).

Trees 13–25(–40) m tall. Twigs glabrous or hairy. Leaves ± clustered towards the tips of twigs; petiole winged, 1–3 cm long; blades obovate, 15–19 (–23) × 6·5–9 cm, obtuse at apex, tapering into the petiole at base, fairly tough, glabrous or hairy, venation generally prominent beneath, with main veins rather crowded (3–4 per 2 cm, rarely fewer), margins serrulate. Inflorescences borne behind the leaves, spreading, 4–12 cm long, finely appressed-hairy, bearing 15–30 flowers on pedicels 10–15 mm long. Sepals 8–10 × 1·5–2 mm, with short appressed hairs on both sides. Petals ± oblong, (7–)8–12 × 2–4 mm, glabrous except for the hairs on the basal half of the margins, irregularly 3–5-lobed, the lobes subdivided into 2–4 narrow tapering divisions, *c.* (8–)15–20 divisions altogether. Disc short-hairy, lobes not very distinct. Stamens 30–37; filaments 1–2 mm long; anthers 4–5 mm, the tip drawn out into a point, often splitting down the sides as well as at the tip. Ovary hairy; loculi (3–)4–5; ovules *c.* 4 per loculus; style 13–15 mm long, glabrous towards the tip. Fruit blue when fresh, globose or ellipsoid, *c.* 10 mm in diameter; flesh thin, drying blackish and dense, clearly distinct from the stone; stone thick-walled, dense, sutures often obscure in T. S., surface somewhat rugose. Seeds 1–5, generally not flattened. Embryo straight.

Two subspecies may be recognized.

KEY TO SUBSPECIES

1. Leaves and twigs persistently and obviously brown-hairy; fruits ± ellipsoid, pointed, 15–25 mm long; petals 7–8 mm long ..... ssp. **collinus**
1. Leaves and twigs less obviously hairy to almost glabrous; fruits globose up to 10 mm long; petals 11–12 mm long ..... ssp. **dolichostylus**

ssp. **dolichostylus**

E. ulapensis Knuth (1941); *E. chloranthus* A. C. Sm. (1944).

Field characters: Often with thin convex buttresses to 3 m.

Distribution: In western New Guinea, ssp. **dolichostylus** has been collected in all districts except Fakfak; there are single collections from near Aitape, East Sepik district, and Karkar Island in the Madang district, which together with several from the Morobe district represent the known occurence in north-eastern New Guinea. It is also known from the Western, Southern Highlands and Northern districts of Papua and from the New Ireland district in the Bismarck Archipelago. Not known from New Britain but may be expected there. Also known from the Moluccas and Talaud Island, and perhaps the Celebes.

Ecology: Primary, and less often secondary forest, often in swampy places, from sea level to *c.* 750 m.

Notes: There are some intermediates between this subspecies and ssp. *collinus*. A few other specimens are rather similar to *E. sphaericus* in leaf but the fruits

are always smaller. The name *E. chloranthus* covers a variant with very leathery, glabrous, almost sessile leaves from Idenburg River in Jayapura district.

ssp. **collinus** Coode *Brunonia* **1**: 188 (1978).

Distribution: Morobe, Western and Eastern Highlands districts; also probably in the Central district of Papua.

Ecology: Mostly in forest, sometimes in disturbed habitats, 1200–2050 m.

Notes: In leaf, this subspecies is easily confused with *E. murukkai* and with some specimens of *E. densiflorus;* all 3 tend to have curious raised lines running down the twigs from the petiole edges. In flower the petals would be larger in *E. dolichostylus* than in the other 2, and the position of the inflorescences on the twigs would be another distinguishing feature. Also the leaves tend to be broader.

16. Elaeocarpus ptilanthus Schltr *Bot. Jb.* **54**: 125 (1916). **Fig. 20.**

E. multiscissus Knuth (1941); *E. acutifidus* A. C. Sm. (1944); *E. aemulus* A. C. Sm. (1944).

Trees to 30 m tall. Twigs moderately robust, glabrous or finely short-hairy at most when young. Leaves rather densely set; petioles 5–10 mm, ± glabrous, flat, and almost winged; blades elliptic to obovate, (4–)5–10 × 2–4 cm, the tip bluntly pointed to acute, the base tapering into the petiole, rather leathery, glabrous except when very young, venation network raised on both surfaces, margin finely toothed, 4–6 teeth per 1 cm near the tip. Inflorescences borne on the twigs behind most of the leaves (sometimes the leaves may persist), (3–)4–7 cm long, spreading, greyish short-hairy throughout in flower, bearing 10–20 downwards-facing flowers on pedicels 8–12 mm long. Sepals cream or pinkish, 10–13 mm long, thin, sparsely short-hairy on both sides. Petals white to pale green, ± obovate, 14–18 × 4–6 mm, glabrous except for the margins, which are densely short-hairy near the base and sometimes also short-hairy on the back near the base, divided into 4–7 irregular lobes, each subdivided into 3–7 long narrow tapering divisions (15–25 divisions in all), up to 6(–7) mm long. Disc hairy, not very distinct. Stamens *c.* 35; filaments 1–2 mm long; anthers 4–6 mm long, the tip pointed and with a few short bristles, splitting deeply down the sides as well as at the tip. Ovary very hairy; loculi usually 5; ovules *c.* 4 per loculus. Fruits bluish or purplish, globose or globose-ovoid, (2·5–)3–4(–5) × 2·5–3·5 cm, sometimes pointed at the tip; flesh contracting slightly on drying onto stone surface, knobbly; stone dense, hard, the surface deeply sculptured with many irregular processes, in T.S. showing some radially arranged fibres in the flesh often passing deeply into the stone along irregular channels but always visibly distinct from the stone, finally (on rotting) separating from the stone completely, sutures *c.* 5. Seeds 1–4, somewhat flattened along the radius. Embryo straight.

Field characters: Often somewhat buttressed at base and with a dense ± umbrella crown. Petioles red in life, venation network reddish.

Distribution: Endemic to New Guinea. Only 1 collection is known from western New Guinea, from Lake Habbema in the Snow Mountains district. In

Fig. 20 **Elaeocarpus ptilanthus** Schltr (A) leafy twig with flowering inflorescences (B) fruit (C) cross-section of fruit (D) sepal outside (E) sepal inside (F) petal outside (G) petal inside (H) stamen

the eastern half of New Guinea it is common in the 3 Highlands districts and in the Morobe district; it is also known from the West Sepik and Central districts.

Ecology: Montane forest; it often becomes a dominant canopy species; (1700–) 2300–2800 m.

Notes: Sometimes considered to be a montane form of *E. sphaericus.* There are intermediate specimens linking the two, usually in the 1200–2800 m altitude range, but they are few compared with the totals in each species. Not only does *E. ptilanthus* have smaller leathery leaves and generally larger flowers and larger fruits with more ornamented stones, but also it differs in ecology, being almost always found in primary forest and rarely as a secondary weedy species; it also has a compact dense crown quite different in appearance from the loftier more slender *E. sphaericus,* which has a relatively diffuse crown.

17. Elaeocarpus sphaericus (Gaertn.) K. Sch.* in Engl. & Prantl *Nat. Pflanzen.* **3,** 6:5 (1890); Foreman *Bot. Bull.* **5** (Check List Vasc. Pl. Bougainville): 112–13 (1971), f.

Ganitrus sphaerica Gaertn. (1791); *Elaeocarpus parkinsonii* Warb. (1891); *E. fauroensis* Hemsl. (1896); *E. novoguineensis* Warb. (1905); *E. muelleranus* Schltr (1916).

Trees up to 40 m tall. Twigs moderately slender, glabrous or sometimes minutely hairy, sometimes with a greyish 'bloom'. Leaves scattered or ± grouped at twig tips; petioles 5–15(–20) mm long, slender and very narrowly winged at least near the tip, glabrous; blades elliptic to obovate, sometimes narrowly so, 12–17 × 4–6 cm, tip generally acute, base tapering into the winging of the petiole tip, thin and papery when dry, glabrous or sometimes finely appressed-hairy, main veins slightly prominent beneath (but not the venation network), margins finely and evenly serrulate, 4–6 teeth per 1 cm. Inflorescences borne on the twigs behind the leaves, spreading, 6–9 cm long, usually glabrous, sometimes minutely hairy, bearing 12–26 flowers on pedicels 9–15 mm long, often pendulous. Sepals 8–11 × 1–2 mm, glabrous or finely appressed-hairy outside, minutely hairy inside. Petals ± oblong-obovate, 12–15 × 3–4 mm, glabrous except for the margins near the base which are short-hairy, thin, flat, divided at the tip into 4–5 lobes, the lobes subdivided into 3–7 narrow tapering divisions (15–25 in all). Disc hairy, not distinctly lobed. Stamens *c.* 35; filaments 1–2 mm; anthers 4–6 mm long, tip pointed and usually with a group of small bristles, splitting down the sides, as well as across the tip. Ovary very hairy; loculi 5(–7); ovules usually 4 per loculus; style 11–18 mm long, glabrous towards the tip. Fruit ± globose, (12–)20–30 mm in diameter; skin bright blue or purplish; flesh fibrous or not, drying dark and dense, 1–4 mm thick, clearly distinct from the stone and finally

* C. Tirel & J. Raynal in *Adansonia II,* **20** (2): 169–77 (1980) have shown that *Ganitrus sphaerica Gaertn.,* the basionym for *Elaeocarpus sphaericus* (Gaertn.) K. Schum., is illegitimate. The oldest available epithet for this widespread species now appears to be *Elaeocarpus angustifolius* Bl. Bijdr. 120 (1825). The name *G. sphaerica* Gaertn. must be rejected because Gaertner included (? accidentally) in the synonymy of the original description, two pre-Linnaean references which by that date (1791) had already been used as the type of *Elaeocarpus serratus* L. (1753), a completely different species.

rotting away from it; stone hard and dense, surface rugose to sculptured, in T.S. loculi arranged radially and sutures usually visible, seedless loculi not much obscured by growth of seeds in the neighbouring loculi. Seeds (1–)2–5 (–7), usually not or scarcely flattened in the middle, though the ends may be flattened. Embryo straight.

Field characters: Usually with thin widespreading buttress to 5–6 m; crown usually diffuse, often partly deciduous, with one branch here and there with brilliant scarlet dying leaves or bare.

Distribution: Throughout lowland Papuasia; *E. sphaericus* is represented at Lae by specimens from every lowland district except Mimika. The species is found from India through Malesia to Australia and Fiji.

Ecology: Generally a very common secondary species in disturbed vegetation, at least in Papuasia. It can persist into advanced secondary or even later, becoming a canopy or even emergent species. It is often recorded from 'primary forest' but many of these primary forests are likely to be mature regrowth, and it is doubtful if the species would regenerate under a closed canopy. Many species of birds are attracted to the bright blue fruits.

Uses: While no uses have been specifically reported in Papuasia, in India and Malaya the hard sculptured stones are used decoratively, being polished and strung onto necklaces or made into charms. There are techniques for partial ringbarking of the trees which result in fruits smaller than usual. These are more highly esteemed by the trade; see Burkill J. M. (1966), *Dict. Econ. Prod. Malay Penins.* ed. 2, **1**: 916.

Notes: Very variable, and intergrading to some extent with *E. ptilanthus;* see there for discussion. Some authors consider that there is a range of closely related species sufficiently distinct to be recognized throughout the range; most now consider it best to regard them all as part of a widespread variable species. For discussion on variation see Coode (1978). *E. kaniensis, E. altisectus* and one form of *E. polydactylus* cannot at present be distinguished from *E. sphaericus* in fruit. In flower it could be confused with *E. dolichostylus* with generally broader leaves and denser leaf venation.

Group V B

Loculi 5–7. Petals 6–8 mm long, hairy on the back or on the margins only. Inflorescences spreading, 8–many-flowered, without persistent bracts, borne behind the leaves, flowers often apparently borne on the side of the inflorescence axis. Stamens 30 or more. Flower buds ovoid, acuminate.

Notes: Apparently endemic to New Guinea. There is still considerable uncertainty over specific limits in this subgroup.

18. Elaeocarpus altisectus Schltr *Bot. Jb.* **54**: 123 (1916).

?*E. breviracemosus* Knuth (1940); *E. trifidus* A. C. Sm. (1944).

Trees 15–27 m tall. Twigs glabrous or minutely hairy when young. Leaves scattered or grouped at twig tips; petioles 1–1·5 cm long, very narrowly

winged at least near the tip, glabrous or minutely hairy; blades elliptic to obovate-elliptic, 9–11 × 4·5–5 cm, tip pointed or blunt, tapering at base into the petiole winging, rather papery when dry, usually glabrous, sometimes hairy beneath, main veins slightly prominent beneath, margins obscurely and finely serrulate (*c.* 4 teeth per 1 cm). Inflorescences borne behind the leaves, *c.* 5 cm long, short-hairy, bearing 8–10 flowers on slender pedicels 10–13 mm long. Flower buds ovoid-acuminate. Sepals 4–5 × 1·5 mm, ovate, acuminate, sparsely and minutely hairy on both sides. Petals ± obovate, 7–8 × 1·5 mm, deeply dissected into 3 lobes, the lobes *c.* 5 mm long, either linear-lanceolate or divided further into 2 linear divisions, the margins slightly inrolled from base to point of division and densely short-hairy, the indumentum extending a little way up the outer margin of the outer divisions, glabrous on the back. Disc hairy. Stamens *c.* 45; filaments *c.* 1 mm long; anthers *c.* 2 mm long, with a small group of bristles at the tip *c.* 1·5 mm long. Ovary hairy, 5–7-locular; ovules 4–6 per loculus; style 3–6 mm long, glabrous toward the tip. Fruit probably very like that of *E. sphaericus;* see below.

Distribution: So far known from only a few widely scattered localities in New Guinea: western New Guinea, Vogelkop, Jayapura and Fakfak districts; northeastern New Guinea, Sepik River near Ambunti; Papua, Western district on the Fly River at Kiunga and Northern district at Kokoda.

Ecology: Rainforest, often in swampy areas; sea level to 400 m.

Notes: A variable species, which integrades with *E. kaniensis* in petal shape and general appearance. There are few collections with hairy leaves. Since flowers are needed to distinguish *E. altisectus* from *E. sphaericus,* the leaves being often indistinguishable, it is not certain what the fruits of *E. altisectus* are like; it is probable that they resemble those of *E. sphaericus* very closely. Follow-up fruit collections from trees previously identified on flowering material are needed.

19. Elaeocarpus kaniensis Schltr *Bot. Jb.* **54:** 123 (1916&.
?*E. glabriusculus* Knuth (1916).

Trees up to 25 m tall. Twigs appressed-hairy at first, moderately robust. Leaves closely clustered towards twig apices; petioles slender, 1–1·5 cm long, very narrowly winged towards the tip; blades elliptic to narrowly obovate, 8–13(–17) × 2–4(–7) cm, obtuse or pointed, tapering into the petiole at base, usually rather papery when dry, with very fine appressed hairs or ± glabrous, venation not very prominent, margins evenly serrulate with 5–6 teeth per 1 cm. Inflorescences borne on the twigs below the leaves, 4–6 cm long, ± slender, appressed-hairy, crowded with 30–50 flowers on pedicels 3–10 mm long. Sepals 4·5 × 1·5 mm, appressed-pubescent. Petals ± elliptic, 6–7 × *c.* 2 mm, incurved and thick, hairy on the margins and on the back, glabrous inside, not expanded at tip, divided to only about 1(–3) mm into a few narrow divisions. Disc hairy, not distinctly lobed. Stamens 50–60; filaments *c.* 1 mm; anthers 1–1·5 mm, awnless but sometimes with a few bristles at the tip. Ovary hairy, 5-locular; 4 ovules per loculus. Fruit probably very like that of *E. sphaericus* (see below).

Field characters: Often buttressed.

Distribution: Known certainly only from the East Sepik, Madang and Morobe districts. Other specimens may belong here; if so they extend the range to the Vogelkop and Jayapura districts of western New Guinea and the Eastern Highlands of northeastern New Guinea.

Notes: As with *E. altisectus,* material in fruit only cannot be certainly identified as *E. kaniensis;* the fruit is almost certainly very like that of *E. sphaericus.* Fruit from trees previously identified by the flowers is needed. *E. kaniensis* intergrades with *E. altisectus* in petal shape; see Coode (1978) for discussion.

Group V C

Loculi 4–5. Petals 5–8 mm long, glabrous except for the margins. Inflorescences borne among the leaves, erect to semi-erect, usually robust, (7–)15–30-flowered with broad boat-shaped or linear-spathulate bracts that persist until the flowers open at least; flowers borne all around the inflorescence axis. Stamens 20–30. Flower buds ± ellipsoid.

Distribution: Perhaps endemic to New Guinea.

20. Elaeocarpus bakaianus Coode *Brunonia* **1**: 195 (1978).

Trees 12–24 m tall. Twigs glabrous, stout. Leaves probably ± scattered; petioles absent or up to 5 mm long and robust, glabrous; blades oblanceolate to obovate 10–14 × 2·5–5·5 cm, obtuse or pointed at the tip, subcordate at the base, leathery, glabrous but with many small blisters in the leaf surface, midrib red in life, venation network slightly prominent on both surfaces, margin obscurely crenate, sometimes with hair-points, 3–4 teeth per 1 cm. Inflorescences 11–15 cm long, semi-erect, borne in the axils of the lower leaves, with fine grey appressed hairs and corky blisters, bearing 15–30 flowers all round the axis in the axils of linear-spathulate bracts, bracts 12–14 mm long and exceeding the flowers, pedicels short and thick, 3–4 mm long, held ± erect and close to the inflorescence axis. Sepals 5–6 × *c.* 1·5 mm, with short-appressed hairs outside, ± glabrous inside, except for a few hairs on the central keel. Petals white, ± obovate, *c.* 5 × 2 mm, glabrous except for the densely short-hairy margins, divided unequally to at least half-way into 20–25 linear divisions. Disc hairy, indistinctly lobed. Stamens *c.* 20; filaments 1–1·5 mm long; anthers 2·5–3 mm long, with a few short setae in a clump at the tip. Ovary sparsely short-hairy to almost glabrous. Fruit unknown, but see below.

Distribution: Known only from the type, collected at Bakaia near Garaina in the the Morobe district, and from 1 other specimen, which probably belongs here, from the Idenburg River in Jayapura district of western New Guinea.

Ecology: Forest, 1750–2000 m.

Notes: A recent specimen from Bosavi in the Western district of Papua may belong here. It has globose fruits 2·5–4 cm in diameter with 5 carpels and a deeply sculptured stone, in section like those of *E. ptilanthus.*

With sessile leaves at these altitudes, *E. bakaianus* could only be confused with *E. myrmecophilus,* some forms of *E. dolichostylus* and perhaps *E. terminalioides.* Flowers would be needed for certain identification; more collec-

tions of this species, particularly with fruit, are desirable.

21. Elaeocarpus murukkai Coode *Brunonia* **1**: 197 (1978).

Trees up to 35 m tall. Twigs rather stout, densely brown-hairy at first, often with narrow wings decurrent from the petioles. Leaves rather scattered; petioles 1–2 cm long, winged; blades obovate or narrowly obovate or narrowly elliptic, (7–)10–17 × (3–)4–7 cm, obtuse or sometimes in narrow leaves pointed, tapering into the winged petiole at base, rather tough, densely brownish-hairy beneath, especially on the nerves, main nerves and venation prominent beneath, margins obscurely to finely serrulate (3–5 teeth per 1 cm). Inflorescences in flower borne in the axils of the lower leaves, occasionally just below, in fruit the subtending leaves fallen, 13–27 cm long, erect, brown-hairy, bearing (7–)15–25 rather distant flowers all round the rachis, the flowers subtended by felty-hairy bracts up to 17 × 3 mm, usually with the tip bent outwards, persisting until late flowering; pedicels robust, erect, 5–10 mm, lengthening in fruit to 12–15 mm. Sepals 5–6 × 2 mm, thick, shortly and densely hairy outside, less so inside. Petals obovate or obtriangular, 8 × 4 mm, glabrous except on the margins, irregularly 5–8-lobed, the lobes divided into 3–8 narrow divisions (25–30 divisions in all). Disc hairy, indistinctly lobed. Stamens *c.* 30; filaments 1–1·5 mm long; anthers 2·5–3 mm long, not awned though sometimes with a few short bristles at the tip. Ovary hairy, 4–5-locular; 4 ovules per loculus; style *c.* 3 mm long, hairy only at base. Fruits blue when ripe, asymmetrically ± ellipsoid, 4·5–6 × 2·5–3 cm; skin smooth; flesh when dry 1–2 mm thick, leathery-fleshy, detaching from the stone on rotting; stone obovoid, hard, dense, thick-walled, showing 4–5 ± obscure sutures in section, sutures visible on stone surface at least near the tip, surface slightly rugose. Seed usually 1 in an asymmetric ± flattened loculus. Embryo straight.

Field characters: The brownish hairs on the leaves can be seen at a distance; the crown is frequently flat-topped, with the inflorescences and fruits just overtopping the leaves.

Distribution: So far known mainly from the Edie Creek/Kaindi area near Wau in the Morobe district, where it is common. Also known from Mt Shungol and near Aseki, both in the Morobe district, from Mt Piora in the Eastern Highlands and from Mt Strong near Tapini and Mt Tafa near Woitape in the Central district.

Ecology: Generally reported as being found in montane forest; it regenerates freely in disturbed habitats and it seems likely that it is usually a secondary species and indicative of disturbance in the fairly recent past. On Mt Kaindi it appears to dominate, with a species of *Macaranga*, a flat-topped even-age stand about 20 m tall on what is probably an old landslip. The altitude range is from 1800 to 2350 m, possibly to 2750 m.

Notes: This species has been confused with the rather variable *E. densiflorus,* one form of which also grows on Mt Kaindi; this is distinguished from *E. murukkai* by its smaller elliptic leaves, smaller flowers on slender pedicels in less robust ebracteate spreading racemes, and much smaller ± globose fruit. See also *E. dolichostylus* ssp. *collinus.*

Group V D

Loculi 2–5. Petals up to 6 mm long, glabrous or hairy on the margins only or sometimes with a few hairs on the back. Inflorescences spreading to ± erect, usually many-flowered, without persistent bracts, borne (usually) amongst the leaves; flowers borne all round the axis. Stamens generally less than 20, rarely to 25. Flower buds ± ovoid or ellipsoid.

Notes: It is not certain what the whole range of this subgroup is; apart from New Guinea it is found at least in Australia. Species limits are exceedingly difficult to determine; more material of the less well-known taxa or variants is needed. The subgroup contains rather diverse elements and may be further subdivided in the future; it corresponds to the section *Fissipetalum* as originally defined by Schlechter (1916).

22. Elaeocarpus arfakensis *Schltr Bot. Jb.* **54**: 118 (1916).

E. koebrensis Gibbs (1917); *E. pulleanus* O. C. Schm. (1924); *E. alpestris* A. C. Sm. (1944).

Trees 10–25 m tall. Twigs slender, hairy when young at least. Leaves rather congested towards twig tips; petioles (1–)2–7(–10) mm long, ± narrowly winged towards the tip, hairy; blades obovate to elliptic, rarely broadly elliptic, (30–)40–70 × 15–30(–40) mm, usually obtuse, tapering at base into the petiole, often rather tough, persistently but variously hairy beneath, venation prominent beneath, margins serrulate, often inrolled. Inflorescences borne amongst the leaves, 4–8(–11) cm long, hairy, bearing 9–25 flowers on pedicels 3–7 mm long. Sepals 3–5 × 1–1·5 mm, usually hairy outside, glabrous inside. Petals obovate, 3·5–5·5 × 1·5–2·5 mm, glabrous or with a few scattered hairs on the back or margins, with 10–19 very narrow divisions 1–1·5 mm long. Disc densely hairy, 5-lobed. Stamens 15–20; filaments *c.* 1 mm; anthers 1–1·5 mm, opening widely at tip and sometimes splitting nearly to base, occasionally with a few bristles at the tip. Ovary densely hairy; loculi usually 3; ovules 4 per loculus, style *c.* 3 mm long, glabrous towards apex. Fruits blue when ripe, ovoid-ellipsoid, *c.* 10 × 7 mm (rarely 16 × 10 mm), pointed or blunt at tip; skin ± smooth to lumpy; flesh contracting on drying to a thin dense blackish layer detaching from stone on rotting; stone hard, dense, thick-walled, surfaced rugose; sutures obscure in T. S. Seed 1. Embryo probably straight.

Distribution: Probably endemic to New Guinea, where it is scattered.

E. arfakensis is known in western New Guinea from the Arfak mountains of the Vogelkop, where the type was collected; a few more specimens are known from 2 separate areas in the Snow Mountains. In the eastern part of New Guinea, the species is apparently quite common in the Western highlands and very common in the Doma peaks area of the Southern Highlands; it is also known from Mt Giluwe in the same district.

Ecology: Montane forest, mostly between 2500 and 2750 m, occasionally to 3225 m.

Notes: While the bulk of the material is fairly uniform and apparently similar to the original material from the Arfak mountains, other specimens vary con-

siderably. *E. pulleanus* covers specimens with broad-elliptic leaves with a very pronounced venation network all over the lower leaf surface, and larger fruits (16 × 10 mm); *E. alpestris* covers specimens with thicker, very felty-hairy leaves, perhaps associated with higher altitudes. For discussion of these points see Coode (1978). *E. arfakensis* is difficult to separate from the rare example of *E. polydactylus* with hairs on the leaf underside.

23. Elaeocarpus arnhemicus F. Muell. *Descr. Not. Pap. Pl.* **1:** 6(1875). **Fig. 21.**
E. reedyi F. Muell. (1888); *E. brassii* Knuth (1940); *E. papuanus* Knuth (1941); ?*E. peekelii* Knuth (1940).

Trees 5–16(–31) m tall. Twigs slender, glabrous, often reddish and with corky lenticels. Leaves scattered; petiole (5–)6–15(–22) mm long, usually glabrous, often slightly thickened and very slightly winged at the tip; blades variable, lanceolate, ovate, elliptic or obovate, (5·5–)6·5–10(–12)× 2·5–4(–5) cm, acute and usually acuminate, though the tip itself may be minutely rounded, base tapering into the petiole and often slightly asymmetric, fairly leathery when dry, glabrous or minutely and sparsely appressed-hairy, main nerves reticulate at two-thirds to three-quarters the distance from midrib to margins and not much more distinct than the slightly prominent venation network, sometimes with a few domatia along the midrib, margins obscurely serrulate to distinctly and coarsely crenate. Inflorescences scattered amongst the leaves or a little below them, 4–8 cm long, slender, glabrous or finely appressed-hairy, bearing 11–30 flowers (sometimes more) almost to the base on a slender pedicels 3–6 mm long. Sepals 2–2·5(–3) × *c.* 1 mm, rather thin, glabrous or with scattered appressed hairs outside. Petals obtriangular, 2·5 × 1–1–2 mm, glabrous, ± truncate at the tip, and divided into 9–12 ± linear blunt divisions. Disc hairy, 5-lobed, lobes not very distinct. Stamens 15; filaments 0·5 mm long or less; anthers 0·5–1 mm long, tip-toothed, with a small group of short bristles, but neither awned nor beaked, though the outer tooth sometimes longer than the other. Ovary hairy or sparsely hairy or almost glabrous, 2-locular; ovules 4 per loculus; style glabrous, 1–2 mm long. Fruit blue when ripe, ± ellipsoid, 10–15 × 6–11 mm, usually rounded at both ends when mature; skin and flesh wrinkling on drying ± detaching in mature fruit from the stone; stone sculptured, with walls 1–2 mm thick, dense, with 2 obscure sutures. Seed 1. Embryo straight.

Field characters: Often reported to have an open crown.

Distribution: In Papuasia, mainly in Papua, with most specimens from the Western district (south of the Fly River) and Central district; there is 1 specimen from Normanby Island in the Papuan Islands, and a few from Lake Wanum in the Markham Valley; there are also 2 specimens from New Britain. *E. arnhemicus* was described from northern Australia where it appears to be fairly common.

Ecology: The species in apparently restricted to areas with a distinct dry season in scrubland or open woodland rather than in forest with a closed canopy; however, the specimen from Heath Island, New Britain, was apparently growing in forest; from sea level to 200 m. The fruits are reported to be eaten by Torres Strait pigeons.

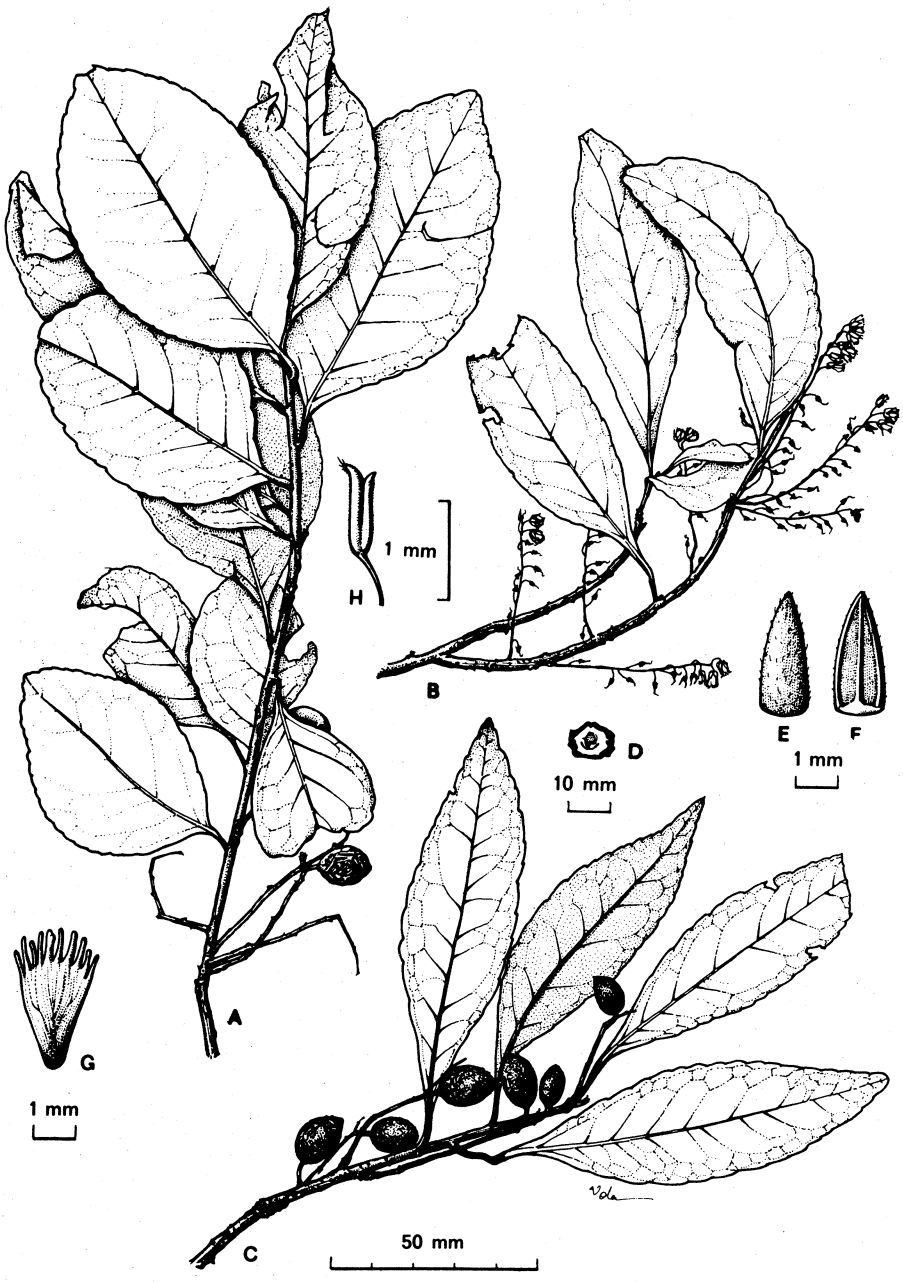

Fig. 21 **Elaeocarpus arnhemicus** F. Muell. (A) leafy twig of broad-leaved form (B) leafy twig with flowering inflorescences (C) leafy twig with fruit (D) cross-section of fruit (E) sepal outside (F) sepal inside (G) petal outside (H) stamen

Notes: Very variable in leaf shape and size, the extreme forms being quite unlike each other. A future worker may prefer to treat the extremes as varieties, but first the species should be studied throughout its range; it may even be found to be the same as *E. obovatus* Don from Australia. If *E. peekelii* Knuth is correctly placed here, the range is extended to New Ireland; no specimens of *E. peekelii* are known to have survived.

24. Elaeocarpus dasycarpus A. C. Sm. *J. Arnold Arbor.* **25:** 244 (1944).

Trees 7–25 m tall. Twigs robust, densely short-hairy when young. Leaves crowded towards the twig tips; petioles 2–5 mm long, winged at least towards the tip, hairy; blades obovate or elliptic, 2–5(–7) × 1–3 cm, the tip bluntly pointed or rounded, the base tapering into the petiole winging, tough, persistently and densely short-hairy beneath, main veins prominent and venation network slightly less prominent beneath, both very slightly raised above, and often slightly inrolled (at least when dry), margin obscurely or finely serrulate with 4–6 teeth per 1 cm. Inflorescences borne amongst the leaves, ± erect and rather robust, 8–15 cm long, densely short-hairy throughout, bearing 20–30 flowers on robust pedicels 3–5 mm long in the axils of linear-oblanceolate bracts up to 10 mm long which may persist until early flowering. Sepals greenish, 5–6 × 1·5 mm, outside and margins densely short-hairy, inside much less hairy or glabrous. Petals creamy or white, obovate, 6 × 2·5 mm, mostly glabrous but with a few hairs on the back, rounded at the tip and divided into 4–5 lobes, subdivided into *c.* 20 very narrow divisions altogether. Stamens *c.* 25; filaments 1 mm or less; anthers 2–2·5 mm, pointed at the tip and with a few short bristles on the outer tooth. Ovary hairy, 3–4-locular; ovules 4 per loculus; style 3–4 mm long, glabrous towards the tip. Fruit ± ellipsoid, up to 5·5 × 4·8 cm, borne on much thickened inflorescences; skin and flesh not shrivelling on drying though they may crack, drying *c.* 3 mm thick, dense, rather granular, hard, clearly distinct from the stone; stone massive, dense, hard, with narrow air spaces and 3–4 sutures generally distinct in T. S. Seed 1. Embryo straight.

Field characters: Crown flattish, dense; fruits held stiffly up, just above the leaves.

Distribution: So far known from the foothills of Mt Wilhelm and near Goroka in the Eastern Highlands district and from the foothills of Mt Albert Edward in the Central district.

Ecology: Apparently always in forest, where it can be a common canopy species; from 2300 to 2900 m.

Notes: E. dasycarpus is rather similar to *E. densiflorus* and *E. murukkai;* its relationships with both are discussed in Coode (1978). The Albert Edward material, including the type, has smaller leaves, 2·9–4·5 × 1–2 cm; good flowering material from this area is needed before the material from north-eastern New Guinea can be placed here with complete certainty. On Albert Edward there is also a small-leaved form of *E. trichophyllus* which is very similar in facies and leaf but can be distinguished even when sterile by its venation network sunk in the upper leaf surface, not slightly prominent as in *E. dasycarpus.*

25. Elaeocarpus densiflorus Knuth *Feddes Rep.* **50:** 82 (1941).
E. decorus A. C. Sm. (1944); *E. archboldianus* A. C. Sm. (1944).

Trees 8–30 m tall. Twigs robust, densely short-hairy when young, sometimes flattened and usually with rather obvious winging continuing down from the edges of the leaf petioles. Leaves grouped towards twig tips but not crowded; petioles 1–3 cm, usually obviously winged, hairy; blades elliptic to obovate, 9·5–14(–17) × 3·5–5(–7·5) cm, acute or less commonly obtuse, tapering to the winged petiole at base, fairly tough, persistently hairy or at least sparsely hairy on the nerves beneath, main nerves and first branches prominent beneath, network rather less prominent on both sides, margins obscure to serrulate, the teeth often ending on a hair-point, 3–5 per 1 cm. Inflorescences borne amongst the leaves (subtending leaves often fallen in fruit), erect or spreading, rather slender, (8–)12–19 cm long, short-hairy to densely hairy, bearing 40–70 flowers, occasionally less, ± erect in bud but facing downwards when open; pedicels 5–8 mm long; bracts 3–5 mm long, hairy and quickly caducous or absent. Sepals 3·5 × 1–1·5 mm, hairy outside, glabrous inside or with a few scattered hairs. Petals obovate, 5–5·5 × 1·5–2 mm, flat, glabrous except for the short-hairy margins near the base, the tip rounded and divided into 3–5 lobes further divided into 17–23 linear-filiform divisions 1·5–2·5 mm long. Disc hairy, indistinctly 5-lobed. Stamens 15–20; filaments 0·5(–1) mm long; anthers 1·5–2 mm, the tip acute and occasionally with a few small bristles, splitting deeply sometimes to base. Ovary densely hairy, 3-locular; ovules 4 per loculus; style 2–2·mm long, ± glabrous. Fruit globose to ellipsoid, blue when ripe, 12–15 × 10–12 mm, tip rounded; skin and flesh often cracking over the sutures when dry, *c.* 1 mm thick, dense and blackish, clearly distinct from stone; stone thick-walled, surface ± rugose, showing 3 sutures in T. S. Seed cavities 1(–2); seeds and embryo not seen.

Distribution: Endemic to New Guinea, where it is widely scattered. Known from the Vogelkop and from the Wissel Lakes and Lake Habbema in the Snow Mountains district of western New Guinea; from northeastern New Guinea it is known from the Morobe district, near Aseki, in the Huon Peninsula, and on Mt Kaindi near Wau where it is common; in Papua only 2 specimens are known, 1 from the Ok Tedi headwaters in the north of the Western district and 1 from Mt Dayman in the Milne Bay district.

Ecology: Forest, often in open situations and secondary regrowth; from (1200–)1800 to 2300 m.

Notes: The typical form has large obovate leaves; the form most commonly collected has smaller elliptic leaves and corresponds to *E. archboldianus.* However, there is no real separation possible even at varietal rank. The distribution is peculiarly patchy; probably it is undercollected.

26. Elaeocarpus orohensis Schltr *Bot. Jb.* **54:** 130 (1916) amplified by A. C. Sm. *J. Arnold Arbor.* **25:** 233 (1944).

Tree to 20 m tall. Twigs fairly robust, hairy when young, with narrow wings continuous with the raised middle line on the back of the petioles running down the twig. Leaves scattered; petioles 10–12 mm long, ± glab-

rous, ridged down the back, narrowly winged toward the tip, with blisters; blades obovate, 10–13 × 5–7 cm, usually with the tip rounded, tapering towards a ± rounded base, probably rather papery, finely appressed-hairy when young, usually glabrous when mature, conspicuously blistered particularly beneath, venation network slightly prominent, main nerves more prominent beneath, margins obscurely serrulate. Inflorescences borne in the axils of the leaves or behind them, ± erect, 10–17 cm long, rachis appressed-hairy, bearing 30–40 flowers on pedicels 6–9 mm long. Sepals light green, 4–5 × *c.* 1 mm, appressed-hairy outside, less hairy inside. Petals white, ± obovate, 5–6 × 3–4 mm, thin, flat, slightly hairy on the edges near the base, otherwise glabrous, divided at the tip into 20–30 very narrow tapering segments. Disc hairy, obscurely lobed. Stamens 15–17; filaments 0·5 mm long; anthers 1·5–2 mm long with a few bristles at the tip. Ovary hairy, 4–5-locular; ovules 4 per loculus; style 3–4 mm long, glabrous towards the tip. Fruit unknown.

Distribution: Known only from the type which has collected in the Lorentz River area of the Mimika (or perhaps the adjacent Snow Mountains) district of western New Guinea.

Ecology: Altitude 1300 m.

Notes: Very similar in flower details to *E. densiflorus* but differing in the 4–5-locular ovary and rounded-obovate blistered leaves that are almost or completely glabrous.

27. Elaeocarpus polydactylus Schltr *Bot. Jb.* **54:** 119 (1916) in the broadest sense. **Fig. 22.**

Trees (3–)8–30 m tall. Twigs usually slender, sometimes moderately robust, glabrous or appressed-hairy when young at most. Leaves clustered or scattered; petioles 3–26 mm long; often reddish, generally ± glabrous and narrowly winged towards the tip at least; blades broadly elliptic, elliptic or obovate, 1·5–14 × 0·7–6 cm, acute or obtuse at apex, sometimes acuminate, tapering at base into the petiole winging, tough and leathery or papery, generally glabrous, sometimes with a few scattered hairs beneath, sometimes blistered, venation prominent or obscure, often reddish, often with domatia along the midrib beneath, margins obscure or serrulate. Inflorescences borne in leaf axils or behind the leaves, erect or spreading, 4–18 cm long, glabrous or with appressed short hairs, bearing 6–50 flowers on pedicels 4–10 mm long, flowers often facing down when open; bracts generally absent or falling very quickly, occasionally present. Sepals reddish or purplish, 3–4 × 1 mm or less, slightly hairy or glabrous outside, usually glabrous inside. Petals creamy or white, obovate, 3–5(–5·5) × 1–2 mm, glabrous outside but with the margins near the base short-hairy, divided into 5–6 lobes (or lobes obscure), further divided into 11–19 narrow tapering divisions in all. Disc short-hairy, indistinctly 5-lobed. Stamens 14–20; filaments 1 mm long or less; anthers 1–2 mm long, tip pointed but not awned, often with a group of small bristles. Ovary short-hairy, sometimes only sparsely hairy, 3(–5)-locular; ovules 4 per loculus; style *c.* 2 mm long, ± glabrous. Fruit ± globose to ellipsoid, the tip rounded, 8–18 × 7–15 mm; skin and flesh drying blackish,

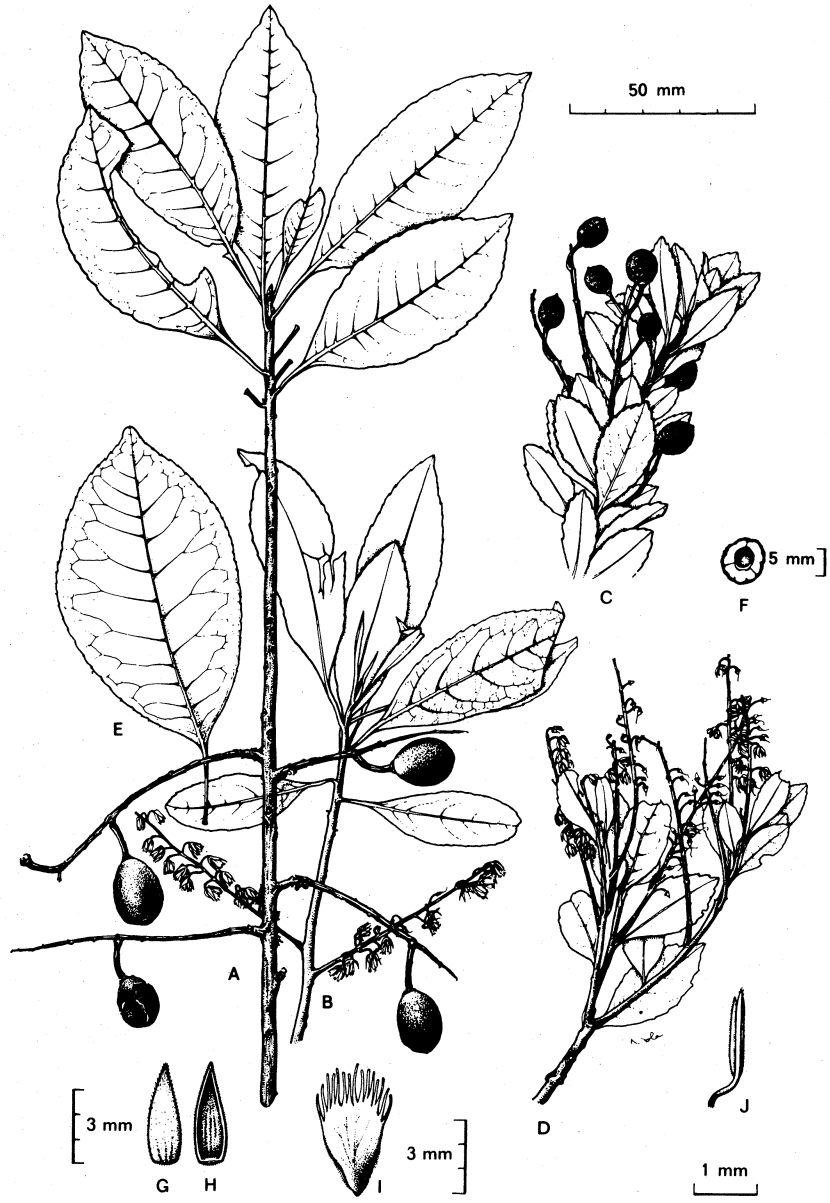

Fig. 22 **Elaeocarpus polydactylus** Schltr (A) leafy twig with fruit — gp 4 (B) leafy twig with flowers — gp 1 (C) leafy twig with fruit — gp 3 (D) leafy twig with flowers — gp 2 (E) leaf — gp 4 (F) cross-section of dried fruit (G) sepal outside (H) sepal inside (I) petal outside (J) stamen

c. 1 mm thick, dense, often cracking over the sutures; clearly distinct from and separating from the stone on drying or rotting; stone hard, dense, thick-walled, surface rugose, in T. S. showing 3(-5) ± obscure sutures. Seeds 1(-2). Embryo straight.

Distribution: Endemic to New Guinea.

Notes: Under this name are grouped a number of forms which, while they are vegetatively quite distinct when in their extreme states, are all interconnected by so many intermediates that they cannot be recognized as species; there are virtually no floral differences. To avoid most of the complications discussed in Coode (1978) these are here considered informally as 'groups', with synonymy as indicated. The following key should help to place most of the specimens into 'groups'.

KEY TO INFRASPECIFIC GROUPS OF E. POLYDACTYLUS

1. Leaves (30-)35-60 mm wide, broad-elliptic
 2. Inflorescences few, 5-11 cm long; leaves leathery ..... group **4**
 2. Inflorescences often rather many, 7-18 cm long; leaves ± papery, often ± acuminate .... group **5**
1. Leaves 7-26(-30) mm wide, elliptic or ± obovate
 3. Leaves mostly 55 mm or more long, papery, acuminate; inflorescences 7-18 cm long .... group **5**
 3. Leaves shorter, usually not acuminate, papery or leathery; inflorescences not more than 9 cm long, usually less
 4. Leaves papery, acute ..... group **1**
 4. Leaves thick and tough, usually obtuse
 5. Leaves 15-30(-40) × 7-14(-18) mm ..... group **3**
 5. Leaves (35-)40 × 16-25 mm or larger ..... group **2**

group **1. Fig. 22B.**

?*E. polydactylus* Schltr var. *polydactylus*

Apart from the characters given in the key, group 1 generally has leaves (45-)55-70(-80) × (20-)21-26(-30) mm, being (2.1)2.4-2.8(-3.2) times longer than broad, often with small blisters; petioles 5-11 mm long; inflorescences among the leaves, 4-8(-13) cm long; fruits 8-14 mm long.

Field characters: Crown usually rather open.

Distribution: So far known only from the eastern half of New Guinea; it is found in the Wau area of the Morobe district, is common in the Western Highlands, and rather less common in the Eastern and Southern Highlands districts; it has been collected once in the Wharton Range of the Central district and once on Mt Dayman in the Milne Bay district.

Ecology: Forest, sometimes in disturbed habitats; (1550-)1900-2800 m.

Notes: Occasional specimens from the Western and Southern Highlands have sparsely hairy leaves and petals with a few hairs on the back, being thus very similar to *E. arfakensis* which also occurs in the same area.

group **2. Fig. 22D.**

E. azaleifolius Knuth (1940); ?*E. raphiolepidiifolius* Kan. & Hat. (1942); *E. mundulus* A. C. Sm. (1944).

Apart from the characters given in the key, group 2 has leaves 2–2·6(–2.7) times longer than broad, generally without blisters; petioles 3–5 cm long; inflorescences borne among the leaves 4–9 cm long; fruits as in group 1.

Field characters: While usually trees, sometimes found as a shrub, particularly in exposed places.

Distribution: Known from a single specimen from Lake Habbema in the Snow Mountains of western New Guinea; in northeastern New Guinea from the Telefomin area of the West Sepik district, rather common in the Morobe district, a single specimen from each of the Western and Southern Highlands, very common in the Eastern Highlands, and a few from the Albert Edward foothills in the Central district.

Ecology: Forest, usually in understory, often associated with regrowth; (1800–)2100(–3300) m.

Notes: Perhaps not really distinct from group 3, and linked by intermediates with groups 1 and 4.

group **3. Fig. 22C.**

Apart from the characters given in the key, group 3 has leaves (1.7–) 2·0–2·4 times longer than broad, generally without blisters but often with a few prominent domatia along the midrib beneath; petioles 3–5 mm long, inflorescences borne among the leaves and usually overtopping them, 4–8 cm long, when young sometimes with narrow bracts about as long as flowers; fruits as in infraspecific group 1.

Field characters: Often a robust if not very tall tree with dense foliage in a flattish crown.

Distribution: So far known only from the eastern half of New Guinea; in northeastern New Guinea it is known from a few scattered localities in the Morobe, Western and Eastern Highlands districts. There are more collections in Papua, particularly in the Southern Highlands, and 3 from the Central district.

Ecology: Montane forest and subalpine shrubbery. On Mt Giluwe the species is found at as high an altitude as most other tree species; only about 4 other species (*Symplocos* sp., *Rapanea* sp., *Pittosporum pullifolium, Podocarpus* sp.) are found higher. Altitude range 2750–3500 m.

Notes: The material considered here shows local variation; i.e. the material from the Doma Peaks in the Southern Highlands is very uniform but differs slightly (in leaf margin and venation) from the Mt Giluwe specimens also in the Southern Highlands and also uniform). Both differ slightly (in leaf shape and robustness of twigs) from the Central district collections. It is possible that these local small-leaved populations arose independently from infraspecific groups 1 and 2, perhaps in response to altitude.

group **4. Fig. 22A, E.**

E. nubigenus Schltr (1916); *E. florulentus* Ridley (1916).

Apart from the characters given in the key, group 4 has leaves 6–11 cm

long, being 1·7–2·2(–2·8) times longer than broad, often with many small blisters and rather prominent domatia along the midrib beneath; petioles (8–)10–25 mm long; inflorescences borne among or just behind the leaves, 5–11 cm long, without bracts; fruits 14–17 × 10–12 mm.

Field characters: Generally a shrub or small tree up to 8 m tall, sometimes up to 13 m.

Distribution: Known in western New Guinea from 1 specimen collected at Lake Habbema in the Snow Mountains district. It is common in the Western Highlands but is otherwise known from only the Eastern Highlands in northeastern New Guinea. In Papua it has been collected only from the Central district and there is a single specimen from Mt Dayman in the Milne Bay district.

Ecology: Forest, often in disturbed or regrowth areas: 1850–2550 m.

Uses: The wood is split and used to make shields.

Notes: Small-leaved forms occur which intergrade with infraspecific groups 1 and 2; there are also some specimens intermediate between this group and infraspecific group 5.

group **5.**

E. polydactylus var. *podocarpoides* Schltr (1916); *E. albiflorus* Knuth (1941); *E. leptopus* A. C. Sm. (1944); *E. savannarum* A. C. Sm. (1944).

Apart from the characters given in the key, group 5 has leaves (6·5–)7–14.5 cm long, being 2·6–3·7 times longer than broad, sometimes with small blisters; petioles 10–24 mm long; inflorescences borne in the axils of the lower leaves or behind them, often rather many, 9–18 cm long, without bracts; fruits 12–18 × 9–15 mm.

Field characters: Trees 7–30 m tall; flowers quite conspicuous from underneath the tree.

Distribution: Common in the foothills of the Cycloop Mountains and elsewhere near Jayapura in western New Guinea; in northeastern New Guinea scattered mostly in the Morobe district with 2 specimens from the Western Highlands; there are 2 specimens from Papua and 1 each from Milne Bay and Misima in the Papuan Islands.

Ecology: Savannah country near Jayapura, from 120 to 600 m; elsewhere from 600 to 2200 m, in forest, often in advanced regrowth.

Notes: The Jayapura specimens, for which *E. savannarum* was published, tend to have narrower leaves than the others, but the differences are too slight to recognize formally. There are intermediates between this group and infraspecific group 4. In fruit, this group can closely resemble *E. sphaericus;* usually the leaves of this group are more pointed and have obvious domatia, the loculi not more than 4 and the fruit not more than 18 mm long.

28. Elaeocarpus sericoloides A. C. Sm. *J. Arnold Arbor.* **25:** 245 (1944).

Trees up to 33 m tall. Twigs ± slender, densely and shortly brown-hairy

when young. Leaves opposite, subopposite or ± alternate; petioles 1·5–3 mm long, hairy, not winged; blades ovate, ovate-oblong or ovate-elliptic, 3·8–5·5 × 1·5–2·4 cm, generally acuminate and acute at the tip, rounded to abruptly tapering at base, fairly tough, glabrous above or brown-hairy on midrib, brown-hairy beneath or rarely sparsely hairy on midrib only, venation network slightly prominent on both sides, the main veins branching at one half to two-thirds the distance from the midrib to margin, margins obscure or rather distantly toothed, *c.* 2–4 teeth per cm. Inflorescences probably among the leaves or a little behind them, very slender, 2–3.5(–4) cm long, ± sparsely hairy throughout, bearing *c.* 6 flowers nearly to base on pedicels 4–6(–8) mm long. Sepals 3.5–4 × *c.* 1.7 mm, glabrous. Petals obovate, 3.5–4 × *c.* 1.5 mm, glabrous, the tip regularly divided into 10–12 linear blunt divisions. Disc indistinctly 5-lobed, minutely hairy. Stamens 12–13, filaments *c.* 1 mm long; anthers *c.* 1.5 mm long, pointed at the tip. Ovary glabrous, 3(?–4)-locular; ovules 4 per loculus; style *c.* 1.5 mm long. Fruits globose, 25–32 mm in diameter; flesh drying dark and shrivelled, the skin cracking irregularly, distinct from the stone; stone dense, hard, thick-walled, surface deeply sculptured, in T. S. showing the sutures (see below). Seed probably 1, not seen. Embryo not seen.

Field characters: Once reported to have stilt-roots.

Distribution: Known certainly from only 4 specimens, 3 from western New Guinea (1 from Sidai, west of Manokwari in the Vogelkop, and 2 from the Idenburg River); the 4th is from Sogeri in the Central district of Papua.

Ecology: Forest, from 5 to 1230 m.

Notes: An interesting species, undercollected. Individuals should be studied to see how constant is the character of opposite leaves, and if it is reflected in the branching pattern. The only fruit in Lae has 4 sutures while the one at Kew has 3; there are no flowers in Lae, the description being taken from Smith's original.

Group V E

Loculi 2. Petals 6–7 mm long, hairy on the back. Inflorescences borne among the leaves, 2–3-flowered or flowers solitary in leaf axils, bracts quickly falling. Stamens 15–20. Flower buds ovoid.

29. Elaeocarpus crenulatus Kruth *Feddes Rep.* **48:** 74 (1940). **Fig. 23.**
E. myrtoides A. C. Sm. (1944).

Shrubs to small trees, 2–12 m tall. Twigs slender, glabrous or appressed-hairy when young. Leaves rather densely set or crowded towards twig tips; petioles 2–4(–8) mm long, sometimes appressed-hairy when young but usually glabrous, often reddish, narrowly winged at least toward the tip; blades elliptic to obovate or broadly so, rarely ovate, 1·4–3(–4·6) × 0·6–2 cm, acute or obtuse at tip, tapering at base into the petiole winging, rarely rounded and with a thickened tip to the petiole, leathery, glabrous throughout, sometimes shiny, or persistently and finely appressed-hairy, with conspicuous or obscure

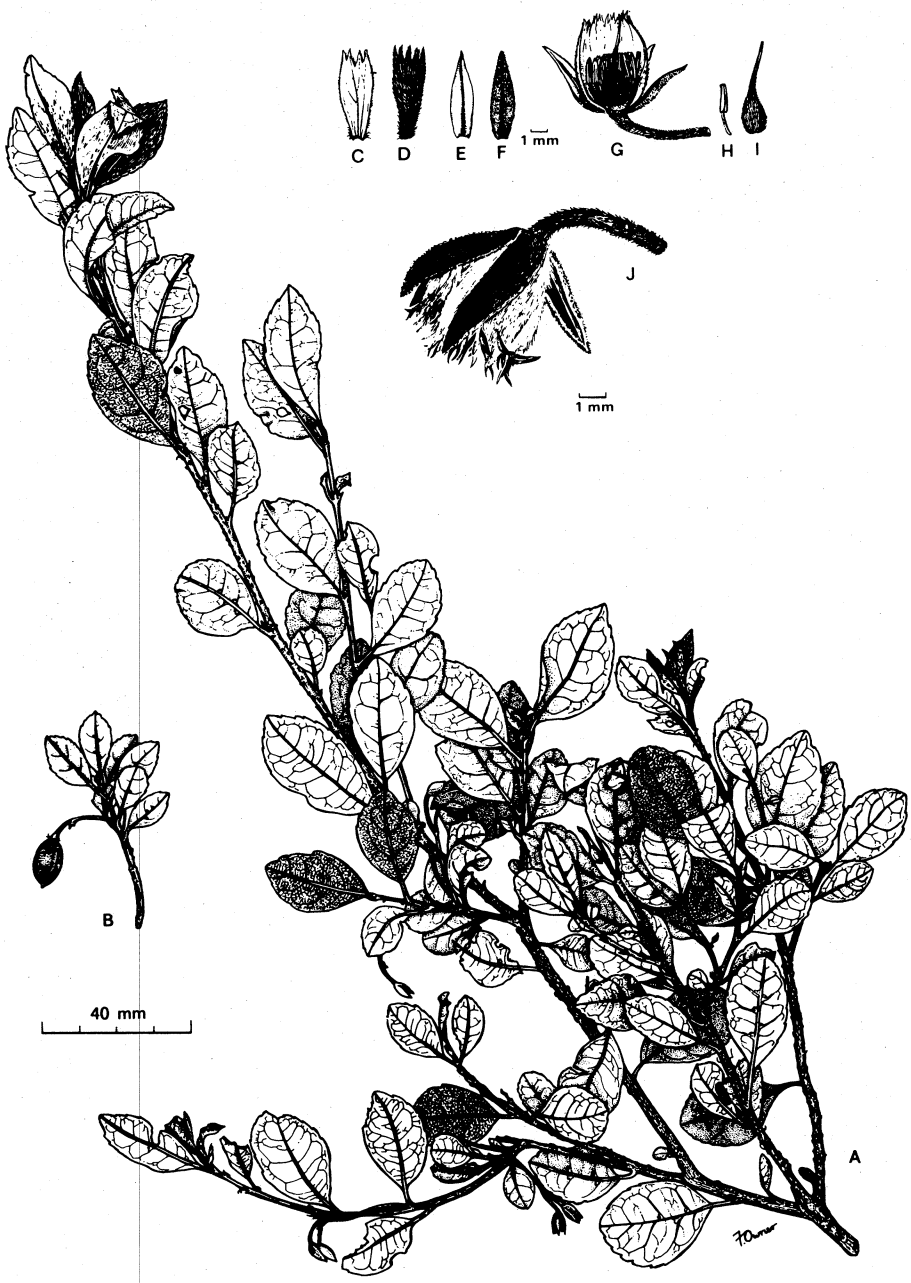

Fig. 23 **Elaeocarpus crenulatus** Knuth (A) leafy twig with flowers (B) leafy twig with fruit (C) petal inside (D) petal outside (E) sepal inside (F) sepal outside (G) longitudinal section of flower (H) stamen (I) ovary and style (J) flower enlarged

appressed silky hairs when young, venation network fine and prominent on both surfaces, the main veins not or scarcely more prominent than the network, usually with a few distinct domatia along the midrib beneath, margins often slightly rolled underneath, crenulate-serrulate (teeth 3–4 per 1 cm) or with a few large blunt teeth or sometimes ± entire and notched at apex in the smallest leaves. Inflorescences few, borne among the leaves, 1–3 cm long with 1–3 flowers on curved pedicels 4–8 mm long, often appressed-hairy, or flowers solitary in the axils of leaves or reduced leaves on continuing leafy shoots. Sepals usually red or pinkish, 5·5–7 × 0·5–2 mm, sparsely hairy or ± glabrous on both sides. Petals white, ± obovate or oblong-oblanceolate, 6·7 × 1·5–3 mm, appressed-hairy on the back, glabrous inside, divided at the tip into 3–8 narrow tapering divisions *c.* 1 mm long. Disc hairy, not distinctly lobed. Stamens 15–20; filaments *c.* 1·5 mm long; anthers 1·5–2 mm long, pointed at the tip, the point sometimes a little drawn out or flattened and sometimes with a small group of bristles, often splitting to base. Ovary hairy, sparsely hairy or glabrous, loculi 2; 4(–5) ovules per loculus; style 3–4 mm long, glabrous. Fruit ovoid, 10–12 × 6–7 mm (perhaps immature), the tip pointed; skin and flesh thin, drying blackish, clearly distinct from stone; stone rather pale and thin-walled, sutures obscure, surface slightly rugose. Seed 1. Embryo not seen.

Field characters: Much branched with dense foliage.

Distribution: Endemic to New Guinea. The collections come from Mt Amungwiwa in the south of the Morobe district, from the Kubor range in the Western Highlands, and in the Eastern Highlands district from Mt Wilhelm and Mt Piora. It is also known in Papua from the Mt Strong–Mt Dickson and the Mt Albert Edward areas of the Tapini subdistrict, Central district.

Ecology: Forest and shrubbery, 2750–3500 m.

Notes: A distinct species with its flowers solitary or in few-flowered racemes. See Coode (1978) for discussion of relationships; spirit material of ripe fruit is needed to determine embryo type, to confirm that *E. crenulatus* does belong in group V. The material from the Western and Eastern Highlands has larger, more regularly crenulate, hairier leaves, the petals and sepals are wider and the ovary hairy; the specimens from Morobe and Central districts have ± glabrous ovaries and the smallest leaves of any *Elaeocarpus* in Papuasia, with the crenulation of the margin reduced to 1 or a few pairs of obvious teeth; however, there are intermediates and more material is needed before the variation can be understood.

Group VI

Ovules 6–12 per loculus; loculi 2; ovary usually hairy (in subgroup E, glabrous). Embryo straight. Petals medium to very large (0·5–3 cm long), variously divided. Stamens many; anthers generally awned. Leaves generally medium to large. Inflorescences generally behind the leaves. Fruits often with a distinct bilaterally symmetrical flattened stone, rarely asymmetrical, sometimes unflattened.

Notes: This group contains the section *Monocera* Brongn. & Gris (and therefore section *Papuanthus* Schltr) as well as some of the species previously considered part of sections *Blepharoceras* and *Oreocarpus*. The last two sections can still be maintained, though each is now restricted to 1 species in Papuasia (*E. blepharoceras* of group IV; *E. culminicola* of group VII).

The group is geographically wideranging, though probably not reaching the temperate zones.

Group VI A

Ovary hairy. Petals 2 cm long, as wide in the middle as at the tip or wider, the divisions 3–9 in number, deep and narrow. Fruit with flesh and stone distinct, flesh not radially fibrous, stone somewhat flattened, bilaterally symmetric, usually slightly winged; loculus flattened; sutures central along the middle of the flattened surfaces.

Distribution: Probably this subgroup includes species in Fiji and New Caledonia. In Papuasia, only found in the Solomon Islands.

30. Elaeocarpus polyandrus A. C. Sm. *J. Arnold Arbor.* **25:** 258 (1944). **Fig. 24.**

Trees to 33 m tall. Twigs usually robust to massive, glabrous, or minutely hairy when young. Leaves mostly clustered at twig tips; petiole (2.5–)4–9 cm long, straight, glabrous, usually thickened at each end, not winged; blades ovate, occasionally ± elliptic, 11–25 × 6–12 cm or rarely smaller, acute at the tip, rounded or tapered rather abruptly at the base, usually ± leathery, glabrous, venation network not very prominent although main veins prominent beneath, margins ± coarsely sinuate-dentate. Inflorescences usually below the leaves, occasionally in the axils of the lower leaves; 2–7 cm long, minutely hairy, bearing 2–6 flowers on pedicels 2–7(–8) cm long, often swelling evenly toward the tip. Sepals falling quickly, 18–25 × 3–5 mm, minutely hairy outside, inside variably hairy. Petals lanceolate-oblong, not wider at the apex than at the base, 22–25 × *c.* 9 mm, the base thickened and folded in on each side and enclosing a batch of stamens, sparsely appressed-hairy on the back, glabrous inside, very irregularly divided at the tip into 3 lobes each with 1–3 lanceolate divisions. Disc hairy, 5-lobed, not very deep, the lobes shallowly bilobed, persisting at the tip of the pedicel after fruit fall. Stamens very numerous, *c.* 30 being enclosed by a single petal (*c.* 150 per flower altogether); filaments 5–7 mm long; anthers 7–10 mm long, each valve with an awn at the tip, the outer 3–5 mm long and minutely bristly, the inner 1–1·5 mm long. Ovary short-hairy; loculi 2; at least 6 ovules per loculus; style 14–20 mm long, glabrous towards the tip. Fruit ellipsoid, *c.* 4 cm long, not seen fresh, presumably shrinking considerably on drying with the skin when dry characteristically yellow, cracked, and much larger than the stone with shrunken flesh attached; stone slightly flattened and often narrowly winged, *c.* 4 × 3·2 × 2 cm, when seeded with one symmetrically placed and flattend loculus; when seedless (often) smaller and with 2 small loculi side by side. Seed 1. Embryo straight.

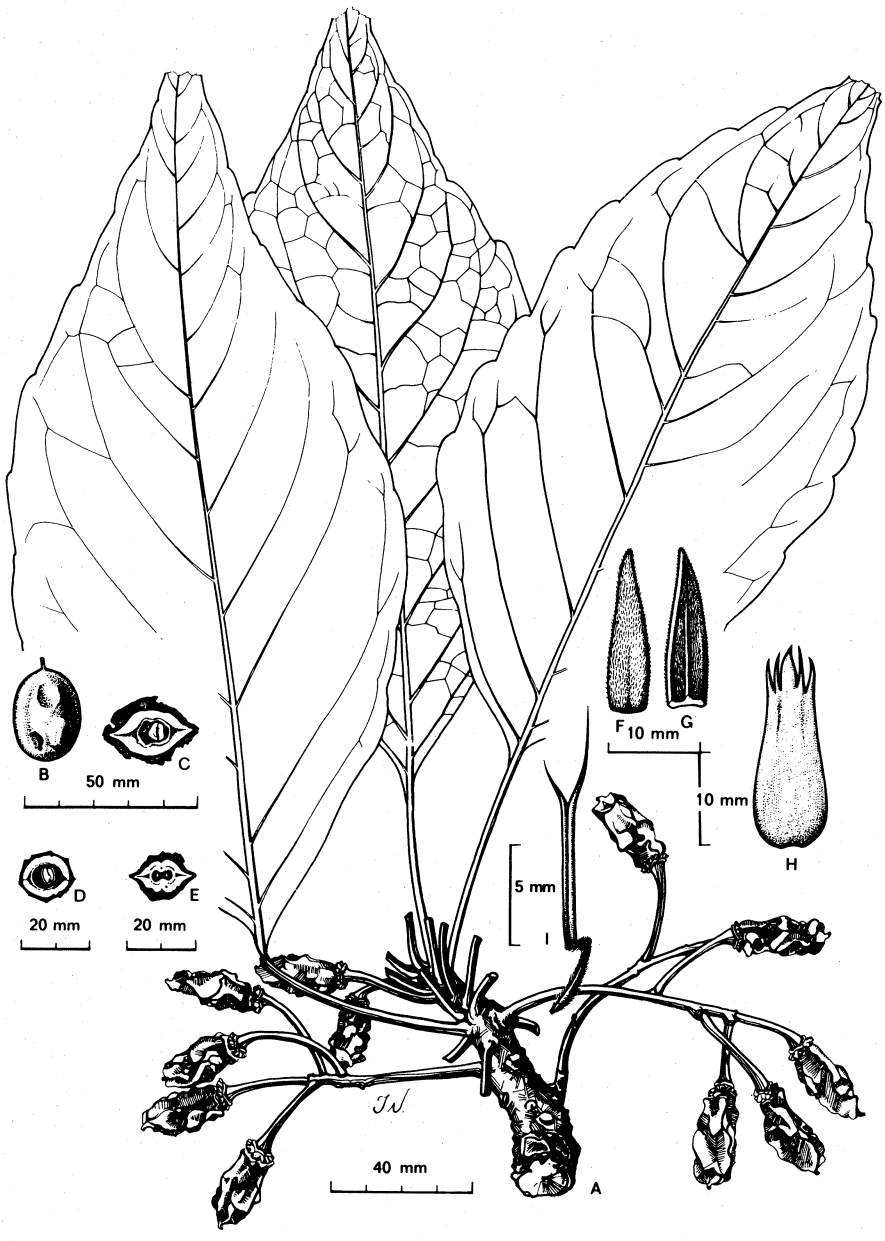

Fig. 24 **Elaeocarpus polyandrus** A. C. Sm. (A) leafy twig with dried immature fruits (B) fruit (C — D) cross-section of fruits (E) cross-section of infertile fruit (F) sepal outside (G) sepal inside (H) petal outside (I) stamen

Field characters: Often buttressed; the buttresses are thick and unequal, and up to 6 m high. The wood is said to be yellowish and hard.

Distribution: Probably endemic to Solomon Islands (and Santa Cruz group?). Papuasian specimens have been collected in Bougainville and all the Island groups of the Solomon Islands except San Cristobal and Rennell.

Ecology: Forest, generally well-drained, sometimes in disturbed areas or advanced regrowth, from near sea level to 800 m.

Notes: A species quite unlike any other in Papuasia though probably more like some Fijian species; the large, thick, deeply divided petals, the inflated fruiting pedicel, usually with the disc persisting at the tip (not firmly attached to and detaching with the fruit), very numerous stamens, etc., are all characteristic. Although there are fairly numerous collections overall, flowering specimens are rare, and there seems considerable variation in floral detail, such as sepal length and hairiness. Spirit material of both flowers and fruits is needed.

Group VI B

Ovary hairy. Petals 25 mm long or more, wider towards the tip than in the middle, the divisions few (3–5), shallow, and broad. Fruit very massive; flesh replaced by dense radial fibres firmly and persistently attached to the stone, stone unflattened, not winged, loculus not symmetrically placed nor flattened.

Notes: Perhaps including 1 species only and endemic to New Guinea.

31. Elaeocarpus womersleyi Weibel *Candollea* **26:** 374 (1971). **Fig. 25.**

Trees up to 34 m tall. Twigs robust, minutely hairy when young, later glabrous. Leaves scattered or more usually clustered towards twig tips; petioles 1–3 cm, usually minutely hairy when young, later glabrous, often thickened at base or tip or both, not winged though flattened on top; blades obovate or sometimes elliptic, 10–15(–18) × 4–8 cm, generally ± acute at the tip, tapering at base, leathery, glabrous, venation network prominent on both sides, margins entire or obscurely sinuate-dentate. Inflorescences borne below the leaves, usually well below, spreading, short and stout, 10–35 × 3–4 mm, bearing 3–8 showy flowers on pedicels (15–)20–30 mm long; indumentum velvety-hairy to ± glabrous, consistent throughout — thus if a specimen has hairy inflorescence axes then the pedicels and sepals outside will be hairy likewise, the sepals often a little hairer. Sepals thick, (13–)18–25 × (3–)4–5 mm, hairy or glabrous outside, conspicuously and densely hairy inside. Petals creamy or white, ± obovate, 25–38 × 12–20 mm, usually ± glabrous or sparsely appressed-hairy outside, densely hairy inside on the lower half or two-thirds, divided at tip into 3–5 shallow broad-triangular teeth. Disc short-hairy, deep but not very distinctly lobed. Stamens *c.* 40; filaments slender, 6–10 mm long; anthers 5–8 mm long, with an awn about 2 mm long on the tip of the outer valve. Ovary hairy, 4(–5)-locular and with *c.* 6 ovules per loculus; style 15–20 mm long, hairy at base. Fruit globose or

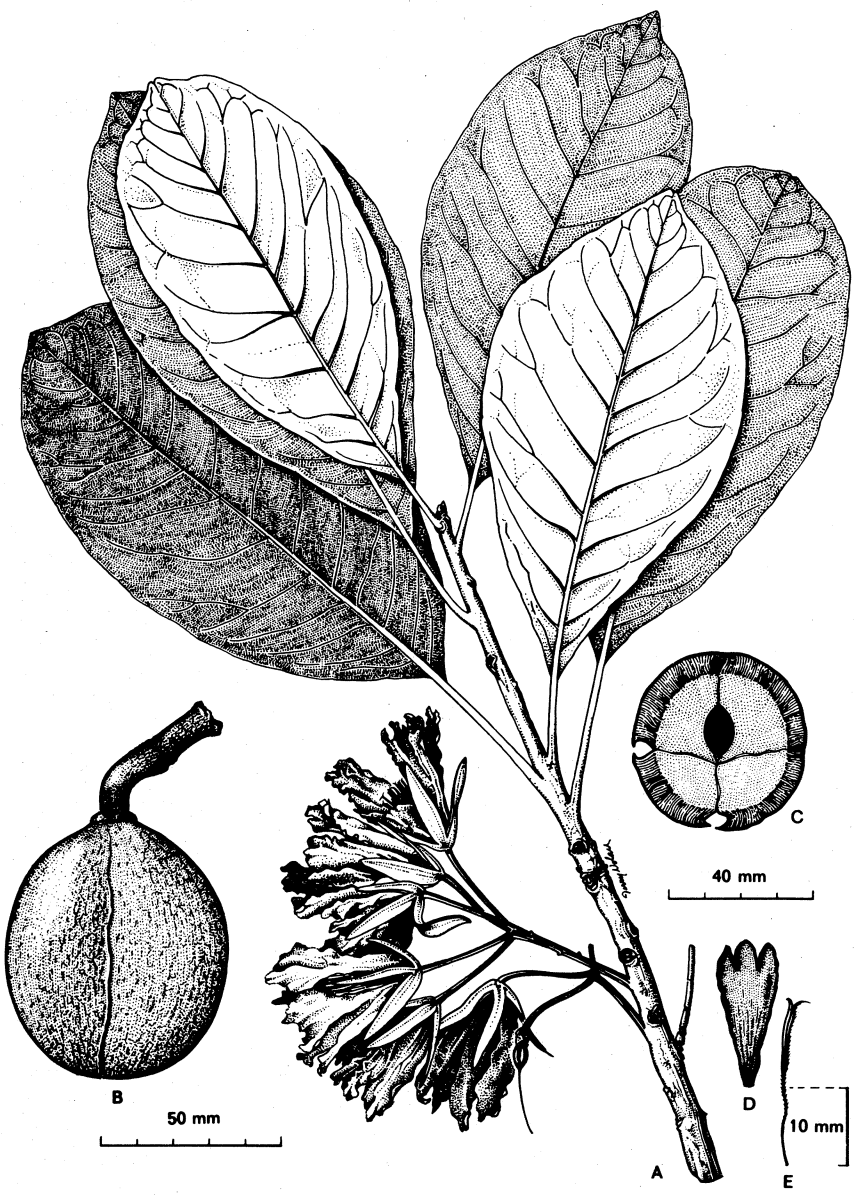

Fig. 25 **Elaeocarpus womersleyi** Weibel (A) leafy twig with flowers (B) fruit (C) cross-section of fruit (D) petal (E) stamen

obovoid, 4–5·5 × 3–5 cm long (up to 7 cm when fresh), blackish or dark blue or dark green; skin thin, often cracking over the sutures when dried, surrounding a thick (5–9 mm) layer of dense fibres growing out radially from the central stone; the fibrous layer and stone merge into one another and never separate; stone massive, dense, hard, 4(–5) sutures visible in T. S., often splitting along the sutures after falling, loculi radially arranged, seedless loculi usually not distorted by growth of seeds in other loculi. Seeds 1(–2). Embryo straight.

Field characters: Crown dense, dark; red old leaves usually scattered. Buttresses may be present. The wood is extremely hard.

Distribution: Scattered through New Guinea and the Papuan Islands, and also in the Moluccas. In western New Guinea it has been collected from the Vogelkop, from near Jayapura and the Idenburg River in the Jayapura district and from near Lake Habbema in the Snow Mountains. It has been collected once from near Kaironk in the Madang district, a few times in the Morobe and Western Highlands districts; it appears to be fairly common in the Eastern Highlands district. From Papua it is known from near Kiunga in the Western, from Sogeri in the Central and Ioma in the Northern districts; there are 3 collections from Misima in the Papuan Islands.

Ecology: Usually in primary forest, with a wide altitude range from near sea level to 2000 m. Occasionally planted or preserved.

Uses: The seed is edible and is sought after.

Notes: Very like *E. bancroftii* F. Muell. & F.M. Bail. of Queensland, also with edible seeds; the flesh of *E. bancroftii* fruit, however, is not radially fibrous and permanently attached, and the anthers lack the awns of *E. womersleyi*. The flower of *E. womersleyi* could easily be confused with flowers of *Dubouzetia* but the distinct, if rather few, teeth on the petal tips and presence of anther awns distinguish them. The species is very variable in leaf size and shape, in the density of the venation network and in the hairiness of the inflorescence; this variation is not correlated with the wide altitude range.

Group VI C

Ovary hairy. Petals 10–30 mm (where known) long, wider towards the tip than in the middle; the divisions ± sharp-pointed, narrow to triangular, more than 10. Fruits (where known) usually flattened at least when dried; flesh not very fibrous, often separating from the stone on drying as two 'plates'; stones usually strongly flattened, loculus symmetrically placed and strongly flattened; (*E. schlechteranus* has an unflattened fruit, massive, a slightly flattened stone, bilaterally symmetrical, with a strongly flattened loculus). Sutures central along the plane of symmetry.

Notes: Probably fairly widespread in Malaysia, and perhaps includes some Australian and Fijian species as well. The subgroup contains all those species included by Schlechter in his section *Papuanthus*.

32. Elaeocarpus amplifolius Schltr *Bot. Jb.* **54:** 133 (1916).
?*Elaeocarpus amygdaliferus* Schltr (1916).

Trees 20–33 m tall. Twigs massive, 10–15 mm thick, rusty-hairy when young. Leaves clustered at twig tips; petioles robust, generally densely hairy, 3–6 cm long, often thickened at each end, not winged; blades oblong-obovate or obovate, 22–45 × 12–18 cm (usually 2 times longer than broad or more), the tip obtuse or acute, subcordate or cordate at base, fairly tough, obviously brownish-hairy beneath, main veins prominent beneath, margin ± obscurely sinuate-dentate. Inflorescences borne below the leaves, robust, 4–7 cm long, densely brown-hairy throughout, bearing 3–6 flowers on robust pedicels 15–22 mm long, with boat-shaped bracts when in bud. Sepals 18–20 × *c.* 5 mm, densely brown-hairy like the pedicels outside, sparsely appressed-hairy towards the tip inside, thick. Petals greenish yellow, ± oblong-obovate, 20–23 × *c.* 8 mm, glabrous or scattered appressed-hairy outside, divided at the tip into *c.* 13–18 narrow tapering divisions 3–5 mm long. Sepals and petals fall before the stamens. Disc deep, not distinctly lobed, hairy. Stamens *c.* 35; filaments 7–8 mm long; anthers 6–7 mm long, usually with a short awn *c.* 1 mm long at apex. Ovary hairy, 2-locular; ovules 6 per loculus; style 14–20 mm, appressed-hairy at least at base. Fruit probably greenish with distinct brown hairs at least at first, when fresh probably slightly flattened-globose, when dry strongly flattened-ovoid, 5–5·5 × 3·8–4 × *c.* 2 cm; skin and flesh wrinkling but not cracking, often detaching cleanly from the stone as 2 plates on drying; flesh not very fibrous; stone strongly symmetrically flattened; very thin and wing-like towards the edges, bony and rigid throughout, surface somewhat sculptured; loculus central, strongly flattened. Seed 1, flat. Embryo straight.

Field characters: Low buttresses sometimes present. The bark has been consistently reported as dark brown, variously smooth or cracked, with reddish underbark and staw-coloured inner bark.

Distribution: Endemic to New Guinea. Rather scattered though locally common. There is a single collection from western New Guinea, from south of Manokwari in the Vogelkop. It has been collected most often in the Madang district, both in the Gogol and Ramu River Valleys; it is also known from Oomsis in the Morobe district. The species is known from the Brown River area of the Central district of Papua.

Ecology: Lowland rainforest, rarely in advanced secondary regrowth; 20–100 m.

Notes: Differs from *E. undulatus* in the much longer stamen filaments and shorter awns and from *E. nouhuysii* in the hairier leaves with obscurely wavy margins. Spirit material of fruit is needed to determine how much the fruit changes on drying.

33. Elaeocarpus badius Coode *Brunonia* **1:** 214 (1978).

Trees, reported to 40 m tall but probably usually smaller. Young twigs moderately robust, brown-hairy. Leaves crowded at twig tips, stipulate; stipules linear-lanceolate, 6–8 mm long, persistent, appressed-hairy, slightly curved, margins occasionally somewhat irregular and membranous with an

occasional ± linear tooth; petioles 0·5–1·5 cm long, hairy; blades elliptic or obovate, 15–27 × 6–13 cm, acute and sometimes acuminate at the tip, tapering towards a rounded base, fairly tough, hairy beneath, especially on veins, venation prominent beneath, especially main veins, margins ± entire with occasional small black bristles terminating the veins. Inflorescences borne in the axils of, or just below, the leaves, 4–12 cm long, densely pinkish- or brown-hairy when dry, bearing 7–15 flowers on hairy pedicels 7–8 mm long. Sepals 8–10 × *c.* 2 mm, with similar indumentum outside, inside glabrous at base but appressed-hairy above the middle. Petals obovate, 11–13 × 4–5 mm, glabrous, sometimes with 3 lobes, more often the lobes indistinct, altogether with 12–15 narrow tapering divisions *c.* 3 mm long. Disc densely hairy, indistinctly lobed. Stamens *c.* 25; filaments *c.* 1·5 mm long; anthers 2–2·5 mm long, with distinct awns at the tip *c.* 1 mm long. Ovary densely hairy; loculi 2; ovules 6 or more loculus; style 4–4·5 mm, glabrous at tip. Fruit unknown.

Field characters: The bark has been noted as having brown and white blotches.

Distribution: Endemic to the Solomon Islands. So far known from 4 collections, 1 from the Toyu valley in Bougainville, 1 from northwestern Choiseul and 2 from Santa Isabel.

Ecology: Forest at low altitude.

Notes: The material available is rather poor and the species needs collecting again both in flower and especially in fruit. It differs from all other Papuasian *Elaeocarpus* species in having leaves that are sessile or relatively very short-petiolate and hairy beneath and in having persistent stipules. Perhaps this would be better placed in subgroup D, but the flowers are larger than is usual for that subgroup.

34. Elaeocarpus finisterrae Schltr *Bot. Jb.* **54:** 132 (1916).

Differs from *E. undulatus* mainly in having longer stamen filaments, 3–4 (–6) mm long, and longer petals, up to 2·4 cm long, and from *E. amplifolius* in the longer anther awns, shorter petioles, and narrower petals. Fruit unknown.

Distribution: Only known from the type, collected in the Finisterre Mountains of the Madang district.

Ecology: Forest at 1200 m.

Notes: More material, in flower and fruit, is needed before the real status of this species can be determined. 1 fruiting specimen which may belong here has large globose fruit with a slightly flattened stone inside, very like that of *E. schlechteranus.*

35. Elaeocarpus nouhuysii Kds *Nova Guinea* **8:** 173 (1909) **Fig. 26.**

Trees up to 40 m tall. Twigs robust to massive, often very short-hairy when young, quickly becoming glabrous. Leaves usually clustered at twig tips; petioles robust, (2·5–)4–7 cm, usually glabrous though sometimes hairy at

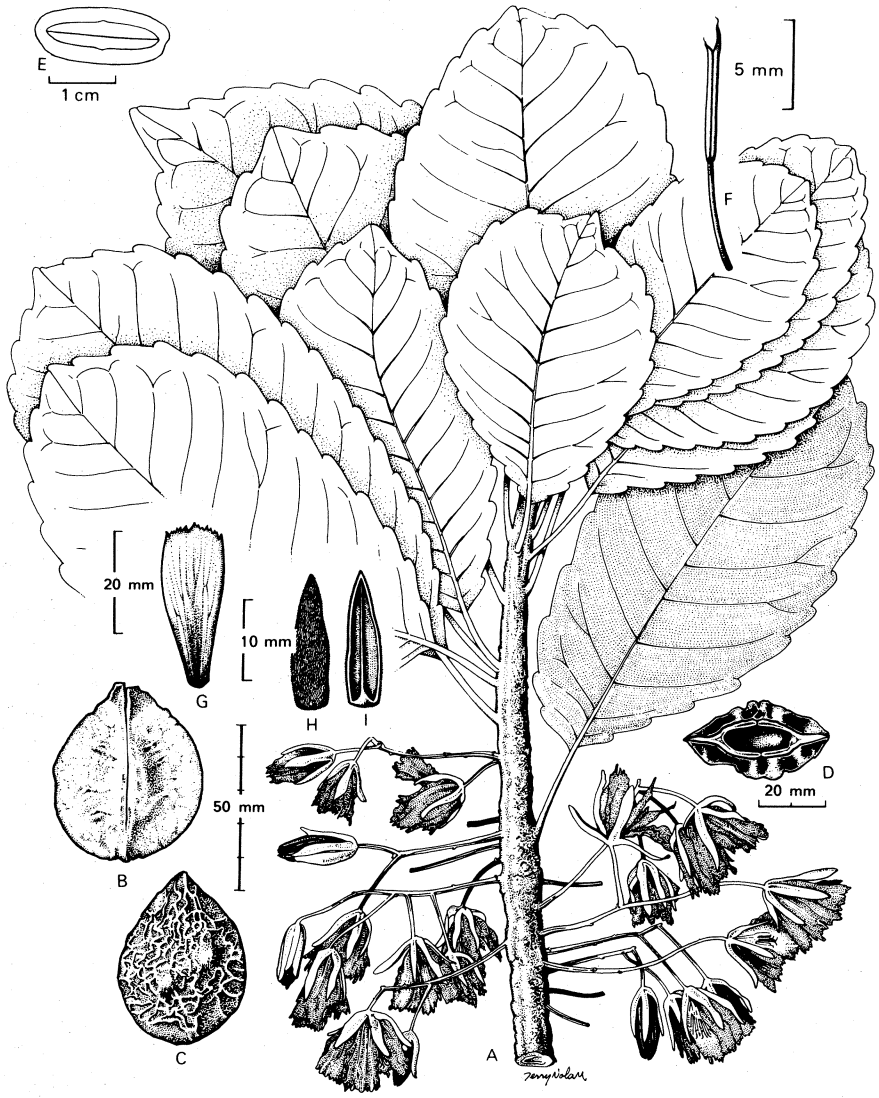

Fig. 26 **Elaeocarpus nouhuysii** Kds (A) leafy twig with flowers (B) stone of fruit (C) dried fruit (D) cross-section of dried fruit (E) cross-section of seed (F) petal (G) stamen (H) sepal outside (I) sepal inside

least when young, ± thickened at each end; blades elliptic to obovate, 12–23 × 6–10 cm, acute or obtuse at tip, sometimes acuminate, rounded at base, leathery, generally glabrous throughout but sometimes with ± appressed short hairs on the main nerves beneath, main veins very prominent beneath, margins usually coarsely crenate-dentate, teeth 1–2 per 2 cm or sinuate or ± entire. Inflorescences generally below the leaves though sometimes in the axils of the lower leaves, 4–10(–12) cm long, with short dense hairs or almost velvety, bearing 4–8 flowers on ± stout pedicels (12–)14–17 mm long. Sepals 12–15(–17) × 3–4 mm, with indumentum similar to that of the inflorescence outside, densely and shortly hairy inside. Petals yellowish-white, ± obovate with straight sides, 20–27(–30) × 8–12(–12) mm, flat, thin, the tip ± square or slightly rounded, divided into *c.* 8–20 broad triangular divisions *c.* 1–2 mm deep, lower half of margins and inner surface ± short-hairy, sometimes scattered appressed-hairy elsewhere. Disc short-hairy, rather indistinctly lobed. Stamens 23–35; filaments 5–8 mm long; anthers 6–7 mm long with a tooth or short thick awn not more than 1(–1·5) mm long at the tip. Ovary velvety-hairy, 2-locular; ovules 6 or more per loculus; style 14–18 mm long. Fruit broad-ovoid or even orbicular, when dried 3·5–4 × 3–3·5 × 1·2–1·5 cm and strongly flattened, very similar to *E. amplifolius* in all respects. Seed 1, flat. Embryo straight.

Field characters: Often buttressed with dense crown of large leaves.

Distribution: Moluccas, New Guinea. There are many specimens from the Vogelkop, both on the mainland and on Salawati Island. Otherwise it is known from 2 collections from the Jayapura district, and 1 from the Noord River in Mimika. In northeastern New Guinea it is known from a few collections from the West Sepik and Madang districts, several from Morobe, and 1 from the Western Highlands. There are only 2 collections from Papua, 1 from each of the Gulf and Northern districts.

Ecology: Lowland rainforest, often in areas subject to flooding, occasionally at the back of mangroves, or in advanced secondary regrowth, from sea level to 200 m.

Notes: Very like *E. amplifolius* but with glabrous leaves or at least much less hairy, often with the margins much more obviously toothed or wavy. The twigs are sometimes inhabited by ants.

36. Elaeocarpus piestocarpus Schltr *Bot. Jb.* **54:** 132 (1916).
E. lamekotensis Knuth (1940).

Trees up to 30 m tall. Twigs robust or moderately robust, short-hairy when young, later glabrous. Leaves ± clustered at twig tips; petioles (2·5–)4–9 cm long, glabrous or ± appressed-hairy, often straight and thickened each end; blades somewhat irregular and variable in shape and size, ovate or elliptic, 10–25 × 5–12 cm, undulate (thus pressing into folds), the tip acute or (less often) obtuse, rounded or ± tapering towards a subcordate base, fairly tough, glabrous, main venation prominent beneath, margins ± entire to sinuate-dentate. Inflorescences borne below the leaves, (4–)8–10 cm long, ± velvety brown-hairy when young at least, bearing 6–13 flowers on pedicels *c.* 1·5 cm long. Sepals 10–17 × 2–3 mm, with indumentum outside like that

of inflorescence, generally sparsely hairy or glabrous inside. Petals ± obovate, 15–19 × 9–12 mm, flat, thin, ± appressed-hairy (the hairs short and not conspicuous) on the back, much less hairy or glabrous inside, ± square or slightly rounded at the tip and divided into 12–18 tapering teeth 1–2 mm deep. Disc hairy, not distinctly lobed. Stamens probably *c.* 50; filaments 1–2 mm long; anthers 3–4 mm long, bearing a long, often refracted awn 2–4 mm long. Ovary hairy, 2-locular; ovules *c.* 6 per loculus; style *c.* 6 mm long. Fruit ± flattened, ellipsoid or globose when fresh, *c.* 4 × 3·5 × 3 cm, becoming strongly flattened on drying, *c.* 4 × 3·5 × 2 cm, apparently exactly as in *E. amplifolius*. Seed 1. Embryo straight.

Field characters: Slightly buttressed.

Distribution: E. piestocarpus was described from the East Sepik district at Malu near Ambunti, but it has never been collected again from the mainland of New Guinea. There is 1 collection from Karkar Island off Madang; otherwise the species is known from 4 collections made in each of New Britain and New Ireland, and a doubtful specimen from Bougainville; 2 specimens from San Cristobal have been collected.

Ecology: Lowland rainforest, or in disturbed forest or secondary regrowth, sometimes in open forest along river banks, from sea level to 600 m.

Notes: Very similar to *E. undulatus,* differing mainly in the leaves and petioles being almost or completely glabrous, the inflorescence hairs being paler and shorter, and in having slightly larger flowers. Ripe fruit in spirit is needed.

37. Elaeocarpus schlechteranus A. C. Sm. *J. Arnold Arbor.* **25:** 256 (1944).
E. megacarpus Schltr (1916) not Elmer (1915); *E. leiophyllus* A. C. Sm. (1944).

Trees up to 25 m tall. Twigs massive, velvety-hairy when young. Leaves clustered at the tips of the twigs; petioles 1·5–5 cm long, straight, robust, often thickened at each end, glabrous or hairy, unwinged; blades obovate, 15–27 × 6–12 cm, the tip acute or obtuse or tapering, tapering or rounded at base, tough, glabrous or ± appressed-hairy beneath, especially on nerves, main nerves prominent beneath, margins ± entire or obscurely crenate. Inflorescences borne below the leaves, 2·5–10 cm long, hairy, bearing 3–7 (–more?) flowers on robust pedicels 1·5–2·2 cm long. Sepals 19–22 × 5 mm, short-hairy outside, inside hairy towards the tip and ± glabrous in the lower half. Petals yellowish, oblong-obovate, 19–26 × 7–12 mm, thick and tough, inrolled and with a keel inside near the base, flat towards the tip, densely and obviously hairy outside, ± glabrous inside near the base but hairy towards the tip, irregularly divided into 20–25 tapering divisions 1–3 mm long. Disc distinctly 5-lobed, hairy. Stamens 50–100, often persisting at the base of young fruit; filaments 5–9(–12) mm long; anthers 7–8 mm long, at the tip with a minutely hairy awn on the outer tooth up to 3 mm long, sometimes with a shorter awn on the inner tooth also. Ovary very hairy, probably 2-locular; ovules *c.* 12 per loculus; style *c.* 12 mm long, hairy for almost its entire length. Fruit globose or globose-ellipsoid when fresh, when dry slightly flattened, *c.* 5·5 × 4·5 × 3·5 cm, skin and flesh usually wrinkling on drying,

2–6 mm thick; stone massive, usually slightly flattened, *c.* 5 × 4·5 × 3 cm, usually with thick low flanges at the flattened margin, dense, hard, surface irregular or ± smooth, sutures 2, at right angles to the plane of flattening of the loculus, deep and obvious; loculus 1 (at least when seed present), flattened symmetrically. Seed 1, flat. Embryo straight.

Field characters: Large buttresses often present.

Distribution: Scattered, apparently uncommon. 3 collections from the Idenburg River in Jayapura district in western New Guinea; 1 from the Hunstein Mountains south of Ambunti in the East Sepik district. There are also collections from Aseki and Ogeramnang in the Morobe district, Dunantina valley and near Okapa in the Eastern Highlands district, Doma Peaks in the Southern Highlands district, and on the Kemp Welch River in the Central district of Papua.

Ecology: Mixed forest from 850 to 1850 m.

Notes: This species is very inadequately known, and more collections in flower or fruit are needed. It is likely to be a striking tree when flowering.

38. Elaeocarpus undulatus Warb. *Bot. Jb.* **13:** 378 (1891). **Fig. 27.**

?*E. nephelephilus* Schltr (1916); *E. comatus* C. T. White & Francis (1927).

Trees up to 45 m tall. Twigs robust, brown-hairy at least when young. Leaves ± clustered towards twig tips; petioles 2·5–6 cm long, brown-hairy, often thickened at each end; blades mostly obovate, sometimes elliptic or broadly elliptic, (8–)11–23 × (5–)6–15 cm, the tip variable from acute to ± rounded, base tapering abruptly or rounded or slightly cordate, fairly tough, brown-hairy beneath, particularly on veins, main veins prominent beneath, margins sinuate to strongly sinuate-crenate. Inflorescences borne in the axils of or just below the leaves, brown-velvety-hairy throughout, 6–10 cm long, bearing 6–10 flowers on pedicels 7–12 mm long. Sepals 8–10 × 2–3 mm, often somewhat inrolled, densely rusty-hairy outside, glabrous or scattered appressed-hairy inside. Petals ± obovate, 10–13 × 6–8 mm, thin, flat, with ± scattered appressed hairs on the back. Disc hairy, ± indistinctly lobed. Stamens persistent after the petals and sepals have fallen, *c.* 50; filaments *c.* 1 mm long; anthers 2·5–3 mm long, with a flexuous hairy awn at tip 2–3 mm long. Ovary short-hairy; loculi 2; ovules *c.* 6 per loculus; style *c.* 6 mm long, hairy at base at least. Fruit probably scarcely flattened when fresh, when dry flattened, like *E. amplifolius* in all characters except that it may tend to be more elliptic in outline than ovate. Seed 1. Embryo straight.

Field characters: Often buttressed, sometimes to as high as 5 m.

Distribution: Scattered throughout New Guinea; it also occurs on the Solomon Islands. There are specimens from Vogelkop and from near Jayapura in western New Guinea; from the Sepik, Madang and Morobe districts, and in Papua from the Central and Northern districts. There are 2 specimens from the Solomons, both from Malaita. It does not seem to be common anywhere.

Ecology: Lowland rainforest; sea level to 400 m.

Fig. 27 **Elaeocarpus undulatus** Warb. (A) leafy twig with flowers (B) sepal outside (C) sepal inside (D) petal (E) stamen

Notes: Very like *E. piestocarpus* but more variable in leaf size and always with leaves brown-hairy beneath, and petals somewhat smaller. See also *E. finisterrae.* Large-leaved specimens can also be confused with *E. amplifolius* and even *E. nouhuysii;* if stamens are present (in bud, flower or persisting at fruit base) the longer awn and shorter filaments of *E. undulatus* are distinctive. Ripe fruit in spirit is needed.

Group VI D

Ovary hairy. Petals (5–)6–12 mm long, wider towards the tip, with 8–17 ± sharp-pointed, narrow-triangular divisions. Fruit (where known) slightly flattened or not, flesh not very fibrous, usually distinct from stone but not separating as 'plates'; stone slightly flattened or not, rather thin-walled; cavity ± central, 1, slightly flattened or not, sutures not clearly visible.

Notes: Species from outside Papuasia would almost certainly be included in this subgroup, in which *E. coloides,* previously placed with *E. blepharoceras* in section *Blepharoceras,* is now placed.

39. Elaeocarpus coloides Schltr *Bot. Jb.* **54:** 130 (1916) amplified by A. C. Sm. *J. Arnold Arbor.* **25:** 250 (1944).

E. ihuensis O. C. Schm. (1929).

Usually small trees, but some specimens to 30 m tall. Twigs robust, glabrous or minutely hairy when young. Leaves clustered at twig tips; petioles 2–4·5 cm long (perhaps longer), glabrous, usually thickened at each end, unwinged; blades elliptic or obovate, sometimes relatively narrow, 10–20 (–25) × 4–10(–12) cm, the tips acute and sometimes acuminate, tapering at base, not very tough, glabrous, main veins fairly prominent beneath, margins sinuate or ± entire. Inflorescences borne amongst or behind the leaves, 5–12 cm long, minutely hairy, bearing 10–14 flowers on pedicels 8–12 mm long. Sepals 7–8·5 × 1·5–2·5 mm, glabrous or short-hairy outside, densely and minutely greyish-velvety inside, particularly towards the tip. Petals white or yellow, obovate, 8–12 × 3–6 mm, thin, flat, glabrous, the tip divided into 10–17 narrow tapering divisions 1–2 mm long, the divisions sometimes grouped into 3–6 lobes. Disc hairy, 5-lobed. Stamens 25–30; filaments 1–1·5 mm long; anthers 2–4 mm long with an awn at the tip 0·5–1·5 mm long and usually bent back. Ovary hairy 2-locular; ovules 6(–8?) per loculus; style 3·5–6 mm long, mostly glabrous. Fruit (probably not fully mature) ellipsoid-ovoid, flattened at least when dried, 3·2–3·8 × 1·8–2 × 1–1·3 cm, skin and flesh wrinkling on drying, *c.* 1 mm thick, not detaching but distinct from the stone; stone flattened, winged on the edges, walls 1–2 mm thick enclosing a relatively large seed cavity, *c.* 8 × 5 mm in T.S., sutures obscure in T.S., surface probably almost smooth. Seed 1. Embryo straight.

Field characters: Once reported as having flying-buttress roots. The flowers smell unpleasant.

Distribution: Probably endemic to Papuasia. The specimens are rather few and from scattered localities. In western New Guinea there is a single collec-

tion from the Gauttier mountains in the Jayapura district, and 2 from islands in the Fakfak district. In northeastern New Guinea it is known from Vanimo in the West Sepik district, and from near Madang. In Papua there is 1 specimen from each of the Gulf and Central districts. There are 2 collections from Guadalcanal in the Solomon Islands.

Ecology: Lowland rainforest, from sea level to 650 m.

Notes: The fruit description and the report of flying buttresses are taken from the 2 Solomon Island specimens. Until further specimens are collected there must remain some doubt whether these Solomon Island specimens are truly conspecific with the others, none of which are fruiting. *E. ihuensis* was supposed to differ from *E. coloides* in having anthers setose at apex and less prominent leaf venation; neither character can be used with the new material. *E. coloides* is very like *E. fairchildii,* which differs in larger leaves on longer petioles; and *E. coodei,* which has very obvious coarse teeth on the leaf margin. The Solomon Island specimens particularly approach *E. piestocarpus,* which differs in flower and fruit size.

40. Elaeocarpus coodei Weibel *Candollea* **26:** 377 (1971).

Small tree to 3 m tall. Twigs probably robust, minutely hairy when young. Leaves clustered at twig tips; petioles 4–6 cm long, glabrous, thickened slightly at each end, slender, unwinged; blades obovate, 19–27 × 8–11 cm, the tip acute or acuminate, base tapering or rounded, papery, glabrous, main veins prominent beneath, the margins conspicuously toothed, up to 5 mm deep and 2 cm between points, sometimes with a smaller subsidiary tooth between 2 larger ones. Inflorescences borne amongst the leaves, up to 15 cm long, short-hairy, bearing 8–15 flowers on curved pedicels 10–15 mm long. Sepals 7–9 × 1–1·5 mm, appressed-hairy outside, similar but sparser inside. Petals white or yellow when fresh, drying to dark brown, ± obovate, 10–11 × 3·5 mm gradually narrowed to base, glabrous, divided to about one-third into *c.* 11 narrow tapering divisions in 3 ± distinct lobes. Disc hairy, not deeply lobed. Stamens 35–40; filaments 1–1·5 mm long; anthers 1·5–2 mm long with a distinct slender awn often bent back, *c.* 1 mm long. Ovary hairy, 2-locular; *c.* 7 ovules per loculus; style *c.* 4 mm long, hairy, sparser to glabrous at tip. Fruit unknown.

Distribution: Known only from the type, which was collected on Guadalcanal in the Solomon Islands.

Ecology: Forest at 70 m.

Notes: Differs from *E. coloides* principally in the obvious coarse toothing of the leaf margin. There are minor floral differences such as petals narrower, anthers shorter, style hairier, and the petioles and leaves are longer than is usual in *E. coloides.* However, more material is needed before it is certain that *E. coodei* is distinct or merely a variety of *E. coloides.*

41. Elaeocarpus fairchildii Merr. *J. Arnold Arbor.* **32:** 179 (1951).

Very like *E. coloides,* differing in petioles (1·7–)4–8 cm long, leaves (15–)18–28 × (8–)9–12 cm, the sepals less hairy to glabrous inside, petals red.

Distribution: Described from the Moluccas, in Papuasia only known from 2 collections both from south of Manokwari in the Vogelkop district of western New Guinea.

Ecology: Primary forest on flat ground at 20 m altitude.

Notes: More material is needed to determine whether *E. fairchildii* really differs from *E. coloides*. There is considerable overlapping in leaf and petiole measurements in the material that exists now. The original description stated that the flowers smelt unpleasant, a further point of similarity with *E. coloides*.

42. Elaeocarpus rubescens Weibel *Candollea* **26:** 380 (1971).
E. suaveolens Weibel (1971).

Trees up to 25 m tall. Twigs ± slender, with dense appressed silky hairs when young. Leaves clustered towards twigs tips; petioles 2–2·5 cm long, appressed-silky-hairy, often thickened at each end; blades obovate to elliptic to almost ovate-elliptic, 8–15 × 4–6 cm, the tip acute and often acuminate, tapering at base, papery or moderately tough, with minute (golden-) silky appressed hairs beneath, venation network close and prominent on both surfaces, the main veins more prominent beneath, margins ± obscurely crenulate with teeth 1–3 per 1 cm. Inflorescences grouped below the leaves, 6–7 cm long, appressed-silky-hairy, bearing 7–11 flowers (with the lower one-third ± bare of flowers) on pedicels 7–9 cm long, bracts absent or early caducous. Sepals 5–6 × 1·5–2 mm, with the indumentum like on pedicels and petioles outside, glabrous or with a few scattered hairs near the tip inside. Petals creamy ± triangular, (5–)6–7 mm × 3–4 mm, with infolded side flanges, appressed-hairy on the central part of the back (the side flanges glabrous), glabrous inside, indistinctly 3-lobed or not lobed, divided into *c.* 15 narrow tapering divisions 1–2 mm deep. Disc not distinctly lobed, hairy. Stamens 27–39; filaments 0·5–1 mm long, often sigmoid; anthers 2–2·5 mm long, apiculate to shortly awned, awn not more than 0·5 mm long. Ovary densely silky-hairy, 2-locular; ovules 6 per loculus; style 2–3 mm long, glabrous towards the tip. Only immature dried fruits have been seen: ellipsoid, up to 23 × 12 mm; skin and flesh wrinkled, *c.* 1 mm thick, distinct but not separating from the stone; stone unflattened, unwinged, surface becoming rugose or slightly sculptured, walls 1–2 mm thick, sutures ± obscure. Seed 1. Embryo straight.

Field characters: Usually buttressed and sometimes stilt-rooted.

Distribution: So far known only from the southern end of New Ireland, up the Danfu river, and from the Solomon Islands, where it is scattered; there are a few specimens from New Georgia, Santa Isabel, and Guadalcanal and several from Rennell Island.

Ecology: Primary forest, on ridges, slopes or on the flat, from sea level to 1200 m.

Notes: Weibel's original distinctions between *E. suaveolens* and *E. rubescens* based on stamen number, presence or absence of awns and leaf shape no

longer hold on the new material. See Coode (1978) for discussion. The petals are rather distinctive for a species in this subgroup, with hair on the back and side flanges folded in.

43. Elaeocarpus tariensis Weibel *Candollea* **26:** 378 (1971). **Fig. 28.**

Trees up to 16 m tall. Twigs moderately slender to ± robust, with dense short brown hairs and small persistent linear stipules. Leaves scattered or sometimes loosely clustered towards twig tips; petioles (1·5–)2·5–6 cm long, slender, straight and densely brown-hairy when young, thickened at each end; blades elliptic or ovate-elliptic, 9–17(–19) × 4–6(–8) cm, sometimes narrowly so, acute and often acuminate, tapering or rounded at base, leathery, densely brown-hairy when young but the hairs wear away quickly and the mature leaf may be completely glabrous or brown-hairy on the midrib beneath only, main veins prominent beneath, venation network slightly prominent on both surfaces, margins variable, from entire to sinuous to obscurely and shallowly toothed, the teeth usually widely spaced. Inflorescences associated with the leaves, 9–12 cm long, slender, ± spreading, densely and persistently brown-hairy, often somewhat zigzag, bearing 13–17 flowers, scattered from the tip almost to base, on pedicels *c.* 6 mm long. Bracts minute, triangular, and very hairy, caducous but often persisting well into anthesis at least. Sepals 5–6 × *c.* 1 mm, when dried often strongly inrolled, densely brown-hairy outside and appressed grey-hairy inside. Petals white, drying brown, ± obovate, 6–7·5 × 1·5–2·5 mm, thin and flat, glabrous or with a few scattered appressed hairs, divided into 8 narrow tapering divisions 1–2 mm long, sometimes ± grouped into lobes. Disc hairy, not distinctly lobed. Stamens 15–20, persisting sometimes well into fruit; filaments 1–2 mm long; anthers 1·5–2 mm long, with a distinct awn at the tip up to 1 mm long. Ovary hairy, 2-locular; 6 ovules per loculus; style 2–4·5 mm long, glabrous towards the tip. Fruit ellipsoid, bluish grey when dry, 1·8–2·5 × 1–1·2 cm, skin and flesh contracting and wrinkling a little, skin drying yellowish, flesh *c.* 1–2 mm thick distinct but not seen separating from stone; stone unflattened and ± round in T. S., though occasionally with 2 low lateral flanges, walls 1–2 mm thick, sutures 2, obscure or not in T. S., surface probably ± smooth. Seed 1. Embryo straight.

Field characters: Often flowers when only a shrub.

Distribution: Endemic to New Guinea; so far known only from the eastern half of the Island. The specimens come from the Oksapmin area in the south of the West Sepik district, and from the Morobe, Western and Southern Highlands districts; there is 1 specimen from the north of the Western district and 1 from the Milne Bay district. It is probably locally common.

Ecology: Forest, often with *Castanopsis* or other Fagaceae, often on ridges; 1200–2500 m.

Notes: E. tariensis could perhaps be confused with *E. fuscoides,* which is similar when in fruit or sterile and from the same altitude range. If seeds are present the straight embryo of *E. tariensis* would distinguish the two; in flower, there is no difficulty, the petals of *E. tariensis* being ± glabrous while those of *E. fuscoides* are densely and obviously silky-hairy.

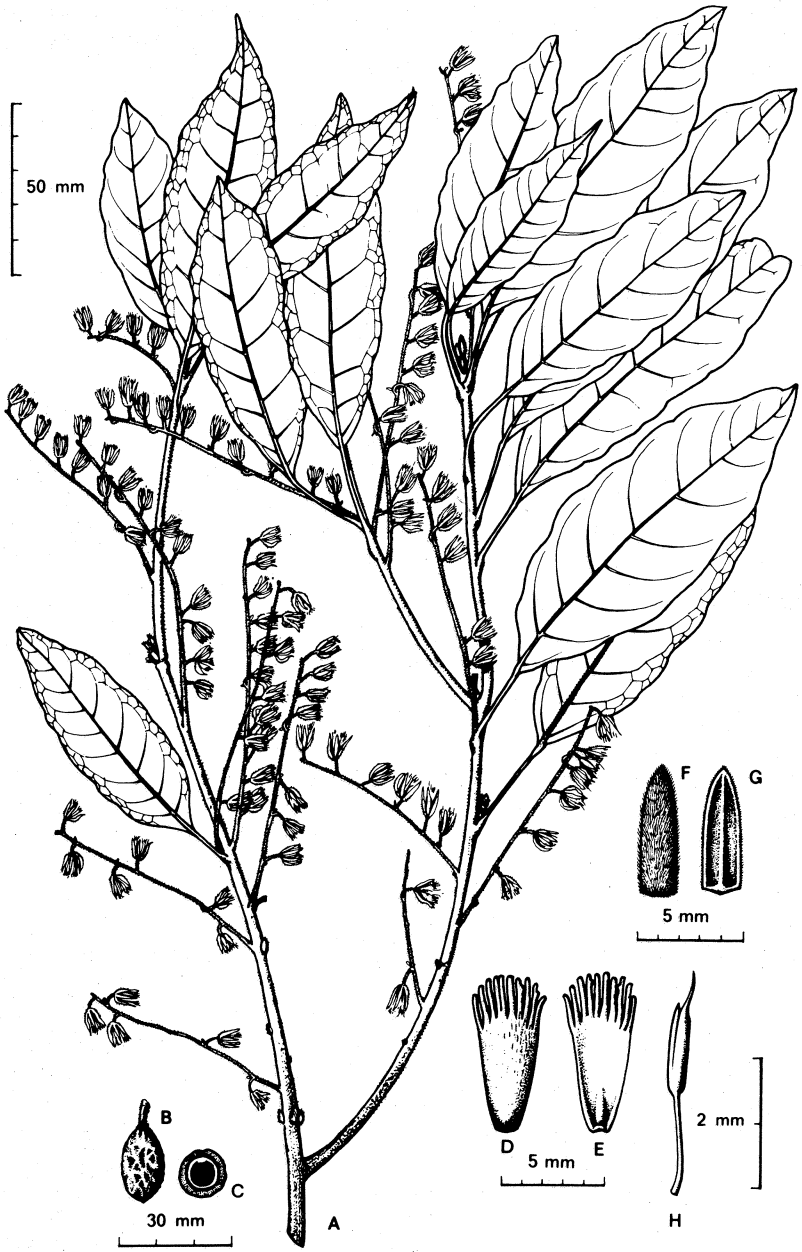

Fig. 28 **Elaeocarpus tariensis** Weibel (A) leafy twig with flowers (B) dried fruit (C) cross-section of dried fruit (D) petal outside (E) petal inside (F) sepal outside (G) sepal inside (H) stamen

Elaeocarpus sp. ?nov. 4.

Differs from *E. rubescens* in having relatively narrower leaves, 8–10 × 2·5–3 cm, and laxer habit. Superficially very like *E. filiformidentatus* but with the petals glabrous inside, and with fine venation of the leaves more prominent. Flower buds known; fruit unknown.

Distribution: A single specimen from Mt Shungol in the Morobe district.

Ecology: Forest, 1800 m.

Notes: The material, though inadequade for formal description and naming, suggests a new species in group VI subgroup D. Fruit is needed to establish if the apparent relationship with *E. rubescens* is supported by the embryo type; whether the glabrous inner surface of the petals is constant has recently been doubted; see Coode (1978).

Group VI E

Ovary glabrous. Petals 5–8 mm long, wider towards the tip, with 5–14 narrow, sometimes ± irregular, tapering divisions. Fruit slightly flattened or not; flesh not very fibrous, usually distinct from the stone but not separating as 'plates'; stone slightly flattened or not, thick- or thin-walled; cavity ± central, 1, slightly flattened or not, sutures not clearly visible.

Notes: Perhaps endemic to Papuasia; includes *E. debruynii,* allotted by A. C. Smith to section *Oreocarpus. E. neobritannicus* is included here, although complete flowers are unknown, since the ovary is glabrous and the anthers without awns; the fruit, however, is more like that of subgroup C.

44. Elaeocarpus debruynii O. C. Schm. *Nova Guinea* 14: 155 (1924).

Trees 6–7 m tall. Twigs robust, glabrous, somewhat gummy-resinous on the bud. Leaves clustered towards twig tips; petioles 6–11 cm long, straight, glabrous, unwinged; blades elliptic to ovate, 23–30 × 11–15 cm, acute and acuminate at apex, rounded at base, tough, glabrous, main veins rather sunken above and very prominent beneath, rather close-set (15–22 pairs, 7–14 mm between adjacent veins), unbranched until very near the margin, margins distantly and shallowly serrate with teeth 6–12 mm apart and tipped with a black hair-point, or ± entire. Inflorescences borne behind the leaves, 5–15 cm long, minutely appressed-hairy, bearing 10–30 flowers on pedicels 8–10 mm long. Sepals *c.* 6 × 1–1·5 mm, very sparsely short-hairy outside, slightly more hairy inside. Petals yellow to white, ± obovate, 7–8 × *c.* 4–5 mm, glabrous, widely flared towards tip and deeply and irregularly divided into 9–14 tapering broad or narrow divisions sometimes grouped into lobes. Disc hairy, indistinctly lobed. Stamens 25–30: filaments 1 mm long or less; anthers 2–3 mm long, without awns or bristles at the tip. Ovary glabrous, 2-locular; ovules *c.* 8 per loculus; style glabrous, 2·5–4 mm long. Fruit (probably immature) ellipsoid or ovoid, when dry flattened, 23–25 × 10 × 6–7 mm, skin and flesh wrinkling slightly on drying, 1 mm thick or less, not separating but distinct from the stone; stone thin-walled, flattened, slightly ridged or flanged at the edges, seed cavity slightly flattened, *c.* 5 × 4 mm in T. S., sutures obscure, surface probably smooth. Seed 1. Embryo straight.

Distribution: Known from only 3 specimens, from the Idenburg River in the Jayapura district of western New Guinea, and 2 from Ingembit on the Fly River near Kiunga in the Western district of Papua.

Ecology: Forest near rivers, 100–200 m.

Notes: Endemic to New Guinea. A very distinctive species; the combination of long-petioled, large, glabrous leaves with close-set main veins running almost to the margin and relatively small flowers with glabrous ovaries and awnless anthers is unique in Papuasia. Material in ripe fruit is needed to be sure that the fruit description is accurate.

45. Elaeocarpus hartleyi Weibel *Candollea* **26:** 371 (1971).

Trees up to 16 m tall. Twigs moderately robust, minutely appressed-hairy when young, quickly becoming glabrous; leaf scars persistent. Leaves in clusters at the tip of the twigs; petioles 2·5–3·5 (–4·0) cm long, straight, minutely appressed-hairy when young, glabrous later, unwinged; blades narrowly elliptic to narrowly oblong-oblanceolate, 8–12 (–15) × (2·5–) 3–4·5 cm, acute and sometimes acuminate, tapering to rounded at base, tough, glabrous or scattered and finely appressed-hairy beneath, venation network slightly prominent above, main veins prominent beneath, margins with strong ± rounded teeth (1–2 per cm), often with a black hair-point at the tip of each. Inflorescences borne below the leaves, spreading, straight, 4–8 cm long, sparsely and minutely hairy, bearing *c.* 20–30 flowers on pedicels 1–3 mm long. Perfect flowers unknown; in old flowers: sepals 5 × 1 mm, ± glabrous; petals *c.* 5 × 1–1·5 mm, glabrous, divided into 5 linear-lanceolate divisions 1–1·15 mm long. Stamens probably few; filaments *c.* 1 mm long; anthers *c.* 2 mm long, awnless and blunt. Ovary glabrous, 2-locular; *c.* 6 ovules per loculus; style 2–3 mm long, fine, straight, glabrous. Ripe fruit dark glossy blue; immature fruit ellipsoid, 1·3 × 0·7 cm.

Field characters: Old leaves turning bright red.

Distribution: Endemic to Papua; known from 3 collections from near Sogeri and 1 from Varirata Plateau in the Central district.

Ecology: Riverine gallery forest in predominantly savannah country, 500–550 m.

Notes: Very similar to *E. miegei* but recognized by the narrow, clustered, stiff-spreading leaves and short pedicels; the petals, although only a few still persist, seem consistently to have fewer divisions at the tip. More material in both flower and fruit is needed to determine whether *E. hartleyi* is really specifically distinct from *E. miegei.*

46. Elaeocarpus miegei Weibel *Candollea* **26:** 370 (1971).

Trees to 35 m tall. Twigs moderately slender to fairly robust, minutely appressed-hairy when young or hairs so minute that twigs appear glabrous. Leaves ± clustered towards twig tips; petioles 1–3 cm long, straight, often ± thickened at each end, minutely appressed-hairy or ± glabrous; blades oblanceolate or obovate to ± elliptic, very variable in size, (4–) 6–17 × 2–7·5 cm, the tip obtuse, rounded, or acute, base tapered, tough, usually

glabrous (rarely a few appressed hairs on nerves beneath), venation network prominent on both sides with the main veins more prominent beneath, margins rarely obscure, usually shallowly but fairly distinctly crenate-dentate (teeth 1–3 per 2 cm), black hair-points often present usually ± between the teeth. Inflorescences borne amongst or behind the leaves, (3–) 5–7·5 (–10) cm long, sparsely appressed-hairy to ± glabrous, bearing 5–20 flowers on pedicels 4–10 mm long. Sepals 4·5–5 × 0·5–1 mm, glabrous or the margins or tips sometimes short-hairy. Petals white, ± obovate or oblong-obovate, *c.* 5 × 1·5–2·5 mm, glabrous, divided at the tip into 6–13 narrow divisions, tapering or not, 1–3 mm long. Disc 4-lobed, ± sparsely hairy. Stamens (8–) 9–15; filaments 1–1·4 mm long; anthers 1–1·5 mm long, acute at the tip or with a short sharp point. Ovary glabrous, rarely hairy, 2-locular; ovules 6–12 per loculus; style 2–3 mm long, glabrous. Fruit only known immature (but probably almost ripe), when dried ellipsoid, 17 × 12 mm, rounded at tip and base, skin and flesh wrinkling, 1–2 mm thick, clearly distinct though not separating from stone; stone slightly winged laterally, surface probably smooth, not compressed, sutures obscure, with a single unflattened seed cavity. Seed 1. Embryo straight.

Field characters: Occasionally reported to have buttresses.

Distribution: Scattered throughout Papuasia. Known from the Vogelkop, Namfoor Island in Geelvink Bay, and the Jayapura area of western New Guinea. In northeastern New Guinea it is known only from the Morobe district (apparently fairly common around Bulolo) and in the Western Highlands. In Papua it is represented by 1 collection from Kiunga in the Western district and several from Normanby in the Papuan Islands; there is also 1 from Rossel Island in the same area. There are several collections from the Solomon Islands, from the New Georgia, Santa Isabel and Guadalcanal groups.

Ecology: In primary forest at low altitudes or associated with *Castanopsis* at medium altitude, often near rivers; sometimes in secondary forest. Sea level–1450 (–2600)m.

Notes: A variable species; leaf shape and size vary, as does the prominence and spacing of the venation network. The flowers are usually 5-merous, but are sometimes 4-merous; the width of the petals and the number of divisions also varies. 1 specimen has hairy ovaries. The variation is not correlated with geography. More material is needed.

47. Elaeocarpus neobritannicus Coode *Brunonia* **1**: 224 (1978).

Trees up to 40 m tall. Twigs massive, gummy-resinous at least when dried, with prominent persistent leaf scars. Leaves clustered towards twig tips; petioles absent or stout and glabrous, 0–10 mm long; blades broad-obovate to suborbicular, (11–) 15–30 × (9–) 12–22 cm, rounded at the tip, never acute, tapering at base, tough, glabrous, main veins fairly prominent beneath, network not very prominent, margins almost entire to weakly crenate, the crenations very widely spaced, *c.* 1–5 per 5 cm. Inflorescences borne below the leaves, stout, glabrous, 2·5–9 cm, bearing probably 10–13 flowers on glabrous pedicels *c.* 1·5 cm long. Sepals and petals unknown. Number of stamens unknown, a few found still attached to very young fruit; filaments 3–4 mm;

anthers 7 mm, almost certainly completely awnless, though with a recurved tooth at the tip of the outer valve. Ovary known only in old flowers, 2-locular, glabrous; style 19–23 mm long, glabrous. Fruit probably globose-ellipsoid when fresh; when dried flattened-ellipsoid, *c.* 3·2 × 2·6 × 2 cm, skin glabrous; skin and flesh contracting and wrinkling on drying, flesh a little fibrous, clearly distinct, and separating cleanly from the stone on rotting and sometimes on drying; stone compressed, *c.* 3 × 2·5 × 1·5 cm, hard, dense, deeply sculptured, 2 sutures visible on surface, scarcely visible in T. S.; loculus central, symmetrically flattened. Seed 1. Embryo straight.

Field characters: Often mistaken for a *Terminalia* with whorled branches and bunches of big leaves at the ends of thick twigs, often with red old leaves, like *T. catappa.* However, the bark of *Elaeocarpus neobritannicus* would not be deeply fissured with yellowish fibrous inner bark blueing with iron; it would be greyish and smooth or slightly cracked outside, granular and ± creamy or pinkish inside. Also the leaves always show a minute black hair-point on the margins between each crenation.

Distribution: Endemic to the Bismarck Archipelago. Known from 11 collections, all from New Britain.

Ecology: Lowland rainforest, occasionally in advanced regrowth, sometimes along river banks; from sea level to 250 m.

Notes: A very distinctive species quite unlike any other in Papuasia, yet judging by the glabrous ovary and awnless anthers belonging to this subgroup. The twigs have been reported as housing black ants. Flowers are needed to complete the description.

Elaeocarpus sp. ?nov. 5.

Differs from *E. miegei* in having bigger leaves, up to 22 × 10 cm, and longer petioles, up to 6 cm long. Known from material in fruit and young fruits; embryo straight.

Distribution: 4 collections from the coast of the Morobe district South of Lae.

Ecology: Forest, sea level to 130 m, sometimes beside rivers.

Notes: Though the material is inadequate for formal description and naming, this appears to be a new species in group VI subgroup E. The leaves could be mistaken for those of *E. schlechteranus,* but the fruit of sp. ?nov. 5 is glabrous and much smaller, or for *E. lingualis,* whose fruits have curved embryos.

Group VII

Ovules 6–8 per loculus; loculi 2–3; ovary glabrous. Embryo curved. Petals medium to fairly large, 0·7–1·7 cm long, thin, flat, and divided at the tip into many triangular teeth. Stamens 25–35; anthers awned. Leaves small to medium. Inflorescences just below or well below the leaves. Fruits not flattened; stone not flattened, surface sculptured or merging gradually with the flesh.

Notes: This group now contains only *E. culminicola* and thus corresponds to section *Oreocarpus* Schltr, but excluding *E. debruynii* which was placed in

section *Oreocarpus* by Smith (1944). *E. sterrophyllus* is insufficiently known and is listed at the end of the genus.

48. Elaeocarpus culminicola Warb. *Bot. Jb.* **16**: 23 (1893) in the broadest sense. **Fig. 29.**

E. viscosus Warb. (1894); *E. gjellerupii* Pulle (1912); *E. populneus* Schltr (1916); *E. sogerensis* Bak. f. (1923); *E. boridiensis* Knuth (1940) *E. patens* Knuth (1940); *E. populneoides* Knuth (1940); *E. rugulosus* Knuth (1940).

Shrubs or trees up to 25 m tall. Twigs slender, glabrous or minutely hairy when young, rarely villous, occasionally with linear-triangular blackish caducous stipules *c.* 5 mm long. Leaves usually scattered, sometimes ± grouped together near the tips of the twigs; petioles (0·7–) 2–4 cm long, straight, slender, glabrous or rarely sparsely hairy, usually thickened at each end; blades very variable, ovate, elliptic, or lanceolate, often relatively narrow, 5–13 × 2–6 cm, always acute and usually acuminate at the tip, broadly tapered to rounded at base, leathery, usually densely long-hairy when young, the hairs appressed and shiny but quickly lost so at maturity the leaves are glabrous or rarely sparsely appressed-hairy beneath, main veins prominent beneath or the whole venation network ± prominent on both sides, margins from entire to sinuate-crenate to finely and shallowly serrate to sharply and coarsely crenate-serrate. Inflorescences borne generally just below the leaves, sometimes some distance below, 4–7 cm long, glabrous or sparsely and minutely hairy, bearing 4–8 (–12) flowers on pedicels 0·8–2·7 cm long. Sepals (6–) 8–17 × 1–2 mm, usually glabrous outside, sometimes appressed-hairy, with short appressed hairs inside. Petals white, cream, or pink, obovate, (6–) 8–17 (–20) × (2–) 3–6 mm, glabrous or sparsely hairy on both sides with the margins in the lower half densely short-hairy, thin and flat for most of the length but often with an inrolled lower margin and thickened keel inside at the base, the tip divided into 16–40 narrow tapering divisions sometimes grouped into 3–5 lobes. Disc apparently 10-lobed, ± glabrous. Stamens 25–35; filaments 1–2·5 mm long, often sharply bent back at base; anthers 4–8 mm long, with a conspicuous hairy awn 1–3 mm long at the tip. Ovary glabrous, 2–3-locular; 6–8 ovules per loculus; style 9–11 mm long, glabrous. Fruit variable, globose or ± ovoid when fresh, shrinking on drying to 12–20 × 9–18 mm; skin blue or purplish when ripe, often drying yellow, flesh shrivelling considerably, 1–2 mm thick, not cracking over the stone sutures, generally not separating from stone surface and often merging gradually with it; stone hard, pale, relatively thick-walled, surface sculptured, if exposed, sutures generally obscure in T. S. Seed 1–2. Embryo curved.

Field characters: Often flowering when little more than a shrub; flowering can be profuse.

Distribution: Scattered throughout New Guinea, also known from the Bismarck Archipelago, possibly endemic. *E. culminicola* is known from 1 collection from the Vogelkop, several from Biak Island in Geelvink Bay and various places in the Jayapura district. In northeastern New Guinea there is 1 collection from Karkar Island in the Madang district and many from the Morobe, Eastern and Western Highlands districts. In Papua there are many specimens from the Southern Highlands and Western, 1 from Gulf, several from Central

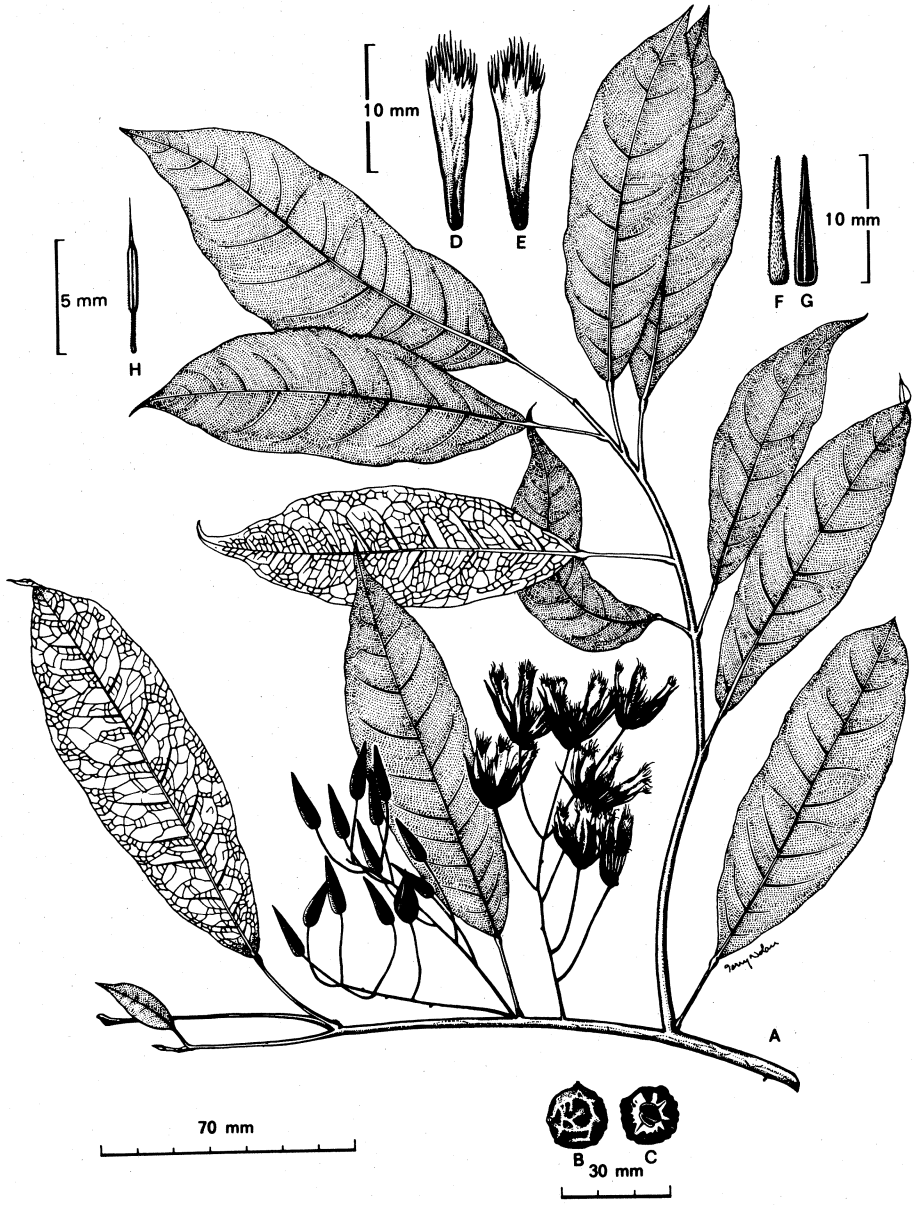

Fig. 29 **Elaeocarpus culminicola** Warb. (A) leafy twig of typical form, with flowers (B) dried fruit (C) cross-section of dried fruit; note single seed with curved embryo cut through twice (D) petal outside (E) petal inside (F) sepal outside (G) sepal inside (H) stamen

and 1 each from Northern and Milne Bay districts. In the Bismarck Archipelago there is 1 collection from New Britain and 1 from New Ireland.

Ecology: Generally an understory tree in forest, sometimes associated with disturbed areas, river beds, savannah, or monsoon forests. Known from sea level to 2750 m, but mostly between *c.* 1000 and 2000 m.

Notes: Very variable. One variant, almost certainly *E. culminicola* in Warburg's original sense, is very striking; it is usually a single-stemmed shrub and has long entire leaves with pronounced venation network, is generally found at higher altitudes (2000–2500 m) mostly in the Morobe and Central districts and has large very attractive pinkish flowers. Another variant has characteristic coarse teeth on the margins, and is commonest in the Western district and Eastern and Southern Highlands at 200–2700 m; none of the published names seems to cover this. *E. populneoides* covers specimens with small flowers and leaves often with residual hairs, all from low altitudes in the Western district. The Milne Bay, New Britain and New Ireland specimens have very small flowers. Scattered specimens have hairy sepals or other often relatively striking single characters. All the variants are connected by intermediates; it may be possible to recognize varieties but this is not attempted here.

Group VIII

Ovules 6–12 per loculus; loculi 2–3 (–4), ovary hairy (glabrous only in *E. floridanus* and *E. habbemensis).* Embryo curved. Petals small to medium, thick, ± flat or incurved, expanded or narrowed at the tip, with or without teeth, hairy on the back. Stamens 15–90; anthers awned or not. Leaves small to fairly large. Inflorescences generally borne amongst leaves, occasionally behind *(E. clethroides).* Fruit and stones small, neither flattened nor winged, flesh ± distinct from stone, sometimes radially fibrous.

Notes: This group is certainly widespread throughout most if not all the range of the genus. It includes all the section *Coilopetalum* in Schlechter's original sense and in Smith's later wider sense, and some species which Smith placed in section *Blepharoceras.*

Group VIII A

Petals clearly broader at apex than at base, densely hairy and often keeled inside. Anthers with long awns. Stamens 35–55.

Notes: It is not known if this subgroup is represented outside Papuasia. The species here are apparently endemic to New Guinea. Subgroup A is occasionally difficult to separate from subgroup C; it includes species which Smith placed in section *Blepharoceras.*

49. Elaeocarpus fuscoides Knuth *Feddes Rep.* **38**: 75 (1940). **Fig. 30.**

Trees 13–22 m tall. Twigs moderately robust, densely soft-spreading-hairy at least when young. Stipules linear-triangular, acute, usually falling quickly, 2–3 mm long. Leaves scattered or grouped towards the twig tips; petioles

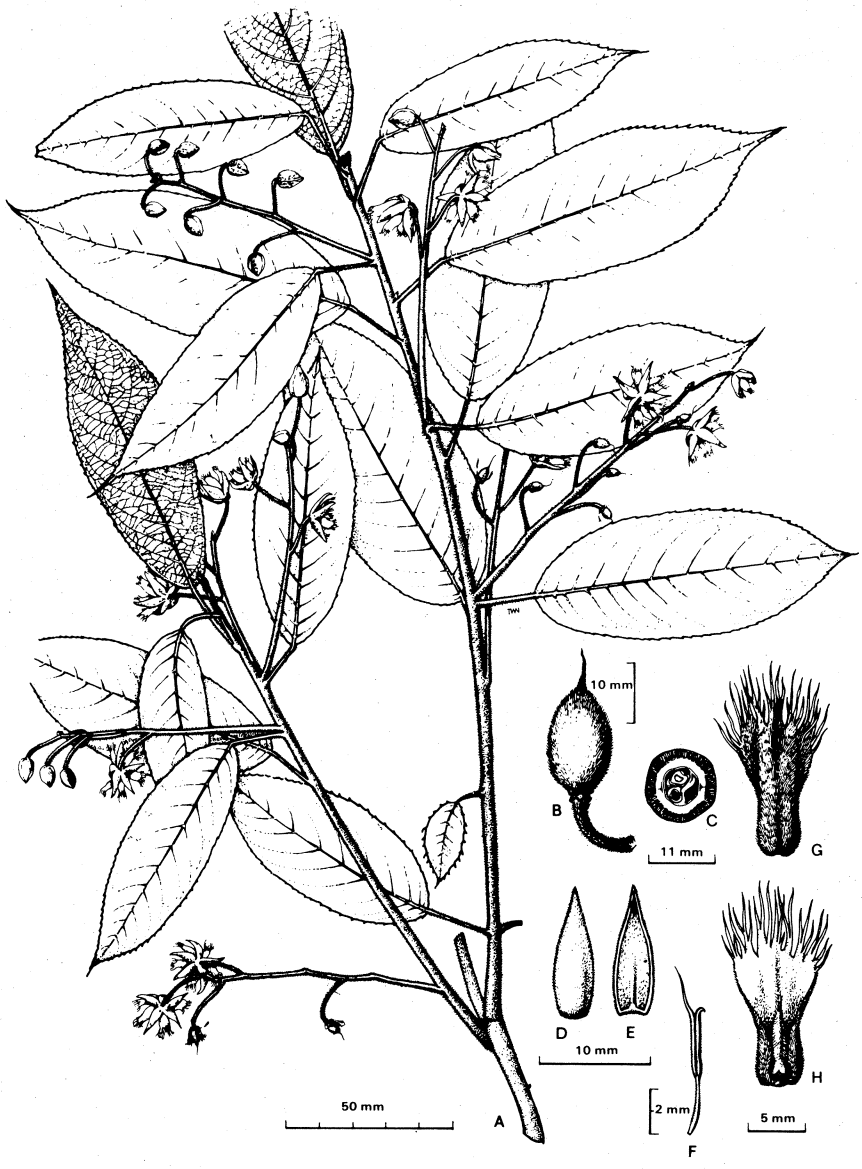

Fig. 30 **Elaeocarpus fuscoides** Knuth (A) leafy twig with flowers (B) fruit (C) cross-section of fruit; note single seed with curved embryo cut throught wice (D) sepal outside (E) sepal inside (F) stamen (G) petal outside (H) petal inside

1·2–3·8 cm long, straight, densely brown-hairy, ± thickened at each end; blades ovate-elliptic, (7–) 8·5–13 × (2·6–) 3–8 cm including an acumen up to 2 cm long, the tip acute and acuminate, rounded at base, tough, densely brown-hairy beneath, often soft-hairy all over when young, main nerves and midrib sunken above, very prominent beneath, venation network prominent beneath, main nerves rather dense, (8–) 12–16 pairs, running almost to margin before dividing; margins serrate, serrations obscure and ending in a small black tooth or relatively coarse and running out into black hair-like processes. Inflorescences borne amongst the leaves, 5–9 cm long, densely brown-hairy at first (sometimes the hairs largely lost in old specimens), bearing 4–15 flowers on robust usually curved pedicels (with dense pale and more persistent hairs) 10–20 mm long. Flowers 4- or 5-merous. Sepals 10 × 2·5 mm, densely brown-hairy outside, inside with sparser shorter and appressed hairs. Petals white or brownish, obovate or obtriangular, 9–10 × 3–4 mm at level of division, 6–8 mm at or just below the tip, with dense long appressed hairs outside, the hairs extending to the bases of the divisions, slightly less and less extensively hairy inside, slightly keeled inside near the base, divided into ± 3 lobes or not, subdivided into 30–40 irregular narrow tapering divisions 1–3 mm long, sometimes small divisions present low down on the margins, towards the base. Disc densely hairy, the lobes ± hidden. Stamens *c.* 50; filaments 1·5–2 mm long; anthers 2·5–3 mm long with a pale awn 2–2·5 mm long at the tip. Ovary densely hairy, 2 (–3)-locular; 10–12 ovules per loculus; style 4–5 mm long, glabrous towards the tip. Fruits ovoid or ovoid-ellipsoid, 14–12 × 10–14 mm, hairy only when young, skin and flesh often splitting or cracking on drying (not over the sutures), when dry flesh 1–2 mm thick, dark, usually with pale fibres arranged radially, clearly distinct and probably separating from stone on rotting; stone surface ± finely pitted-rugose, sutures 2 visible on surface and sometimes in T. S., walls fairly thick. Seeds usually 1. Embryo curved.

Distribution: So far known only from the eastern half of New Guinea and adjacent western New Guinea, where it has been found twice in the northeast corner of the Digul district. There are specimens from Morobe, Eastern and Western Highlands districts and from the Central district of Papua.

Ecology: Generally in primary forest often on ridges, from 1150 to 2050 m, occasionally up to 2500 m.

Notes: Very similar to some forms of *E. trichophyllus* but can usually be distinguished by the predominantly ovate and acute leaves. *E. fuscoides* could also be confused when in fruit with *E. tariensis,* which differs in having a straight, not curved, embryo. There is variation in leaf size and shape.

50. Elaeocarpus trichophyllus A. C. Sm. *J. Arnold Arbor.* **25**: 251 (1944) in the broadest sense.

E. erianthus A. C. Sm. (1944); *E. eximius* A. C. Sm. (1944).

Trees up to 27 m tall, often smaller. Twigs moderately robust, densely brown-hairy at least when young. Stipules often present, ± triangular, *c.* 2 mm, usually falling quickly. Leaves ± grouped towards twig tips; petioles (5–) 10–30 mm long, usually densely hairy, sometimes only sparsely hairy or even glabrous, not winged; blades obovate or elliptic, sometimes broadly so,

4–10 × 2–6 cm, usually rounded or obtuse at the tip, rarely acute, tapered to rounded to almost cordate at base, tough, densely short-hairy beneath, sometimes whitish-scurfy, rarely only sparsely hairy, main venation and sometimes venation network sunken above, both prominent beneath, main veins or first branches often running to the margin, margins ± entire to serrate, often inrolled. Inflorescences borne in the axils of the leaves, 4–10 (–15) cm long, sometimes overtopping the leaves, with dense short brown hairs, bearing 6–17 nodding flowers on pedicels 7–14 (–18) mm long; bracts small, falling quickly. Sepals 6–8 × 1·5–2·5 mm, densely brown-hairy outside, hairs as dense but greyish and shorter inside. Petals ± obovate, 6–9 × 4–9 mm, densely hairy on both sides all over, only the tips of the divisions glabrous, rounded or truncate at the tip, divided into *c.* 3 lobes or unlobed, further subdivided into 30–40 narrow tapering divisions, sometimes the petals almost round and with divisions down the margins almost to base, petals often slightly keeled inside. Disc densely hairy, lobes obscure. Stamens 35–55; filaments 1–1·5 mm long; anthers *c.* 2 mm long with a long flexuous awn 1·5–2 mm long, pale and bent outwards when dried at least. Ovary densely hairy, 2-locular; ovules *c.* 10 per loculus; style 2–3 mm long, mostly glabrous. Fruit ovoid, densely hairy at first, later ± glabrous except at tip and base, otherwise exactly as with *E. fuscoides.* Seed 1. Embryo curved.

Field characters: The brown hairs on the leaves give the whole crown a yellow-brown appearance; in some places where the species predominates as a canopy tree it is very conspicuous.

Distribution: Endemic to New Guinea. Only once collected in western New Guinea, in the Snow Mountains district near Lake Habbema. In northeastern New Guinea *E. trichophyllus* is known from the Finisterre range in the Madang district and from the Huon Peninsula of the Morobe district. It is apparently common in the Western and Eastern Highlands districts. Papuan specimens have been collected from the Southern Highlands, the Central district (it appears common in the foothills of Mt Albert Edward) and the Northern and Milne Bay (Mt Dayman) districts.

Ecology: Forest, often with *Nothofagus,* sometimes dominant or common, rarely in secondary forest; generally a canopy species. Altitude range from 1800 to 2800 m, rarely up to 3300 m.

Notes: A very variable species; variation is in leaf size, shape, and hairiness, and in petal size and depth of lobing. *E. erianthus* covered specimens with small leaves and the petal divisions not grouped into lobes; the specimen with the smallest leaves, however, has deeply lobed petals. *E. eximius* had a whitish scurfiness under the leaves, but the recent specimens do not differ sufficiently to be recognized as species; there is no geographical or altitudinal correlation. See Coode (1978, pp. 230–1) for discussion and provisional grouping.

Group VIII B

Petals oblong to obovate, glabrous inside except for the central swollen keel, which is densely hairy. Anthers with ± short awns up to 1 mm long. Stamens 25–40.

Notes: Probably endemic to New Guinea; the 2 species here were previously placed in section *Coilopetalum* by A. C. Smith.

51. Elaeocarpus poculiferus A. C. Sm. *J. Arnold Arbor* **25**: 266 (1944). **Fig. 31.**

Trees up to 30 m tall. Twigs ± robust, glabrous, stipules ± persistent, 2–4 × 0·5–1 mm. Leaves ± crowded at the tips of the twigs; petioles 10–20 mm, straight, often ± slender; blades narrowly oblong-elliptic to elliptic-obovate, 3–8(–10) × 1·5–2·5 cm, acute or obtuse at the tip, tapering to almost rounded at base, tough, glabrous, fine venation network raised above, often rather less prominent beneath, main veins usually slightly prominent beneath and often with domatia in their axils, often yellowish in life, margins obscurely crenulate-serrulate to ± entire. Inflorescences erect in leaf axils, 4–7 cm long, sometimes with leaf-like bracts below the flowers, often slightly inflated towards the tip, glabrous or minutely hairy, bearing 4–7 flowers in the 1 cm or so near the tip or with a group of 3–5 on the tip itself; pedicels robust, ± hairy, 6–9(–12) mm long, sometimes with bracts at base just like the stipules. Sepals pinkish, 6–9 × 1–2 mm, usually ± appressed-hairy outside, sometimes almost glabrous, ± sparsely and minutely appressed-hairy inside. Petals yellowish-pink, oblong-obovate, 8–10 × 3–4 mm, ± flared at apex and divided into ± 5 irregular lobes themselves divided into narrow tapering divisions (*c.* 15 in all), densely appressed-hairy on the back (the indumentum obscuring the lobing), inside glabrous, except for a densely appressed-hairy keel at base. Disc 10-lobed, the lobes ± globose, hairy. Stamens persisting after the sepals and petals have fallen, 25–40; filaments 1 mm long; anthers 3–3·5 mm long with a refracted awn *c.* 1 mm long at the tip. Ovary densely hairy, 3-locular; *c.* 8 ovules per loculus; style 5–6 mm long, mostly glabrous. Fruit blue-green, when dried ovoid or blunt-ellipsoid, 10–13 × 5–8 mm, skin and flesh often splitting ± along the length, 1–2 mm thick, distinct from the stone; stone surface slightly rugose, sutures obscure in T. S., walls 1–2 mm thick. Seed 1, not flattened. Embryo curved.

Field characters: Crown flat-topped.

Distribution: Known from the Snow Mountains of western New Guinea, from the Hindenburg Range in the south of the West Sepik district, from the Western Highlands district and from 1 specimen from the Eastern Highlands district of northeastern New Guinea. In Papua there are a few specimens from the Southern Highlands district.

Ecology: Forest, rarely fire-induced secondary growth, 2100–2900 m.

Notes: A very distinctive species, with the flowers grouped towards the tip of the inflorescence, petals mostly glabrous inside, often swollen inflorescence axis, and narrow, glabrous leaves.

52. Elaeocarpus pycnanthus A. C. Sm. *J. Arnold Arbor.* **25**: 265 (1944).

Trees 13–25 m tall, perhaps more. Twigs moderately robust, minutely appressed-hairy when young, sometimes with gummy exudate. Stipules present in bud, usually dropping before leaves expand but sometimes persistent,

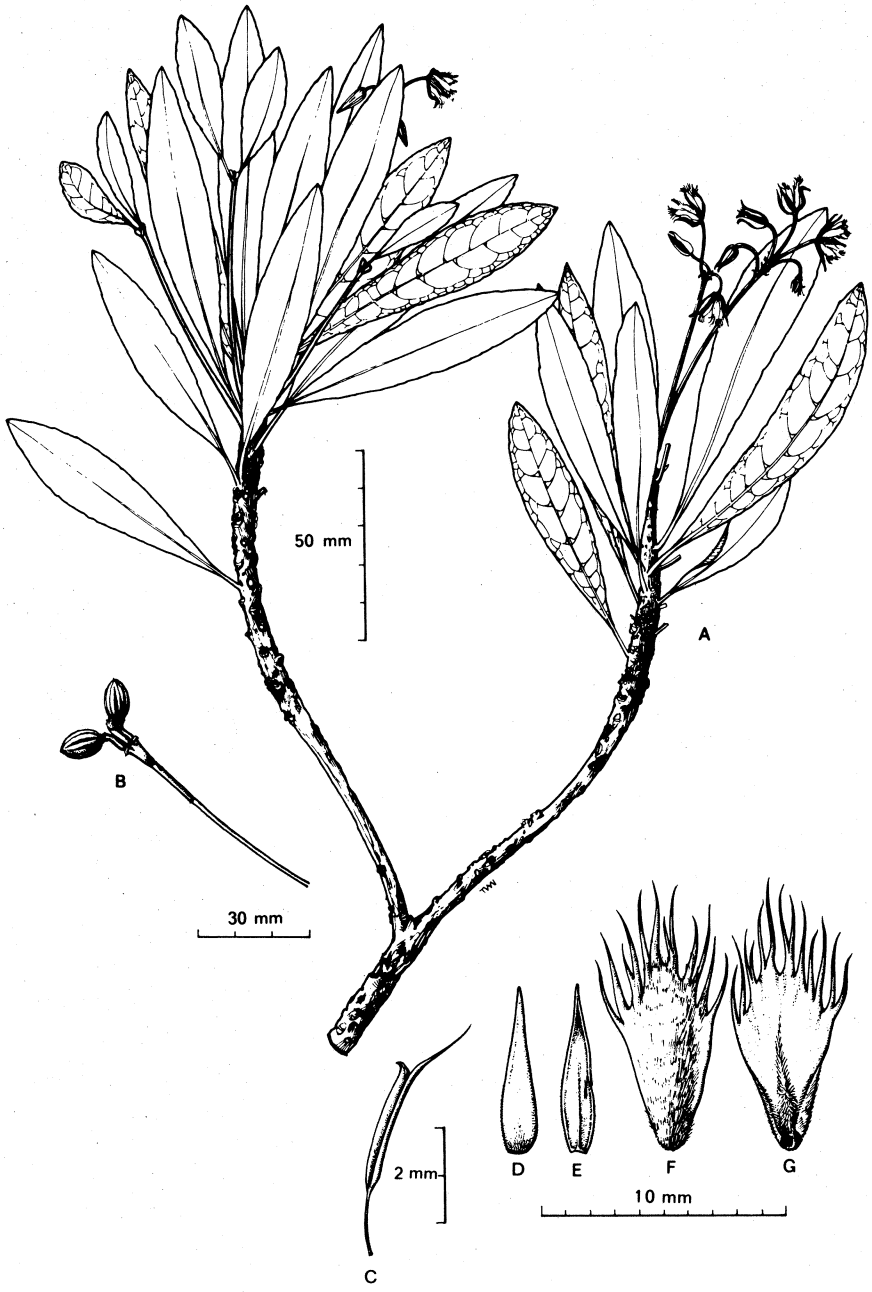

Fig. 31 **Elaeocarpus poculiferus** A. C. Sm. (A) leafy twig with flowers (B) fruiting inflorescence (C) stamen (D) sepal outside (E) sepal inside (F) petal outside (G) petal inside

narrow, *c.* 3 mm long. Leaves ± clustered at twig apices; petioles 21–32 mm long, straight, slender, glabrous or with some ± appressed hairs; blades elliptic to obovate, sometimes narrowly so, 7–12 × 2–3(–4·5) cm including the acumen up to 1 cm long, acute and often acuminate at the tip, tapering to rounded at base, rather tough, minutely and sparsely appressed-hairy beneath, venation rather close-set, main veins 8–10 pairs, sharply angled forwards, the venation network fine, raised above and usually raised beneath, main veins prominent beneath, often with domatia in their axils, margins obscurely crenulate-serrulate. Inflorescence axillary, 3–5(–7) cm long, ± appressed-hairy, bearing 5–10 flowers in the half near the tip, on pedicels (4–)6–9 mm long; occasional small leaf-like bracts are present. Sepals 5–6 × 1·5–2 mm, densely appressed-hairy outside, ± glabrous and drying dark reddish inside. Petals oblong-lanceolate, 5–6 × 1·5–2 mm, densely appressed-hairy outside, glabrous inside except on the keel which is hairy, apex ± tapering but divided into 7–11 divisions, the middle one often much the broadest. Disc lobes 10, hairy, acute. Stamens 25–40, persisting after sepals and petals have fallen; filaments 0·5 = 1 mm long; anthers 2– = mm long, tip acute or shortly acute, beaked or with a small awn up to 0·5(–1) mm long. Ovary densely hairy, 3-locular; ovules 6–8 per loculus; style *c.* 4 mm long, mostly glabrous. Fruits greyish-blue when fresh; when dry grey or yellowish, ovoid, 12–13 × *c.* 8 mm, skin and flesh wrinkling but not cracking, flesh 1–2 mm thick, distinct from stone but apparently separating cleanly from stone leaving some fine fibres attached; stone surface ± rugose, sutures obscure in T.S., walls 1–2 mm thick. Seed 1. Embryo not seen in good state, probably curved.

Field characters: Crown flat-topped or rounded; quite conspicuous when flowering.

Distribution: 3 collections in the Snow Mountains of western New Guinea. In northeastern New Guinea, known from the Oksapmin area of the West Sepik district, Mt Kaindi in the Morobe district, and from the Western Highlands district. There is a collection from the Doma Peaks area of the Southern Highlands of Papua and 2 others from near Kokoda in the Northern district.

Ecology: Forest, 1800–2300 m.

Notes: A sterile or fruiting specimen might be mistaken for *E. ledermannii,* which has similar thinly-hairy leaves with forward-angled venation. However, *E. ledermannii* is not known above 1000 m; it differs most obviously in having petals hairy inside. Small-leaved specimens of *E. pycnanthus* could also resemble *E. altigenus* in the *E. sayeri* group, but the twigs are more robust and leaves congested towards twig tips, not slender with scattered leaves.

Group VIII C

Petals obovate, ± flat or inrolled near the base, hairy or glabrous inside, without a central keel or keel not very pronounced. Anthers with short awns or beaks.

Notes: Perhaps endemic to New Guinea; corresponds to part of section *Coilopetalum* Schltr, and includes 1 species that A. C. Smith placed in section *Blepharoceras*.

53. Elaeocarpus altigenus Schltr *Bot. Jb.* **54**: 143 (1916). **Fig. 32.**

Trees 10–22 m tall, occasionally flowering when smaller. Twigs ± slender, glabrous or very finely appressed-hairy, young twigs sometimes with dense appressed shiny hairs, often with narrow stipules up to 5 mm long. Leaves scattered; petioles 1–2 cm long, straight, slender, usually glabrous and thickened at each end; blades ovate, ovate-lanceolate, or ovate-elliptic, 3–8·5 × 1·5–3 cm, the tip acute and acuminate, base ± rounded, moderately tough, densely appressed-silky-hairy when young, later glabrous or finely appressed-hairy beneath, main veins curving forward at a sharp angle, prominent beneath, often with domatia in their axils, margins finely serrate, often with minute black hair-points. Inflorescences borne amongst the leaves, 3–10 cm long, hairy or ± glabrous, bearing 5–9 flowers (lowest nearly to base) on pedicels 10–14 mm long. Sepals 4–7 × *c.* 1 mm, hairy or appressed-hairy outside, similar inside but hairs usually shorter. Petals ± obovate, 5–7 × 1.5–2 mm, with dense appressed shiny hairs on the back, more sparsely so inside, claw inrolled but not distinctly keeled inside, ± rounded at the tip, irregularly divided into 15–20 narrow tapering divisions up to 2·5 mm long, sometimes ± grouped into 3 lobes. Disc indistinct, obscured by long hairs. Stamens 15–20; filaments 1–1·5 mm long; anthers 1·5–2 mm long, with a beak up to 0·5 mm long at the tip, splitting sometimes almost to the base. Ovary densely hairy, 2-locular; 8 ovules per loculus; style 2–3 mm long, hairy at the base only. Fruit bluish to purple when ripe; when dried, ovoid, 11–12 × 6–7 mm, skin and flesh sometimes cracking irregularly, flesh *c.* 1 mm thick, with some radial fibres; stone surface rugose, 2 sutures visible, in section thin-walled, walls 1–2 mm thick, sutures obscure. Seed 1. Embryo not seen in good state, probably curved.

Field characters: Crown domed or flat-topped and silvery in mature trees. Old leaves die red.

Distribution: Once collected in western New Guinea, from the Wissel Lakes in the Snow Mountains district. In northeastern New Guinea it is known from the Hindenburg Range in the south of the West Sepik district and from the Madang district; it is fairly common in the Morobe, Western and Eastern Highlands districts; it is also apparently common in the Southern Highlands district of Papua.

Ecology: Usually in mixed forest, but also coming up in disturbed regrowth areas, 1800–2900 m.

Notes: Very like *E. filiformidentatus, E. luteolus* and *E. sayeri* in flower and fruit, differing only in leaf shape and hairiness.

54. Elaeocarpus filiformidentatus Knuth *Feddes Rep.* **48**: 74 (1940).

Differs from *E. altigenus* and *E. sayeri* in larger leaves, 6·5–12 × 2·3–4·3 cm, with few or no hairs beneath.

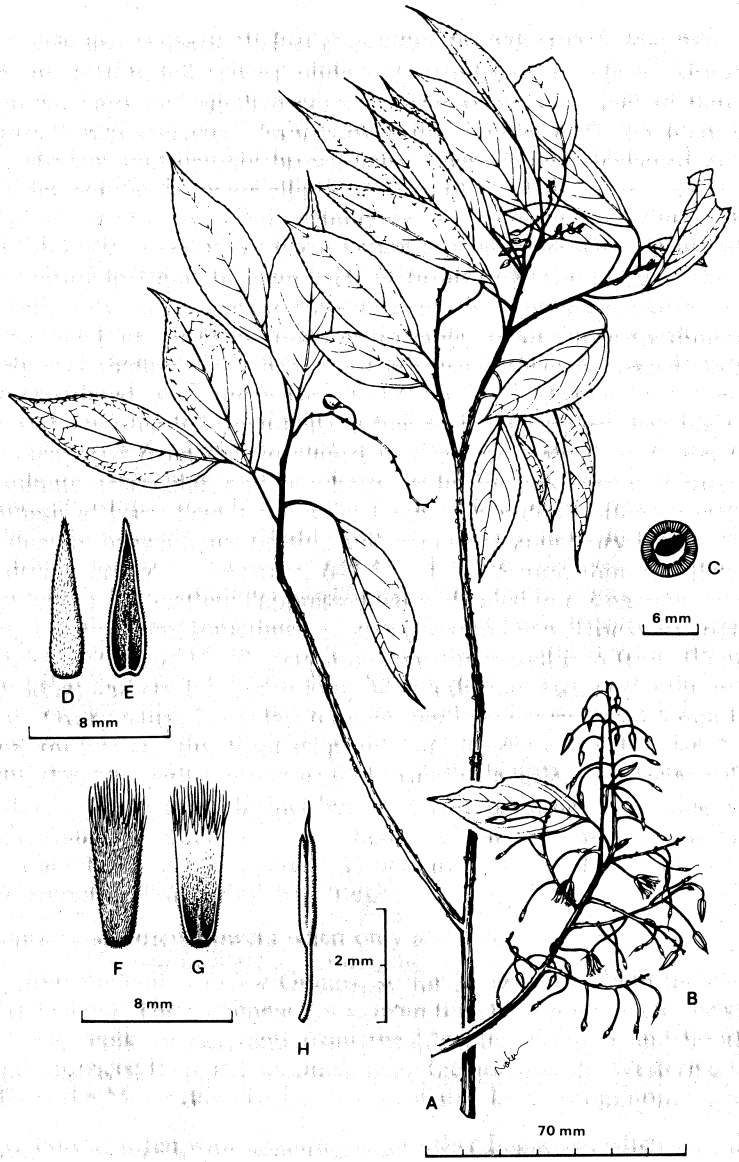

Fig. 32 **Elaeocarpus altigenus** Schltr (A) leafy twig with buds (B) flowering inflorescence (C) cross-section of fruit; seed shrivelled, not showing curved embryo (D) sepal outside (E) sepal inside (F) petal outside (G) petal inside (H) stamen

Distribution: A few collections from the Morobe and Eastern Highlands districts of northeastern New Guinea.

Ecology: Forest, 2300–2600 m.

Notes: More collections are needed to be sure that *E. filiformidentatus* is really distinct from *E. altigenus*. See also sp. nov. 4 on p. 122 and Coode (1978 p. 233) for discussion.

55. Elaeocarpus habbemensis A. C. Sm. *J. Arnold Arbor.* **25**: 267 (1944).

Trees usually less than 15 m tall, though up to 25 m recorded. Twigs slender, glabrous. Stipules present only in bud, rarely persisting. Leaves scattered to loosely clustered; petioles 7–16(–24) mm long, glabrous, often channelled above; blades obovate or elliptic, 5–8(–12) × 2–4(–5) cm, the tip obtuse to ± acute, tapering at base, leathery, glabrous, main nerves prominent beneath, breaking up into ± prominent reticulate venation in one-half to two-thirds the distance from midrib to margin, fine network prominent on both surfaces, conspicuous domatia usually present in the axils of the main nerves, venation often yellow, margins evenly if obscurely crenate-serrate. Inflorescences axillary, 4–11 cm long, glabrous, bearing 4–8 flowers in the half nearest the tip only, on spreading or reflexed pedicels 7–11 mm long. Sepals 5·5–6·5 × 1·5 –2 mm, sparsely and finely appressed-hairy outside, ± glabrous inside except for the low narrow keel which is often minutely hairy. Petals white, obovate, 6–7·5(–9) × 2–2·5(–4) mm, ± flat but fairly thick, with short appressed hairs on the back, glabrous inside except for the low central keel which is short-hairy, divided into 9–12 narrow tapering divisions 0·5–2 mm long. Disc obscurely 5-lobed, the lobes ± blunt, sparsely and finely hairy. Stamens 20–25; filaments 0·5–1 mm long; anthers 1·5–2·5 mm long, with a short sharp beak at the tip up to 0·5 mm long, usually less. Ovary glabrous, 2-locular; ovules 6–8 per loculus; style *c.* 3 mm long, glabrous. Fruit blue-green to black when fresh, when dried ovoid-ellipsoid, 8–9 × 5–6 mm, skin ± smooth or slightly rugose, usually not wrinkling and cracking, flesh at most 1 mm thick, distinct from stone; stone surface ± rugose, sutures 2, obscure or not, walls 1–2 mm thick. Seed 1, slightly flattened. Embryo curved.

Field characters: Usually a slender branched small tree; dying leaves have been reported as brownish, not red.

Distribution: Endemic to New Guinea. Very scattered. Known in western New Guinea from the type specimen collected at Lake Habbema in the Snow Mountains district, and in northeastern New Guinea from many specimens from the Wau subdistrict of the Morobe district; it is common in the Mt Kaindi/Edie Creek area. There are sterile specimens from the Western and Eastern Highlands districts; in Papua it is known from a single specimen from the Doma Peaks in the Southern Highlands and 1 (with large flowers) from Milne Bay.

Ecology: Forest or regrowth, usually an understory tree or treelet; 1900–2800 m.

Notes: A distinctive species with its glabrous ovary and expanded petals hairy on the back and glabrous inside. The inflorescence with the basal half devoid

of flowers is also an unusual feature, shared in Papuasia with *E. poculiferus, E. pycnanthus, E. branderhorstii* and *E. crenulatus.*

56. Elaeocarpus latescens F. Muell. *Trans. R. Soc. Vict.* **1**,2: 2 (1899) amplified by A. C. Sm. *J. Arnold Arbor.* **25**: 253 (1944).

Shrubs or trees to 15 m tall. Twigs slender, densely brown-hairy at first. Leaves ± scattered or loosely clustered; petioles 4–10 mm long, hairy when young; blades obovate to obovate-elliptic, 2–5 × 1·5–3 cm, rounded at the tip, abruptly tapered at base, fairly tough, brown-hairy beneath, main nerves very prominent and venation network rather prominent beneath, margins obscurely serrulate. Inflorescences in the axils of leaves, slender, 3–9 cm long, hairy, bearing 10–17 flowers on curved pedicels 5–7 mm long. Sepals 4·5–6 × *c.* 1·5 mm, hairy outside, minutely hairy inside. Petals ± obovate, 5–7 × 2·5–3·5 mm, flat, fairly thick, densely hairy outside, glabrous or almost glabrous inside, irregularly divided into 12–25 narrow tapering divisions 1–2 mm long. Disc hairy, ± 5-lobed. Stamens 20–25; filaments *c.* 1·5 mm long; anthers 1–1·5 mm with a short beak or awn at the tip up to 0·5 mm long. Ovary hairy, 2-locular; ovules 8 per loculus; style 2–2·5 mm long, glabrous towards the tip. Fruit ellipsoid, 10 × 8 mm; skin and flesh 2–3 mm thick; stone with 1 cavity, sutures inconspicuous. Seed and embryo not seen.

Distribution: Known only from the Central district of Papua: Mt Tafa near Woitape and Mt Musgrave in the southern foothills of Mt Victoria.

Ecology: Recorded from burnt-over moss forest, at about 2300 m.

Notes: Apparently not a very distinct species, differing from *E. sayeri* on the technicality of petals glabrous or almost glabrous inside. More material is needed to evaluate its status. Fruit has not been seen; the description given above is extracted from A. C. Smith's description.

57. Elaeocarpus luteolus A. C. Sm. *J. Arnold Arbor.* **25**: 268 (1944).

Shrubs 3 m tall to trees 25 m tall. Twigs ± slender, appressed-hairy when young, later glabrous and producing corky pustules, sometimes with narrow stipules 2–3 mm long. Leaves usually rather crowded; petioles 4–7 mm long, glabrous or sparsely hairy, usually thickened at each end; blades obovate, 2·5–6(–7) × 1·2–3 cm, acute or sometimes obtuse at the tip, tapering at base, fairly tough, with fine appressed silky hairs above when young, quickly becoming glabrous above, appressed-hairy beneath; main veins prominent beneath, margins ± crenulate-serrulate, the teeth often ending in hair-points. Inflorescences borne amongst the leaves, sometimes overtopping the foliage, 3–7 cm long, puberulous, bearing 4–8(–13) flowers on pedicels 6–11 mm long. Sepals 4–6 × *c.* 1 mm, appressed-hairy on both sides, the hairs shorter inside. Petals brownish or yellow, oblong-obovate, 4–5·5 × 1–1·5 mm, ± oblong, densely appressed-hairy on the back, much less densely hairy or almost glabrous inside, not keeled inside but rather strongly inrolled and thickened at base, the tip rounded and divided into 9–16 narrow tapering divisions not usually grouped into lobes. Disc densely hairy, 5-lobed, the lobes themselves grooved. Stamens *c.* 15; filaments 1–1·5 mm long; anthers 1–1·5 mm long, acute, beaked or not on the outer tooth, beak somewhat short-bristly when

present. Ovary hairy, 2-locular; *c.* 8 ovules per loculus; style 2–4 mm long, hairy at base only. Fruit as in *E. altigenus*. Seed and embryo not seen in good state.

Field characters: Young leaves bronzy-red; dying leaves red.

Distribution: So far known from a relatively small area from Lake Habbema in the Snow Mountains of western New Guinea, the Hindenburg Range in the south of the West Sepik district, the Doma peaks in the Southern Highlands and the headwaters of the Ok Tedi in the north of the Western district.

Ecology: Mixed forest, sometimes in secondary regrowth, 2000–2400 m.

Notes: Very similar to *E. altigenus* and *E. sayeri* in flower and fruit but differing from both in the small obovate leaves.

58. Elaeocarpus sayeri F. Muell. *Trans. R. Soc. Vict.* **24**: 174 (1888).

Shrubs 2 m to trees 20 m tall. Twigs slender, hairy, sometimes with narrow stipules 2–3 mm long. Leaves scattered; petioles 1–2 cm long, straight, slender, thickened at each end, hairy; blades ovate, sometimes broadly so, 3·5–6 (–7·5) × 2–4 cm, including the acumen of 5–10 mm, acute and acuminate at the tip, rounded at base, fairly tough, young leaves with dense appressed silky hairs, quickly becoming ± glabrous above, remaining hairy beneath, main nerves prominent beneath, margins serrate-dentate, teeth ending in a hair-point, sometimes rolled under slightly. Inflorescences borne amongst the leaves, 1–3(–8) cm long, brown-hairy, bearing 3–9 flowers nearly to base, on pedicels 8–10 mm long. Sepals *c.* 5 × 1–2 mm, densely brownish ± appressed-hairy on both sides, the hairs shorter inside. Petals creamy, *c.* 6 × 1·5–2 mm, oblong-obovate, with dense brownish appressed silky hairs on both sides, not keeled inside but base thickened and somewhat inrolled, the tip rounded and divided into 15–20 narrow tapering divisions up to 1(–1·5) mm long. Disc ± obscured by dense hairs, not very distinctly lobed. Stamens *c.* 15; filaments *c.* 1 mm long; anthers *c.* 1·5 mm long with a distinct minutely bristly awn or beak on outer tooth *c.* 0·5 mm long. Ovary densely hairy, 2-locular; 6–8 ovules per loculus; styles 2–3 mm long, glabrous near the tip. Fruit as in *E. altigenus*.

Field characters: Old leaves die red.

Distribution: Endemic to New Guinea; not known yet from western New Guinea. In northeastern New Guinea it is known from 1 specimen from the Finisterre Range in the Madang district, several from each of the Morobe, Western and Eastern Highlands districts, also in the Southern Highlands district of Papua; there is 1 specimen from the Central district.

Ecology: Mostly in mixed forest or in association with *Nothofagus*, 1200–3100 m.

Notes: The typical *E. sayeri* is fairly easy to recognize, with small ovate acute leaves with strong venation prominent beneath and brownish hairs. There are, however, several specimens that are less typical, with ovate-elliptic larger

leaves or less hairy leaves, that link *E. sayeri* with *E. altigenus* and *E. whartonensis*. It may be better to treat these two taxa as part of a variable *E. sayeri* which might also include *E. filiformidentatus* (and even *E. luteolus*, although there are no intermediate specimens in this case). There are also specimens linking *E. sayeri* and *E. trichophyllus*. See Coode (1978, p. 234) for further discussion.

59. Elaeocarpus whartonensis A. C. Sm. *J. Arnold Arbor.* **25**: 254 (1944).

Differs from *E. sayeri* in the sharp-serrate leaf margin, dense short felty hairs on the leaf undersurface and the main veins occasionally branching but often not branched and running to the margins of the leaf. Differs from *E. latescens* in the ovate not obovate leaf and in the petals hairy inside.

Distribution: So far only collected in the Mt Albert Edward/Wharton Range/Murray Pass area of the Central district of Papua.

Ecology: Apparently an understorey species in forest or part of subalpine shrubbery; 2500–2900 m.

Notes: Combines features of subgroup C (flower and fruit type) with subgroup A (leaf nerves running to margin, anther awns pale though short). More collections are needed of both these subgroups, particularly from the Owen Stanley Range, before it can be decided if *E. whartonensis* really merits recognition or whether it is merely part of the wide range of so far unexplained and unnamed variation that has been collected in this area.

Group VIII D

Petals ovate, strongly incurved and inrolled, usually densely hairy on both sides (*E. branderhorstii* much less hairy), with few or no teeth at the tip, rarely ± oblong with up to 9 teeth or with a glabrous patch inside. Anther awns short or ± absent.

Notes: Subgroup D contains diverse elements that a monographer would probably further split up; it is geographically widespread. It contains most of the species in Schlechter's section *Coilopetalum*.

60. Elaeocarpus branderhorstii Pulle *Nova Guinea* **8**: 662 (1912).

E. microdontus Schltr (1916); *E. subinteger* Schltr (1916); *E. lancipetalus* Merr. (1951).

Trees 3–12 m tall. Twigs slender, ± appressed-hairy when young only, usually with long leafless shoots bearing short leafy shoots. Minute stipules often present. Leaves in tight clusters; petioles 5–12 mm, usually ± thickened at each end, glabrous or minutely hairy; blades obovate, 4–8(–9) × 2–4 cm, rounded or acute at tip, sometimes bluntly acuminate, tapering at base, papery, glabrous or minutely and finely appressed-hairy, main veins only slightly prominent beneath, margins ± entire to very slightly crenulate with hair-points. Inflorescences borne in the axils of leaves or just below them, 2·5–5 cm long, appressed-hairy, bearing 3–9 flowers on pedicels 6–9 mm long. Sepals 5–7 × 1 mm, appressed-hairy outside, glabrous inside except

for the low narrow puberulous keel. Petals white, lanceolate, 4.5–7 × 1–1.5 mm, tapering towards the obtuse tip, which is minutely 3–5-notched, rather sparsely appressed-hairy on the back, almost glabours near the tip, glabrous inside except for the densely hairy keel and lower margins. Disc hairy, 5-lobed, the lobes deeply notched. Stamens *c.* 25; filaments 1·5–2 mm long, with a short-hairy awn 0·5 mm long. Ovary densely hairy, 2-locular; 6–8 ovules per loculus; style *c.* 3·5 mm long, glabrous for most of its length. Fruits purple or blue, probably succulent; when dried ellipsoid, 8–10 × 4–5 mm, the tip blunt, flesh and skin wrinkling on drying, *c.* 1 mm thick, not fibrous, not readily separating but distinct from stone; stone surface ± sculptured-rugose (seen in T.S.), walls 1–2 mm thick, sutures obscure in T.S. Seed 1. Embryo curved.

Distribution: Scattered in New Guinea, perhaps endemic though resembling at least 1 species from the Philippines. There are specimens from Biak Island in Geelvink Bay, from the Cycloop mountains behind Jayapura and from the Fakfak district of western New Guinea. 3 specimens are known from north-eastern New Guinea, 1 from the Frieda river area of the West Sepik and 2 from the Hustein mountains south of Ambunti, in the East Sepik district. There are 2 collections from the northwest of the Western district of Papua.

Ecology: Forest, often near rivers or swamps, sometimes in stunted or secondary forest; 30–450 m.

Notes: Distinct in this subgroup; the ovate but not very hairy petals and leaves crowded into short shoots with longer leafless twigs between are characteristic.

61. Elaeocarpus elatus A. C. Sm. *J. Arnold Arbor.* **25**: 262(1944).

Trees 10–25 m tall or more. Twigs robust or moderately robust, glabrous, often with minute stipules. Leaves usually clustered at twig tips; petioles 4–6 cm long, glabrous, ± straight, thickened at each end; blades ± elliptic, 12–18 × (5–)6·5–10 cm, the tip rounded but acuminate, rounded or broadly tapering at base, papery, glabrous, main veins ± prominent beneath, margins slightly serrare or ± entire. Inflorescences amongst or just below the leaves, minutely appressed-hairy, bearing 8–25 flowers on pedicels 8–14 mm long. Flowers (4–)5-merous. Sepals 5–7 × 2–2·5 mm, minutely hairy outside, glabrous inside or with a few scattered hairs near the tip, variably keeled. Petals ovate or ovate-oblong, 5·5–7·5 × 2–2·5 mm, tough or fairly flexible, densely shiny-hairy on both sides, with a ± swollen broad keel in the lower part, the tip acute or obtuse, entire or minutely 2–3-toothed. Disc (8–)10-lobed, short-hairy, not deep but very flat and quite wide, with the stamens apparently inserted on the top. Stamens 60–90; filaments 0·5–1 mm long; anthers 2–3·5 mm long, apiculate or awned, the awn up to 1 mm long. Ovary short-hairy, slightly grooved, loculi 3(–4); ovules 6–10 per loculus; style 1·5–2·5 mm long, hairy at base. Fruit not definitely known mature, when young ± ellipsoid, obtuse, up to 11 × 6 mm, skin and flesh ± collapsing on drying, *c.* 1 mm thick, distinct from stone; stone walls *c.* 1–2 mm thick. Seed 1. Embryo curved.

Field characters: Often reported to have buttresses or prop-roots.

Distribution: So far known from relatively few collections from the Morobe district of northeastern New Guinea, the Northern district of Papua, and New Britain.

Ecology: Primary or secondary forest, 30–800 m.

Notes: Very similar to *E. sepikanus,* differing in usually larger papery leaves and 3(–4)-locular ovary. There is variation in leaf width and flower size. Fruiting collections from trees previously identified in flower are needed, and more flowers are wanted to check if the disc is consistently as distinct as it appears.

62. Elaeocarpus floridanus Hemsley *Kew Bull.* **1896**: 158 (1896); Foreman *Bot. Bull.* 5 (Check List Vasc. Pl. Bougainville): 110 (1971), f.

E. pseudosepicanus O. C. Schm. (1929).

Trees to 20 m tall. Twigs moderately slender, glabrous, buds often gummy-resinous. Leaves ± grouped at the ends of twigs; petioles 2–5(–6) cm long, slender, glabrous, thickened at each end; blades ovate or ovate-elliptic, sometimes narrowly so, 8–15 × (3–)4–7 cm, acute or bluntly pointed at the tip, tapering or rounded at the base, papery, glabrous, main veins ± prominent beneath, margins coarsely sinuate-crenate to almost entire. Inflorescences erect in flower, sometimes spreading in fruit, borne amongst the leaves, 5–13 cm long, finely hairy, bearing 8–23 flowers on pedicels 12–22 mm long. Sepals 6–6·5 × 1·5–2 mm, finely appressed-hairy outside, glabrous and narrowly keeled inside. Petals creamy, ± oblong, *c.* 7 × 2·5 mm, thick and fleshy, scarcely contracted at the tip but often ± inrolled, thus appearing strongly contracted, densely shining-appressed-hairy on both sides,inside with a large keel, divided at the tip into 7–9 narrow tapering teeth up to 1 mm long. Disc 10-lobed, lobes very distinct and hairy. Stamens *c.* 50; filaments up to 1 mm long; anthers 2 mm long, with a minutely hairy awn *c.* 1 mm long. Ovary glabrous or with a very few scattered hairs, 3--locular; 6 ovules per loculus; style glabrous, 4–5 mm long. Fruit blue or black when ripe, ± ovoid; drying to ovoid, 12–16 × 7–10 mm, yellowish or greenish, skin and flesh not usually cracked or withering except in the ripest material, *c.* 1 mm thick, weakly fibrous, disntinct from stone, separating only when quite ripe; stone surface ± smooth to longitudinally ridged over the 3–4 sutures and sometimes with an additional ridge alternating with the sutures, in section walls *c.* 2 mm thick, sutures usually visibly darker. Seed 1. Embryo curved.

Field characters: Often buttressed. Old leaves die red.

Distribution: In Papuasia *E. floridanus* is known from 3 collections from the Bismarck Archipelago, 2 from Jacquinot Bay, New Britain, and 1 from Emira Island, north of New Ireland. There are a few specimens from Bougainville, and the species is very common in the Solomon Islands; there are many specimens from all the island groups. The species is also known from the Santa Cruz Islands; further east and south there are very similar species that may in fact be the same.

Ecology: Primary and secondary forest, from sea level to 400 m.

Notes: Similar in general appearance to *E. sepikanus, E. ledermannii* and *E. elatus,* differing most obviously in its glabrous ovaries. *E. floridanus* holds an isolated position in this subgroup.

63. Elaeocarpus ledermannii Schltr *Bot. Jb.* **54**: 141 (1916).

E. confertifolius Knuth (1940); *E. brevirostris* A. C. Sm. (1944); *E. idenburgensis* A. C. Sm. (1944); *E. fluviatilis* A. C. Sm. (1944).

Trees 10–30 m tall. Twigs moderately robust, often with short leafy shoots and long leafless shoots, buds often resinous, narrow stiplues up to 5 mm long sometimes present. Leaves clustered at twig tips; petioles 2–4 cm long, glabrous, straight, slender ± thickened at each end; blades elliptic to rather narrowly elliptic, 8–12(–15) × 3·5–5·5 cm, acute and acuminate at the tip (though the acumen may be blunt), tapering to ± rounded at base, papery, glabrous or with some scattered fine appressed hairs beneath, occasionally with soft appressed hairs above when young, main nerves set at a rather acute angle to the midrib and somewhat prominent beneath, and domatia usually present in their axils, margins ± obscurely serrate-crenulate. Inflorescences borne amongst the leaves, often many, 3–10 long, slender, appressed-hairy, or silky-hairy, bearing 5–25 flowers on pedicels 6–11 mm long; bracts often present in bud, boat-shped or spathulate, the tip dentate, up to 7 × 3 mm. Flowers (4–)5-merous. Sepals 5–7 — 2–2·5 mm, ± acuminate (the buds therefore acuminate), appressed-hairy or sparsely so, outside glabrous and scarcely keeled inside. Petals ovate, 5–6·5 × 1·5–2·5 mm, thick, acute, even acuminate, densely shining-hairy throughout, with a swollen central keel in the lower half inside. Disc hairy, indistinctly (4–)5-lobed. Stamens 30–45; anthers 1·5–2·5 mm long, distinctly awned, awn up to 1 mm long, filaments 1–1·5 mm long. Ovary hairy, loculi 2; ovules 8–14 per loculus; style 2·5–3 mm long, ± glabrous. Fruit blue, ellipsoid; when dried ellipsoid, 10–12 × 6–7 mm, skin and flesh wrinkling, *c.* 1 mm thick, distinct from stone; stone surface rugose, in T.S. walls 1–2 mm thick, sutures obscure. Seed 1. Embryo curved.

Field characters: Often showing whorled *'Terminalia-branching';* sometimes stilt-rooted. Young leaves bronzy; old leaves die red.

Distribution: So far known from 2 collections from western New Guinea, 1 from Japen Island in Geelvink Bay and 1 from the Idenburg River in the Jayapura district. There are 2 specimens from the West Sepik district; several were collected in the East Sepik district. The species is common in Morobe district, and there are several from the Western district of Papua. There are a few from Papua in the Gulf and Central district, and the Papuan Islands, and 1 from New Britain.

Ecology: In primary forest or secondary regrowth, often near rivers; sea level to 1000 m.

Note: The leaves vary in size and shape; in general the leaf nervation, rather acutely angled forwards and usually with domatia in the axils, is the best feature distinguishing *E. ledermanii* from *E. sepikanus;* also the anther awns are longer. The peculiar bracts are characteristic when present. Schlechter described a variety *timoniifolius* with shining appressed hairs on the leaf

underside; no material is known to have survived nor do any new specimens appear to fit in here.

64. Elaeocarpus lingualis Knuth *Feddes Rep.* **48**: 76 (1940).

Trees 20–33 m tall. Twigs robust to massive, glabrous or sparsely hairy when young, sometimes with small stipules. Leaves ± clustered at twig tips; petioles 3·5–8 cm long, glabrous, straight, stout, thickened at each end; blades ovate to elliptic, 15–25 × 6·5–11·5 cm, acute at the tip, rounded at base, tough, glabrous, fine venation network ± raised on both sides, main veins prominent beneath, margins obscurely sinuate-crenate. Inflorescences borne below the leaves, 3–10(–18) cm long, obscurely or densely hairy, bearing 6–10 or more flowers on recurved pedicels 8–10 mm long. Sepals 6–7 × 2–3 mm, thick, tough, short-hairy outside and more so inside. Petals yellow or orange, ± ovate, 5–6·5 × 2–3 mm, incurved, tough and thick with a basal central swelling inside, densely ± shining-hairy throughout, margins inrolled, the tip undivided or with 2–3 minute teeth. Disc with *c.* 10 rather small though distinct velvety lobes. Stamens *c.* 45; filaments *c.* 1 mm long; anthers 2 mm long, acute or with a minute acute apiculus but not awned or beaked. Ovary short-hairy, 2-locular; *c.* 12 ovules per loculus; style 2–3 mm long, glabrous towards the tip. Fruit not known with certainty; probably indistinguishable from those of *E. sarcanthus.*

Distribution: Apart from the type specimens from the Huon Peninsula of the Morobe district, *E. lingualis* is known definitely only from the Idenburg River in the Jayapura district of western New Guinea, and from the Jimi Valley in the Western Highlands district. Fruiting collections which may belong here fill in the gaps in the range; in the south of the West Sepik district, more from the Western Highlands, Eastern Highlands and 1 from the far north of the Western district of Papua.

Ecology: Forest; 1400–2300 m.

Notes: Differs from *E. sepikanus* in the thick tough petals and from *E. sarcanthus* in the scarcely divided petals. In fruit not distinguishable from *E. sepikanus* except that it generally is a more robust species, and from *E. sarcanthus* apparently only in leaf size and position of the inflorescences. More material in different stages from the same trees is needed.

65. Elaeocarpus pachyanthus Schltr *Bot. Jb.* **54**: 136 (1916).

Trees 25 m tall. Twigs robust or moderately so, ± felty-hairy when young, minute stipules sometimes present. Leaves clustered towards twig tips; petioles 4–7 cm long, felty-hairy, straight, thickened at each end; blades ovate or elliptic, sometimes broadly so, 11–16 × 5·8–7·5 cm, the tip blunt and acuminate, the acumen 1–2 cm long, rounded or broadly tapering at base, tough, felty-hairy beneath, fine venation network ± prominent above, beneath with only the main nerves prominent and looping forward, not running to the margin, margins ± entire, often with minute blackish hair-points ± embedded in the margin. Inflorescence borne amongst or just below the leaves, 9–14 cm long, felty-hairy, bearing 30–40 flowers to near the base, on robust spreading pedicels 7–10 mm long. Flowers 4–5 merous. Sepals *c.* 5 × 1·5–2

mm, with short felty hairs outside, sparsely hairy inside near the margins and tip but with the central area glabrous and not or scarcely keeled. Petals dull yellow, ovate, 4·5–5·5 × *c.* 2 mm, thick, in the lower half with a swollen central keel inside, margins inrolled, densely ± shining-hairy on both sides, the tip undivided or minutely 2–3-denticulate. Disc 5-lobed, the lobes, hairy and ± bilobed. Stamens *c.* 30; filaments 0·5–1 mm long; anthers *c.* 2 mm long, the tip acute but neither beaked nor awned. Ovary hairy, 2-locular; 10–12 ovules per loculus; style 3 mm long, hairy only near the base. Ripe fruit unknown; immature fruit ovoid, 7 × 4 mm when dried, skin and flesh wrinkling, distinct from stone; stone surface probably rugose, sutures 2, probably obscure in T. S. Seed 1. Embryo curved.

Field characters: Young leaves dull reddish; old leaves die bright red.

Distribution: Endemic to New Guinea. A single collection is known from the Idenburg River in Jayapura district, western New Guinea; there are 4 collections from the Frieda River in the south of the West Sepik district, and 4 more from the Ambunti area of the East Sepik district.

Ecology: Generally an understorey tree in primary forest; 100–850 m.

Notes: Although very like *E. sepikanus, E. pachyanthus* is easy to recognize in flower; the combination of thick, ovate, scarcely divided, hairy petals and long-petioled hairy leaves is unique in Papuasia. Ripe fruit is needed.

66. Elaeocarpus sarcanthus Schltr *Bot. Jb.* **54**: 138 (1916). **Fig. 33.**

Trees 18–28 m tall. Twigs robust, glabrous, often with minute stipules. Leaves clustered towards the tips of the twigs; petioles 2·5–6 cm long, glabrous, straight, thickened at each end; blades ovate-oblong to oblong-elliptic, often relatively narrow, 9–18 × 4–6·5 cm, acute and sometimes acuminate at the tip, rounded or broadly tapering at base, tough, glabrous, fine venation prominent on both surfaces, main nerves only a little more prominent beneath, often with domatia in their axils, margins almost entire to coarsely serrate-crenate. Inflorescences borne ± amongst the leaves (sometimes the leaves fallen in fruit), often many, 9–13 cm long with ± fine appressed hairs, bearing 6–17 flowers on stout pedicels 8–13 mm long and recurved at tip. Sepals 7–9 × 2–2·5 mm, thick, tough with short appressed hairs outside, usually with a central glabrous area and short dense felty hairs near the tip and margins, sometimes hairy all over. Petals creamy-orange, irregularly ± oblong, 7–9 × 2·5–4 mm, thick, tough, somewhat incurved but not strongly so, margins inrolled, with a central swollen keel inside, the tip ± truncate, sometimes a little broader than the rest, divided into 5–7(–9) narrow acute teeth up to 1·5 mm long, densely hairy throughout, hairs rather silky and long. Disc hairy, 5-lobed, the lobes not very large and themselves bilobed. Stamens 30–55; filaments 1–1·5(–2) mm long; anthers 2–3 mm long, excluding the variable awn 0·5–1 mm long. Ovary short-hairy, thick-walled, 2(–4)-locular; ovules 8–12 per loculus; style 3–4 mm long, glabrous towards the tip. Fruit blue-green to purple, ovoid, up to 13 × 8 mm when dried, skin and flesh wrinkling on drying, distinct from stone, sometimes with some weak radial fibres; stone surface rugose to sculptured, 2–3 mm thick, and with

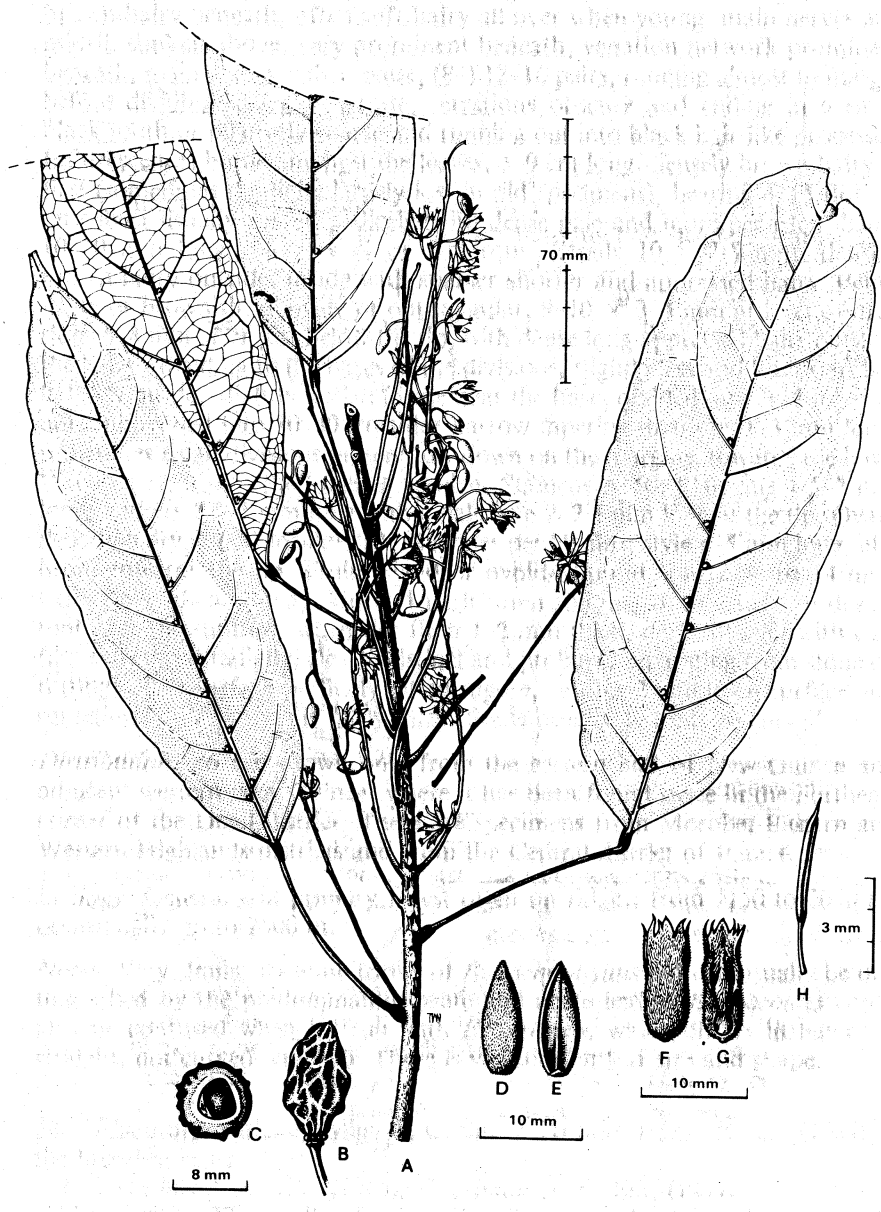

Fig. 33 **Elaeocarpus sarcanthus** Schltr (A) leafy twig with flowers (B) dried fruit (C) cross-section of dried fruit; seed not clearly showing curved embryo (D) sepal outside (E) sepal inside (F) petal outside (G) petal inside (H) stamen

sutures obscure. Seed 1; many fruits seedless, when the 2 loculi remain open and empty. Embryo curved.

Field characters: Once reported with stilt-roots; the crown may be narrow or widespreading.

Distribution: Scattered in the highlands. Known from a few specimens from Idenburg River in the Jayapura district of western New Guinea, the southern mountains of the West Sepik district, and the Finisterre Range in Madang district. It seems fairly common in the Morobe, Eastern and Western Highlands districts, and was found once in the Doma peaks of the Southern Highlands and once near Woitape in the Central district of Papua.

Ecology: Primary forest, often on ridges or in open places; also often found in secondary regrowth; 1600–2300 m.

Notes: While distinct in flower, sometimes very difficult to separate from *E. lingualis* in fruit or sterile; generally the leaves of *E. sarcanthus* are smaller or narrower, and the inflorescences are amongst the leaves, not behind them.

67. Elaeocarpus sepikanus Schltr *Bot. Jb.* **54**: 135 (1916). **Fig. 34.**

Trees 18–20 m tall. Twigs moderately robust, glabrous or minutely hairy, sometimes with small stipules. Leaves loosely clustered towards twig tips; petioles 3–5·5 cm, glabrous, straight, ± thickened at each end; blades elliptic, sometimes narrowly so, 9–16 × 3·5–7·5 cm, the tip acute, often acuminate, broadly tapering or rounded at base, usually fairly tough, glabrous, main veins slightly raised beneath, margins entire to serrate. Inflorescences borne amongst or below the leaves, slightly hairy, bearing 15–25 flowers on pedicels 8–10 mm long. Flowers 4–5-merous. Sepals 5–7 × 1·5–2·5 mm, ± appressed-hairy outside, inside glabrous or appressed-hairy near the margins and tip only, not or only very slightly keeled. Petals ovate, 5·5–6·5 × 1·5 mm, incurved, thick, margins inrolled, with a central swollen keel inside near the base, densely shining-hairy on both sides, the tip acute and entire or sometimes with 2–3 minute teeth. Disc hairy, indistinctly lobed. Stamens (37–) 50–60; filaments 0·5–1·5 mm long; anthers 2·5–3 mm long, acute at apex but not awned, rarely ± apiculate to 0·5 mm. Ovary hairy, 2-locular; 12 ovules per loculus; style 3·5–4 mm long, hairy or almost glabrous. Fruit ovoid and not usually exceeding 11 × 7 mm when dry, skin and flesh wrinkling on drying, skin sometimes separating from flesh, flesh 1–2 mm thick, often with ± radial fibres occasionally difficult to detach from the stone; stone surface occasionally weakly longitudinally 2-ridged, rugose to sculptured, 2 sutures visible on surface and obscurely in T. S., walls *c.* 1 mm thick. Seed 1. Embryo curved.

Field characters: Occasionally slightly buttressed, usually not.

Distribution: Perhaps endemic to Papuasia, not in the Solomon Islands. There are many specimens from the Vogelkop and Jayapura districts and 1 each from the Geelvink Bay and Digul districts of western New Guinea. In northeastern New Guinea it appears common in the West and East Sepik districts, and less common in Madang and Morobe. There are several speci-

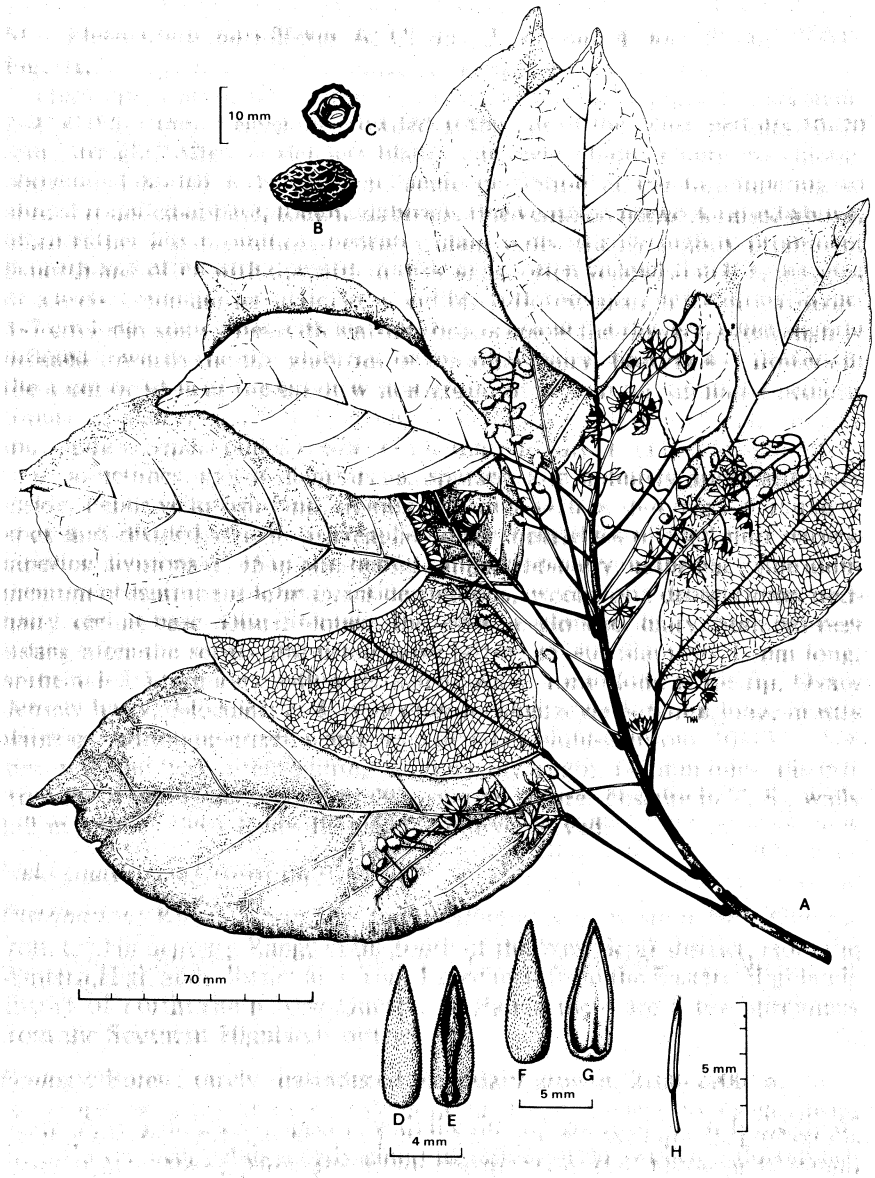

Fig. 34 **Elaeocarpus sepikanus** Schltr (A) leafy twig with flowers (B) dried fruit (C) cross-section of dried fruit; note single seed with curved embryo cut through twice (D) petal outside (E) petal inside (F) sepal outside (G) sepal inside (H) stamen

mens from the Western district of Papua and 1 from the Gulf district. There is also 1 specimen from near Talasea in New Britiain and 1 from Manus Island.

Ecology: Usually primary forest, sometimes by rivers or in damp places, or on slopes or ridges; sea level to 800 m, sometimes up to 1200 m.

Notes: Rather variable species; flowers and fruit size, leaf shape and size, and twig thickness are perhaps the most obvious variables; more good flowering material correlated with ripe fruit is needed. Not easy to separate from *E. lingualis, E. elatus* and *E. sarcanthus* without flowers; occasional sterile specimens could resemble some forms of *E. culminicola.* It is possible that more than one taxon is involved here; see discussion in Coode (1978, pp. 240–1).

Elaeocarpus sp. ?nov. 6.

Differs from *E. sepikanus* in having longer petals, 9–10 mm long, with 2–4 teeth at apex up to 1mm deep, and anther awns 1–1·5 mm long. Known from flower fragments and leafy twigs only.

Distribution: 1 specimen from near Kavieng in New Ireland.

Ecology: Disturbed forest, garden regrowth, near sea level.

Notes: This appears to be a new species in Group VIII subgroup D, though the material is inadequate for formal description and naming. Also rather like *E. floridanus,* but differs in the densely hairy ovary.

Group IX

Ovules 8 per loculus; loculi 2; ovary hairy. Embryo unknown. Petals small, thin and flat, short-hairy but not densely so, with a few irregular broad divisions at the tip. Stamens *c.* 15; anthers without awns. Leaves small. Inflorescences amongst and below the leaves. Fruit unknown.

68. Elaeocarpus schoddei Weibel *Candollea* **26:** 372 (1971).

Trees up to 29 m tall. Twigs slender, hairy or sparsely hairy when young. Leaves set densely along the twigs; petioles 1·3–1·6 cm long, slender, appressed-hairy; blades elliptic, 6·5–7 × 2·5–3 cm, acute and acuminate at the tip, tapering at base, sometimes abruptly so but not rounded, ± papery, appressed-hairy beneath at least when young, especially on nerves, rarely subglabrous, main veins slightly raised beneath, margins crenulate-serrulate. Inflorescences scattered among the leaves, 2–3·5 cm long, slender, flexuous, hairy, bearing *c.* 6 flowers (some right to base) on slender pedicels 2–6(–8) mm long. Flowers 4-merous. Sepals *c.* 3 × 1–1·5 mm, thin, hairy outside, sparsely hairy inside. Petals cream, ± obovate, 3·5–5 × 1–2 mm, thin, flat, hairy outside, subglabrous inside, irregularly divided into 5–7 unequal ± triangular teeth up to 1·5 mm deep. Disc inconspicuous, ± obscured by hairs. Stamens 10–15; filaments up to 1mm long; anthers *c.* 1 mm long without awn or acumen. Ovary densely short-hairy, 2-locular; 6 ovules per loculus; style 1–2 mm long, mostly glabrous. Fruit unknown.

Distribution: So far known from 4 collections, all from near Port Moresby in the Central district of Papua, 1 at Sirinumu, 3 at Ower's Corner.

Ecology: Rainforest, gallery forest, 450–700 m.

Notes: Resembling *E. altigenus* or *E. sayeri* in general appearance, but can be distinguished by the thin, flat, irregularly lobed, less hairy petals and awnless anthers. *E. fulgens,* listed at the end of the genus, also resembles *E. schoddei* in facies and stamens but has hairier leaves.

Group Unknown

Elaeocarpus sp. ?nov. 7.

Quite distinct from all other species in Papuasia with narrow-elliptic leaf blades, 5–7·5 × 1·4–2·4 cm, the tips acuminate but the acumen blunt, ± glabrous when mature, with rather prominent main veins and slightly less prominent network beneath and very regularly serrate-crenate margins. Ovary densely hairy. Young fruit ellipsoid, blunt, *c.* 7 × 4 mm. Seeds not seen.

Distribution: A single specimen from Rossel Island, in the Papuan Islands.

Ecology: Ridge forest at 600 m.

Notes: Material inadequate for formal description, naming, or assignment to a group.

Elaeocarpus sp. ?nov. 8.

Differs from *E. multisectus* in having widely spaced blunt teeth on the leaf margins and fewer leaf nerves which are less prominent beneath. Only fruiting material known; fruits ellipsoid, like *E. multisectus.* Seed 1. Embryo straight.

Distribution: A single specimen from Mt Popomanasiu, Guadalcanal, Solomon Islands.

Ecology: 1350 m, said to be frequent.

Notes: The leaves resemble those of *E. cassinoides* A. Gray from Fiji, whose position is uncertain, belonging either to section *Dactylosphaera* (Group II — 2 ovules per loculus) or section *Fissipetalum* (Group V subgroup D — petals like those of *E. arnhemicus).* However, all descriptions give the loculus number of *E. cassinoides* as 2 whereas the specimen from Guadalcanal is clearly 3-locular. Flowering material is needed before formal description and naming can be undertaken.

The following, recently-described, species has not been assigned to a group.

Elaeocarpus bilongvinas Coode *Kew Bull.* **35**:247 (1980).

Tree, 8 m tall. Twigs slender, ± densely hairy at first, later glabrous. Leaves grouped at the twig-tips; petioles 1–3(–4) mm long, sometimes almost absent; blades obovate or obovate-elliptic, (15–)25–35(–40) × 10–17 mm, the tip acute, rarely rounded, sometimes acuminate, the base tapering gradually into the petiole, papery, hairy on the veins at first, finally ± glabrous, veins slightly prominent above and more so beneath, margins distantly slightly

crenate. Inflorescences on old twigs, slender and fragile, hairy like the young twigs, 1·5–2·6 cm long, pedicels 5–6 mm long. Flowers 4-merous. Sepals narrow-triangular, 2·5 × 0·8 mm, with sparse short appressed hairs outside, minutely and densely felted on the margins inside. Petals obovate-elliptic, 2·25 × *c.* 1 mm, divided into 8–10 relatively wide, rounded, thin and flat laciniae, sometimes not deeply divided but the lateral laciniae almost halfway down the margin, glabrous. Disc a continuous weakly 4-cornered cushion, densely short-velvety-hairy. Stamens apparently 4–5, inserted on the disc at the base of the ovary, glabrous; filaments to 0·5 mm long, anthers less than 1 mm long, rounded-truncate and slightly flattened at the tip with 2 equal unawned teeth. Ovary 3-lobed, 3-locular, broad ovoid, with rather sparse, relatively coarse hairs; style *c.* 0·5 mm long, stout, 3-fluted and tapering, glabrous, early-caducous; ovules 2 per loculus. Fruit unknown.

Distribution: Known only from near Busilmin airstrip, West Sepik district, northeastern New Guinea.

Ecology: Ridge-top in secondary montane forest.

Notes: This species does not fit readily into any of the established infrageneric groups; for discussion, see Coode, *loc. cit.* above. In the key to flowering material of *Elaeocarpus, E. bilongvinas* would key out either at alternative 10 *(E. crenulatus* — but petals are not hairy on the back) or 28/29 near *E. marafunganus* or *E. arnhemicus.*

NAMES UNACCOUNTED FOR IN THE GENUS ELAEOCARPUS

Group II

Elaeocarpus heptadactylus Schltr *Bot. Jb.* **54**: 114 (1916), f.4.

Collected in the remote Schrader Range of the Madang district (never botanically explored since), this may be distinct, with its obovate leaves with brown-felty hairs beneath. No specimen known to have survived. Possibly part of *E. dolichodactylus* as treated here.

Elaeocarpus pachydactylus Schltr *Bot. Jb.* **54**: 113 (1916).

From the Sepik River area, said to differ from *E. dolichodactylus* in hairy inflorescence rachis and larger petals, both variable characters. No specimens known to have survived. Probably part of *E. dolichodactylus.*

Elaeocarpus pentadactylus Schltr *Bot. Jb.* **54**: 111 (1916).

Collected in the same general area of the Sepik as *E. cephalodactylus;* small-leaved, with 5-lobed petals. From the description it would differ from *E. marafunganus* in shorter racemes and entire leaf margins. No specimen known to have survived. Probably part of *E. dolichodactylus* as treated here.

Group V subgroup A

Elaeocarpus cuneifolius Schltr *Bot. Jb.* **54**: 126 (1916).

Described from a single collection from the Kani Mountains in the south-east of the Madang district of northeastern New Guinea. Described as having large leaves 20–23 cm long, glabrous, and 'cuneate-oblanceolate' in shape.

Allied by Schlechter to *E. dolichostylus.* No specimen is known to have survived.

Elaeocarpus terminalioides Schltr *Bot. Jb.* **54**: 125 (1916).

Described from 3 collections from the East Sepik district. The leaves have very short petioles and are about 12–16 cm long. It is likely to be a distinct species, judging from the description and the 1 sterile specimen that is known to exist, with much smaller flower parts than *E. buderi;* further differences are the leaves sparsely but distinctly hairy beneath, and the altitude range from 850 to 1300 m. In view of the difficulties in this subgroup it seems better to list *E. terminalioides* here and wait until it is collected again.

Group V subgroup D

E. roseo-albus Schltr *Bot. Jb.* **54**: 119 (1916).

Schlechter considered this to differ from *E. polydactylus* in having shorter pedicels, smaller flowers, and petals with only 7 divisions. While it is possible that *E. roseo-albus* would now be considered to be part of the *E. polydactylus* group, the petal charater may be sufficient to keep it separate. See Coode (1978) for discussion. No specimen known to have survived.

E. divaricativenus Kan. & Hat. *Bot. Mag. Tokyo* **56**: 317 (1942).

Described from 2 collections from the Arfak Mountains of the Vogelkop in western New Guinea. From the description and illustration this seems to be most like *E. arfakensis,* but the ovate leaves figured have not otherwise been noted for that species. Presumably the type exists but it could not be obtained for study.

Group VIII

E. clethroides Schltr *Bot. Jb.* **54**: 136 (1916).

Described from 4 specimens in flower bud and fruit collected in various places near the Sepik River; very like *E. lingualis* but the sepals are only partially hairy inside. Duplicates of 3 of the collections exist, but are scrappy, and buds too young. More material from these Sepik localities is needed.

E. compactus Schltr *Bot. Jb.* **54**: 138 (1916).

Described from 2 collections from south of Ambunti in the East Sepik district. Perhaps distinct; it is said to have short few-flowered racemes, only 20 stamens and short petioles. No specimen known to have survived.

E. dallmannensis Kan. & Hat. *Bot. Mag. Tokyo* **56**: 316 (1942).

Described from a single specimen from near Nabire, Geelvink Bay, western New Guinea. From the description and illustration it seems likely that this would be considered part of *E. sepikanus* or *E. ledermannii.* The specimen presumably exists but could not be obtained for study.

E. flavescens Schltr *Bot. Jb.* **54**: 139 (1916).

Described from a single collection in the same locality as for *E. compactus* and said to be different from it in narrower leaves with shorter stalks, and longer racemes with more flowers. No specimen known to have survived.

E. mallotoides Schltr *Bot. Jb.* **54**: 142 (1916).

Described from a single specimen from southeast of Ambunti in the East Sepik district. Schlechter commented that the species is remarkable for looking like a *Mallotus* sp. (Euphorbiaceae) with striking thick brown hairs on twigs, petioles and racemes. The leaves were 12–15 × 5·5–7 cm; some specimens of *E. trichophyllus* might be similar in habit, but the petals are clearly stated to be oblong-lanceolate. No specimen known to have survived.

Groups Unknown

E. amabilis Kan. & Hat. *Bot, Mag. Tokyo* **56:** 315 (1942).

Described from imperfect material, a collection from the summit of Mt Koebre in the Arfak Mountains of the Vogelkop, western New Guinea. From the drawing and description *E. amabilis* appears most like *E. altigenus* or *E. sayeri,* neither of which is known from as far west; besides, the petals are much less hairy. Presumably the type exists, but could not be obtained for study.

E. cheirophorus Schltr *Bot. Jb.* **54**: 121 (1916).

Described from a single specimen from the Schrader Range in the southeast of the East Sepik district. The combination of characters given by Schlechter, if correct, would make it a distinct species: smallish glabrous leaves, few-flowered racemes, 'hand-shaped' petals densely hairy on the back, glabrous ovary, 4-ovulate loculi. Possibly most like *E. crenulatus* with rather larger leaves. No specimen known to have survived.

E. firmus Knuth *Fedde, Rep.* **48**: 75 (1940).

Described from Ogeramnang in the Huon Peninsula, Morobe district. The material was inadequate, lacking ovaries; the description of what does exist is also inadequate. The anthers are blunt and the flowers not large; leaves ovate up to 9 × 7 cm, ± glabrous. A sterile isotype has been seen and resembles specimens currently placed with *E. leucanthus,* but which are probably specifically distinct.

E. fulgens A. C. Sm. *J. Arnold Arbor.* **25**: 269 (1944).

Described from 2 specimens from 1150 m near the Idenburg River, Jayapura district, western New Guinea. Sepals and petals are unknown. Smith allied it to *E. altigenus* and *E. luteolus.* Specimens seen suggest rather that it be closer to *E. schoddei* of Group IX, with blunt awnless anthers. In fact the only difference with *E. schoddei* that the current material shows is that the leaves of *E. fulgens* are much hairier beneath. Material with perfect flowers is needed to resolve this difficulty.

E. fuscus Schltr *Bot. Jb.* **54**: 140 (1916).

Described from 1 collection from the Schrader range in the southeast of the southeast of the East Sepik district. The illustration and description resemble *E. trichophyllus,* except that the petals are glabrous inside. However, the illustration clearly shows a branched inflorescence and an unlobed disc, more like a *Sloanea.* No specimen known to have survived.

E. hebecarpus Kan. & Hat. *Bot. Mag. Tokyo* **56**: 318 (1942).

Described from 1 fruiting collection from near Nabire in the Geelvink Bay, western New Guinea. The leaves are described as being long-petiolate, elliptic-oblong, 10–11 × 3·5–5·5 cm and silky-hairy beneath; fruits were globose, 6–7 mm across and hairy. It is not possible to suggest what it would most resemble. Presumably the type exists but it has not been possible to obtain it for study.

E. novomecklenburgensis Knuth *Feddes Rep.* **48**: 77 (1940).

Described from 1 collection from New Ireland with 1 other from the Huon Peninsula of the Morobe district. The description reads very much like *E. miegei,* and the Morobe district specimen seen certainly belongs there, but the type has apparently been lost. The petals, however, are described as hairy near the base outside; in *E. miegei* they are apparently consistently glabrous throughout.

E. schlechteri Knuth *Feddes Rep.* **50**: 87 (1941).

Described from 1 collection from near Finschhafen in the Morobe district. Again inadequately described, it is possible that with glabrous ± oblong leaves 12 × 3·5 cm on petioles up to 1 cm long, petals 5 mm long and anthers unawned, this is most similar to *E. kaniensis.* No specimen is known to have survived.

E. sterrophyllus Schltr *Bot. Jb.* **54**: 128 (1916).

Inadequately described from a single collection from the Cycloop Mountains near Jayapura in western New Guinea. From the few notes Schlechter published it is impossible to be certain, but the combination of petals nearly 3 cm long, a 5-locular glabrous ovary and leaves like those of *E. culminicola* is hard to place. The type may still exist but has not been seen.

SERICOLEA Schltr

Mischopleura Wernh. (1916); *Pyrsonota* Ridl. (1916); *Hormopetalum* Laut. (1918)

Shrubs or small trees. Leaves often stipulate, opposite, simple. Inflorescence short, sometimes with a few branches, the flowers borne in opposite bracteate pairs. Flowers 4–5-merous, small. Sepals free. Petals distinct from sepals, free, entire, emarginate or shallowly 3–5-lobed. Disc 5-lobed, the lobes emarginate to shallowly bilobed. Stamens 10–15; filaments about equalling the anthers, straight; anthers blunt at the tip, gaping at dehiscence, without awns or bristles. Ovary glabrous, 2-locular; loculi (2–)4-ovulate. Fruit a small berry, turning from green to red to purple or blackish on ripening; flesh succulent, formed from long radially arranged non-lignified cells; stone not developed, but seed cavity walls slightly lignified, thin and weak. Seeds 1–4, reniform-obovoid with a cap-like thickened area of seed coat at the tip, seed coat slightly succulent with a stony layer inside; endosperm present, cotyledons flat.

Field characters: The leaves are small or relatively narrow, often with striking silvery- or golden-sericeous indumentum; such species are very characteristic

and not readily confused with any other genus. Less shiny-hairy species are less characteristic; the combination of small, opposite, usually serrate, often free-stipulate leaves without oil dots should rule out most other genera although on the habit they could be taken for Ericaceae or one of the small-leaved myrtaceous genera. Small-leaved species of *Aceratium* are similar and flowers or fruits would be necessary for determination.

Distribution: Endemic to New Guinea.

Ecology: Montane or subalpine forests or shrubberies, often on margins or in ridge-forests.

Notes: The species limits are very difficult to determine; very few species are distinct and always clearly separable from the other. The following key should cope with the species as recognized here, but as there are a great many specimens intermediate between these species such specimens may not key out.

Owing to problems discussed in Coode (1978, pp. 246–7) this account is in a provisional state; 2 species, both probably new and distinct, are given letters only here and must await a thorough revision of the whole genus. In this account characters of the leaves and sepals are used to delimit species. Other floral details are too difficult to see or of no use in identification and have been omitted from the descriptions, as are the fruit details, which scarcely differ from species to species.

KEY TO SPECIES

1. Leaves up to 3·5 mm wide, usually less ..... **S. ridleyana**
1. Leaves all or mostly 4 mm wide or more
2. Pedicels and sepals glabrous outside
3. Leaves lanceolate, (2–)3–5 cm long ..... **S. calophylla**
3. Leaves elliptic to broadly elliptic or narrowly elliptic-obovate, up to 2·2 cm long
4. Leaves broad-elliptic, thick, margins inrolled, densely woolly-hairy beneath ..... **S. pachyphylla**
4. Leaves narrow-elliptic or elliptic-obovate, thin, ± flat, silky-hairy beneath ..... **S. collinsii**
2. Pedicels and sepals hairy, sometimes only obscurely so
5. Leaves basically ovate, up to 4 times longer than broad (some leaves may be relatively narrower), not usually more than 5·5 cm long.
6. Upper leaf surface with minute raised venation network, without main veins more conspicuous than the rest, main veins obscure or a little raised beneath; hairs fine, appressed, usually fallen from mature leaves ..... **S. sp. A**
6. Upper leaf surface with main veins more conspicuous than the venation network (sunken or prominent), or if as above then with main veins prominent beneath and with more persistent hairs; hairs various
7. Leaves rounded at base
8. Leaves minute, up to 17 × 8 mm, ± glabrous or sparsely hairy ..... **S. lamii**
8. Leaves larger or densely hairy or both
9. Leaves ovate, rarely lanceolate, 14–32(–36) × 7–11(–13) mm, long-acute or acuminate at the tip, with shining woolly-silky hairs beneath ± obscuring the main veins in mature leaves; main veins not very prominent even when not obscured by hairs ..... **S. pullei**
9. Leaves broad-ovate to ovate-elliptic, sometimes oblong-ovate, 20–70 × 9–20(–34) mm, obtuse or acute, often acuminate at the tip, with dense often matted shaggy hairs beneath obscuring the nerves usually in young leaves only; main veins very prominent in mature leaves ..... **S. gaultheria**
7. Leaves tapering at base ..... **S. sp. B**

5. Leaves basically lanceolate, at least 4 times longer than broad (some leaves may be relatively broader) or over 5·5 cm long
10. Leaves rounded at base ..... **S. pullei**
10. Leaves tapering at base
11. Leaves crowded, the tips pointing downwards, and with obvious coarse but narrow-pointed teeth ..... **S. calophylla**
11. Leaves scattered or if crowded then spreading, margins obscurely or finely serrate
12. Leaves (6–)8–12(–17) mm broad ..... **S. micans**
12. Leaves 15–22 mm broad ..... **S. brassii**

Sericolea brassii A. C. Sm. *J. Arnold Arbor.* **23**: 108 (1944).

Differs from *S. micans* in having larger or at least broader leaves (40–82 × 15–22 mm), with usually a glaucous underside ± covered with silvery hairs.

Distribution: Scattered in the Vogelkop, Jayapura and Snow Mountains districts of western New Guinea and the Western Highlands of northeastern New Guinea.

Ecology: Forest and shrubberies, 1850–2750 m.

Notes: Possibly not distinct, or better considered as one of the forms intermediate between *S. micans* and *S. gaultheria.*

Sericolea calophylla (Ridl). Schltr *Bot. Jb.* **55**: 194 (1918).

Pyrsonata calophylla Ridl. (1916); *S. decandra* A. C. Sm (1944).

Shrubs 3 m tall or more usually small trees up to 10 m. Twigs appressed-hairy or silky-hairy when young, later glabrous; internodes short, 6–10 nodes per 5 cm. Petioles *c.* 3 mm long. Leaves held with the tips pointing down, lanceolate, (20–)30–50(–63) × (4–)6–9(–12) mm including an acumen of *c.* 5–15 mm (the acumen may bear a short needle-point), base broadly tapered but often strongly inrolled so as to appear narrowly tapered, glabrous above or with fine appressed hairs on the midrib, glossy-appressed-hairy beneath, from silvery to golden, mostly golden when dried; venation distinct above and mostly ± obscured beneath, main veins stronger and branching in the outer *c.* two-third of the leaf; margins with distinct sharp teeth 2–3 mm apart, the teeth running out into a fine tip *c.* 1 mm long. Inflorescence axis 2–7(–12) mm long bearing (1–)2–4(–6) flowers on pedicels (4–)5–7(–8) mm long. Flowers 4–5 merous. Sepals 2–3 × *c.* 1 mm, hairy or glabrous outside, glabrous inside. Petals white or cream, obtriangular, 2·5–4 × 1·5–3 mm, with 2–3 lobes (the lobes occasionally subdivided into 2 or 3), or sometimes irregularly notched only, glabrous throughout or with scattered fine appressed hairs and margin of claw minutely hairy. Stamens (9–)10(–11).

Two subspecies may be recognized.

KEY TO SUBSPECIES

1. Sepals and pedicels glabrous to sparsely appressed-hairy ..... ssp. **grossiserrata**
1. Sepals and pedicels distinctly hairy ..... ssp. **calophylla**

ssp. **calophylla**

Differs from ssp. *grossiserrata* most noticeably in the hairy pedicels and calyx; the leaves have a larger range of size, being up to 63 × 12 mm.

Distribution: 2 specimens are known, 1 from Lake Habbema in the Snow Mountains of western New Guinea, and 1 from the Star Mountains in the south of the West Sepik district of northeastern New Guinea.

Ecology: Subalpine shrubbery, 3350–3500 m.

ssp. **grossiserrata** Coode *Brunonia* **1**: 240 (1978).

Distribution: So far known from about 15 collections from Mt Wilhelm and 1 from Mt Piora both in the Eastern Highlands district of northeastern New Guinea.

Ecology: Subalpine forest or shrubbery, not usually in the open; 3200–3700 m.

Notes: Occasionally specimens from other localities are found with the characteristic crowded downpointed leaves, but these lack the almost glabrous pedicels and calyces of subspecies *grossiserrata* and the very obvious sharp toothing of the species.

Sericolea collinsii Coode *Brunonia* **1**: 249 (1978).

Shrubs or small trees to 5 m tall. Twigs appressed-shining-hairy at first, later glabrous; internodes short to very short, 7–12 nodes per 5 cm. Petioles *c.* 1 mm long. Leaves elliptic to ± narrowly obovate, 14–22 × 4–6(–7) mm, not acuminate but the tip acute and usually bearing a distinct slender needle up to 1·5 mm long, base tapering, never rounded, appressed-silky-hairy beneath, greyish or silvery in life but apparently turning yellower with drying, venation network prominent above with stronger main veins, ± obscured beneath; margins ± inrolled in basal half, serrate, the teeth more distinct in the upper half but never very distinct. Inflorescence axis 1–5 mm long, ± appressed-hairy, bearing (1–)2–4(–6) flowers on glabrous pedicels 4–7(–8) mm long. Flowers 4-merous. Sepals 2 × 1 mm, glabrous outside, quite densely short-hairy inside. Petals white to cream, broad-obovate, 2–2·5 × 1·2–1·5 mm, glabrous or with a few hairs near the base, rounded and with 2–5 shallow wide irregular teeth at the tip. Stamens *c.* 8.

Distribution: 2 specimens from each of the Western and Eastern Highlands districts of northeastern New Guinea.

Ecology: Subalpine to 'alpine' shrubbery or forest margins, 3200–3600 m.

Notes: The glabrous pedicels and sepal outsides and small narrow-elliptic to obovate leaves make this species relatively easy to recognize.

Sericolea gaultheria (F. Muell.) Schltr *Bot. Jb.* **54**: 100 (1916).

Aristotelia gaultheria F. Muell. (1891).

Shrubs or trees up to 15 m tall. Twigs with dense short hairs; internodes (1–)2–4(–6) per 5 cm. Stipules present or not, up to 2·5 mm, linear or subulate, hairy at first. Petioles 2–4(–6) mm long; leaf blades ovate or sometimes elliptic, very variable in dimension, 20–70 × 9–20(–35) mm, acute or obtuse, acuminate or not, rounded or broadly tapering at base, often thick and leathery, variously hairy beneath, with dense matted hairs, or appressed-woolly or ± shining-hairy (not silky-hairy), sometimes the hairs fall in oldest

leaves; venation usually not very prominent above and with the main nerves distinguishable, rarely with the whole upper surface minutely reticulate, main nerves prominent beneath though sometimes obscured by the dense hairiness, margins sharply, moderately or weakly toothed, sometimes rolled under. Inflorescences (2–)4–14(–20) mm long, densely brown-hairy, bearing 2–6(–14) flowers on pedicels (4–)7–11(–15) mm long. Sepals 2–3(–4) mm long, usually densely brown-hairy outside and with less dense, greyer, shorter hairs inside. Petals 3–4 mm, ± glabrous, notched or weakly lobed at the tip. Stamens 12–15.

Two groups may be recognized.

KEY TO GROUPS

1. Leaf hairs soft-woolly beneath, usually not obscuring the main veins; main veins prominent beneath but not strikingly so; leaf blade acuminate at the tip, not very tough and thick ..... group **2**
1. Leaf hairs densely appressed-matted, rarely rather shining-appressed, often obscuring the veins in the younger leaves; main veins very prominent beneath; leaf blade obtuse, acute or acuminate at the tip, tough and thick ..... group **1**

group **1. Fig. 35.**

Sericolea gaultheria in the strict sense; *?S. arfakensis* Gibbs (1917); *S. lanata* A. C. Sm. (1944).

Within this group the leaves may be ovate or elliptic or oblong; the base is always rounded or subcordate.

Distribution: Apparently only twice collected in western New Guinea, from the Vogelkop and Jayapura districts; in northeastern New Guinea it is known from Madang, Morobe (several collections), Western Highlands and Eastern Highlands (several collections). In Papua, known from the Southern Highlands and Central districts. Within the districts the distribution is apparently very local, being found commonly on one mountain but not the next; i.e. known from Mt Otto but not from Mt Wilhelm.

Ecology: Montane forest, from 2150 to 3450 m.

Notes: There are specimens intermediate between groups 1 and 2.

group **2**

Leaf shape is more uniform in this group, being ovate-acuminate with a rounded or broadly tapered base.

Distribution: Known from the Morobe, Western and Eastern Highlands districts of northeastern New Guinea, perhaps from the Southern Highlands, and from the Central district of Papua. As with group 1, very local in its distribution, sometimes on the same mountain as group 1 (Mt Otto) or on different mountains (Mt Wilhelm).

Ecology: Montane forest and shrubbery, 2500–3400 m.

Notes: Group 2 is ± intermediate between group 1 and *S. pullei.*

Fig. 35 **Sericolea gaultheria** (F. Muell.) Schltr group 1, leafy twigs with flowers (A) typical form (B—C) other forms

Sericolea lamii O. C. Schm. *Nova Guinea* **14:** 152 (1924).

Differs from *S. pullei* in being almost glabrous throughout, with sparse hairs on the calyx and very short hairs on the growing tips. The leaves are all small, up to 17 × 8 mm, ovate, rounded to very broadly tapered at base, often with margins rolled under.

Distribution: Known certainly from only 1 collection (from Doorman Top, a mountain on the borders of the Jayapura and Snow Mountains districts of western New Guinea). A specimen from the Vogelkop may also belong here.

Ecology: At 3200 m, no further details.

Notes: Many more collections of small-leaved *Sericolea* species are needed, particularly from western New Guinea, before we can hope to understand the variation or judge specific limits confidently.

Sericolea micans Schltr *Bot. Jb.* **54:** 98 (1916). **Fig. 36.**

?S. chrysotricha Schltr (1916); *?S. elegans* Schltr (1916); *S. glabra Schltr (1916); S. salicina* Schltr (1916); *?S. werneri* (Laut.) Schltr (1919) and *Hormopetalum werneri* Laut. (1918); *?S. gracilis* (Laut.) Schltr (1919) and *Hormopetalum gracilis* Laut. (1918); *S. floribunda* A. C. Sm. (1944).

Shrubs or trees up to 15(–25) m; sometimes epiphytic, rarely climbers. Twigs appressed-silky-hairy to ± inconspicuously hairy, later glabrous; internodes 2–4(–6) per 5 cm. Stipules of irregular occurrence, apparently fairly persistent when present, linear, 3 mm long. Petioles 2–4 mm long. Leaf blades lanceolate, (30–)40–75(–90) × (6–)8–12(–17) mm, with an acumen 10–25(–30) mm long, often with a needle-point as well, base tapering usually with the margins rolled in at the base, ± papery, generally shining silky-hairy beneath, golden or silvery, sometimes dull and greyish, rarely very sparsely hairy to ± glabrous, main veins visible but never prominent, margins weakly serrulate. Inflorescences occasionally with a pair of opposite branches near the base, axis (3–)4–15(–26) mm long, bearing 2–7(–11) flowers on pedicels (7–)9–11(–14) mm long, appressed ± silky-hairy throughout. Sepals 2–2·5 × 0·5–1 mm long, appressed-hairy outside, minutely greyish-hairy inside (sometimes only sparsely so). Petals white, glabrous or with a few scattered hairs at the base, variously shallowly few-toothed or -lobed. Stamens 11–14.

Distribution: Widespread but scattered in western New Guinea, from the Vogelkop, Jayapura and Snow Mountains districts. Known in northeastern New Guinea from the West and East Sepik, Morobe, Western and Eastern Highlands districts, and from the Milne Bay district of Papua.

Ecology: Forest, often on margins, or disturbed areas of shrubbery, regrowth, etc.; twice recorded as a climber in tall forest; (850–)1300–2850 m.

Notes: A striking plant when it bears the shining silky hairs usual for the species. Differs from *S. decandra* in leaf arrangement and margin and *S. pullei* in having tapered leaf bases with the margins rolled under. Intermediates occur, particularly with *S. pullei* group 2.

Fig. 36 **Sericolea micans** Schltr (A, C) leafy twigs with flowers (B, D) leafy twigs with fruits. Different forms shown

Sericolea pachyphylla Coode *Brunonia* **1**: 256 (1978).

Shrubs. Twigs densely brown to blackish-hairy, finally glabrous, internodes 3–11 per 5 cm. Stipules, if present, obscured by hairs. Leaves broad-elliptic, 7–14 × 4–8 mm, obtuse to rounded at the tip, broadly tapering or rounded at base, very thick and tough, densely woolly-hairy beneath, venation network raised above and obscured by hairs beneath except for the prominent midrib, margins strongly inrolled and scarcely toothed. Inflorescences very short, bearing 1–2 flowers on glabrous pedicels 3–4 mm long. Flowers imperfectly known. Sepals 2·5 × 1 mm or less, glabrous outside, minutely and sparsely hairy inside. Petals white, obovate, *c.* 2 × 1 mm, not divided at the tip, glabrous. Stamen number unknown.

Distribution: 2 specimens are known, both from the summit region of Mt Amungwiwa, south of Wau, Morobe district.

Ecology: Alpine shrubbery, 3350–3500 m.

Notes: Very distinct with the combination of glabrous sepals and pedicels and very small, thick, obtuse, densely hairy leaves.

Sericolea pullei (Laut.) Schltr *Feddes Rep.* **16**: 32 (1919).

Hormopetalum pullei Laut. (1918).

Trees 3–12 m tall. Twigs persistently spreading-hairy; 3–7 nodes per 5 cm. Stipules persistent, linear, up to 2 mm long. Petioles up to 2 mm long, hairy. Leaf blades ovate to lanceolate, 14–50(–54) × (5–)8–14(–15) mm, acute at the tip or rarely obtuse, usually with a needle-point and sometimes long-pointed, gradually narrowing or acuminate, rounded at the base, not very thick, with appressed rather soft or woolly or silky-shining hairs beneath, main veins not very prominent or obscure, margin weakly serrulate. Inflorescence axis (2–)4–11(–13) mm long, occasionally branched near the base, densely brownish hairy, bearing (1–)3–6 flowers on pedicels 5–10(–13) mm long. Sepals *c.* 2 × 1 mm, hairy outside, minutely hairy inside. Petals white, ± obovate, *c.* 2 × 1–1·5 mm, glabrous, ± entire to weakly 2–3-lobed. Stamens 10–15.

Two groups may be recognized.

KEY TO GROUPS

1. Leaves ovate, 14–32(–36) mm long, 1·3–3·2(–4) times longer than broad; leaf hairs ± dull, not silky-shining ..... group **1**
1. Leaves lanceolate, (22–)32–56 mm long, (2·5–)3·2–5·2 times longer than broad or leaf hairs silky-shining or both ..... group **2**

group 1

S. pullei in the strict sense; *S. novoguineensis* Gibbs (1917); *S. venusta* A. C. Sm (1944).

Apart from the characters given in the key, group 1 tends to have shorter internodes (5–7 nodes per 5 cm).

Distribution: Known from a single doubtful specimen from the Vogelkop and several from the Snow Mountains districts of western New Guinea. There is a single collection from the Telefomin area of the West Sepik district in north-

eastern New Guinea and several from the Doma Peaks area of the Southern Highlands district of Papua. There are also 2 specimens from the Ok Tedi headwaters in the Western district.

Ecology: Nothofagus and mixed forest and regrowth, 2050–2850 m.

Notes: There are a few specimens ± intermediate between the 2 groups.

group **2**
Nodes 3–5 per 5 cm.

Distribution: Only known from the Western Highlands district of north-eastern New Guinea, and the Southern Highlands district of Papua.

Ecology: Generally mixed forest, 2000–2900 m.

Notes: Group 2 is not very distinct, and is somewhat intermediate between *S. pullei* and *S. micans,* from which it may be told by the rounded leaf bases.

Sericolea ridleyana (Wernh.) Schltr *Feddes Rep.* **16**: 32 (1919).
Mischopleura ridleyana Wernh. (1916).
Differs from all other *Sericolea* species in having very narrow leaves, not more than 3·5 mm wide. Leaf measurements: 14–17 × 2·5–3·5 mm.

Distribution: So far known certainly from only 1 collection, from the slopes of Mt Carstenz in the Snow Mountains of western New Guinea.

Notes: 1 further specimen, from Mt Piora in the Eastern Highlands district of northeastern New Guinea, may also belong here but has leaves up to 5 mm wide. More collections are needed.

Sericolea sp. **A.**
S. gaultheria in A. C. Smith's 1944 sense, in part; not (F. Muell.) Schltr.
Shrubs to small trees up to 5 m tall. Twigs ± appressed-hairy; (2–)4–6 nodes per 5 cm. Stipules *c.* 1 mm, linear, hairy when young, ± persistent. Petioles 2–4 mm long. Leaves often held point downards, ovate or ovate-lanceolate, 20–40(–55) × 8–15(–20) mm, the tip acute and usually acuminate, base rounded or broadly tapered, leathery, with dense or sometimes ± sparse, soft, dull, appressed hairs beneath (often similar above when very young), main veins not distinct above, fine venation reticulate and ± prominent, main veins weakly prominent beneath or obscured by hairs, margins ± obscurely serrulate. Inflorescences with appressed brown hairs throughout, the axis (5–)8–14 mm long, bearing (2–)4–8 flowers (occasionally branched and bearing up to 15 flowers) on pedicels (6–)8–10 mm long. Sepals 2–3 × *c.* 1 mm, appressed-hairy outside, minutely so inside. Petals white, obovate, 2–3 × *c.* 1·5 mm, rounded or slightly and irregularly notched at the tip, glabrous or minutely hairy on the back. Stamens *c.* 10.

Distribution: A few collections are known, all from a small area in the south of the Morobe district of northeastern New Guinea and in the Central district of Papua.

Ecology: Montane or subalpine forests and shrubberies, occasionally on the forest margin; 2750–3500 m.

Notes: Differs from *S. gaultheria* in the reticulately veined upper leaf surface and much less prominent main veins on the lower leaf surface.

Sericolea sp. **B.**

S. gaultheria in A. C. Smith's (1944) sense, in part, not (F. Muell.) Schltr.

Shrubs to small trees 3–8 m tall. Twigs appressed-hairy when young, sometimes the hairs silky; nodes 4–6 per 5 cm. Petioles 3–6 mm long. Leaf blades elliptic, sometimes ± ovate-elliptic, 25–50 × 10–16 mm, (2–3·8 times longer than broad), acute and acuminate at the tip, base tapered, never rounded, not very leathery, ± appressed-silky-hairy beneath, venation not distinct though main veins more prominent than the network, margins serrulate. Inflorescences ± silky-hairy throughout, axis 4–14 mm long, bearing 3–8 flowers on pedicels 8–16 mm long. Sepals 3–3·5 × *c.* 1·5 mm, hairy outside, much less hairy inside or ± glabrous. Petals creamy to yellow or perhaps white, obovate, *c.* 4 × 2 mm, glabrous, weakly few-toothed at the tip. Stamens 12–14.

Distribution: 3 certain and 2 less certain collections, all from the Central district of Papua.

Ecology: Forest, 2500–2850 m.

Notes: Distinct enough with the mostly elliptic, fairly broad, acuminate leaves with tapered bases.

NAMES UNACCOUNTED FOR

S. gjellerupii O. C. Schm. *Nova Guinea* **14**: 151 (1924).

Described from the Vogelkop; very like *S. pullei* with small broad-ovate leaves with rounded bases, but whose tips are blunt. Type material exists but more specimens are needed before a decision can be made on whether it should be considered a separate species or not.

S. leptophylla Kan. & Hat. *Bot. Mag. Tokyo* **56**: 320 (1942), f. 13.

Described from the Vogelkop. From the description this would seem to be like *S. lamii* but hairier. Much more material of the small-leaved *Sericolea* species is needed before the variation can be understood. The type presumably exists but could not be obtained for study.

S. ovalifolia (Wernh.) Schltr *Feddes Rep.* **16**: 32 (1919); *Mischopleura ovalifolia* Wernh. (1916).

Another plant with small leaves from western New Guinea (Snow Mountains). As with the preceding 2 names, more material is required before a decision can be made. The type exists at the British Museum.

SLOANEA L.

Small or large trees. Leaves stipulate or not, alternate or subopposite, rarely opposite, simple when mature but sometimes pinnate in the sapling stage. In-

florescences racemose, axillary or terminal, or ± fasciculate or flower solitary. Flowers with calyx and corolla (in Papuasia there are no apetalous species), which may be essentially similar or quite distinct when petals may be fused into a complete tube. Disc flat or rounded, unlobed though sometimes polygonal. Stamens many, inserted on the disc surface; filaments straight, stout, much shorter than to about equalling the anthers; anthers dehiscing by 2 slits at the tip separated by a beak or awn. Ovary hairy, 3–5-locular, with many ovules. Fruit a woody loculicidal capsule, smooth or spiny, spines persistent or caducous; seeds with arillodes firmly attached to the seed surface, partial or ± complete. Embryo flat with broad cotyledons.

Field characters: Sometimes partially or wholly deciduous; the fruit may persist during the leafless phase. Often buttressed. The bark is fairly uniform, grey, smooth or pustular, with hard granular dark yellowish, pinkish or orange-brown inner bark. The wood is usually fairly hard and pale.

Distribution: About 90 species, from India, Indochina, South China, Malesia, Australia, New Caledonia; Madagascar; tropical America. Apparently all the *c.* 18 species in Papuasia are endemic with the possible exception of *S. aberrans.*

Ecology: No detailed information is available; some species seem members of primary associations, others are usually found in disturbed habitats or secondary forest.

Notes: The genus is easy to recognize if open fruit is present. The only other genus in Papuasia with approximately similar capsules, *Flindersia,* has pinnate leaves.

Species limits in *Sloanea* in Papuasia are very vague. There are intermediate specimens linking nearly every group with others. Because of this a fairly wide species concept is adopted here, involving the reduction of a large proportion of published names to synonymy.

Following the current broad view of *Sloanea* in our area, originally proposed by A. C. Smith, the three genera of Schlechter's 1916 account *(Anoniodes, Echinocarpus* in Schlechter's sense, *Antholoma)* are considered synonymous with *Solanea.* The genus as a whole is not easily split into sections; it has not been found possible to use A. C. Smith's sectional arrangement in its entirety, and the sections as delimited here are probably only workable in our area. There can be no real improvement until the genus has been studied monographically. Unfortunately the important sectional arillode characters may be difficult to work with in dried material. The completely enveloping arillode typical of sections *Anoniodes* and *Cnidocarpaea* may resemble a hard seedcoat when dried. The partial arillode of section *Antholoma* is generally visible. More field observations on the arillode are needed, with spirit material; or a time-consuming study of seed sections of dried material.

KEY TO SECTIONS (FRUITING MATERIAL)

1. Fruit covered with a dense coating of short detachable ± irritant bristly spines ..... § **Cnidocarpaea**
1. Fruit smooth or with coarse persistent spines
2. Fruit smooth; arillode partial with a cap at the seed tip and a process extending to the point of attachment; leaves ± exstipulate at maturity ..... § **Antholoma**

2. Fruit with persistent spines, very rarely smooth; arillode ± completely enclosing the seed; all species with stipules but some specimens may lack them ..... § **Anoniodes**

KEY TO SECTIONS (FLOWERING MATERIAL)

1. Petals and sepals similar (though petals may be longer), never fused; stamens incurved, without awns though sometimes beaked, borne on a rounded disc, with short filaments; ovary short-spiny and/or densely long-hairy
2. Ovary short-spiny, the spines ± long-hairy; outer whorl of stamens sterile ..... § **Cnidocarpaea**
2. Ovary short-spiny, the spines short-hairy at most, or ovary merely hairy; all stamens fertile .. .. § **Anoniodes**
1. Petals clearly distinct from sepals, often fused into segments of irregular width or into a complete tube; stamens ± straight, awned, borne on a flat disc, filaments distinct; ovary velvety-hairy ..... § **Antholoma**

Section Anoniodes (Schltr) A. C. Sm. (1944)

Anoniodes Schltr (1916)

Apart from characters given in the keys this section includes all the racemose species from our area and all those with foliaceous stipules.

Notes: The recent discovery of 2 specimens, clearly belonging to 2 different species of this section, with the flower and aril characters of section *Anoniodes* but bearing non-spiny fruits like those of section *Antholoma* suggests that the occurrence of the kind of fruit spine otherwise found in this section is rather unimportant; it has also made sectional definition more difficult. Despite the disappearance of this easy 'spot' character it still seems worth recognizing the sections for our area. The presence of absence of stipules appears to be completely without significance in this section. However, when stipules are present the type of stipule seems of importance; *S. pulchra* and *S. speciosa* have linear stipules and the rest ± folicaceous stipules. These foliaceous stipules can be very striking; see Figs. 37 and 38. Even more remarkable are the large, coarsely serrate, pinnate juvenile leaves of *S. sogerensis,* with 2 pairs of lobed laterals and a deeply lobed terminal leaflet. Although definite evidence of other species with such pinnate juvenile leaves has not yet been found, deeply lobed leaves are seen on several specimens of *S. pullei* and *S. nymanii;* it is possible that all those species having foliaceous stipules also have pinnate juvenile leaves.

KEY TO SPECIES OF SECTION ANONIODES

1. Flowers in axillary racemes; stipules usually present and foliaceous, very rarely linear, sometimes absent
2. Open flowers up to 12 mm across
3. Leaf undersides and petioles brownish-hairy; most racemes exceeded by the leaves
4. Petioles up to 2·5 cm long ..... **2. S. ledermannii**
4. Petioles 3–6 cm long ..... **1. S. brachystyla**
3. Leaves scattered-pubescent or glabrous beneath, petioles ± glabrous; racemes often longer than the leaves ..... **3. S. nymanii**
2. Open flowers more than 12 mm across
5. Petioles and inflorescence rachis ± spreading-hairy; highlands only ..... **9. S. velutina**
5. Petioles and inflorescence glabrous or with short sparse hairs; lowlands to *c.* 1200 (–1500) m
6. Basal nerves of leaf more steeply ascending than the others, curving away from the midrib; inflorescences 17–37 cm long; petioles 3–14 cm long, glabrous; leaves ± glabrous .... **5. S. pullei**

6. Basal nerves of leaf more steeply ascending than the others, curving away from the midrib; 1·5–5 cm long, short-hairy (sometimes glabrous); leaves usually hairy, sometimes glabrous ..... **7. S. sogerensis**

1. Flowers in terminal racemes, often with the lower flowers solitary in leaf axils, or with all flowers solitary; stipules linear or absent or if foliaceous then flowers all solitary

7. Flowers all solitary on short (1–3 cm) recurved pedicels; stipules when present foliaceous ... . **6. S. pulleniana**

7. Flowers generally in terminal racemes, when solitary in axils then with longer pedicels (3–7 cm) usually spreading or angled up; stipules when present linear

8. Leaves glabrous or virtually so ..... **8. S. speciosa**

8. Leaves hairy at least beneath ..... **4. S. pulchra**

1. Sloanea brachystyla (Schltr) A. C. Sm. *J. Arnold Arbor.* **25:** 278 (1944).

Anoniodes brachystyla Schltr (1916); *Anoniodes parviflora* Schltr (1916) not *Sloanea parviflora* Planch. ex. Benth. (1861); *S. micrantha* A. C. Sm. (1944).

Trees up to 21 m tall. Young twigs hairy. Stipules irregularly foliaceous, up to 3 × 1 cm or absent. Leaves spirally arranged; petioles 2·5–4·5 cm, hairy, often thickened at each end; blades ovate to ovate-elliptic, 10–18 × 6–9·5 cm, the tip acute or obtuse, base rounded, truncate or slightly cordate, sparsely hairy beneath, margins entire or with shallow ± distant teeth, often wavy. Inflorescences lax, axillary, 4–12 cm long, hairy, bearing 8–20 flowers on pedicels 5–18 mm long. Sepals and petals ovate-triangular, *c.* 3 mm long, with short dense felty hairs on both sides, becoming reflexed. Stamens many, 1–2 mm long, acute but not awned. Style short, ± glabrous. Fruit 2–3·5 × 1–1·5 cm, valves 3(–4) with sharp broad-based spines 2–3 mm long, seed 1(?–2) per loculus.

Distribution: Scattered, uncommon. Known from the East Sepik district, from Karkar Island off Madang, and from near Kiunga in the north of the Western district of Papua. Other specimens may belong here, from near Jayapura in western New Guinea and the Western Highlands districts of northeastern New Guinea.

Ecology: Forest, 1000–2000 m.

Notes: S. brachystyla may well be seen to be conspecific with the variable *S. sogerensis.* The flower size is not easy to judge and there are no other constant characters.

2. Sloanea ledermannii A. C. Sm. *J. Arnold Arbor.* **25:** 281 (1944).

Anoniodes rufa Schltr (1916) not *Sloanea rufa* Planch. ex. Benth. (1861).

Trees up to 17–30 m tall. Twigs ± velvety-hairy. Stipules usually present at least on young twigs, asymmetrical, foliaceous, up to 2 cm long. Leaves ± spirally arranged; petioles 1–1·5(–2) cm long, stout, densely velvety or spreading-hairy; blades ovate to elliptic to obovate, 9–15 6–10 cm, usually acute or broadly acute at the tip, often constricted towards the base with the base itself truncate or cordate, hairy beneath, margins irregularly sinuous or ± serrate. Inflorescences axillary, condensed, 4–9 cm long, densely hairy, bearing *c.* 15 flowers on velvety pedicels 5–12 mm long; lower bracts sometimes like minute leaves, upper bracts lanceolate to linear. Sepals ovate, *c.* 3

mm long, felty-hairy on both sides; petals similar but up to 5 mm long. Stamens many, *c.* 1·5 mm long, filaments very short, apex acute not awned. Style *c.* 2 mm long. Fruit 2–3 × *c.* 2 cm (excluding spines), spines dense, sharp, up to 1 cm long though often less, generally 3-locular, the loculi 1-seeded at most (fruits often 1-seeded). Seed *c.* 1 cm long, arillode ± complete, red.

Distribution: Known from the Oksapmin area of the West Sepik district and from west of May River on the border of West and East Sepik districts; there are 5 specimens from Morobe district.

Ecology: Forest, often dominated by Fagaceae; rarely secondary forest; 1500–2000 m.

Notes: S. ledermannii may not be specifically distinct from *S. sogerensis,* but it is quite different from *S. brachystyla,* which has much longer petioles. There is enough difference in flower and fruit size to keep it separate from *S. sogerensis* for the present; more material is needed.

3. **Sloanea nymanii** K. Sch. in K. Sch. & Laut. *Nachtr.* 314 (1905).
Anoniodes nymanii (K. Sch.) Schltr (1916); *A. glabra* Schltr (1916); *S. glabra* (Schltr) A. C. Sm. (1944).

Trees 12–37 m tall. Twigs sparsely hairy at first, later glabrous. Stipules usually absent, if present small and irregularly foliaceous, rarely linear. Leaves alternate or sometimes subopposite; petioles 8–20 mm long, slender, glabrous or ± sparsely short-hairy, ± thickened at each end; blades narrow-elliptic to elliptic to elliptic-obovate, 6–9 × 2–5 cm, the tip acute to ± obtuse, sometimes notched, base broadly tapered to subcordate, glabrous or sparsely short-hairy beneath, margins entire, wavy, or with some wide-spaced teeth. Inflorescences axillary, (6–)10–12 cm long, occasionally with 2–3 branches, short-hairy to minutely velvety, bearing 15–30 flowers on slender pedicels 10–20 cm long (the pedicels nearer the base being longer than those near the tip); bracts linear, rarely ± foliaceous. Sepals and petals (3–)4(–5), ± ovate-triangular, 4–5 × *c.* 3 mm (petals may each be up to 8 mm long and ± elliptic), short-velvety on both sides, becoming reflexed. Stamens 50–70; filaments 0·5 mm long; anthers 2–2·5 mm including a thick awn *c.* 1 mm long. Ovary hairy and short-spiny at or soon after anthesis; style 1 mm long. Fruit up to 25 × 22 mm including spines, spines evidently fragile and easily broken, valves rather flat when dehisced, *c. 2–3* mm thick; loculi usually 1-seeded. Seeds *c.* 10 × 5·5 mm, usually covered by a reddish arillode.

Field characters: Often buttressed. 1 specimen of a sapling treelet has deeply pinnatifid leaves as well as some quite entire leaves with large stipules.

Distribution: Known from the East Sepik, Morobe and Eastern Highlands districts of northeastern New Guinea, and from the Central and Milne Bay districts of Papua. There is 1 specimen from Mimika in western New Guinea.

Ecology: Forest, secondary vegetation, old garden sites and grasslands, generally 400–2000 m, occasionally lower.

Notes: Fairly distinct in flower and fruit, with long inflorescences and ± glabrous leaves; sterile material could be confused with *S. pulleniana.* A few specimens show larger leaves and longer petioles.

4. Sloanea pulchra (Schltr) A. C. Sm. *J. Arnold Arbor.* **25**: 281 (1944).
Anoniodes pulchra Schltr (1916).

Trees 20–30 m tall. Twigs hairy. Stipules linear, up to 10 mm long, or absent. Leaves spirally arranged; petioles 1–3(–5) cm long, ± velvety-hairy; blades obovate or elliptic, occasionally ± ovate, 8–17 × 4–12(–12) cm, the tip acute or obtuse, base tapering to cordate, hairy or velvety-hairy beneath, margins obscurely and distantly toothed or coarsely sinuate or both. Inflorescences terminal or terminating lateral ± leafy shoots, densely hairy, up to 10 cm long, bearing 10–20 flowers on pedicels 2·5–5·5 cm long (the lower pedicels longer), lower flowers solitary in leaf axils (rarely all flowers solitary), bracteate near the tip; bracts ± linear, 10–18 mm long, occasionally with subsidiary linear lobes. Sepals and petals creamy-white, ovate-triangular, 13–15 (petals up to 25 mm) × 5–9 mm, eventually reflexed, densely hairy outside, hairs inside similar but shorter. Stamens *c.* 60; filaments *c.* 2 mm long, the inner ones much less; anthers 4–6 mm long, beaked. Ovary with dense long hairs obscuring the incipient spines at anthesis; style 5–10 mm long. Fruits spiny, 4(–5)-locular, spines ± dense, 4–20 mm long; seeds 1–2 per loculus, not known in good condition.

Two subspecies may be recognized.

KEY TO SUBSPECIES

1. Anthers densely hairy all round; lowlands ..... ssp. **morobensis**
1. Anthers ± sparsely appressed-hairy on the back; above 1000 m ..... ssp. **pulchra**

ssp. **pulchra**

S. aculeata A. C. Sm. (1944) in part, not the type; *S. clemensiae* A. C. Sm. (1944).

Apart from the difference in anther hairness and altitude it seems that the largest flowers of ssp. *pulchra* (with petals up to 25 mm long, ovary 6 mm, style *c.* 10 mm) exceed those of ssp. *morobensis;* it is also possible that fruits of ssp. *pulchra* (± globose, 2·5–3 cm, and spines *c.* 5 mm long) may be consistently smaller, and the longest petioles (up to 3 cm) shorter.

Distribution: Known from the Idenburg River of the Jayapura district of western New Guinea; from the south of the East Sepik district, and various places in the Morobe and Eastern Highlands districts of northeastern New Guinea; and from the Central district of Papua.

Ecology: Forest; 800–1900 m.

Notes: ssp. *pulchra* varies in leaf size, shape and hairiness.

ssp. **morobensis** Coode *Brunonia* **1**: 267 (1978).

Petals in this subspecies are up to 17 × 7 mm; ovary 4–5 mm long with a 5–8 mm style. Fruit: only 1 seen, dehisced and dry; the valves 5–6 × *c.* 2·5 cm. Seeds unknown, but clearly more than 2 per loculus.

Field characters: Often buttressed.

Distribution: The specimens that certainly belong here come from the Morobe district between Lae and Morobe; others, similar but insufficient for confident determination, extend the range to the West and East Sepik districts and to the Western district of Papua.

Ecology: Ridge tops and sides in mixed rainforest often with *Anisoptera,* sea level to 170 m.

5. Sloanea pullei A. C. Sm. *J. Arnold Arbor.* **35**: 277 (1944). **Fig. 37.**

Trees 15–30 m tall. Twigs glabrous to sparsely or minutely hairy. Stipules foliaceous, variously attached, dentate, 10–35 × 5–22 mm, glabrous or sparsely hairy; sometimes absent. Leaves mostly clustered spirally towards twig tips; petioles 3–10(–14) cm long, glabrous or sometimes sparsely hairy; mature blades very variable, sometimes lobed, ovate to obovate, 18–34 × 9–27 cm, the tip usually acute, sometimes obtuse, base tapering to cordate, glabrous or with a few hairs on the midrib beneath, basal nerves more steeply ascending than the others, usually curving outwards away from the midrib, margins dentate to serrate to ± entire. Inflorescences axillary, 17–26(–37) cm long, with short velvety hairs or ± glabrous, bearing (10–)20–50 or more flowers on velvety pedicels (15–)20–45 mm long, longer near the base. Sepals and petals ovate-triangular, 6–9 (–14 mm in petals) × 4–5 mm, acute, felty-hairy on both sides, finally reflexed; sepals often falling early. Stamens *c.* 70; filaments very short; anthers *c.* 3·5 mm long. Ovary densely pilose; style *c.* 2–3 mm long. Fruits ± 4 valved, 3–4 × 2–3 cm, spiny, spines variously sparse or dense, 10–20 mm long. Seeds generally more than 1 per loculus, completely enclosed in the arillode, not seen in good state.

Field characters: Sometimes buttressed. It is likely that the juvenile leaves will be found to be pinnate.

Distribution: Western New Guinea, from the Vogelkop mainly but also found in the Jayapura district. See below.

Ecology: Usually primary forest near sea level, occasionally in advanced secondary forest up to 650 m altitude.

Notes: The western New Guinea specimens are distinct but in the eastern half of New Guinea *S. pullei* intergrades in various ways with *S. sogerensis.* Such intermediates are known from the Sepik district, and from the Morobe, Western and New Britain districts. Some specimens also show characters not found in *S. pullei* or *S. sogerensis.* This very complex situation is grossly oversimplified in this account, but to work out the variation would entail more extensive field work than can be undertaken now. See Coode (1978, pp. 269–73) for further discussion.

6. Sloanea pulleniana Coode *Brunonia* **1**: 270 (1978).

Trees 10–20(–31) m tall. Twigs ± slender, usually minutely hairy when young. Stipules small, irregularly ± foliaceous, up to 8 × 3 mm, caducous, or absent. Leaves scattered, alternate; petioles (1–)2–3 cm long, minutely hairy or more usually glabrous; blades ovate to elliptic or sometimes ±

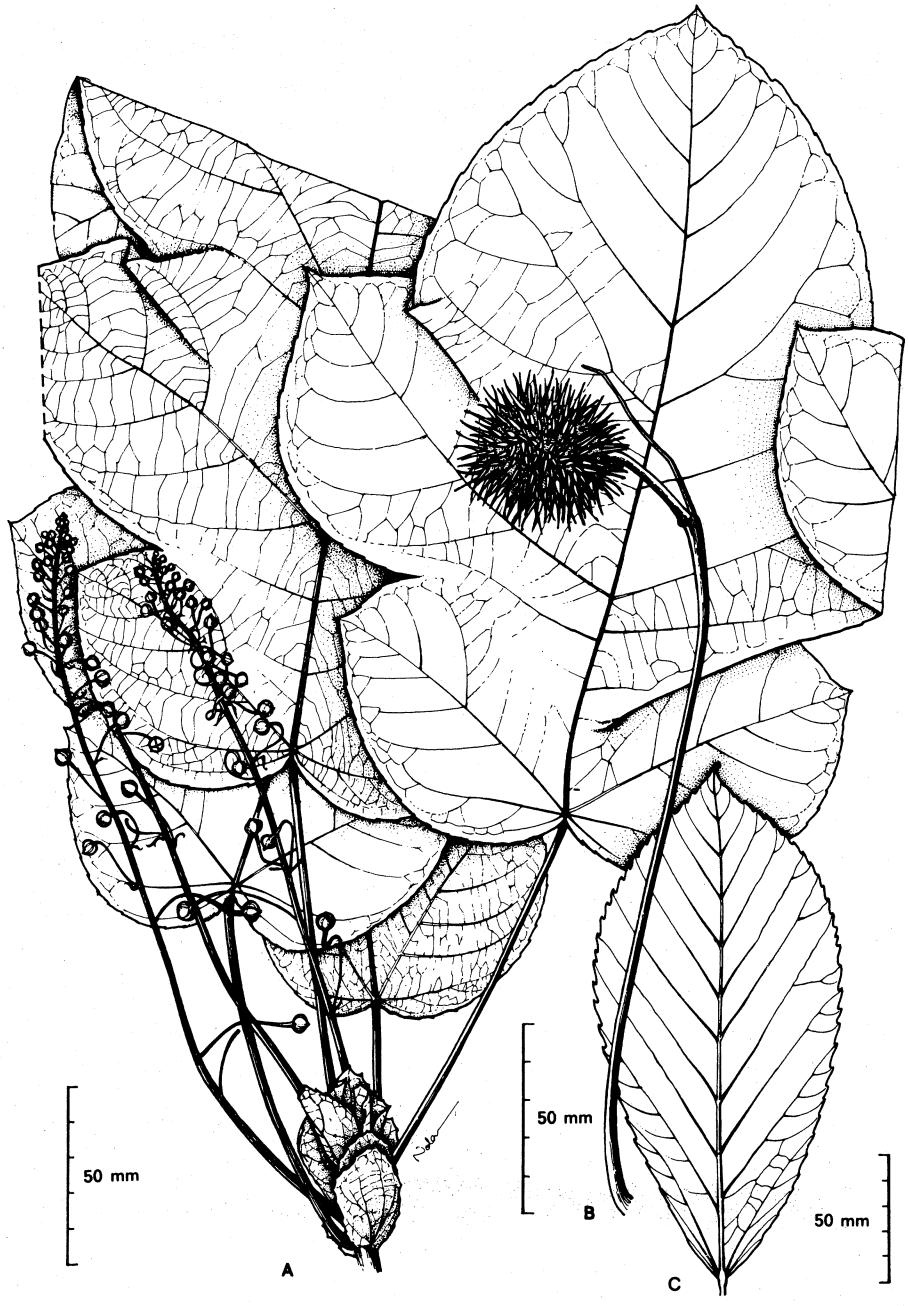

Fig. 37 **Sloanea pullei** A. C. Sm. (A) leafy twig with flowers in bud and stipules; typical form (B) fruiting raceme (C) leaf of small-leaved form

obovate, 5–17 × (3–)5–9 cm, tip obtuse or acute, base rounded, truncate, or cordate, glabrous or ± sparsely-hairy on nerves beneath, venation impressed above and prominent and reticulate beneath, margins ± serrate, sometimes obscurely so. Flowers solitary in leaf axils, on very finely felty-hairy pedicels 10–30 cm long, erect at base, nodding at the tip. Sepals ovate, *c.* 8 × 5 mm, acute, with short velvety hairs on both sides, brownish-yellow. Petals similar but paler. Stamens *c.* 35; filaments 1 mm long or less; anthers *c.* 5 mm, with a ± glabrous apical beak 1–1·5 mm long. Ovary densely hairy, shorter than the stamens; style *c.* 2 mm long. Fruit ± oblong, (16–)30–35 × (11–)15–20 mm, ± sparsely spinose, spines 1–5 mm long, rarely completely spineless, loculi 1–4-seeded. Seeds not seen in good state.

Distribution: 1 specimen is known from the Idenburg River of the Jayapura district of western New Guinea, and 1 from the Western Highlands district of northeastern New Guinea. Most of the specimens come from the Eastern Highlands district, with a few from the Central district of Papua.

Ecology: Forest, usually undisturbed; (850–)2000–2600 m.

Notes: In flower, *S. pulleniana* is distinct, with solitary flowers; in fruit it is less distinct, as a twig bearing solitary fruits is often leafless and may not be distinguishable from a fruiting raceme. In fruit or sterile, small-leaved specimens of *S. pulleniana* could be confused with *S. nymanii.* 2 of the specimens have smooth fruit, though generally the fruit is spiny.

7. Sloanea sogerensis Bak. f. *J. Bot. Lond.* **61**: suppl. 6 (1923). **Fig. 38.**

?Anoniodes sterculiacea Schltr (1916) not *Sloanea sterculiacea* Rehder & Wilson (1915); *S. oxyacantha* A. C. Sm. (1944).

Trees 10–40 m tall. Twigs ± robust, short-hairy at least when young. Stipules irregularly foliaceous, attached ± laterally, margins serrate, 0·5–2·7 cm long, rarely absent. Leaves spirally arranged; petioles 1·5–5 cm long, rarely more, hairy, ± robust, thickened at each end; blades of adult leaves simple, ovate to elliptic to elliptic-obovate, (10–)13–24(–32) × 7–15(–23) cm, the tip ± acute, base rounded, truncate, or cordate, hairy or even felty-hairy or glabrous, basal nerves ± parallel to the others, margins variously irregular-sinuate-serrate. Inflorescences axillary, 5–19 cm long, rarely more, short-hairy, bearing up to *c.* 30 flowers on pedicels 1–3(–4) cm long in the axils of usually linear bracts. Sepals and petals creamy, ovate-triangular, 7–10 (–14 mm in petals) × 5–6 mm, felty-hairy on both sides though sparser in the longer petals, acute, rarely the petals with a few small teeth at the tip, ± reflexed. Stamens *c.* 100; filaments very short; anthers 4–6 mm long, ± beaked. Ovary hairy; style partly glabrous, 2–3 mm long. Fruits mostly 4-valved, reddish when young, becoming dry and brown, 3–6 × 2–4 cm, very variable, spiny, spines weak or stout, sparse or dense. Seeds generally more than 1 per loculus and irregularly polygonal, arillode probably orange or red.

Field characters: Often buttressed. The juvenile leaves (probably not the first seedling leaves) are pinnate, with 1–2 pairs of lateral leaflets and a terminal leaflet. All leaflets are lobed or incised; the stipules are very prominent at this stage.

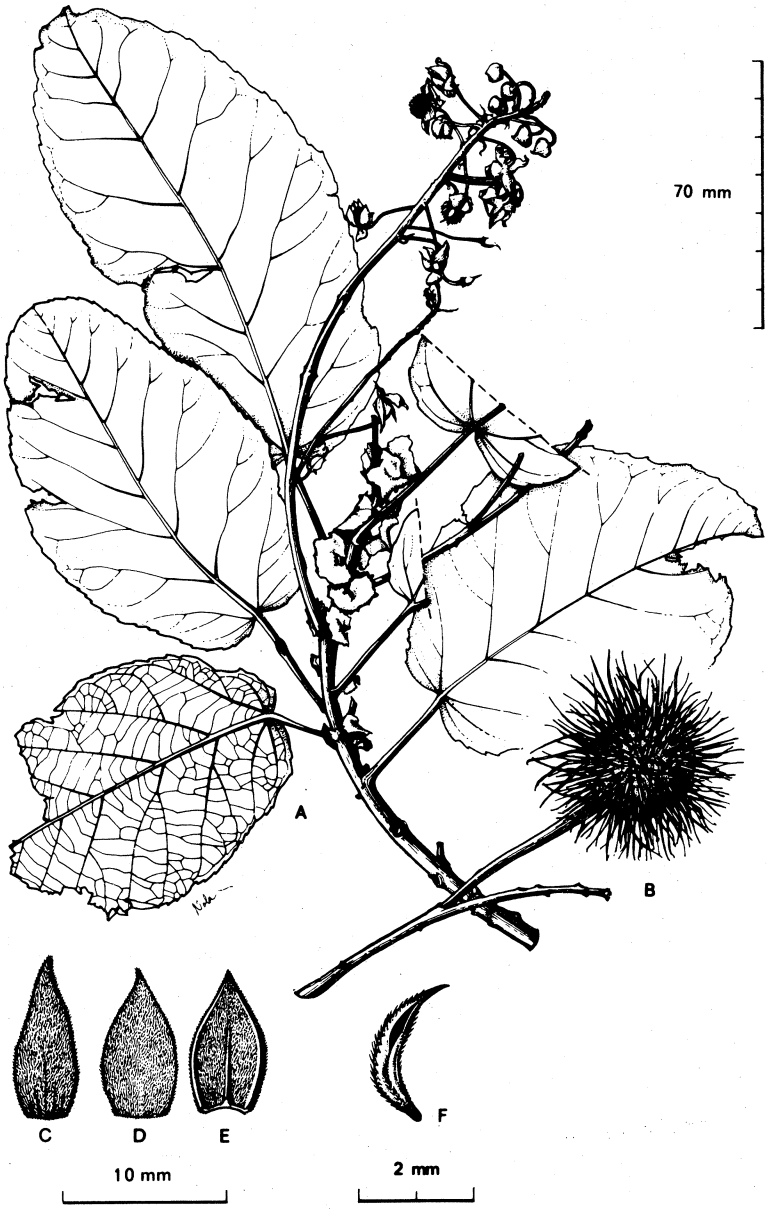

Fig. 38 **Sloanea sogerensis** Bak. f. (A) leafy twig with flowers and stipules (B) fruiting raceme (C) sepal outside (D) petal outside (F) petal inside (F) stamen

Distribution: There are specimens from the Jayapura, Snow Mountains (Wissel Lakes) and Digul districts of western New Guinea. In northeastern New Guinea, Papua and the Bismarck Archipelago it is known from every lowland district except the Gulf and Manus Island. Not known from the Solomon Islands. It seems particularly common in the Morobe district.

Ecology: Forest or disturbed areas, from sea level to 1000(–1700) m.

Notes: This description covers a wide range of variation, perhaps the commonest variant being ± glabrous. Certain rather distinct variants, often represented by only 1 or 2 collections, are included. *S. sogerensis* intergrades with *S. pullei;* in this case the types of *S. sogerensis* and *S. pullei* are quite different and ± represent the 'norm' of each group. Unfortunately the earliest name in *Sloanea* for our area, *S. schumannii* Warb., was probably based on 1 of these intermediates, judging by the description; the type has apparently been destroyed. The division of *S. sogerensis* and *S. pullei* is possibly too arbitrary; future workers may prefer to unite them and recognize subspecies with new descriptions for at least some of the variants, in which case almost certainly the complex would have to be called *S. schumannii* Warb. If such a broad view were taken then the possibility that *S. ledermannii, S. velutina* and *S. brachystyla* would also be included has to be considered.

8. Sloanea speciosa A. C. Sm. *J. Arnold Arbor.* **25**: 279 (2944).
?S. aculeata A. C. Sm. (1944), the type only.

Differs from *S. pulchra* in having relatively narrower leaves, 6–11 × 3–4·5(–5·5) cm, with acuminate or sharply acute tips, sparsely hairy beneath. Fruit unknown.

Distribution: Definitely known from 2 localities in the Morobe district of northeastern New Guinea. Possibly also western New Guinea; Idenburg River in the Jayapura district.

Ecology: Forest, 30–750 m.

Notes: Although easily recognized with its long-pedicellate flowers in terminal racemes and narrow, acute, sparsely hairy or glabrous leaves, the difference in anther idumentum between the 2 specimens is almost as much as that found in the 2 subspecies of *S. pulchra,* with the higher altitude type also being less hairy. This suggests that further collecting may fill in the gaps between *S. speciosa* and *S. pulchra,* resulting in *S. speciosa* being considered as another variant of the already variable *S. pulchra.*

9. Sloanea velutina (Schltr) A. C. Sm. *J. Arnold Arbor.* **25**: 282 (1944).
Anoniodes velutina Schltr (1916).

Trees 10–20(–45) m tall. Twigs robust, densely hairy when young. Stipules irregularly foliaceous, up to 15 × 8 mm, often caducous, hairy like the leaves. Leaves alternate or spirally arranged; petioles 2–4(–7) cm long, densely hairy; blades ovate to elliptic to ± obovate, often constricted between base and middle, 8–19(–30) × 6–12(–18) cm, the tip obtuse, sometimes notched, sometimes broadly acute, base usually cordate, sometimes truncate, densely hairy beneath, margins variably sinuous to dentate. Inflores-

cences axllary often with lower bracts like minute leaves, 5–9(–16) cm long, densely hairy, bearing 2–12 flowers on pedicels 8–20 mm long. Sepals ovate, 6–7 × 3–4 mm, acute, long-hairy outside, ± felty-hairy inside. Petals ± similar but felty-hairy throughout. Stamens *c.* 70, 3–4 mm long, with very short filaments; anthers ± beaked. Ovary long-hairy; style 1·5 mm long. Fruit 3·5 × 2·5 cm with spines 6–8 mm long; seeds 1–2 per loculus, 11–18 mm long, ± enclosed by the arrillode.

Field characters: Usually a small tree, rarely large; apparently unbuttressed.

Distribution: A few of the specimens were collected in the Morobe and Western Highlands districts, and the rest from the Eastern Highlands district.

Ecology: Usually in undisturbed forest, 1500–2300 m.

Notes: This is another species which is very similar to *S. sogerensis,* differing in dense long hairs and montane habitat. It differs from both the other 2 montane species in this relationship (*S. ledermannii* and *S. brachystyla)* in size of flowers and fruit, in density of indumentum from *S. brachystyla,* and in petiole length from *S. ledermannii.*

Section Antholoma (Labill.) A. C. Sm. (1944)

Antholoma Labill. (1800); *Sloanea* § *Pachycarpaea* A. C. Sm. (1944); *Echinocarpus* in Schlechter's 1916 sense, not in Blume's original 1825 sense. This section as delimited here includes all Papuasian species of *Sloanea* with fused corollas, whether partially or wholly. The fruits are always smooth and arillodes partial, i.e. with a cap covering the apex of the seed and a lateral extension or process to the hilum.

Field characters: The flowers are often showy. It seems likely that the fresh colours of arillodes, seed coats and interior of loculi of just-opened ripe fruits may well be important characters; unfortunately we have very little information on these.

Notes: Species limits are very difficult to decide in this section. In the following account there is apparently only 1 species which is not connected with the others by intermediates: *S. gymnocarpa.* Of the others, *S. insularis* is perhaps the least confused, probably because it overlaps geographically only with *S. forbesii* (in New Britain). All the others form a continuum, wide-ranging geographically, altitudinally and morphologically; within this continuum specimens can be grouped together in different ways, always leaving several intermediates unplaced. It is hoped that the key and species group suggested below leaves the fewest number of specimens unplaceable; the variation is, however, much more complex than this account implies.

KEY TO SPECIES OF SECTION ANTHOLOMA (flowering material)

1. Petals fused into a complete tube, occasionally partially (rarely completely) split in 1 or 2 places; flowers ± solitary in leaf axils
2. Sepals glabrous outside. Leaves leathery, glabrous ..... **15. S. lamii**
2. Sepals hairy outside, the indumentum often very short

3. Leaves and young twigs spreading-hairy ..... **16. S. streimannii**
3. Leaves and young twigs floccose-hairy and glabrescent, or glabrous, or if persistently hairy then hairs crisped, not straight and spreading ..... **17. S. tieghemii**
1. Petals separate, ± free, though often fused into irregular widths; flowers in ± fascicles or short racemes
4. Leaves acute and often acuminate, glabrous
5. Sepals hairy outside; Bismark Archipelago and Solomon Islands ..... **14. S. insularis**
5. Sepals glabrous outside; mainland New Guinea..... **11. S. anacantha**
4. Leaves rounded at the tip or obtuse, sometimes acute, usually not acuminate, glabrous or hairy
6. Leaves 13–30 × 8–18 cm
7. Petioles 2–7 cm long; leaves entire or obscurely sinuate, glabrous and leathery ..... **13. S. gymnocarpa**
7. Petioles 1–4·5 cm; leaves generally sinuate to serrate, glabrous or hairy, not leathery ..... **12. S. forbesii**
6. Leaves (6–)8–13 × 5–8 cm..... **10. S. aberrans**

10. Sloanea aberrans (Brandis) A. C. Sm. *J. Arnold Arbor.* **25:** 288 (1944).
Elaeocarpus aberrans Brandis (1899); *Echinocarpus papuanus* Schltr (1916); *?Sloanea coriacea* Ridley (1916); *S. papuana* (Schltr) A. C. Sm. (1944).

Trees up to 30 m tall but usually smaller. Twigs minutely hairy when young. Leaves opposite, subopposite or spirally arranged; petioles 8–30 mm long, glabrous; blades elliptic to obovate, often broadly so, (6–)8–13 × 5–8 cm, usually obtuse at the tip, sometimes acute, tapering to rounded at base, usually glabrous, sometimes hairy when young, rarely persistently hairy beneath, margins entire to obscurely sinuous-dentate. Inflorescence short-racemose or fasciculate, greyish-felty-hairy throughout, bearing 2–5 flowers (flowers rarely ± solitary), on pedicles 10–35 mm long. Sepals very variable, ± lanceolate-triangular, 6–15 × 2–5 mm, usually short hairy outside. Petals creamy, very variable, from 6 free petals to 4 equal or unequal petals, or fused with several deep splits (1 tree often yielding several types), 15–28 mm long, the segments toothed at the tip, shortly and ± sparsely felty-hairy in basal part at least. Stamens 23–108; filaments 1·5–3 mm long; anthers 2–4 mm long, with a flexuous awn 3–8 mm long at the tip. Style 8–14 mm long. Fruits 3–8 × 2·5–5 cm, 2–4-locular, valves generally ± rounded on the back. Seeds several per loculus, ± black or brown, arillodes partial, reddish-brown, thick and waxy or withered and papery, variable in shape.

Distribution: Common throughout mainland New Guinea. There are many specimens from the Vogelkop and a few from Geelvink Bay, Jayapura and Fakfak districts of Western New Guinea. Known from every district in northeastern New Guinea and Papua except the Gulf district; commonest in Morobe, Western and Eastern Highlands.

Ecology: Forest, disturbed or regrowth vegetation; (30–)1000–2800 m.

Notes: As delimited here, *S. aberrans* has extremely variable flowers, from 6 free almost equal petals through fewer irregular petals to a completely fused corolla. The leaves are considered diagnostic, being glabrous (with the exception of a few specimens from western New Guinea which have short close persistent indumentum), typically rounded at apex, of a fairly narrow size range, and with the fine venation not or little prominent. Future workers

may consider it to be conspecific with *Sloanea celebica* Boerl. & Kds known from about 3 scrappy specimens from the Celebes; this seems very similar and the name is earlier, but good specimens from the Celebes are needed before a decision can be made.

11. Sloanea anacantha A. C. Sm. *J. Arnold Arbor.* **25:** 289 (1944).

Differs from *S. aberrans* in acute, leathery, glabrous leaves with raised reticulate fine venation and the sepals glabrous outside.

Distribution: Known from 2 collections from the Central district of Papua.

Ecology: Forest, 1200–1300 m.

Notes: The petals are apparently free throughout. This may not be specifically distinct from *S. aberrans;* more specimens are needed.

12. Sloanea forbesii F. Muell. *Vict. Nat.* **9:** 111 (1892); *J. Bot. Lond.* **31:** 323 (1893).

Echinocarpus forbesii (F. Muell.) Schltr (1916).

Trees 10–35 m tall. Twigs generally short and sparsely hairy at least when young. Leaves opposite or spirally arranged; petioles glabrous or short-hairy, (1–)2–4·5 cm long; blades ovate, elliptic or obovate, 13–19(–30) × (7–) 8–12 (–18) cm, acute or obtuse at the tip, base tapering to truncate to subcordate, glabrous or short-hairy beneath, margins sinuate-dentate to ± entire. Inflorescences ± axillary, sometimes ± branched greyish-felty-hairy, bearing 1–4 flowers on pedicels 1–3 cm long. Sepals very irregular, 8–13 × 2–4 mm, hairy on both sides. Petals 4–6, greenish-white or cream, ± oblong or narrowly obovate, 15–22 × 4–7 mm, occasionally fused into wider segments but never fused into a complete tube even at base, finely ± appressed-hairy on both sides. Stamens *c.* 50; filaments 2–5 mm long; anthers 2–3 mm with a flexuous awn 2–6 mm long at the tip. Style 10–11 mm long. Fruit generally massive, 7–11 (–15) × 5–6·5(–10) cm, smooth, 3–5-valved. Seeds 3–6 per valve, 10–15 mm long, arillode generally thick and waxy but sometimes thin.

Field characters: Partially or wholly deciduous; during the leafless phase the fruits may persist. Often buttressed.

Distribution: Scattered in New Guinea and on New Britain. Known from the Idenburg River, Jayapura district, western New Guinea. In northeastern New Guinea known from both Sepik districts, Madang, Morobe (several specimens) and the Western Highlands. Known from the Western and Central districts of Papua, and from New Britain.

Ecology: Forest, sometimes in swampy places; also sometimes becoming dominant in abandoned garden sites; sea level to 1000(–1900) m.

Notes: Variable in leaf size and whether the leaves are hairy or not. Forms with smaller glabrous leaves are not easily distinguished from *S. aberrans* or *S. insularis;* the fruit is generally larger.

13. Sloanea gymnocarpa A. C. Sm. *J. Arnold Arbor* **25**: 288 (1944).

Differs from *S. forbesii* in the always glabrous leathery leaves, often longer petioles (2–7 cm), and in the fruit valves with lateral margins curled back after dehiscence, sometimes sulcate before dehiscence; the fruit is also probably much redder or more orange than the buff-brown fruit of *S. forbesii*.

Distribution: Very scattered in New Guinea; known from only 4 collections, 1 from the Garaina area of the Morobe district of northeastern New Guinea, 2 from the Palmer/Black River area of the Western district and 1 from the Gulf district of Papua.

Ecology: Forest; 750–1400 m.

14. Sloanea insularis A. C. Sm. *J. Arnold Arbor.* **25**: 290 (1944); Foreman *Bot. Bull.* **5** (Check List Vasc. Pl. Bougainville: 164–5 (1971), f.

Trees up to 30 m tall, usually less. Twigs glabrous or minutely hairy when young. Leaves opposite to alternate; petioles (1–)2–3(–4) cm long, usually glabrous, thickened at each end; blades ± elliptic, 8–16(–21) × 3–8(–11) cm, acute and often acuminate at the tip, cuneate towards a minutely rounded or subcordate base, glabrous, margins ± entire to sinuate-dentate. Inflorescences as in *S. forbesii* but never branched; flowers apparently quite regular and polypetalous (occasional sepal fusions may occur); otherwise as in *S. forbesii* but a little smaller (petals up to *c.* 16 mm long). Fruit short-ovoid to ± subglobose, 3·5–5 × 3–4 cm, otherwise as in *S. forbesii* but seeds probably fewer; fresh seeds creamy with yellow arillodes which are always thick and waxy.

Field characters: Often buttressed.

Distribution: Known definitely only from New Britain, New Ireland, scattered in the Solomon Islands, being known from Bougainville, Choiseul, New Georgia, Santa Isabel, Guadalcanal (several specimens), Malaita and several from Rennell Island.

Ecology: Primary forest, occasionally secondary forest, often on coralline limestone; sea level to 1100 m.

Notes: There is a specimen from Goodenough Island, in the Papuan Islands, which may belong here but has larger petals (up to 18 × 16 mm). There is also a sterile specimen from western New Guinea which looks similar.

15. Sloanea lamii A. C. Sm. *J. Arnold Arbor.* **25**: 294 (1944).

Antholoma papuana O. C. Schm. (1924) not *Echinocarpus papuanus Schltr* (1916) nor *Sloanea papuana* (Schltr) A. C. Sm. (1944).

Differs from *S. tieghemii* in having pedicels, sepals and corolla glabrous outside; from *S. anacantha* (the only other species in this section with glabrous pedicels, sepals and corolla) in having the petals fused into a tube. The leaves are elliptic, 8–15 × 5–7·5 cm, acute and acuminate, completely glabrous, leathery, margins obscurely sinuate to distantly denticulate, with prominent fine venation. Fruits unknown.

Distribution: Known from only 1 collection from western New Guinea, Doorman Top on the borders of the Jayapura and Snow Mountains districts.

Notes: S. lamii may be no more than a glabrous narrow-leaved form of *S. tieghemii* with pronounced fine venation network.

16. Sloanea streimannii Coode *Brunonia* **1**: 278 (1078).

Trees 7–20 m tall. Young parts densely spreading brown-hairy. Leaves opposite or alternate; petioles 10–25 mm, hairy like young twigs; blades ovate, elliptic or obovate, sometimes relatively narrow, (7–)10–15)–22) × (2·5–) 5–8(–11) cm, the tip accute and sometimes acuminate, base tapering, rounded or truncate, with persistent brown spreading hairs beneath, main venation prominent beneath, margins coarsely sinuate or dentate sometimes ± entire. Flowers solitary, axillary; on pedicels 12–33 mm long, with dense yellow-brown hairs. Sepals triangular-ovate, acute, 13–18 × 4–8 mm, brown- or golden-velvety outside, greyish-felty inside. Petals green to yellow to pale yellow or whitish, completely fused into a toothed corolla 20–30 mm long, sometimes split to *c.* halfway in 1–3 places, golden-hairy outside (when dry) at least near the base. Stamens *c.* 80; filaments 2·5–3 mm long; anthers 3–4 mm long, tapering into an awn 3–6 mm long. Style 12–15 mm long. Fruit brownish or reddish, ovoid or oblong, 4·5–6·5(–9) × 2·5(–4·5) cm, 4-valved, valves often with a single deep or shallow groove down the back; when fresh the interior of loculi lilac-purple. Seeds *c.* 5 per valve, irregularly ovoid, *c.* 10 × 6 mm; arillode thick and waxy, orange; fresh colour of mature seed-coat not known, creamy when nearly mature.

Distribution: The typical specimens come from the south of the Morobe district in northeastern New Guinea, and from the north of the adjacent Gulf district in Papua. Other specimens, rather less typical (see below), have been collected in the West Sepik and Western Highlands districts and in the north of the Western district of Papua.

Ecology: Generally commonest in disturbed vegetation; frequent in the Aseki area; 1500–2000 m.

Notes: Typically very distinct with rather narrow brown-hairy leaves with widely spaced shallow teeth and with ± grooved fruit valves. There are specimens which lack the fruit grooves and begin to look like some forms of *S. tieghemii.* Others vary individually. Other species in the section may sometimes have weak-floccose hairs usually falling off quickly, or have matted crisped hairs; *S. streimannii* is distinguished by the persistent spreading hairs.

17. Sloanea tieghemii (F. Muell.) A. C. Sm. *J. Arnold Arbor.* **25**:293 (1944) in the broadest sense. **Fig. 39.**

Shrubs 2 m to trees up to 30 m tall. Twigs hairy or glabrous. Leaves opposite to alternate; petioles 5–20(–30) mm long, or glabrous, usually thickened at each end; blades elliptic, obovate or obovate-rhomboid, 3–12(–21) × 2–6(–10) cm, acute or obtuse at the tip, often ± acuminate, tapering at base, glabrous or hairy, margins entire to sinuate to coarsely sinuate-dentate. Flowers usually solitary in leaf axils, or sometimes in fascicles of 2–3; pedicels 1·5–23·5 cm long, generally short-hairy. Sepals 8–20 × 3–10 mm, ± yellowish-hairy outside,

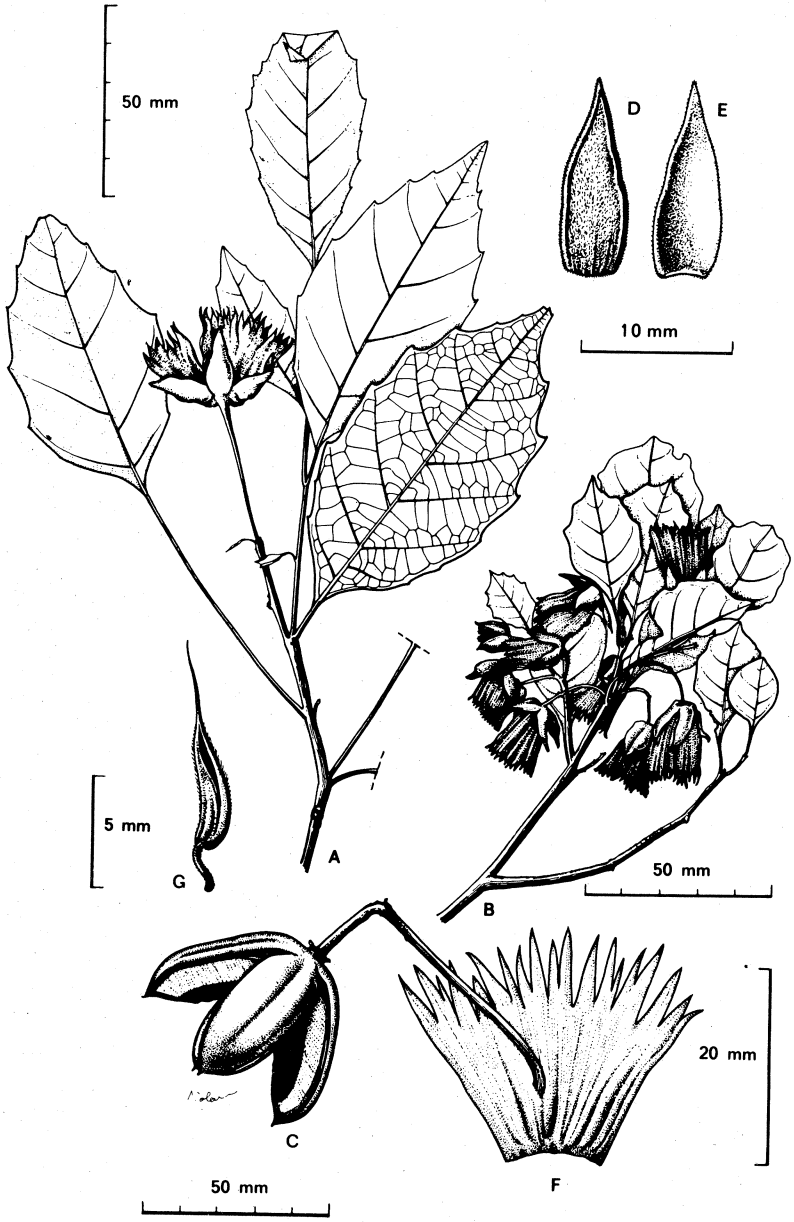

Fig. 39 **Sloanea tieghemii** F. Muell.) A. C. Sm. (A) leafy twig with flowers—gp 1 (B) leafy twig with flowers—gp 4 (C) fruit (D) sepal outside (E) sepal inside (F) corolla tube slit and opened out (G) stamen

greyish-felty inside. Petals cream or yellow, usually completely fused into a tube or with a few partial splits, occasionally split to base, 20–28 mm long, usually short-hairy outside at least near the base, toothed at the rim, the teeth 1–10 mm long. Stamens 50–90; filaments 1·5–2 mm long; anthers 2·5–6 mm long, with awns 2–3 mm long at the tip. Styles 11–14 mm long. Fruits 3–4·5 (–5·5) × 1·5–3 cm. Seeds 1–2 mm long, arillodes thick and waxy or thin and ± papery when dry.

Distribution: Endemic to New Guinea.

Notes: Under this name all those *Sloanea* with tubular corollas and ± solitary flowers (except *S. lamii* and *S. streimannii*) are included. It is generally possible to key out a specimen to one of the groups below, but the complex is even more difficult to deal with than is the rest of the genus; there are so many intermediates that it would be misleading to list the groups as species (describing at least one 'new' one in the process) to be compared with species as accepted elsewhere in *Sloanea.*

KEY TO GROUPS WITHIN *SLOANEA TIEGHEMII*

1. Leaves 7–12 × 3·5–6 cm, sharply serrate-dentate, the teeth widely spaced and often spinulose
 2. Leaves glabrous or floccose-hairy, the hairs falling quickly ..... group **1**
 2. Leaves persistently hairy ..... group **2**
1. Leaves smaller or margins entire to sinuous
 3. Leaves glabrous or floccose-hairy, the hairs falling quickly, sometimes with persistent tufts in the nerve axils of leaf undersides
  4. Leaves 3–5 × 2–3 cm ..... group **4**
  4. Leaves 5–18 × 3–9 cm ..... group **3**
 3. Leaves persistently hairy, 2·5–4·5 × 1·5–3 cm ..... group **5**

group **1**

Sloanea tieghemii (F. Muell). A. C. Sm. (1944) in the strict sense; *Antholoma tieghemii* F. Muell. (1892, 1893).

Apart from the characters given in the key this group consists of shrubs or small trees with prominent fine venation in the leaves, and relatively large flowers always solitary, with the petal tube 25–28 mm long and teeth 7–10 mm long, and 70–90 stamens. The fruit is not properly known; apparently the valves are rather thin-walled.

Field characters: Occasionally many-stemmed as a shrub. The branching is lax and slender.

Ecology: Forest, often dominated by Fagaceae or secondary regrowth, 1300–2300 m.

Notes: Probably the most distinct group in this complex.

group **2**

Differs from group 1 in having persistent hairs on leaf undersides, petioles and young twigs. Fruit is present on 1 specimen and resembles that of group 3 and *S. aberrans.*

Distribution: Only 3 collections known, all from the Wissel Lakes area of the Snow Mountains in western New Guinea.

Ecology: 1750–1800 m.

Notes: This group differs from *S. streimannii* in the crisped matted hairs under the leaves; the leaves are never narrow-elliptic as are often found in *S. streimannii.* It may represent a large-leaved form of group 5.

group **3**

Echinocarpus arfakensis Kan. & Hat. (1942); *Sloanea archboldiana* A. C. Sm (1944); *S. versteeghii* A. C. Sm. (1944); *S. arfakensis* (Kan. & Hat.) Merr. (1951).

Differs from the other groups in the characters given in the key.

Distribution: Scattered throughout the range of the complex; in western New Guinea from the Vogelkop, Jayapura and Snow Mountains districts, in northeastern New Guinea from the Western Highlands, and in Papua from the Central district.

Ecology: Primary or secondary forest, 1100–2300 m.

Notes: The material considered in this group is really what is left in *S. tieghemii* after the other, more easily identified, groups have been removed. They form a continuum of variation; each specimen (there are 10 in all) is slightly different from the next. At one 'end' there is *S. versteeghii* with leaves up to 21 × 10 cm, which are curiously scurfy-hairy when young and glabrous when mature; very similar otherwise is the type of *S. archboldinana,* linking with other specimens with much smaller leaves often with distinct serrations on the leaf margins. Until more material has been collected it will be impossible to decide which specimens are sporadic variants and which represent groups worth recognizing.

group **4**

Apart from the characters given in the key, group 4 consists of trees that are up to 30 m tall, generally glabrous throughout, with the fine venation of the leaves rather obscure (though the main veins are often prominent beneath), usually relatively small flowers, petal tube less than 25 mm long and with teeth up to 3 mm deep; stamens *c.* 50. The fruit is like that of *S. aberrans* but is often smaller, and the seeds fewer in each valve.

Field characters: Larger individuals are often buttressed. The flowers are showy.

Distribution: Known from the Madang, Western Highlands and Eastern Highlands districts of northeastern New Guinea and from the Southern Highlands district of Papua.

Ecology: Forest, often disturbed; also secondary regrowth and in garden sites, 2200–2800 m.

Uses: The fruit is roasted and the seeds eaten.

Notes: Most of the specimens form an easily recognized uniform group, but there are specimens linking it with group 3 and fruiting specimens which could belong here or be small-leaved variants of *S. aberrans.* Further, it differs

from group 5 apparently only in lacking the persistent hairs on the twigs and leaves.

group **5**

S. perbella A. C. Sm. (1944).

Differs from group 4 in having persistent indumentum on twigs and leaf undersides and from group 2 in having smaller leaves.

Distribution: Only known from 2 collections, both from near the Idenburg River in the Jayapura district of western New Guinea.

Ecology: Forest, 2150–2200 m.

Notes: Probably not really distinct from group 2.

Section Cnidocarpaea A. C. Sm (1944)

This section, considered here to contain the single variable species *S. paradisearum,* is fairly distinct in flower with its outermost whorls of stamens sterile, and very distinct in fruit with the dense coating of detachable irritant spines. Flowers are solitary in the specimens seen but the pedicels have articulations suggesting that short few-flowered racemes may be found. Sterile material may be separated from Section *Antholoma* by the distinct, if caducous, filiform stipules present in the vegetative buds, but would be difficult to tell from section *Anoniodes.*

Distribution: Endemic to New Guinea.

Notes: Other species with irritant-spiny fruits occur throughout most of the range of the genus, but have various flower types. It is likely that section *Cnidocarpaea* will not survive as defined at present, but for our purposes it is convenient.

18. Sloanea paradisearum F. Muell. *Descr. Not. Pap. Pl.* **1:** 84 (1877). **Fig. 40.**

Echinocarpus brassii O. C. Schm. (1929); *Sloanea brassi* (O. C. Schm.) A. C. Sm. (1944); *S. myriandra* A. C. Sm. (1944).

Trees 10–30 m tall. Twigs hairy or glabrous. Stipules minute, linear-filiform, falling quickly. Leaves alternate to opposite; petioles 1·5–3(–5) cm, hairy or glabrous; blades elliptic to obovate (rarely ± ovate), sometimes ± irregular, 11–27 × 6–14 cm, the tip acute and usually acuminate, rounded or tapered towards a minutely subcordate base, hairy or glabrous, margins coarsely dentate to sinuate to ± entire. Flowers solitary, axillary; pedicels 2–4 cm long, hairy or glabrous. Sepals pink, (2–)4 (irregular when less than 4), ± broadly triangular to ovate, lengthening after opening, up to 13 × 8 mm, usually reflexed, acute, hairy or glabrous outside, minutely hairy inside. Petals 4–6, ± oblong-triangular, up to 15 × 7 mm, acute, densely and minutely hairy outside, similar but less dense inside. Stamens very numerous, the outer 1–2 whorls being sterile; filaments 0·5–1·5 mm long; anthers *c.* 5 mm long, beaked at the tip. Ovary showing at anthesis hairy processes projecting beyond the hairs covering the ovary; style 1–2 mm long. Fruits brown

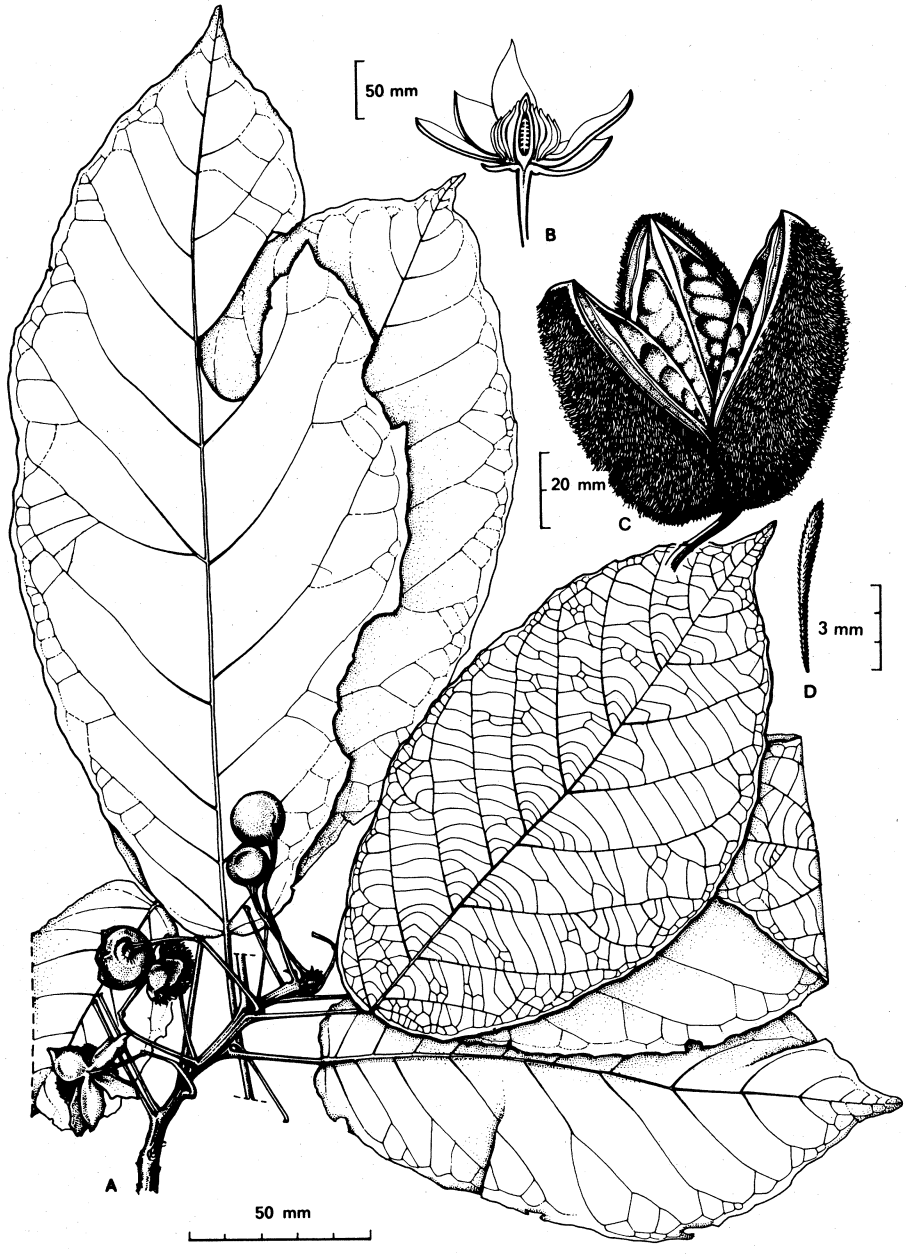

Fig. 40 **Sloanea paradisearum** F. Muell. (A) leafy twig with flowers (B) longitudinal section of flower (C) fruit (D) fruit-spine detached, the point of attachment at the narrower end

or orange-red, 5·5–10 × 3–5 cm, densely coated outside with detachable spines 3–5 mm long; the spines sharp-pointed at base with fine ascending bristles, therefore irritant only when detached; seed number variable from 2 to 16 per loculus; seeds 12–16 mm long, completely covered by the arillode; arillode described as yellow or orange.

Distribution: Scattered throughout much of lowland New Guinea. There are several specimens from the Vogelkop and 2 from the Idenburg River in the Jayapura district of western New Guinea. Known from only 2 specimens from the Morobe district in northeastern New Guinea, it has been collected from every Papuan district except Gulf and Papuan Islands.

Ecology: Primary and secondary forest; from sea level to 1000 m.

Notes: It has been stated to be common in the Papuan plain (Lane-Poole, C.E., *The Forest Resources of the Territories of Papua & New Guinea,* 1925, p. 111), but the low number of specimens so far obtained does not support this.

HAMAMELIDACEAE

J. R. Croft

Monoecious (rarely dioecious) evergreen (or outside Papuasia, deciduous) trees or shrubs, often stellate-tomentose. Leaves simple, alternate, rarely opposite, with entire or crenate-serrate or dentate margins, pinnately (less often 3–5 palmately) veined. Stipules usually present, persistent or caducous. Flowers free or connate, in racemes or heads or spikes, unisexual, polygamous, or bisexual, usually actinomorphic, 4–5-merous with alternate whorls of floral parts; calyx small or lacking; petals absent or 4 or more, linear or ligulate; stamens 4 or more, perigynous, free, anthers 2-locular opening by a lengthways slit or by valves, basifixed, connective often extended; disc lacking or annular or represented by small lobes; ovary inferior or semi-inferior, composed of 2 carpels often free at the apex, 2-locular; styles 2, free, subulate; ovules pendent and solitary in each loculus or 5 or more and attached to the ovary wall. Fruit a 2-celled loculicidal and septicidal capsule, hence 4 valves, 1 or many seeds in each cell.

Distribution: About 110 species in 25 genera found in the temperate and warm temperate regions of the northern hemisphere, South East Asia, north-eastern Australia and tropical East and South Africa.

Sycopsis is the sole genus in Papuasia, and is represented by a single species.

Literature: P. K. Endress (1970), Die Infloreszenzen der apetalen Hamamelidaceen, *Bot. Jb.* **90**: 1–54, f. 1–114. H. Harms (1930), Hamamelidaceae, in Engl. F. & Prantl, *Nat. Pflanzen.* **18**: 303–45, f. 164–80. J. Hutchinson (1967), Hamamelidaceae, *The Genera of Flowering Plants* **2**: 93–103. W. Vink (1957), Hamamelidaceae, *Fl. Males.* ser. 1, **5**(3): 363–78, f. 1–9; Addenda **6**(6): 952. E. H. Walker (1944), A revision of *Distylium* and *Sycopsis* (Hamamelidaceae), *J. Arnold Arbor.* **25**: 319–41, f. 1–4.

SYCOPSIS Oliv.

Evergreen polygamous-monoecious trees or shrubs. Leaves simple, alternate, entire (or denticulate above the middle). Stipules present, minute, lanceolate and caducous. Inflorescence in short axillary racemes subtended by stellate-tomentose bracts. Calyx and corolla absent. Stamens 4–10; anthers basifixed oblong to ellipsoid, 2-locular with 4 pollen sacs dehiscing latrorsely by 2 longitudinal slits, connective often produced; staminodes usually absent. Disc absent. Ovary semi-inferior, free, 2-locular, each locule with a single pendent ovule; styles 2, free, subulate, slender, divergent with stigma decurrent along adaxial surface. Rudimentary ovary usually lacking in male

flowers. Fruit a woody 2-locular capsule opening by 2 or 4 valves; 1 wingless seed in each locule.

Distribution: A genus of 7 species ranging from Assam, central and southern China and the Philippines through Indonesia to New Guinea and New Britain.

Notes: Endress (1970) created the genus *Distyliopsis,* a segregate of *Sycopsis* based on differences in morphology of the inflorescence. It appears that these characters have insufficient correlation with others and that the segregation should be made at an infrageneric level, if at all.

If the narrow view of *Sycopsis* is accepted, the Malesian genus is *Distyliopsis,* a genus of 4 species, ranging from Southern China and Taiwan, throughout Malesia to New Britain, *Sycopsis* in the strict sense being restricted to a narrow arc from north Taiwan through central China to Assam.

Sycopsis dunnii Hemsley in Hook. Icon. Pl. **29** (1907) t. 2836. **Fig. 41.**

Distyliopsis dunnii (Hemsley) Endress (1970).

Evergreen shrub or tree to 20(30) m tall, diameter to 60 cm at breast height. Innovations with a stellate tomentum, mostly glabrescent. Leaves ± coriaceous, ovate, oblong, lanceolate, elliptic, or broadly so, 4–10(–12) × 2·5–5 cm, glabrescent or with a densely lepidote and/or stellate tomentum beneath, apex acute and shortly decurrent into the petiole; margin entire and often tightly recurved; midrib and 5–9 pairs of lateral veins depressed above and prominent below; tufted hairy domatia present in most vein axils; petiole 4–10(–15) mm long, persistently lepidote. Stipules caducous, stellate-tomentose, glabrescent, lanceolate, 2–3(–5) × 1–2 mm, apex acute. Inflorescences 3–6-flowered, 10–25 mm long, the female flowers generally apical, male flowers basal, male inflorescences generally shorter. Subtending bracts densely stellate-tomentose, ovate, oblong or lanceolate, 2–3(–4·5) × 0·5–2 mm. Receptacle 2–3 mm diameter, stellate-tomentose. Filaments (2–)2·5–4(–5·5) mm long, anthers 1·5–2·5(–3) mm long. Ovary ovoid to conical, 2–3 × 1·5–2 mm, densely covered with erect stellate hairs; styles 6–10–13) mm long, stigmas red. Fruit ellipsoid to ovoid, 11–13 × 6–8 mm, apex acute, mostly with persistent remains of styles, densely sericeous, loculicidal and partially septicidal, thus opening by 2 valves which are themselves partially cleft; receptacle accrescent into 2–3 irregular spathe-like lobes 6–8 mm long, densely stellate-lepidote externally; seeds 6–8 mm long.

Field characters: Although recorded up to 30 m tall, most collections are of trees less than 20 m tall. Bole generally straight and lacking buttresses, up to 20 m, and up to 60 cm diameter at breast height. Outer bark light grey-brown, smooth or slightly pustular, peeling off in small rectangular flakes; under bark red to reddish-brown; inner bark red to red-cream, about 5 mm thick. Young leaves reddish, young twigs yellowish. Wood hard and heavy, sapwood straw, heartwood brown straw to pinkish. No exudates or odours recorded.

Distribution: Malaya and the Philippines through Malesia to New Britain. Infrequently collected but occasionally referred to as 'locally common'.

Ecology: Primary or secondary montane rainforest or lowland hill forest, on well drained slopes or ridges, from 300 to 2400 m altitude. Most collections

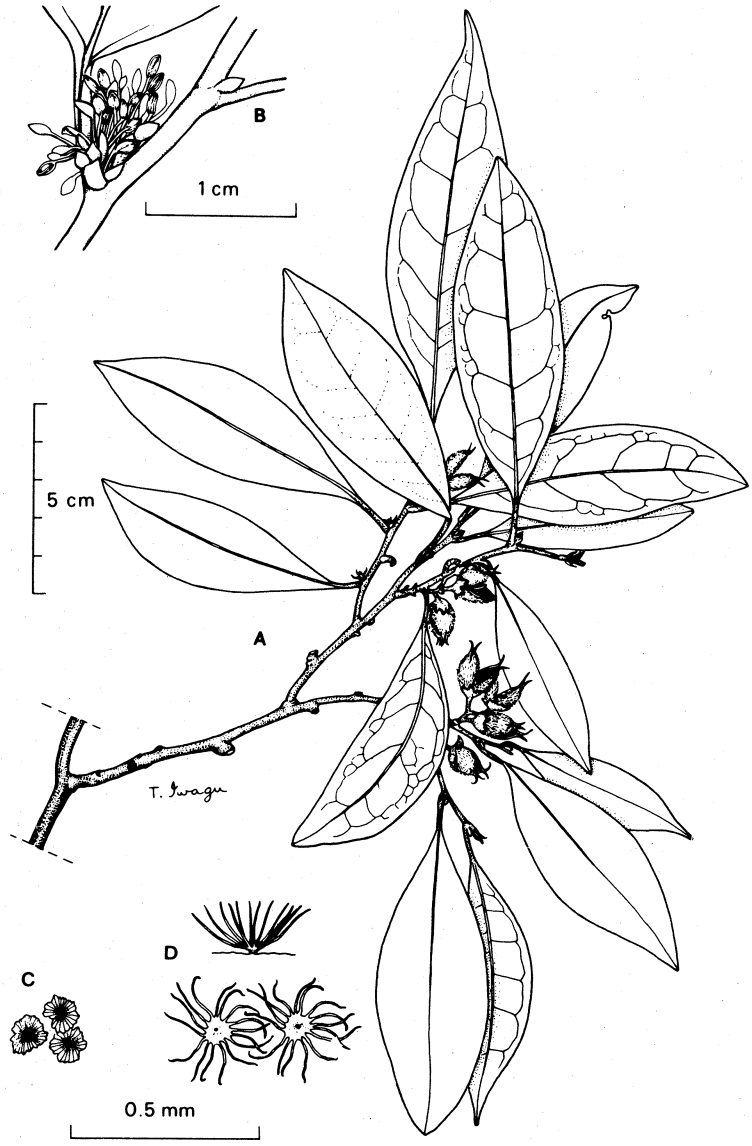

Fig. 41 **Sycopsis dunnii** Hemsley (A) leafy twig with dehiscing fruit (B) male inflorescence with extruding stamens (C) scales of glabrescent forms (D) scales of tomentose forms

are from the understory but several are of canopy trees. Sometimes locally common but never dominant.

Uses: The timber has a reputation for durability, and is used for light construction, scantlings, framing, interior finish, lining, panelling and furniture. In the highlands of Papua New Guinea the bark is used in the treatment of unspecified illnesses, being chewed and spat over the food of the patient.

Notes: There appears to be a correlation between the degree of incision of scales of the leaf indumentum and the density of cover of this indumentum, the margins of the scales of the more naked forms (as seen on the petioles) being almost entire. However, the presence of intermediates makes it difficult to assign any taxonomic rank to this variation. Large stellate-lepidote galls are common in this species.

HERNANDIACEAE

J.R. Croft

Monoecious trees or shrubs, or lianes with bisexual flowers. Leaves alternate or spirally arranged, simple or palmately 3–5-lobed or foliolate; stipules absent. Flowers bisexual or polygamous, actinomorphic, arranged in axillary, rarely terminal, corymbiform, bracteate or ebracteate thyrses or cymes; bracteoles minute or absent. Perianth sepaloid with 3–8 imbricate or valvate segments in 1 or 2 whorls. Stamens 3–5 in a single whorl opposite the tepals, in a double perianth inserted opposite the outer tepals; anthers 2-locular, dehiscing introrsely by 2 valves; staminodes interstaminal, gland-like, minute or lacking. Ovary inferior, 1-locular; ovule solitary, pendulous. Fruit dry, indehiscent, ovoid or elongate, generally longitudinally ribbed, with apical or longitudinal wings, or without wings and enclosed by an expanded fleshy cupule. Seed solitary, lacking endosperm; embryo straight; cotyledons large, planoconvex or flat and twisted around the radicle.

Distribution: About 44 species in 4 genera, throughout the lowland tropics of both hemispheres, especially in coastal regions. In Papuasia there are 3 genera: *Hernandia* with 4 species, *Illigera* with 2 and *Gyrocarpus* with 1.

Note: Some authors consider the genus *Gyrocarpus* to belong with several other extra-Papuasian genera in a separate family, the Gyrocarpaceae, perhaps more closely related to Monimiaceae than Hernandiaceae.

Literature: J. Hutchinson, (1964), Hernandiaceae, *The Genera of Flowering Plants* **1**: 143–5. K. Kubitzki (1969), Monographie der Hernandiaceen, *Bot. Jb.* **89**(1/2): 78–209, f 1–51; (1970); *Biasolettia nympheaefolia* Presl eine Hernandiaceae, *Bot. Jb.* **90**(1/2): 272. C.T. White (1929), *J. Arnold Arbor.* **10**: 197–274.

KEY TO GENERA

1. Deciduous trees; flowers minute, buds less than 1·5 mm diameter; inflorescence an ebracteate thyrse; fruits with 2 apical wings; leaves simple ..... GYROCARPUS
1. Evergreen trees or lianes; flowers conspicuous, buds more than 2 mm diameter; inflorescence a bracteate thyrse; fruits with 2–4 broad lateral wings or surrounded by an expanded fleshy cupule; leaves simple or digitately compound
2. Trees; leaves simple; fruits surrounded by an inflated receptacle; flowers unisexual, rarely bisexual ..... HERNANDIA
2. Lianes; leaves 3–5-digitately compound; fruit with 2–4 lateral wings; flowers bisexual ..... ILLIGERA

GYROCARPUS Jacq.

Deciduous trees. Leaves simple, entire, broadly ovate to lanceolate, or 3–5-lobed; venation pedate, rarely pinnate. Inflorescence a ± repeatedly dicho-

tomous corymbose thyrse, generally ebracteate, clustered with leaves towards the branchlet apices. Flowers minute, numerous, polygamous, mostly male; stamens 4–5, anthers opening laterally by 2 valves; staminodes clavate, alternating with stamens, or partially connate, or (outside Papuasia) solitary, peltate, median and opposite the style. Male flowers with a 4–8-lobed perianth; pistillode present or absent. Bisexual flowers with a minutely (6–)7(–8-lobed perianth; ovary obconic, stigma capitate. Fruit a samara; nut ovoid or elongate-ellipsoid with 2 large, apical, thick membranaceous, spathulate wings formed by 2 accrescent lobes of the calyx. Seeds with spirally twisted cotyledons.

Distribution: A genus of 3 species with 11 subspecies, found in the lowland tropics of both hemispheres, especially in the monsoonal areas. In Papuasia *Gyrocarpus americanus* is the sole species and is represented by ssp. *americanus.*

Gyrocarpus americanus Jacq. *Select. Stirp. Amer. Hist.* 282 (1763), t. 178, f. 80. **Fig. 42.**

ssp. **americanus**

Tree to 30 m tall but mostly less than 20 m. Leaves entire or with 3(–5) acute lobes, generally cordate in outline, 7–24 × 4–21 cm, base subcordate to broadly rounded, glabrescent above, persistently tomentose beneath; venation 5-pedate, midrib with 3–6 pairs of lateral veins, ± persistently hairy above; petiole 4–8 mm long, sulcate above, glabrescent. Inflorescence terminal, finely tomentose, to 12 cm long, including a terete striate peduncle to 6 cm long; flowers in dense clusters, tawny green. Stamens 4, filaments pilose; 4 mm long in male flowers, 3 mm long in bisexual flowers; staminodes 4, 0·5–1 mm long, alternating with the stamens. Style pilose, recurved to sigmoid. Nut ± ovate, finely pubescent, 1·5–2 cm long, slightly laterally compressed, ± prominently longitudinally 8-ribbed; wings 7–10 cm long when mature, 2–4 mm wide at the base, 10–12 mm wide upwards, sparsely tomentose towards the apex, more densely so towards the base.

Field characters: Bole straight, to 12 m long and 75 cm diameter at breast height; no buttresses reported. Branching stout and irregular, crown diffuse. Outer bark pale cream to greenish-brown or pale grey, moderately rough, occasionally scaly-flaky and/or cracking finely and irregularly; vertical lines of pustules may be present; underbark light green; inner bark straw or cream with streaks of brown or amber; exudate cream, yellow or orange in colour, more copious in the branchlets. Wood cream to straw, sapwood and heartwood ill-defined.

Distribution: East Africa, southern Asia, Malesia, Solomon Islands, islands of the South Pacific, Central America. In Papuasia it is collected most commonly in the area around Port Moresby; it has also been reported from the Ramu Valley.

Ecology: Lowland areas from sea level to 400 m altitude, in regions with a distinctly seasonal rainfall. It is reported as being deciduous in the dry season, the leaves probably falling at anthesis and as the fruit develops. In the mon-

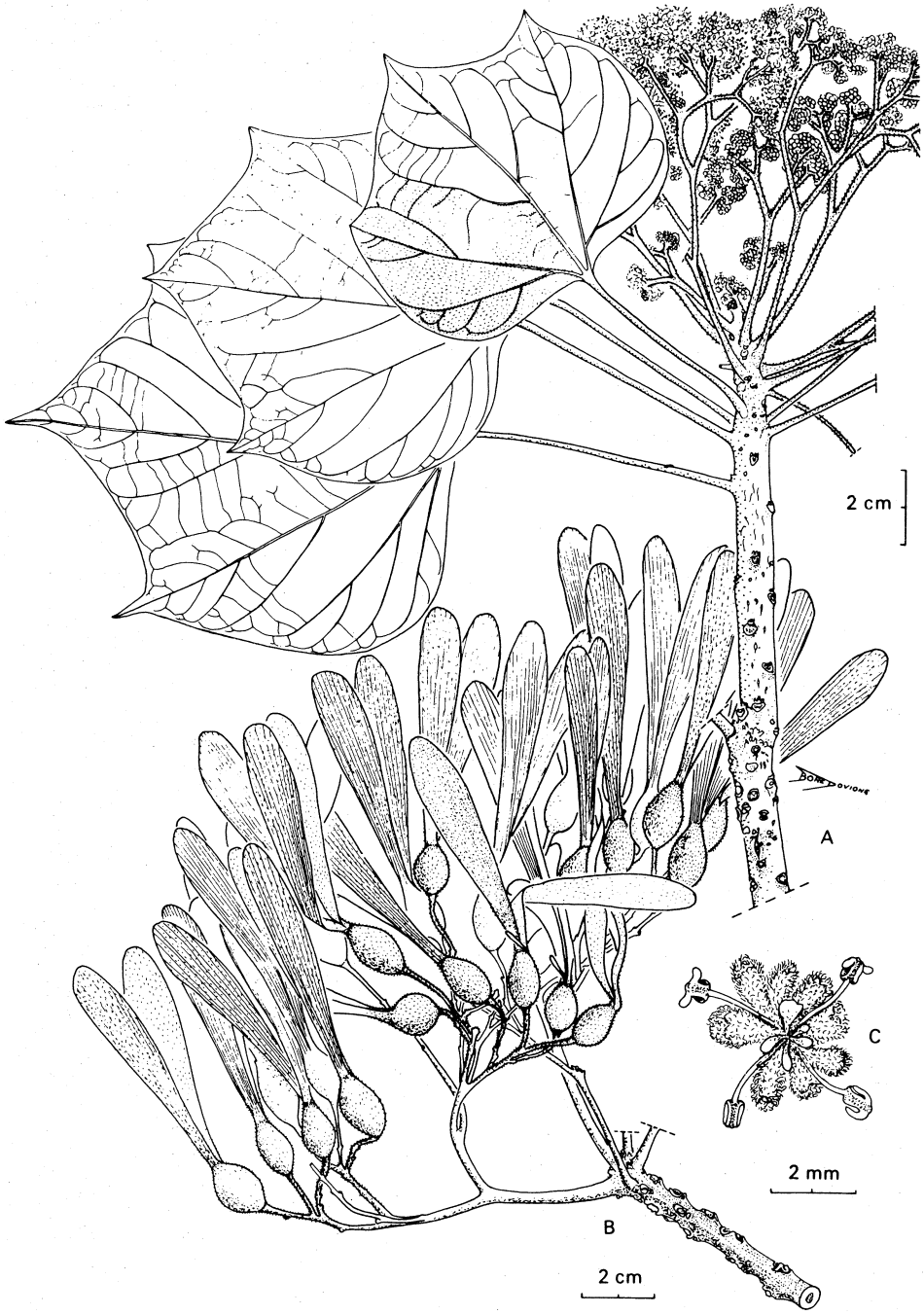

Fig. 42 **Gyrocarpus americanus** Jacq. ssp. **americanus** (A) twig with inflorescence (B) twig bearing fruit (C) flower

soon area around Port Moresby flowers are recorded around April and May and mature fruits around July and August. The winged seeds are an obvious adaptation for wind dispersal in the same manner as the fruits of the Dipterocarpaceae.

Uses: The timber of this species is not used commercially.

HERNANDIA L.

Evergreen trees. Leaves simple, undivided, peltate or not, venation pedate or with 3–7 pairs of lateral veins arching towards the apex. Inflorescence a corymbiform thyrse in the upper leaf axils, with foliaceous bracts subtending each branch; ultimate branches ending in a 4–5-bracteate foliaceous involucre, subtending a dichasium of a single upper female flower and 2 lower male flowers; mostly finely densely tomentose. Male flowers 3–5(–6)-merous; pistillode usually absent, or present as a rudimentary style; stamens 3–5(–6), filaments free to partly connate; paired glands at base. Female flowers in a small cupule, 4–6-merous; ovary slightly laterally compressed; style erect to sigmoid, slightly thickened at the base, stigma dilated or lobed; glands 4–5(–12), free or connate around the style; staminodes lacking. Nut ovoid to elongate-ellipsoid, longitudinally ribbed, generally glabrous, enclosed by the expanded fleshy cupule. Seeds with a hard testa and folded cotyledons.

Distribution: A genus of 24 species in mainly coastal areas of the tropics and subtropics of both hemispheres. In Papuasia there are 2 species that range throughout the area and 1 ranging from Manus and New Britain eastwards through the Solomon Islands. A species endemic to Santa Isabel in the Solomon Islands is included in this account.

KEY TO SPECIES

1. Female flowers 5-merous, male flowers 5(–4)-merous; fruit 10-ribbed; domatia present, especially in lower vein axils; margin of cupule ± entire; involucral bracts 8–10 mm long; leaves not peltate nor with a cuneate base; filaments free; tepals tomentose externally ..... **H. moerenhoutiana** ssp. **samoensis**
1. Female flowers 4-merous, male flowers 3-merous; fruit 6- or 8-ribbed; domatia absent; margin of cupule entire or with 2 teeth; involucral bracts less than 7 mm or greater than 15 mm long; leaves peltate, or base cuneate or acute to broadly obtuse; filaments free or united to about the middle; tepals externally tomentose or glabrescent
   2. Leaves cordate or broadly ovate, apex ± acute, base broadly rounded to cordate; involucral bracts less than 7 mm long; filaments free; tepals persistently tomentose externally; cupule with entire or 2-toothed margin, not long-beaked; nut umbonate or not, not attenuate apically, stalked or not
      3. Leaves peltate; margin of cupule entire; nut not, or indistinctly, stalked, umbonate ..... **H. nymphaeifolia**
      3. Leaves not peltate; margin of cupule with 2(–3) large inward-directed teeth; nut distinctly stalked, not umbonate ..... **H. ovigera**
   2. Leaves oblanceolate, apex broadly rounded, base narrowly cuneate; involucral bracts 15–30 mm long; filaments united to about the middle; tepals glabrescent externally; cupule long-beaked with 2 teeth; nut attenuate apically, not stalked ..... **H. rostrata**

KEY TO SPECIES (VEGETATIVE MATERIAL)

1. Leaves peltate, strand species ..... **H. nymphaeifolia**
1. Leaves not peltate, lowland rainforest species

2. Leaves ± cuneate-obovate, apex broadly rounded ..... **H. rostrata**
2. Leaves broadly ovate to cordate, apex ± acute or acuminate
3. Hairy domatia present in axils of lower veins; leaves ± coriaceous ..... **H. moerenhoutiana** ssp. **samoensis**
3. Hairy domatia absent; leaves ± chartaceous ..... **H. ovigera**

Hernandia moerenhoutiana Guillem. *Ann. Sc. Nat. Bot.* 2, **7**: 189 (1937). ssp. **samoensis** (Hochr.) Kubitzki *Bot. Jb.* **89**: 129 (1969), f. 25.

H. samoensis Hochr. (1925); *H. cordigera* auct. non Vieill.: Walker (1948).

Tree to 30 m tall. Leaves thin coriaceous, elliptic-lanceolate to broadly so, or obovate, 4–22 × 2–11 cm; base obtuse, rarely acute or rounded, apex acute; midrib and veins ± flat above, prominent beneath; 36 pairs of lateral veins arching towards the apex, hairy domatia present in the axils, especially of the basal veins, remainder of leaf glabrescent; margin slightly revolute; petiole terete, or slightly flattened above, finely striate, 1–8 cm long. Inflorescence 15–30 cm long, including terete striate peduncle 10–15 cm long; involucral bracts elliptic to obovate to broadly so, 8–10 × 4–6 mm, finely densely tomentose. Male flowers 5(–4)-merous, 5 mm long in bud, 5 clavate glands alternating with the stamens. Female flowers 5-merous, 4 mm long in bud, cupule ± urceolate, 2–3 mm long, apical margin irregularly undulate. Nut laterally compressed, globose with a slight apical beak, 2–2·5 × 1·5–2 cm, longitudinally 10-ribbed, 2 more prominent than the others; inflated cupule reddish when mature, margin often recurved.

Field characters: Bole generally straight and cylindrical, unbuttressed, to 24 m long, diameter at breast height to 75 cm. Crown deep and narrow. Outer bark light brown to grey-green-fawn, smooth to slightly fissured with or without longitudinal rows of large raised lenticels; inner bark pale brown, darkening on exposure; sweet odour; slight clear exudate. Wood white, light and soft; no differentiation between heartwood and sapwood.

Distribution: In Papuasia, Manus and New Britain; also in the Solomon Islands, New Hebrides and Samoa.

Ecology: A canopy or subcanopy tree of primary and secondary lowland rainforest from sea level to 900 m altitude. Usually on well drained slopes or ridges.

Uses: Canoe building; mouldings and interior finish.

Note: In Papuasia, the presence of domatia in *Hernandia* is restricted to this species.

Hernandia nymphaeifolia (Presl) Kubitzki *Bot. Jb.* **90**: 272 (1970). **Fig. 43.**

Biasolettia nymphaeifolia Presl (1835); *Hernandia peltata* Meissn. (1864); *H. ovigera* auct. non L.: C.T. White (1929); *H. sonora* auct. non L.: F. Muell. (1877).

Tree to 22 m tall, branchlets terete, finely striate. Leaves chartaceous to thin coriaceous, peltate with petiole attached 1–3 cm from margin, lanceolate-ovate to broadly so, 7–30 × 6–22 cm; base broadly rounded, apex shortly acute or obtuse; venation ± palmate basally with 7–9 veins radiating from insertion of petiole, central vein with 2–4 pairs of lateral veins arching towards

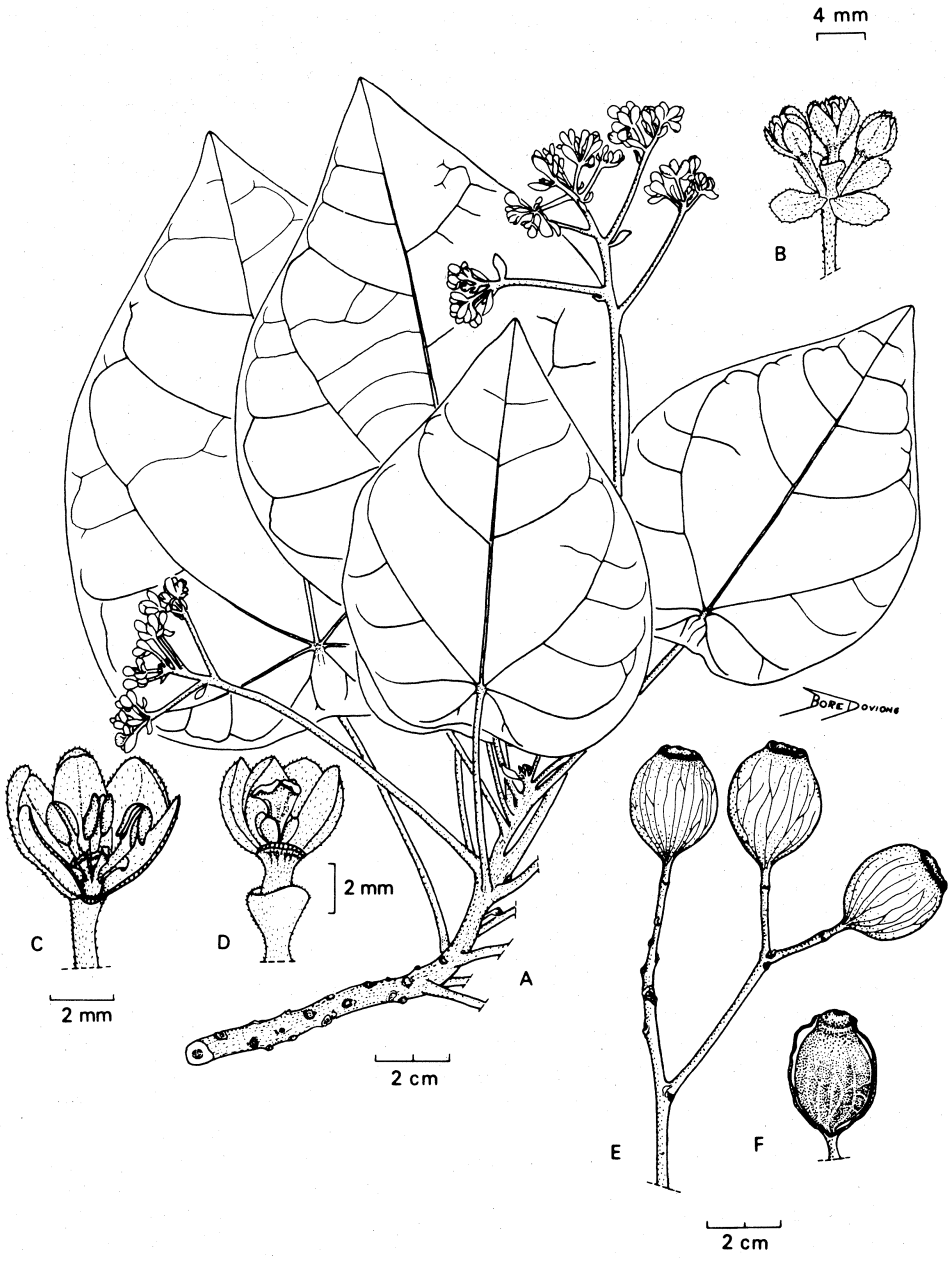

Fig. 43 **Hernandia nymphaeifolia** (Presl) Kubitzki (A) twig with inflorescences (B) dichasium of central ♀ flower and 2 lateral ♂ flowers (C) ♂ flower (D) ♀ flower (E) twig with fruit (F) cut-away view of fruit within calyx

the apex; margin entire; petiole 5–17 cm long, terete, striate. Some leaves may be cordate and not peltate, especially reduced leaves in the inflorescence. Inflorescence 10–30 cm long, including a terete striate peduncle 6–20 cm long; involucral bracts elliptic to obovate, 2–5 × 1–2 mm, finely densely tomentose. Male flowers 3-merous, 3–4 mm long in bud; filaments minutely pubescent with 2 small spathulate glands, sometimes connate in pairs between the stamens. Female flowers 4-merous, cupule ± 2 mm long, ± turbinate, not at all constricted below the margin, apical margin entire or slightly undulate. Nut ± ellipsoid, 2·5–3 × 1·7–2·3 cm, slightly or not at all stalked, obscurely longitudinally 8-ribbed, apex with umbo 8–10 mm wide, 2–3 mm high; inflated cupule white (rarely tinged red) when mature and loosely enveloping fruit, aperture round, entire margin slightly revolute.

Field characters: Buttresses to 1 m high may be present. Bole mostly crooked with heavy branching low down, to 10 m long, diameter at breast height or above buttresses to 90 cm. Crown broad and spreading. Outer bark grey to light brown, smooth to finely fissured, often with longitudinal rows of brown pustules which may be elongated horizontally; underbark straw to mottled olive-green; inner bark pale straw or white, 1–2 cm thick, spongy. Wood soft and light, pale cream to white, sapwood and heartwood ill-defined.

Distribution: East Africa and India, southeast Asia to Taiwan, Malesia, and the South Pacific as far east as Pitcairn Island; all coastal districts of Papuasia.

Ecology: A coastal species, common in the *Barringtonia asiatica* association on the sandy crest to the beach, but may occur in rather swampy conditions behind the beach. A common colonizer of disturbed coastal areas.

Uses: Because of the generally poor form of this tree it is of little use as timber. The wood is used in New Britain for making ceremonial drums and the bark is mixed with pig fodder for fattening.

Note: Hybrids are thought to exist between this species and *Hernandia ovigera* (Kubitzki, 1969). The suspected hybrids are very like *H. ovigera* in form and leaf shape.

Hernandia ovigera L. *Herb. Amb.* **14** (1754). **Fig. 44.**

H. papuana C. T. White (1929).

Tree to 40 m tall. Branchlets terete, finely striate. Leaves chartaceous to thin coriaceous, broadly lanceolate-ovate to cordate, 10–25 × 6-21 cm; base broadly rounded to cordate; apex acute to acuminate; venation 5–7-palmate at the base, central vein with 3–6 pairs of lateral veins; immature leaves finely pubescent, especially the veins beneath, glabrescent; petiole terete, striate, 7–19 cm long. Inflorescence 15–30 cm long, including a terete striate peduncle 6–18 cm long; involucral bracts elliptic to obovate, 4–7 × 1–3 mm, finely densely tomentose. Male flowers 3-merous, 5–6 mm long in bud, filaments sparsely pilose, with 2 usually free glands. Female flowers 4-merous, 4–5 mm long in bud, cupule 3–5 mm long, ± urceolate, with 2 lobes to the apical margin, entirely enclosing the ovary at anthesis. At maturity, cupule inflated and tinged with red, loosely enveloping fruit, aperture margin with 2(–4)

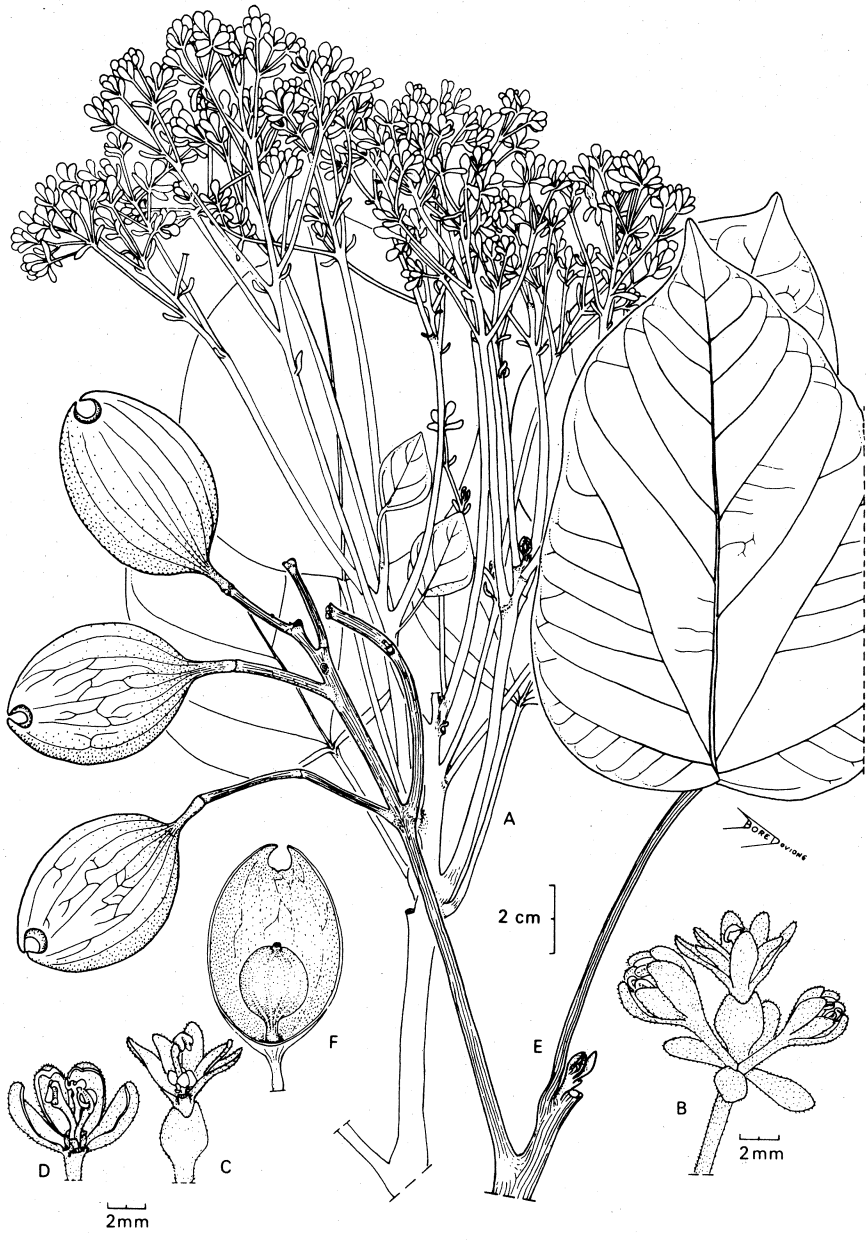

Fig. 44 **Hernandia ovigera** L. (A) twig with inflorescence (B) dichasium of ♀ and 2 ♂ flowers (C) ♀ flower (D) ♂ flower (E) twig with fruit (F) cut-away view of fruit within calyx

prominent teeth. Nut subglobose to broadly elliptic or ovate, somewhat compressed laterally, ± 2–2·5 cm diameter, dark brown to black, longitudinally faintly 8-ribbed, abruptly tapering into a stalk 2–6 mm long.

Field characters: Buttresses to 1·5 m high may be present. Bole generally straight and cylindrical, up to 25 m long and up to 1 m diameter above buttresses. Crown generally deep and narrow. Outer bark grey to brown, finely longitudinally fissured, sometimes minutely flaky; underbark cream to mottled red-brown; inner bark pale cream darkening to red-brown on exposure; exudate slight and clear. Wood soft, light, pale cream or white, heartwood and sapwood ill-defined.

Distribution: Sumatra and Sulawesi (Celebes), New Guinea, the Bismarck Archipelago, and the Solomon Islands to the Marianas Islands. Many collections throughout the range; a common species.

Ecology: Primary or secondary lowland alluvial rainforests or hill forests from ? sea level to 900 m altitude. Occurs often on flat ground by rivers subject to periodic inundation; occasionally on steeply sloping ground. Appears to flower and fruit throughout the year.

Uses: The timber is not very durable; suitable for light construction, mouldings and interior finish.

Note: This species is thought to occasionally hybridize with the strand species *Hernandia nymphaeifolia* (Kubitzki, 1969).

Hernandia rostrata Kubitzki *Bot. Jb.* **89**: 134 (1969) f. 28.

Tree to 35 m tall. Branchlets terete, sparsely puberulous, soon glabrescent. Leaves thin coriaceous, glabrous, obovate-oblong or spathulate, 14–25 ± 3·5–9 cm; base narrowly cuneate, apex broadly rounded; midrib and lateral veins ± flat above, prominent beneath, lateral veins 10–16 pairs, arching towards the apex; margin sometimes slightly revolute; petiole terete, finely striate, 2–5 cm long. Inflorescence to 20 cm long, including a terete striate peduncle 7–9 cm long; involucral bracts elliptic, oblong or obovate to 3 × 1·2 cm. Tepals to 10 mm long, persistently puberulous inside, glabrescent outside. Male flowers on pedicels 10–20 mm long, 3-merous; filaments united to slightly below the middle; 6 free glands arranged around base of united filaments. Female flowers 4-merous; cupule contracted at the margin; margin bifid. Nut ovoid, to 2·5 × 4 cm, slightly compressed laterally, constricted below the apex, prominently longitudinally 6(?8)-ribbed; cupule thick, fleshy, inflated, 7–10 cm long including a narrow bifid apical beak.

Field characters: Buttresses to 1·5 m high may be present; thin plank-like, steep to equal in height and width. Bole straight and cylindrical, diameter at breast height or above buttresses to 50 cm. Outer bark grey, scaly; inner bark brown. Wood soft and white. Flowers white, scented.

Distribution: So far only known from Santa Isabel in the Solomon Islands.

Ecology: A canopy or subcanopy tree of primary lowland rainforest. It has been collected from steep slopes, ridge crests and valley bottoms.

Uses: The timber has not yet been used commercially, but it may be suitable for the same purpose as that of *Hernandia ovigera.*

ILLIGERA Bl.

Lianes or scandent shrubs, generally evergreen. Leaves 3-foliolate (rarely digitately 5-foliolate, rarely simple and 3-lobed). Inflorescence terminal and axillary, bracteate thyrses; 1–3 bracteoles present at base of flowers. Flowers bisexual, 5-merous; tepals in 2 whorls of 5, deciduous, valvate in bud; stamens 5, inserted opposite the external tepals, alternating with sessile glands or not, filaments straight and hardly flattened or circinate and quite flattened, with 2 spathulate or tubular staminodes at the base, anthers opening latrorsely by 2 valves; ovary ovoid, 1-locular; ovule solitary, pendulous. Fruit a samara with 2-4 longitudinal membranous wings. Seeds with planoconvex bilobed cotyledons.

Distribution: 18 species with several subspecies and varieties from West Africa to Madagascar and Indochina and the Philippines to New Guinea. A rare genus in Papuasia.

KEY TO SPECIES

1. Filaments very flattened and circinate, staminodes clavate, 0·6 mm long, interstaminal glands absent; leaves glabrous, with 5–7 pairs of lateral veins, domatia absent; samara 4-winged ..... **I. celebica**
1. Filaments only slightly flattened, straight to curved, staminodes urceolate, 2 mm long, interstaminal glands present; leaves pilose on midrib above and on lower surface of blade, 4(–5) pairs of lateral veins, domatia present; samara 3(–4)-winged ..... **I. novoguineensis**

Illigera celebica Miq. *Ann. Mus. Bot. Lugd.-Bat.* 2: 215 (1866). **Fig. 45.**

Evergreen liane. Leaves 3-foliolate. Leaflets lanceolate to lanceolate-elliptic, 8–17 × 3·5–8·5 cm, base cuneate to subcordate, apex 6–10 mm acuminate, thick chartaceous, drying olivaceous, by no means blackish, margin subrevolute, 5–7 pairs of lateral nerves arching towards the apex, glabrous on both surfaces; petiole terete, 4·4–11 cm long; petiolute canaliculate, 1–2·5 mm long, partially tomentose or totally glabrous; bracts caducous. Flower buds globose, 4–5 mm diameter. Tepals lanceolate, minutely pubescent; outer whorl 3–5 veined, 5–7 mm long; inner whorl 1–3-veined, slightly shorter. Filaments in bud circinate about the anthers, at anthesis twice or more the length of the perianth segments, base very flattened, 1·5–2·5 mm wide, narrowing upwards, puberulous, reddish, margin revolute basally; staminodes clavate, ± 0·6 mm long; glands absent. Samara 4-winged, 2·5–3·5 cm long; major wings 2–2·7 cm long, minor wings 1–1·5 cm long.

Distribution: South China and Indochina, the Philippines and Sulawesi (Celebes) to Vogelkop in western New Guinea.

Ecology: In the Vogelkop district it is locally common in lowland rainforest to ± 100 m altitude.

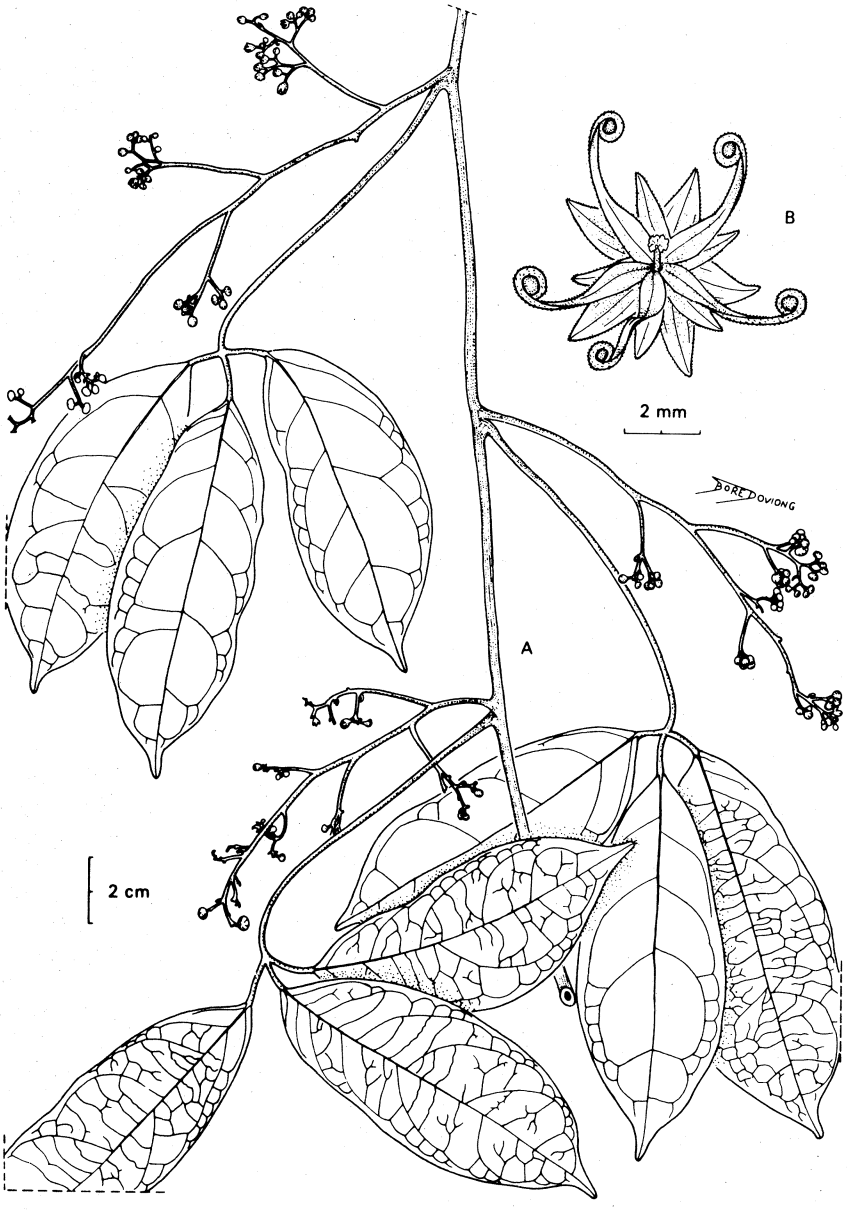

Fig. 45 **Illigera celebica** Miq. (A) stem with inflorescences (B) flower

Illigera novoguineensis Kubitzki *Bot. Jb.* **89**: 161 (1967), f. 37.

I. appendiculata auct. non Bl.: K. Sch. & Laut. (1900).

Evergreen liane. Leaves 3-foliolate. Leaflets ovate, lanceolate or lanceolate-elliptic, 5–10 × 3–7·5 cm; base subcordate to broadly rounded, apex abruptly 3–7 mm acuminate, chartaceous, drying black or dark brown, 4(–5) pairs of lateral veins curving towards the apex, midrib pilose above, the remainder of the upper surface glabrous or minutely pilose, laxly pilose beneath with domatia in axils of lateral veins; petiole terete, 4–11 cm long; petiolule slightly canaliculate above, 7–22 mm long. Flower buds ovoid, immediately before anthesis pyriform, 3–4 mm long, sparsely pilose. Tepals scarious, outer whorl 5-veined, inner whorl 3-veined, to 6 mm long, the internal whorl a little shorter than the external whorl. Filaments a little flattened towards the base, pilose ventrally, dorsally almost glabrous, to 2 mm long. Staminodes urceolate, shortly stipitate, apical margin laciniate, hardly opening; sessile glands alternating with the stamens. Samara (3–4)-winged, ± 2 cm long; major wings 2–2·5 cm long, minor wing(s) 2–7 mm long.

Distribution: Endemic, apparently restricted to the lower Ramu valley of the Madang district of northeastern New Guinea.

Ecology: In lowland rainforest up to 700 m altitude. Apparently very rare; no collections have been made since the turn of the century.

JUGLANDACEAE

*W.R. Barker**

Trees. Leaves deciduous, pinnate; stipules absent. Flowers small, unisexual, arranged singly in catkins, subtended by a bract; perianth absent or with 4 lobes in 2 series; stamens few to many (3–8 in Papuasia), subsessile, anthers 2-celled, dehiscing loculicidally; ovary inferior, with 2 carpels, but 1-celled by incomplete septum, ovule 1, basally attached to top of septum, style terminal, erect, with (in Papuasia) 2 ascending branches. Fruit 1-seeded; seed without endosperm.

Distribution: 7 genera with 59 species in northern temperate regions and tropical mountains of the Americas, Malesia and Asia. Only 1 genus is represented in Malesia (including Papuasia).

Literature: M. Jacobs. (1960), Juglandaceae, *Fl. Males.* ser. 1, **6**: 143–54. W. E. Manning (1978), The classification within the Juglandaceae, *Ann. Missouri Bot. Gard.* **65**: 1058–87.

ENGELHARDIA Lesch. ex Bl.

Trees, usually with tiny golden yellow glandular scales. Leaves spirally arranged, with ± asymmetrical leaflets. Flowers (sub)-sessile; male flowers in pendulous catkins, with perianth fused with bract, the bract-perianth ± entire or pinnatifid with 7 lobes; female flowers in ascending catkins which recurve when fruiting, fused into adaxial cup-like base of erect, membranous, conspicuously veined wing-like bract with 3 spreading lobes, the middle lobe longer than the 2 lateral ones. Perianth with 4 sometimes unequal lobes surrounding the style, 1–2 lobes sometimes resembling bract lobes, otherwise small. Fruit an indehiscent pea-sized nut fused with the enlarged bract. Cotyledons deeply 4-lobed.

Distribution: 5 species from India to southern China and throughout Malesia as far west as the New Guinea mainland, where 2 species occur, 1 widespread, the other known from a single collection.

Ecology: Jacobs (1960) notes that while 'pollination and seed dispersal are clearly adapted to wind', the sole New Guinea species is reported to have been 'repeatedly found with all the fruiting catkins, shed as a whole, on the ground under the tree'. It is possible, however, that the dense sharp bristles on the outside of the nutlets in the New Guinea species attach on contact to animals and so assist in dispersal.

* State Herbarium of South Australia, Adelaide, S.A.

Literature: W. E. Manning (1966), New combinations and notes on *Engelhardia* (Juglandaceae) of the Old World, *Bull. Torrey Bot. Club* **93:** 34–52.

KEY TO SPECIES

1. Leaflets entire. Petiole and leaf rachis combined (2–)3–8·5(–10) cm long ..... **E. rigida**
1. Leaflets conspicuously serrate. Petiole and leaf rachis combined (3–)5–18(–21) cm long ..... **E. serrata**

Engelhardia rigida Bl. *Bijdr. Fl. Ned. Ind.* **10**: 528 (1825). **Fig. 46.**
E. lepidota Schltr (1913).

Tree, dioecious, to 30(–36) m high; bole to 20 m high, to 65(–100) cm diameter at breast height. Leaves ± paripinnate, usually densely, rarely very sparsely covered by golden-yellow scales, densest on underside of leaflets, rarely also pubescent on petiole, rachis and veins; petiole and rachis slender, channelled above, petiole (0·8–)1–2·5(–3) cm long, rachis (1·5–)2·5–6(–7) cm long; leaflets in (1–)2(–4) subopposite pairs, petiolule (1–)2–4 mm long, blade obliquely lanceolate to obovate-lanceolate, sometimes broadly so, (2–)4–9(–13·5) cm long, (1·5–)2·5–4(–5·5) cm broad, ± coriaceous, dark green, glossy or dull, with slightly raised veins above, mid-green to golden-brown, dull, with prominent veins below, base obliquely obtuse to narrow attenuate, margin entire, narrowly recurved, apex usually acuminate, sometimes obtuse or rounded. Inflorescences many-flowered catkins with axes covered by sparse to dense golden-yellow scales, often mixed with white hairs. Male catkins usually 3–4, borne alternately on short peduncle, slender pale green to golden or reddish spikes 1·5–5 cm long; male flowers *c.* 5 mm long, bearing (3–)4–6(–8) glabrous or hirsute, oblong, pale yellow to red anthers 1–1·5 mm long. Female catkins solitary, pendulous, (4–)8–15(–22) cm long; wing-like, 3-lobed bract finally reaching 3(–4) cm long, the lobes green, pale brown or red, the base surrounding the flower covered by golden-yellow scales and dense long white bristles; female flower with perianth lobes sometimes unequal, 1–2 lobes sometimes half length of bract, otherwise tiny, style as long as or much shorter than the fimbriate-papillose red stigmatic branches. Fruit fused with base of wing-like bract to form nut *c.* 3 mm diameter covered by dense long bristles.

Field characters: Tree with open or dense, slender or spreading crown, bole straight or ± crooked, unbuttressed or (especially in western New Guinea) with deep buttresses to 2 m high. Bark: outer bark ± smooth and lenticellate to rough and longitudinally fissured, sometimes strongly peeling in small scales, green or grey to brown; under bark (if discernible) greenish-brown or tan and cream marbled; inner bark white, orange-brown, light brown or reddish-cream. Wood white, white streaked with brown, cream, yellowish, pink or reddish-brown; heartwood usually indistinguishable, but twice noted as black or dark brown.

Distribution: Common in Papuasia; known from Vogelkop, Geelvink Bay, Jayapura and Snow Mountains districts of western New Guinea and all districts of mainland Papua New Guinea excluding the little-botanized Gulf district. The species occurs throughout Malesia, but is rare outside Papuasia.

Fig. 46 **Engelhardia rigida** Bl. (A) fruiting twig (B) flowering twig

Ecology: Found at altitudes from near sea level (especially on the north coast of western New Guinea and in the Western district of Papua New Guinea) to 2600 m. In lowland rainforest on hills and ridges, including mixed dipterocarp forest and 'mixed forest and sago swamp' (Lake Kutubu). In higher regions it is common in lower mountain rainforest (usually with *Castanopsis* or *Lithocarpus*), often in the canopy or sometimes as a pioneer species in the reestablishment of forest in neighbouring grassland and disturbed areas. It has been once observed in *Nothofagus* forest (Mt. Nettoti, Vogelkop).

Uses: Commercial timber under the trade name Engel, for moulding, interior finish, light construction, weatherboards, packing cases and furniture; canoes and native buildings (Oriomo River, Western Province).

Notes: Manning (1966) recognizes two varieties, both occurring in Papuasia. Var. *subsimplicifolia* (Merr.) Manning (basionym *E. subsimplicifolia* Merr.) has 1–2(–3) pairs of leaflets, fruiting catkins 10–15 cm long and 'fruits' (?bracts) 2·5–2·7 cm long; var. *rigida* has 3–5 pairs of leaflets and longer fruiting catkins and 'fruits'.

In herbarium collections from Papuasia, subglabrous forms of *Engelhardia* have been sometimes attributed to *E. spicata* Lesch. ex Bl., a species which is known from Java westwards and is characterized by flat greyish scales when present and fruiting catkins with a stout angular stalk. These specimens are clearly *E. rigida,* as they bear occasional golden-yellow scales on the underside of the leaflets and a slender catkin stalk, both typical of this species.

Engelhardia serrata Bl. *Fl. Jav. Jugl.* **14,** t. 4, 5c (1829).

Similar to *E. rigida,* but differing by its conspicuously serrate leaflets and its usually much longer leaves, the petiole and leaf rachis combined being (3–) 5–18(–21) cm long.

Distribution: Known in Papuasia only from a single sterile collection from Motito, Wissel Lakes (Snow Mountains district). Widespread elsewhere, from the Moluccas into Southeast Asia.

Ecology: In primary forest on sandy clay at 1800 m altitude.

LORANTHACEAE

*B.A. Barlow**

Hemiparasitic aerial stem-parasitic shrubs. Leaves mostly opposite, sometimes alternate or verticillate. Flowers more than 5 mm long, dichlamydeous, hermaphrodite. Calyx reduced to a lobed or truncate limb at the apex of the ovary, without vascular bundles. Corolla choripetalous or gamopetalous, usually regular, 4–6(–9)-merous, valvate. Stamens as many as and opposite the petals, epipetalous; anthers primarily 2- or 4-locular (sometimes with transverse partitions), mostly basifixed, immobile and continuous with the filament but sometimes dorsifixed and then usually versatile, opening longitudinally; pollen trilobate. Ovary inferior, uni- or plurilocular, with or without a central placental column (mamelon); ovules absent; sporogenous tissue massive, located in the mamelon or at the base of the ovarian cavity. Style and stigma simple. Fruit baccate, with a viscous layer outside the vascular bundles.

Distribution: About 65 genera and 900 species, throughout the tropics of both hemispheres and with fewer species in temperate regions. In the Papuasian region there are 12 genera; 4 are endemic, and another 3 have their major centres of development in the region. Most of the non-endemic genera extend westward in Indomalaya, and 5 of them also occur in Australia. Of the 59 Papausian species 47 are endemic; only 5 species appear to be represented elsewhere in Indomalaya and 9 species occur also in Australia.

Literature: B.A. Barlow (1974), A revision of the Loranthaceae of New Guinea and the South-western Pacific, *Aust. J. Bot.* **22**: 531–621.

KEY TO GENERA

1. Leaves sessile, opposite, each pair united at the margins into a cup ..... TETRADYAS
1. Leaves not as above
 2. Inflorescence a head with an involucre formed from 2 or more enlarged bracts (this sometimes deciduous)
  3. Flowers 8 or more in the head
   4. Bracts 2, persistent, united at the margin when young; flowers pedicellate ..... PAPUANTHES
   4. Bracts in 3–12 pairs, deciduous in the New Guinean species, free; flowers sessile ..... LEPEOSTEGERES
  3. Flowers 6 in the head
   5. Corolla 6-merous, gamopetalous ..... DISTRIANTHES
   5. Corolla 4-merous, choripetalous ..... AMYEMA
 2. Inflorescence not a head (or if so, then without an involucre)
  6. Anthers dorsifixed, versatile ..... CECARRIA
  6. Anthers basifixed, immobile

* Flinders University of South Australia, Bedford Park, S.A. 5042.

7. Petals free or shortly united at the base
 8. Inflorescence a raceme of opposite triads ..... DECAISNINA
 8. Inflorescence a raceme of whorls of triads ..... DACTYLIOPHORA
 8. Inflorescence not as above (a simple or compound umbel, a solitary flower or a head) ... . AMYEMA
7. Petals united to the middle or higher
 9. Inflorescence a solitary flower ..... SOGERIANTHE
 9. Inflorescence a raceme of triads ..... AMYLOTHECA
 9. Inflorescence not as above (a simple umbel or raceme or an umbel of triads or tetrads)
  10. Inflorescence a simple umbel or raceme
   11. Bracts 3 under each flower ..... MACROSOLEN
   11. Bracts usually single under each flower
    12. Flowers alternate in the raceme ..... DENDROPHTHOE
    12. Flowers opposite in the raceme or in umbels ..... AMYLOTHECA
  10. Inflorescence an umbel of triads or tetrads
   13. Flowers in tetrads, all sessile or nearly so ..... AMYEMA
   13. Flowers in triads with the lateral flowers distinctly pedicellate ..... AMYLOTHECA

AMYEMA Tiegh.

Aerial stem-parasitic shrubs with or without runners (with runners in most of the species dealt with here). Leaves opposite or verticillate (rarely scattered), penninerved to curvinerved. Inflorescences axillary, rarely internodous or in some species arising from the runners, consisting primarily of a pedunculate many-rayed umbel of dichasia (triads), but showing various kinds and degrees of reduction in some species (e.g., to a simple umbel, head or solitary flower); bracts single under each flower (rarely more in reduced inflorescences). Corolla usually 4-, 5- or 6-merous; open flower actinomorphic, usually choripetalous but rarely gamopetalous in the lower part. Anthers basifixed, immobile, 2- or 4-locular. Style usually articulate at the base.

Distribution: About 90 species, ranging from Malaya and the Philippines to Australia and the western Pacific, the main centres of development being New Guinea and Australia. There are 27 species in Papuasia, of which 20 are endemic to the New Guinean mainland.

Ecology: Widely distributed throughout the region, with representatives occurring in most habitats from mangrove communities to subalpine forest at 3750 m altitude.

KEY TO SPECIES

1. Inflorescence an umbel of triads or tetrads
 2. Flowers in triads
  3. Triads with all flowers sessile
   4. Leaves regularly opposite
    5. Leaves sessile and cordate at the base ..... **A. cercidioides**
    5. Leaves petiolate
     6. Lamina mostly acute and acuminate at the apex, mostly more than 8 cm long .... **A. friesianum**
     6. Lamina rounded at the apex, less than 8 cm long ..... **A. obovatum**
   4. Leaves in whorls of 3–8 (sometimes scattered)
    7. Stems triangular below the nodes when young ..... **A. angulare**
    7. Stems terete even when young
     8. Lamina less than 1 cm wide, channelled above ..... **A. canaliculatum**
     8. Lamina more than 1 cm wide, flat

9. Lamina almost orbicular, up to 8 cm long ..... **A. pentactis**
9. Lamina lanceolate to ovate, more than 8 cm long ..... **A. scandens**
3. Triads with at least the lateral flowers pedicellate
10. Rays in the umbel mostly 2
11. Runners present; pedicels of the lateral flowers usually more than 1 mm long; rays of the umbel 3–6 mm long ..... **A. artense**
11. Runners absent; pedicels of the lateral flowers *c.* 0·5 mm long; rays of the umbels 1·5–2·5 mm long ..... **A. conspicuum**
10. Rays in the umbel 3 or more
12. Corolla mostly 4-merous
13. Rays of the umbel 5–12 ..... **A. wichmannii**
13. Rays of the umbel 3–4(–5)
14. Lamina acuminate and acute at the apex, mostly less than 1 cm wide ..... **A. kebarense**
14. Lamina rounded at the apex (sometimes with a small mucro), mostly more than 1 cm wide
15. Peduncle 1–1·5 mm thick, less than 12 mm long; internodes mostly less than 3 cm long, strongly articulate at the nodes ..... **A. pachypus**
15. Peduncle slender (up to 1 mm thick), more than 12 mm long; internodes slender, not strongly articulate at the nodes
16. Lamina ovate to orbicular, less than 4 cm long; peduncle more than 18 cm long ... **A. corniculatum**
16. Lamina elliptical to ovate, more than 4 cm long; peduncle mostly less than 18 mm long ..... **A. clavipes**
12. Corolla 5- or 6-merous
17. Rays in the umbel 7–20 ..... **A. stronglophyllum**
17. Rays in the umbel 3–6
18. Corolla up to 30 mm long; bracts of the lateral flowers of the triads rounded, concave, enclosing the calyx ..... **A. involvens**
18. Corolla up to 20 mm long; bracts of the lateral flowers of the triads acute, not enclosing the calyx
19. Runners absent; lamina 2·5–4 cm long, rounded at the apex; rays usually 3 ..... **A. mackayense**
19. Runners present; lamina 4–8 cm long; mostly acute at the apex; rays 4–6 ..... **A. novae-brittanniae**
2. Flowers in tetrads
20. Corolla 4-merous, choripetalous ..... **A. dilatipes**
20. Corolla 6-merous, gamopetalous in the lower part
21. Tetrads with all flowers sessile ..... **A. tetraflorum**
21. Tetrads with 3 flowers shortly pedicellate ..... **A. brassii**
1. Inflorescence other than an umbel of triads or tetrads (e.g. a head, simple umbel or solitary flower)
22. Inflorescence a 6-flowered head with an involucre of 2 enlarged bracts ..... **A. tetrapetalum**
22. Inflorescence not as above
23. Inflorescence a simple umbel
24. Rays of the umbel 3; leaves scattered-ternate ..... **A. apodum**
24. Rays of the umbel 2; leaves opposite
25. Peduncle 3–8 mm long ..... **A. seemenianum**
25. Peduncle up to 1 mm long ..... **A. squarrosum**
23. Inflorescence a solitary flower on an articulate peduncle
26. Leaves 4–7 cm long, acuminate, acute, almost sessile; peduncle *c.* 3 mm long ..... **A. hastifolium**
26. Leaves mostly 1·8–4 cm long, rounded, distinctly petiolate; peduncle 4–8 mm long ..... **A. finisterrae**

Amyema angulare Barlow *Aust. J. Bot.* **22**: 565 (1974).

Glabrous. Young stems triangular below the nodes, distinctly pustulate with orbicular lenticels when older. Leaves scattered-ternate; petiole 3 mm long;

lamina elliptical to obovate, 2·5–4 × 1·5–2·5 cm, abruptly attenuate at the base, minutely recurved at the margin, rounded at the apex; venation obscure. Inflorescences few to several in the axils; peduncle 12–20 mm long; rays 4–6, 6–10 mm long; all flowers of the triads sessile; bracts acute, 1–1·5 mm long, forming an open cup below each triad. Calyx funnel- to barrel-shaped, constricted near the apex, 2·5 mm long; limb shortly toothed, 0·5 mm long. Corolla in bud 5-merous, slender, not seen mature.

Distribution: Known only from the Wissel Lake region, Snow Mountains district, western New Guinea.

Amyema apodum Barlow *Aust. J. Bot.* **22**: 565 (1974).

Glabrous. Stems terete. Leaves scattered ternate; petiole 6–10 mm long, lamina elliptical, *c.* 8 × 4 cm, lustrous above, dull brownish below, attenuate at the base, recurved at the margin, obtuse at the apex; venation pennate with only the main veins distinct. Inflorescences several in the axils, each consisting of a simple 3-rayed umbel (perhaps a sessile 4- to 6-rayed umbel of triads with all flowers pedicellate); peduncle of the umbel (perhaps immature) 1–2 mm long; rays (perhaps immature) 2–3 mm long; bracts spreading, acute. Calyx slightly funnel-shaped, constricted at the base of the limb, 2 mm long; limb erect, weakly toothed. Corolla in the immature bud slender, slightly clavate, 5-merous.

Field characters: Distinguished from all other New Guinean species of the genus by its inflorescence structure, which is probably a reduction from the umbel of triads borne by most species.

Distribution: Known only from near Sorong, Vogelkop district, western New Guinea.

Amyema artense (Mont.) Danser *Bull. Jard. Bot. Btzg* **10**: 293 (1929).

Loranthus artensis Mont. (1860); *Neophylum artense* (Mont.) Tiegh. (1896): *Loranthus bamleri* K. Sch. (1901); *L. iboensis* Krause (1922); *Amyema bamleri* (K. Sch.) Danser (1929); *A. iboensis* (Krause) Danser (1929); *A. gracilis* Danser (1931).

Calyx usually shortly brown-tomentose (sometimes the whole inflorescence), rarely completely glabrous. Leaves opposite or rarely ternate; petiole distinct, flat above, (3–)5–8 mm long; lamina (lanceolate) oblong to ovate, (4–)6–9(–14) × (1·5–)2·5–4(–7) cm, shining and frequently red above, dull below, gradually or rarely abruptly attenuate at the base, usually recurved and red at the margins, obtuse or rounded (rarely acute and acuminate) at the apex; venation pennate to almost curvinerved. Inflorescences usually several at the nodes; peduncle (5–)8–20 mm long, slender to robust; rays 2 (rarely 3), 3–6 mm long; pedicels of the lateral flowers (0·5–)1–3 mm long; bracts usually spreading, acute to rounded. *c.* 1 mm long. Calyx funnel-shaped to urceolate, usually constricted just below the limb; limb truncate, irregularly split or toothed, 0·7–1 mm long. Corolla in the mature bud slender, not or weakly clavate; filaments *c.* 8 mm long. Stigma small. Fruit urceolate to ellipsoidal, crowned by the calyx limb.

Field characters: Very polymorphic, varying in leaf size, shape, thickness and pigmentation, and in the dimensions and slenderness of the inflorescence. 1 extreme variant has been distinguished at varietal rank.

Distribution: Papuasia, Santa Cruz Islands, New Caledonia, New Hebrides, Samoa and Caroline Islands. 2 varieties in Papuasia.

KEY TO VARIETIES

1. Lamina lanceolate, 6–14 × 1·5–2(–2·5) cm, acuminate and acute at the apex ..... **var. papuanum**
1. Lamina oblong to ovate, 4–9 × 2–4(–7) cm, obtuse or rounded at the apex ..... var. **artense**

var. **artense**

Distribution: In Papuasia, common in the Eastern, Western and Southern Highlands districts, mostly between 1500 and 2300 m altitude but sometimes as low as 1000 m; also in the Louisiade Archipelago (Papuan Islands district) mostly above 300 m altitude.

var. **papuanum** (Danser) Barlow *Aust. J. Bot.* **22**: 568 (1974).
A. papuana Danser (1938).

Distribution: Known only from the Owen Stanley Range (Central district) and the Hunstein Mountains (East Sepik district) from 1800 to 2300 m altitude.

Amyema brassii Barlow *Aust. J. Bot.* **22**: 568 (1974).

Glabrous except for the inflorescences, bracts and calyx shortly brown-tomentose and the corolla very sparsely white-tomentose. Stems terete, enlarged at the nodes. Leaves opposite; petiole terete, 3 mm long; lamina lanceolate, 12–20 × 3–6 cm, shining above, dull below, contracted at the base, recurved at the margins, acuminate and acute at the apex; venation pennate with only the midrib prominent on both sides. Inflorescences solitary in the axils; peduncle *c.* 4 mm long; rays *c.* 6, 3–4 mm long; flowers in tetrads with the outermost one sessile and the 2 lateral ones and innermost one on pedicels 1–2 mm long; bracts *c.* 8 mm long, narrow acute or truncate, occasionally with a weakly developed dorsal protuberance. Calyx 2·5 mm long, slightly funnel-shaped; limb 0·7 mm long, irregularly toothed. Corolla in the mature bud inflated at the base, weakly clavate at the apex, *c.* 35 mm long; petals in the open flower 6, coherent in the lower 10–12 mm. Anthers 3 mm long; free parts of the filaments 5 mm long.

Field characters: Among Papuasian species of *Amyema,* only *A. brassii* and *A. tetraflorum* have the corolla gamopetalous. Compared with *A. tetraflorum, A. brassii* is generally more slender and has a longer inflorescence with 3 flowers in each tetrad pedicellate.

Distribution: Known only from the Louisiade Archipelago (Sudest Island) at 600 m altitude.

Amyema canaliculatum Barlow *Aust. J. Bot.* **22**: 569 (1974).

Glabrous. Stems terete. Leaves scattered-ternate; petiole obscure, terete, *c.* 3 mm long; lamina linear-lanceolate, 7–13 × 0·3–0·6 cm, thick, convex below and strongly concave above, attenuate at the base, rounded at the apex but with a small mucro. Inflorescence peduncle *c.* 2 mm long; rays 3, *c.* 4 mm long; triads with all flowers sessile; bracts spreading, triangular, *c* 1 mm long, shortly united at the margins into an involucre below the triad. Calyx urceolate, 4 mm long; limb erect, truncate, 1 mm long. Corolla in the mature bud very slender, not clavate, *c.* 24 mm long.

Field characters: A member of the *Amyema scandens* species complex, distinctive in its very narrow strongly channelled leaves without visible venation, in the very short peduncle and in the few-rayed umbel.

Distribution: Know only from Telefomin subprovince, West Sepik district, 600 m altitude.

Ecology: Unusual (but not unique) among Loranthaceae in parasitizing a non-dicotyledonous host (*Dacrydium*).

Amyema cercidioides (Krause) Danser *Bull. Jard. Bot. Btzg* **10**: 194 (1929).
Loranthus cercidioides Krause (1923).

Stems, leaves and inflorescences covered with very short thick simple hairs; flowers glabrous. Leaves opposite, sessile; lamina almost orbicular, thick, 9–12 × 8–10 cm, dull on both sides, cordate at the base, rounded at the apex; venation pennate with the lateral veins as prominent as the midrib and arising near its base. Inflorescence peduncle 5 mm long, 2 mm thick; rays 3 or 4, 6 mm long, 2 mm wide at the base, 3 mm wide at the apex; triads with all flowers sessile; bracts spreading, obtuse, *c.* 2 × 2 mm, shortly united at the margins into an involucre below the triad. Calyx spindle-shaped to ureolate, smooth except for 1 or more weak longitudinal ribs or angles; limb erect, *c.* 1 mm long, with 6 narrow acute teeth *c.* 0·5 mm long. Corolla in immature bud cylindrical, 6-merous, not known mature. Anthers shorter than the free) parts of the filaments, not known mature. Style persistent on the fruit for some time; stigma small. Fruit urceolate, *c.* 8 mm long, sometimes weakly ribbed like the calyx, crowned by the persistent calyx limb.

Distribution: Known only from the Jayapura district, western New Guinea (Doorman Top), 1450 m altitude.

Amyema clavipes Danser *Brittonia* **2**: 132 (1936).

Glabrous or with the inflorescence bearing scattered short simple hairs. Leaves opposite; petiole distinct, flat above, 5–8 mm long; lamina elliptical to ovate, 4–6(–8) × 1·8–2·5(–4) cm, slightly lustrous above, dull below, gradually attenuate at the base, obtuse or rounded at the apex; venation pennate with all venation faintly visible. Inflorescences solitary or few in the axils; peduncle slender (0·8–1·0 mm wide below, 0·5–0·8 mm wide above), 12–16 (–20) mm long; rays usually 4 (rarely 3), thicker than the peduncle (*c.* 1 mm thick), spreading, 5–7 mm long; pedicels of the lateral flowers *c.* 3 mm long; bracts erect, acute, 1 mm long. Calyx barrel-shaped or slightly funnel-shaped; limb 0·3 mm long, minutely irregular. Corolla in the mature bud slender,

clavate, 14–19 mm long; 4-merous. Anthers 1 mm long; free parts of the filaments 2·5–3 mm long.

Distribution: Endemic to New Guinea: highlands of eastern New Guinea from near Garaina, Morobe district, to the eastern Owen Stanley Range, 2380–3000 m altitude.

Amyema conspicuum (F.M. Bail.) Danser *Bull. Jard. Bot. Btzg* **10**: 294 (1929).

Loranthus conspicuus F.M. Bail. (1911).

Young parts, inflorescence, bracts and calyx shortly and densely brown-tomentose, the tomentum of the calyx only at the base and mixed with white hairs and thus light brown in colour. Stems terete, much-branched. Leaves opposite; petiole 3–5 mm long; lamina oblong to obovate, mostly widest above the middle, 3–6 × 1–2 cm, dull on both sides, attenuate at the base, recurved at the margin, rounded at the apex; venation distinctly curvinerved. Inflorescences several in the axils; peduncle 6–8 mm long; rays 2, 1.5–2·5 mm long; pedicels of the lateral flowers of the triads 0·5 mm long; bracts spreading, keeled, 1 mm long. Calyx funnel-shaped, 1·5 mm long; limb 0·7 mm long, erect, irregularly lobed, ciliate. Corolla in the mature bud slender, weakly clavate, acute, 18–22 mm long, 4- or 5-merous. Anthers 1·5 mm long; free parts of the filaments *c.* 9 mm long. Fruit more or less globular, 4–5 mm long, with a distinct neck at the apex.

Distribution: Eastern and northern Australia. 1 of the 3 subspecies is endemic to Papuasia.

ssp. **fulvicalyx** Barlow *Aust. J. Bot.* **22:** 579 (1974).

Field characters: In common with *A. mackayense,* which also has a wide distribution in Australia, this form is distinct among the Papuasian Amyemas in lacking runners, a condition more or less typical of the Australian species of the genus.

Distribution: New Guinea: Morobe district, 1200–1700 m altitude.

Amyema corniculatum Danser *Brittonia* **2**: 133 (1936).

Glabrous. Stem slender. Leaves opposite; petiole 2–4 mm long; lamina ovate to nearly orbicular, 2–4 × 1·8–2·5 cm, shining or lustrous above, dull below, attenuate or contracted at the base, rounded at the apex; venation pennate, indistinct except for the midrib faintly visible. Inflorescences solitary or paired in the axils; peduncle very slender (*c.* 0·5 mm wide below, slightly wider above), 19–26 mm long; rays 4, thicker than the peduncle (*c.* 0·8 mm wide), spreading, 3–4 mm long; pedicels of the lateral flowers 2 mm long; bracts acute, 1 mm long, with a tuberculate dorsal protuberance. Calyx slightly funnel-shaped; limb 0·2 mm long, minutely 4-toothed. Corolla in the mature bud very slender, weakly clavate, 16–18 mm long, 4-merous. Anthers 1 mm long; free parts of the filaments 2·5 mm long. Fruit ellipsoidal, truncate, *c.* 5 mm long.

Distribution: Endemic to New Guinea; known only from Wharton Range, Central district, 2800 m altitude.

Amyema dilatipes Barlow *Aust. J. Bot.* **22**: 575 (1974). **Fig. 47.**

Glabrous. Young stems strongly triangular or quadrangular, becoming terete when older. Leaves ternate or quaternate; petiole distinct, flat or channelled above, (2–)4–6 mm long; lamina broadly lanceolate to broadly elliptical, (2–)4–7 × 1·2–3 cm, shining above, abruptly contracted at the base, acute at the apex; venation pennate with midrib visible on both sides and the lateral veins distinct above. Inflorescences solitary in the axils or on the runners; peduncle (15–)40–50(–90) mm long, 1–1·5 mm wide at the base, dilated up to 7 mm wide at the apex; rays 14–22, radially flattened, 7–11 mm long; flowers in tetrads with central flower sessile and the lateral flowers on terete pedicels 3–5 mm long; tetrads orientated with 1 lateral flower towards the centre of the inflorescence and lower on the ray; central bract erect, variously branched, lobed and twisted, 3–5 mm long; lateral bracts erect, acute, 3–4 mm long, frequently bent in the middle. Calyx barrel-shaped; limb very short, irregularly toothed. Corolla in the mature bud slender, strongly clavate, acute or rounded, 25–40 mm long, 4-merous. Anthers 2–3 mm long, about equal to the free parts of the filaments. Stigma small.

Field characters: Unusual in several characters, including the triangular or quadrangular stems with ternate leaves, greatly dilated peduncle, flowers in tetrads and long forked bracts.

Distribution: Endemic to New Guinea; from the Wahgi divide to Mt Michael, Eastern and Western Highlands districts, 3300–3750 m altitude.

Ecology: Confined to subalpine communities and reaching the highest altitude of any Papuasian species of Loranthaceae.

Amyema finisterrae (Warb.) Danser *Bull. Jard. Bot. Btzg* **10**: 295 (1929).

Loranthus finisterrae Warb. (1893); *L. diversifolius* Ridl. (1916).

Glabrous. Leaves opposite; petiole 4–7 mm long, distinct but double-edged; lamina (oblong to) elliptical-spathulate (to broad ovate), 1·8–4(–6) × 1·5–3 cm, dull on both sides or somewhat lustrous above, darker above than below, attenuate to contracted at the base, recurved at the margins, mostly rounded but very rarely acute and acuminate at the apex; venation pennate with the lateral veins diverging near the base of the lamina, indistinct or with only the midrib visible. Inflorescences solitary to few in the axils, each consisting of a single pedicellate flower on a slender ebracteate peduncle 2–4(–6) mm long (i.e. a flower on a jointed 'pedicel'); pedicel slender, wider at the apex, 1·5–3 mm long, with a single bract (rarely 2 or 3) at the apex; bract erect, acute, *c.* 1·5 mm long. Calyx slightly funnel-shaped; limb truncate or weakly 4-lobed, membranous, 0·7–1 mm long. Corolla in the mature bud quadrangular, more or less winged, sometimes clavate when winged, acute or obtuse, (13–)20–35 mm long, 4-merous. Anther 2–3 mm long; free parts of the filaments about twice as long. Fruit ellipsoidal, slightly pear-shaped.

Field characters: Amyema finisterrae and *A. hastifolium* are distinguished from all other members of the genus except the doubtful species *A. curvifolium* by the extreme reduction of the inflorescence to a single flower on an articulate pedicel. See also *A. hastifolium.*

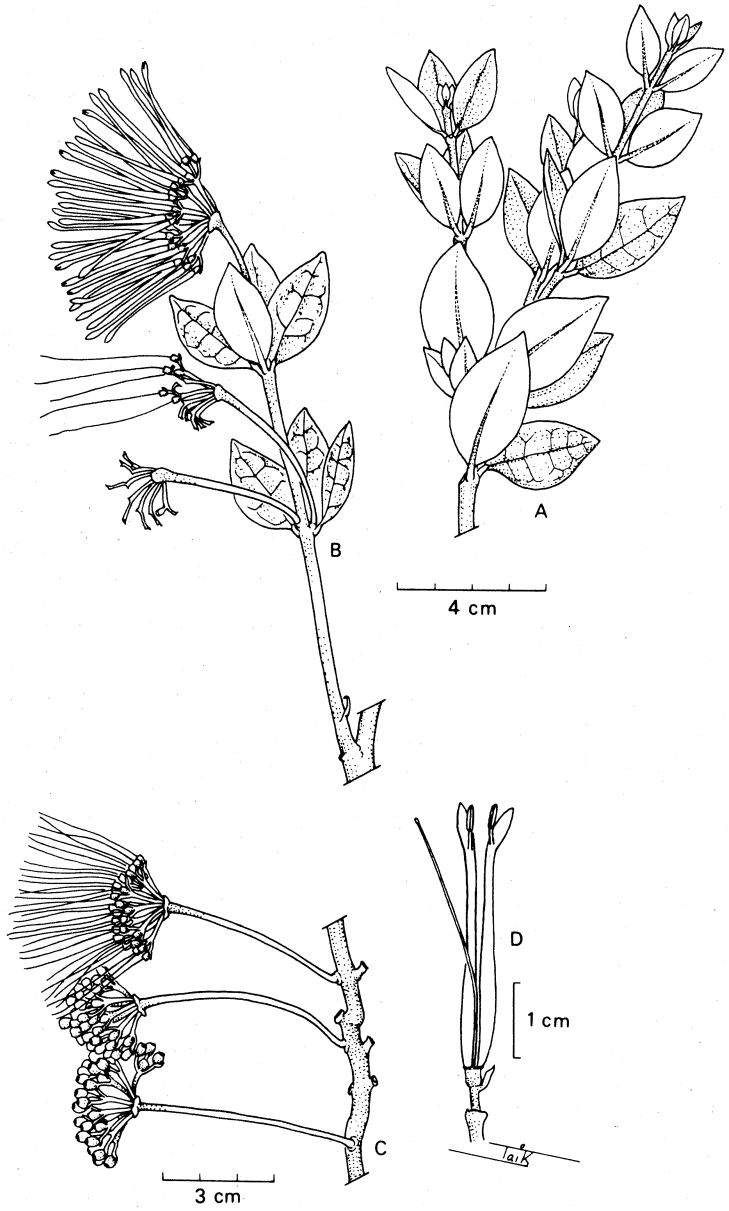

Fig. 47 **Amyema dilatipes** Barlow (A) leafy twig (B) flowering twig (C) inflorescences (D) longitudinal section of flower.

Distribution: Endemic to New Guinea; common in Highlands from Wissel Lakes (Snow Mountains) to Owen Stanley Range (Central district), 1500–2600 m altitude.

Amyema friesianum (K. Sch.) Danser *Bull. Jard. Bot. Btzg* **10**: 295 (1929).
Loranthus friesianus K. Sch. (1905).

Glabrous except for the inflorescence and flowers sparsely to densely white or brown-tomentose. Stems slender with long internodes. Leaves opposite; petiole distinct, channelled above, (8–)10–20(–30) mm long; lamina lanceolate to ovate (to broad ovate), often falcate or oblique, (6–)8–15)(–20) × 3–7(–10) cm, dull on both sides, abruptly attenuate at the base, undulate at the margin, acute and acuminate (rarely obtuse) at the apex; venation nearly curvinerved, distinct on both sides. Inflorescences several at the nodes; peduncle (18–)20–30 mm long, sometimes slightly enlarged and globular at the apex; rays 5–8, (5–)6–9(–10) mm long; triads with all flowers sessile; bracts 3 at the apex of each ray, erect, acute, 1·5–2 mm long, shortly united at the margins into an involucre around each triad. Calyx cylindrical to funnel-shaped; limb erect, truncate, 0·7–1 mm long. Corolla in the mature bud slender, weakly clavate, acute obtuse or rounded at the apex, 28–35 mm long, 6-merous. Anthers 2·5–3 mm long; free parts of the filaments *c.* 1 mm long. Stigma small. Fruit ellipsoidal, *c.* 10 mm long, crowned by the persistent calyx limb.

Distribution: Endemic to New Guinea; common from the Meervlatke, Jayapura district, western New Guinea, to the Central district, Papua, 0-2670 m altitude but most common from 1500 to 2000 m altitude.

Amyema hastifolium (Ridl.) Danser *Bull. Jard. Bot. Btzg* **11**: 337 (1931).
Loranthus hastifolius Ridl. (1916).

Glabrous except for the calyx and inflorescence sprinkled with large unbranched hairs. Leaves opposite; petiole *c.* 2 mm long; lamina elliptical to ovate, 4–7 × 2–5 cm, more or less lustrous above, dull below, contracted at the base, finely recurved at the margin, acute and somewhat acuminate at the apex; venation pennate to almost curvinerved with the midrib distinct on both sides and the lateral veins distinct above. Inflorescences axillary or on the runners, composed of a single shortly pedicellate flower on a slender ebracteate peduncle *c.* 2 mm long (i.e. a flower on a jointed 'pedicel'); pedicel 0·5–1 mm long, funnel-shaped; bract conspicuous, erect, obtuse, 1·5 mm long. Calyx cylindrical to slightly funnel-shaped; limb truncate, 0·7 mm long. Corolla in the mature bud quadrangular, acute, *c.* 40 mm long, 4-merous. Anthers 5 mm long, equal to the free parts of the filaments. Stigma 1½ times as wide as the style.

Field characters: Amyema hastifolium and the more widespread *A. finisterrae* are distinguished from all other members of the genus except the doubtful species *A. curvifolium* by the extreme reduction of the inflorescence to a single flower on an articulate pedicel. *A. hastifolium* differs from *A. finisterrae* in the larger, acute, almost sessile leaves which are more strongly pennineved, the smaller dimensions of the inflorescences (particularly the pedicel) and longer corolla and anthers.

Distribution: Endemic to New Guinea; western New Guinea, in highland districts, 1250–2800 m altitude.

Amyema involvens Barlow *Aust. J. Bot.* **22**: 578 (1974).

Glabrous except for the inflorescence and flowers shortly brown-tomentose. Stems thick, terete, enlarged at the nodes, much-branched. Leaves opposite; petiole 5–10 mm long; lamina ovate to orbicular or spathulate, thick, 3–5(–7) × 2·5–4(–5) cm, contracted or attenuate at the base, rounded at the apex; venation pennate, obscure or with the midrib slightly prominent near the base. Inflorescences 1–3 in the axils, robust; peduncle 10–20 mm long, 1·5–2·5 mm thick; rays usually about 4 (rarely 8), 5–10 mm long; pedicels of the lateral flowers of the triads 3–5 mm long, 1·5–2 mm thick; bracts thick; central bract of the triad erect, triangular, acute, 2–2·5 mm long; lateral bracts concave, rounded at the apex, 2–3 mm long, enclosing the calyx. Calyx barrel-shaped, 3 mm long; limb entire or irregularly split, 1 mm long. Corolla in the mature bud *c.* 30 mm long; petals in the open flower 5 or 6, each with a deflexed spur or tuft of hairs inside at the apex. Anthers 3 mm long, about equal to the free parts of the filaments.

Distribution: Endemic to New Guinea; in highland districts, 840–2440 m altitude.

Amyema kebarense Barlow *Aust. J. Bot.* **22**: 579 (1974).

Small much-branched shrub with many slender runners, glabrous except for a few scattered hairs on the inflorescence, calyx and corolla. Stems terete, slender, pustulate with elongate lenticels. Leaves opposite; petiole 1–3 mm long; lamina narrow lanceolate, rolled when dry, 4–7 ×0·4–0·7(–1·3) cm, dull on both sides, gradually attenuate at the base, acuminate and acute at the apex; venation invisible. Inflorescences 1–3 in the axils; peduncle slender, (8–)10–15(–20) mm long; rays 3 (or 4), slender, wider towards the apex, often curved, *c.* 8 mm long; pedicels of the triads 2–3 mm long in flower but longer in fruit; bracts small, spreading, obtuse, 1 mm long. Calyx narrow, slightly funnel-shaped, 2 mm long; limb only *c.* 0·3 mm long. Corolla in the mature bud very slender with a few scattered white hairs at the tip, rounded at the apex, *c.* 18 mm long, 4-merous. Anthers acute, 2 mm long; free parts of the filaments 4 mm long. Fruit nearly globular, 6 mm long.

Field characters: Distinguished from most other species of *Amyema* by its very slender habit, small narrow leaves and 4-merous flowers.

Distribution: Endemic to New Guinea; Vogelkop Peninsula, in highlands, 700–2100 m altitude.

Ecology: The only recorded host is *Clethra* sp.

Amyema mackayense (Blakely) Danser *Bull. Jard. Bot. Btzg* **10**: 297 (1929).
Loranthus mackayense Blakely (1923).

Glabrous or the calyx and fruit minutely and sparsely brown-tomentose. Runners absent. Stems smooth, enlarged at the nodes, much-branched. Leaves opposite; petiole distinct, 3–6 mm long; lamina broad-spathulate to ovate (to nearly orbicular), 2·5–4 × 1·5–2·5 cm, contracted at the base,

rounded at the apex; venation obscure, curvinerved. Inflorescences solitary or paired in the axils; peduncle usually deflexed, 6–15 mm long; rays usually 3, 4–6 mm long; pedicels of the lateral flowers of the triads 2–4 mm long; bracts acute to truncate, 1 mm long. Calyx funnel-shaped, contracted just below the limb; limb truncate, 0·5–1 mm long. Corolla in the mature bud slender, clavate, 10–16 mm long. Anthers 1·5 mm long; free parts of the filaments 3–5 mm long. Fruit ellipsoidal, crowned by the persistent calyx limb.

Distribution: Northern Australia, in coastal districts. 1 subspecies occurs in Papuasia.

ssp. **cycnei-sinus** (Blakely) Barlow *Aust. J. Bot.* **14**: 472 (1966).

Loranthus cycnei-sinus Blakely (1923); *Amyema cycnei-sinus* (Blakely) Danser (1929).

Field characters: In common with *A. conspicuum,* which also occurs in Australia, this form is distinct among the New Guinean Amyemas in lacking runners, a condition more or less typical of the Australian members of the genus.

Distribution: Northern Australia, from West Kimberley to Arnhem Land. In Papuasia: New Guinea, in coastal habitats in Merauke district, western New Guinea and adjoining parts of Western district, Papua.

Ecology: Exclusively parasitic on mangroves.

Amyema novae-brittanniae (K. Sch.) Danser *Bull. Jard. Bot. Btzg* **10**: 297 (1929).

Loranthus novae-brittanniae K. Sch. (1905); *L. jambosae* Schulze (1936); *Amyema jambosae* (Schulze) Danser (1936).

Glabrous. Stems flattened when young, soon becoming terete. Leaves opposite; petiole 1–1.5 cm long; lamina elliptical to ovate, 4–8 × 2–4·5 cm, dull on both sides, attenuate at the base, undulate at the margin when dry, mostly acute at the apex (less frequently rounded or notched); venation pennate with only the midrib visible and raised below. Inflorescences 1–2 in the axils; peduncle slender, 5–12 mm long; rays 4–6(–7), 5–8 mm long; pedicels of the lateral flowers of the triads 2–3 mm long; bracts spreading, acute, 1–2 mm long. Calyx cylindrical, narrow, 2–3 mm long; limb erect, toothed, 0·7–1 mm long. Corolla in the mature bud clavate and obtuse at the apex, 14–20 mm long; petals in the open flower 5, distinctly narrow-spathulate. Anthers 0·7–1·5 mm long; free parts of the filaments *c.* 4 mm long.

Distribution: Endemic to the Bismark Archipelago, occurring in New Britain and New Ireland, 400–1060 m altitude.

Amyema obovatum Danser *Bull. Jard. Bot. Btzg* **11**: 340 (1931).

Glabrous except for the inflorescence and flowers very shortly and sparsely tomentose. Stems slender. Leaves opposite; petiole slender, terete, 5–8 mm long; lamina obovate, 5–7 × 4–6 cm, thin, attenuate at the base, undulate at the margin, rounded at the apex; venation pennate. Inflorescence peduncle 20 mm long; rays *c.* 5–7 mm long; all flowers of the triads sessile; bracts 1–1·5

mm long, acute or obtuse, shortly united at the margins into an involucre below the triad. Calyx cylindrical to funnel-shaped; limb erect, truncate, *c.* 1 mm long. Corolla in the mature bud cylindrical, 27–28 mm long, 6-merous. Anthers 2 mm long; free parts of the filaments 8 mm long. (Corolla and anther description from Danser, *Bull. Jard Bot. Btzg* **11**: 340 (1931).

Distribution: Known only from Mamberamo River, Jayapura district, western New Guinea, 70 m altitude.

Amyema pachypus (Burk.) Danser *Bull. Jard. Bot. Btzg* **10**: 297 (1929).
Loranthus pachypus Burk. (1899).

Glabrous and somewhat glaucous or the inflorescence and flowers sparsely to densely brown-tomentose. Stems robust, articulate at the nodes; internodes short (rarely exceeding 3 cm). Leaves opposite; petiole 2–7 mm long; lamina oblong to obovate, 2·5–4·5 × 1·2–2 cm, attenuate at the base, thick, rounded at the apex but sometimes with a small mucro; venation pennate, indistinct. Inflorescences solitary or few in the axils; peduncle 8–11 mm long, 1–1·5 mm thick; rays 3–5, mostly 4, thicker than or as thick as the peduncle, cigar-shaped and strongly articulate, 3·5–5 mm long; pedicels of the lateral flowers similar to the rays, 2–4 mm long; bracts acute, 1 mm long, with a rounded dorsal protuberance. Calyx cylindrical to barrel-shaped; limb 0·3 mm long, obscurely toothed. Corolla in the mature bud very slender, clavate, *c.* 15 mm long, 4-merous. Anthers oblong, *c.* 0·5 mm long; free parts of the filaments 2 mm long. Stigma hardly wider than the style. Fruit barrel-shaped.

Distribution: Endemic to New Guinea; highlands from Mt Amungwiwa (Morobe district) to Wharton Range (Central district), 3000–3500 m altitude.

Ecology: Confined to subalpine communities.

Amyema pentactis Danser *Blumea* **3**: 397 (1940).

Glabrous. Stems terete, enlarged at the nodes, distinctly lenticellate. Leaves scattered-ternate; petiole distinct, 0·3–0·5 cm long; lamina broadly elliptical (to orbicular), 4–8 × 3–5 cm, contracted, truncate or rounded at the base, narrowly marginate, rounded at the apex; venation pennate, obscure. Inflorescences several at the nodes; peduncle robust, 18–25 mm long, 2 mm thick, slightly dilated at the apex; rays 5–8, almost as thick as the peduncle, 4–9 mm long; flowers all sessile in the triads; bract triangular, 2 mm long, not united at the margins. Calyx barrel-shaped; limb erect, irregularly lobed or spilt in the upper 0·5 mm, 1 mm long. Corolla in the mature bud cylindrical, obtuse at the apex, 16–19 mm long, 6-merous. Anthers 2 mm long; free parts of filaments 8 mm long.

Distribution: Endemic to New Guinea; Finisterre Mountains (Madang district) and Eastern Highlands, 1500–2400 m altitude.

Amyema scandens (Tiegh.) Danser *Bull. Jard. Bot. Btzg* **10**: 298 (1929).

Neophylum scandens Tiegh. (1894); *Loranthus scandens* (Tiegh.) Engl. (1897); *L. caudiciflorus* Laut. (1910); *L. verticillifolius* Krause (1922); *L. plicatulus* Krause (1923); *L. gigantifolius* Krause (1923); *Amyema caudiciflora* (Laut.) Danser (1929); *A. verticillifolia* (Krause) Danser (1929); *A. plicatula*

(Krause) Danser (1929); *A. gigantifolia* (Krause) Danser (1929); *A. ovariosa* Danser (1931); *A. cephalanthera* Danser (1936); *A. duurenii* Barlow (1964).

Glabrous or with the calyx very shortly and sparsely brown- to white-tomentose. Stems robust, often conspicuously lenticellate. Leaves usually verticillate with 3–4(–8) leaves in the whorl, sometimes opposite; petiole absent or up to 2 cm long; lamina very variable, narrow lanceolate to broadly ovate, 8–20(–30) × (1·5–)4–6(–15) cm, thick or thin, sometimes undulate, attenuate to slightly cordate at the base, acute and shortly mucronate to rounded at the apex; venation always pennate, distinct or obscure. Inflorescences few to several at the nodes or on the runners; peduncle (1–)5–25 mm long; rays 5–8, 6–10 mm long; triads with all flowers sessile; bracts spreading, rounded, 1–2·5 mm long, shortly united at the margins into an involucre under each triad. Calyx cylindrical, funnel-shaped or barrel-shaped; limb erect, truncate or weakly toothed, 0·7–1·3 mm long. Corolla in the mature bud slender, sometimes clavate, acute or obtuse, 20–30(–38) mm long, 5- or 6-merous. Anthers 1–2·5 mm long; free parts of the filaments 5–6 times as long. Stigma knob-like, about 1·5 times as wide as the style.

Distribution: New Caledonia and New Hebrides. In Papuasia restricted to the New Guinea mainland, 0–2500 m altitude. 3 subspecies occur in New Guinea.

KEY TO SUBSPECIES

1. Leaves distinctly petiolate, 7–15 cm long
   2. Leaves scattered-ternate, elliptical to ovate, rounded at the apex ..... ssp. **plicatulum**
   2. Leaves usually in regular whorls of 4–8, lanceolate to oblong, acute to rounded at the apex but usually with a small mucro ..... ssp. **scandens**
1. Leaves sessile or nearly so, 9–25 cm long; leaves usually regularly quaternate ..... ssp. **crassifolium**

ssp. **crassifolium** Barlow *Aust. J. Bot.* **22:** 588 (1974).

Stems very robust, the young ones conspicuously lenticellate. Leaves mostly regularly quaternate (rarely scattered); petiole thick, terete, 0–3 mm long (i.e. leaf sessile or nearly so); lamina broad lanceolate to ovate, 10–25 × 3·5–10 cm thick, contracted at the base (rarely attenuate), acute or rounded at the apex; venation pennate, obscure except for the midrib prominent below. Inflorescences several to many at the nodes, mostly rather robust; peduncle 10–18 mm long; rays *c.* 8 mm long. Calyx cylindrical or slightly barrel-shaped, constricted at the limb. Corolla 25–30 mm long.

Distribution: Endemic to New Guinea; highlands of eastern New Guinea, 1500–2500 m altitude.

ssp. **plicatulum** (Krause) Barlow *Aust. J. Bot.* **22:** 588 (1974).

Loranthus plicatulus Krause (1923); *Amyema plicatula* (Krause) Danser (1929); *A. ovariosa* Danser (1931).

Leaves scattered-ternate; petiole distinct, 0·8–1·5 cm long; lamina elliptical to ovate, 9–13 × 5–7 cm, abruptly contracted to attenuate at the base, strongly undulate at the margin, rounded at the apex. Inflorescence rather slender; peduncle 12–22 mm long. Calyx slightly funnel-shaped.

Distribution: Endemic to New Guinea; western New Guinea, 0–70 m altitude.

Note: See note on intermediate forms under ssp. *scandens*.

ssp. **scandens**

Leaves in regular or slightly scattered whorls of 4–8; petiole distinct, more or less terete, 0·5–2 cm long; lamina lanceolate to oblong, 7–15 × 2·5–3·5 (–4·5) cm, attenuate at the base, acute, obtuse or rounded at the apex but usually with a small mucro; venation pennate with the midrib distinct on both sides and raised below and the other venation obscure. Inflorescences slender; peduncle *c.* 15 mm long. Caylx slightly funnel-shaped. Corolla 30–38 mm long.

Distribution: New Caledonia, Isle of Pines and Lifu Is.; New Hebrides. In New Guinea: lowland habitats, 0–260 m altitude.

Note: Many specimens of *Amyema scandens* are intermediate between the subspecies recognized. They are mostly from the mountains at middle elevations (1000–2000 m).

Amyema seemenianum (K. Sch.) Danser *Bull. Jard. Bot. Btzg* **10**: 299 (1929). **Fig. 48.**

Loranthus seemenianus K. Sch. (1889); *L. articulatus* Krause (1922); *L. melastomatifolius* Krause (1922); *Amyema articulata* (Krause) Danser (1929); *A. melastomifolia* (Krause) Danser (1929).

Glabrous or the inflorescences and flowers shortly and sparsely to densely-brown- or white-tomentose. Leaves opposite; petiole flat or channelled above, 5–18 mm long; lamina broad lanceolate to broad ovate, 6–30 × (3–)5–13 cm, abruptly attenuate at the base, obtuse or acute and acuminate at the apex; venation curvinerved with 3 or 5 veins distinct on both sides. Inflorescences few to several at the nodes, each consisting of a 2-flowered simple umbel; peduncle 3–8 mm long, *c.* 0·5 mm thick, with a small flange at the apex; rays (2–)3–6 mm long, almost at thick as the peduncle; bracts membranous, distinct, spreading, rounded, 1–2 mm long. Calyx cylindrical to funnel-shaped; limb variable (obscure to distinct and membranous, 0·2–2·0 mm long). Corolla in the mature bud thin, curved, more or less inflated, not clavate, acute obtuse or rounded at the apex, 30–63 mm long; petals in the open flower usually 5, often remaining coherent for some time but eventually separating irregularly to the base. Anthers 5–7 mm long, nearly equal to the free parts of the filaments. Stigma 1–1·5 times as wide as the style. Fruit pear-shaped to nearly globular, constricted at the apex and crowned by the calyx limb.

Distribution: In Papuasia: New Guinea, from Jayapura to Sogeri Plateau, 0–2150 m altitude. Further distributed to Cape York Peninsula, Queensland. 3 subspecies occur in New Guinea.

KEY TO SUBSPECIES

1. Anthers strongly curved or hooked at the end; calyx funnel-shaped, tawny in colour but with a dense white tomentum; limb short, irregular, usually folded inwards; lamina mostly acute and acuminate, up to 12 cm long ..... ssp. **flexuosum**

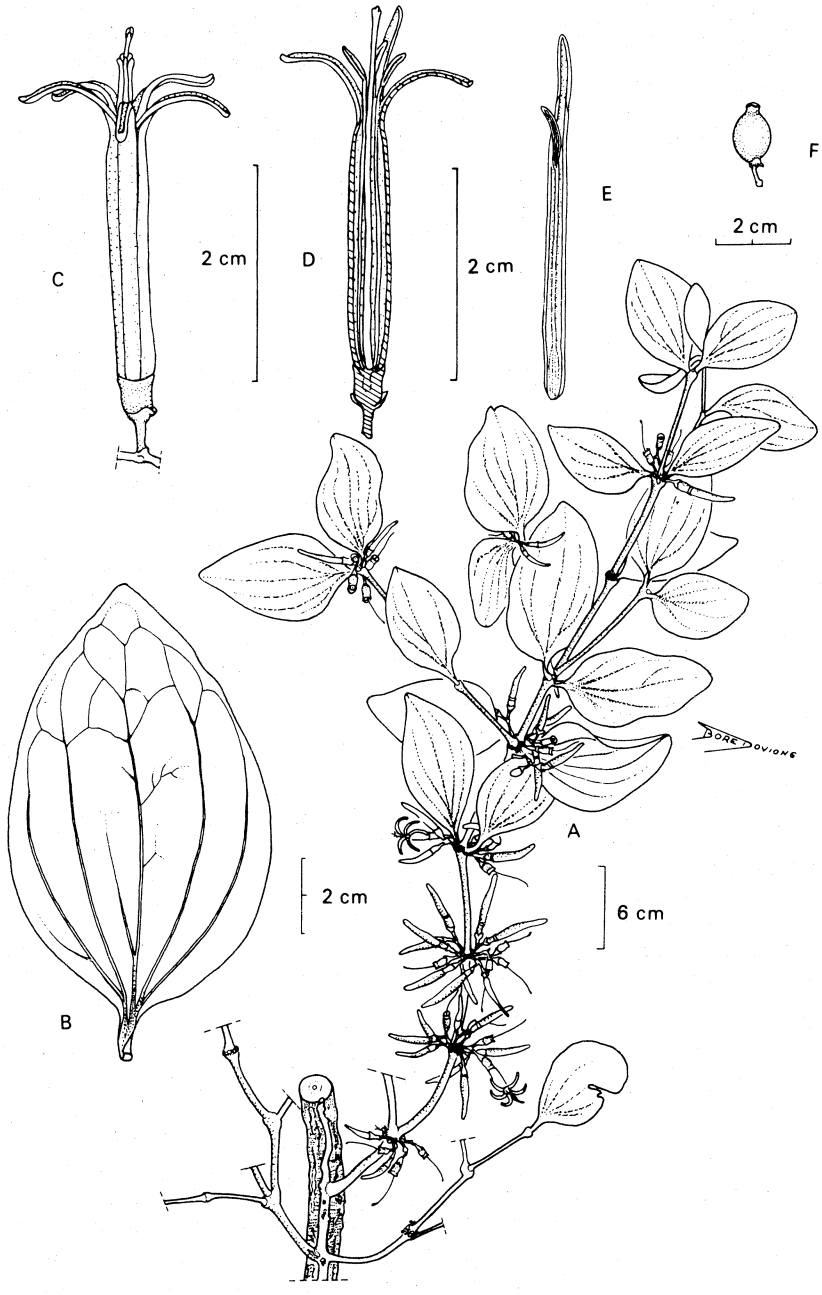

Fig. 48 **Amyema seemenianum** (K. Sch.) Danser (A) flowering and fruiting plant (B) leaf (C) flower (D) longitudinal section of flower (E) petal with stamen (F) fruit

1. Anthers slightly curved or straight; calyx cylindrical, cup-shaped or funnel-shaped, pale- or dark-coloured, glabrous or white- to brown-tomentose; limb distinct, membranous, more than 1 mm long
2. Lamina up to 10 cm long, acute or obtuse, not acuminate. Corolla up to 35 mm long; inflorescence, calyx and corolla glabrous or tomentose; calyx contracted below the limb; limb flaring, conspicuous ..... ssp. **seemenianum**
2. Lamina up to 30 cm long, acute and acuminate; corolla up to 65 mm long; inflorescence, calyx and corolla shortly and sparsely tomentose; calyx cylindrical or cup-shaped, not constricted; limb erect ..... ssp. **melastomifolium**

ssp. **flexuosum** Barlow *Aust. J. Bot.* **22**: 591 (1974).

Calyx densely white-tomentose. Lamina up to 12 cm long, mostly acute and acuminate at the apex. Calyx funnel-shaped, tawny in colour; limb short, irregular, usually folded inwards. Anthers strongly curved or hooked at the end.

Distribution: New Guinea: lowlands from 0 to 480 m altitude, known from Papua (Fly River to Sogeri Plateau) and from Jayapura district, western New Guinea.

ssp. **melastomifolium** (Krause) Barlow *Aust. J. Bot.* **22**: 591 (1974).

Loranthus melastomatifolius Krause (1922); *Amyema melastomifolia* (Krause) Danser (1929).

Inflorescence, calyx and corolla shortly and sparsely tomentose. Lamina up to 30 cm long, acute and acuminate at the apex. Calyx cylindrical or cup-shaped, not constricted; limb distinct, membranous, erect, 1–2 mm long. Corolla in the mature bud 40–65 mm long. Anthers slightly curved or straight.

Distribution: Northeastern New Guinea, 0–1100 m altitude.

ssp. **seemenianum**

Inflorescence, calyx and corolla glabrous or tomentose. Lamina up to 10 cm long, acute or obtuse at the apex but not acuminate. Calyx cylindrical or funnel-shaped, contracted below the limb; limb distinct, membranous, flaring, 1–2·5 mm long. Corolla in the mature bud 30–35 mm long. Anthers slightly curved or straight.

Ecology: Common on introduced trees in settled areas as well as on a wide variety of native rainforest trees.

Distribution: Northeastern New Guinea, from Madang district (Saidor area) to the Eastern Highlands, 1000–2150 m altitude.

Amyema squarrosum (Krause) Danser *Bull. Jard. Bot. Btzg* **10**: 229 (1929).

Loranthus squarrosus Krause (1922); *Amyema rhopalanthes* Danser (1936).

Glabrous or the inflorescence, calyx and sometimes the corolla sparsely brown-tomentose. Leaves opposite; petiole flat or channelled above, 4–9 mm long; lamina lanceolate to broadly ovate, more or less oblique, 8–18 × 2.5–6 cm, abruptly attenuate at the base, acuminate and acute at the apex; venation distinct and raised below, often depressed above, nearly curvinerved but with some lateral veins arising near the base of the midrib. Inflorescences several in the axils, each consisting of a simple 2-flowered umbel; peduncle obscure or up to 1 mm long (or slightly longer in fruit); pedicels 2–4 mm long, 0·7 mm

wide; bract erect, conspicuous, nearly encircling the apex of the pedicel, mostly acute and 1–2 mm long, rarely expanded up to 5 mm long. Calyx barrel-shaped to strongly funnel-shaped; limb erect, truncate or weakly lobed, *c.* 1 mm long. Corolla in the mature bud slender to inflated, thin, 25–36 mm long, 5-merous. Anthers 2·5–3 mm long; free parts of the filaments 6–7 mm long. Stigma capitate, twice as wide as the style. Fruit urceolate, truncate.

Distribution: Endemic to New Guinea; 1 subspecies in highlands from 1000 to 2450 m altitude, and another subspecies known from lowlands in western Papua.

KEY TO SUBSPECIES

1. Corolla cylindrical ..... ssp. **squarrosum**
1. Corolla strongly inflated at the apex ..... ssp. **rhopalanthes**

ssp. **rhopalanthes** (Danser) Barlow *Aust. J. Bot.* **22**: 592 (1974).
Amyema rhopalanthes Danser (1936).

Distribution: Known only from Western district, Papua, 5 m altitude.

ssp. **squarrosum**

Distribution: New Guinea: from the Star Mountains to Mt Michael, usually from 1850 to 2450 m altitude, but rarely found down to 1000 m.

Amyema strongylophyllum (Laut.) Danser *Bull. Jard. Bot. Btzg* **10**: 299 (1929).

Loranthus strongylophyllus Laut. (1912); *L. barbellatus* Blakely (1922); *L. rigidiflorus* Krause (1922); *Amyema barbellata* (Blakely) Danser (1929); *A. rigidiflora* (Krause) Danser (1929).

Vegetative parts glabrous; inflorescence and flowers sparsely to densely brown- or red-brown-tomentose or the flowers rarely glabrous. Leaves opposite; petiole winged in the distal part, flat above, 0·5–1 cm long; lamina broadly ovate to orbicular, 4–13 × 3·5–11 cm, dull on both sides, abruptly attenuate at the base, rounded at the apex; venation pennate with the veins usually distinct and the lateral veins arising near the base of the lamina. Inflorescences usually several at the nodes; peduncle robust, 15–30 mm long, (1–)1·5–2·5 mm thick, more or less dilated at the apex; rays 7–20, (6–)8–13 mm long; pedicels of the lateral flowers spreading, 2–4 mm long; bract erect or spreading, usually obtuse, flat, 1·5–2 mm long. Calyx cup-shaped; limb erect, 0·5–1 mm long, irregularly split. Corolla in the mature bud acute or obtuse, not clavate, (20–)25–45(–60) mm long; petals in the open flower 5 or 6, with a tuft of deflexed hairs inside at the apex, sometimes with a deflexed spur on the inside at the base. Anthers 3–5 mm long, covered in bud with deciduous appressed hairs, with a knob-like sterile tip; free parts of the filaments 4–6 mm long. Fruit cup-shaped to ellipsoidal, 5–8 mm long, crowned by the persistent calyx limb.

Distribution: Endemic to New Guinea and the Papuan Islands, 0–2125 m altitude. There are 3 subspecies with relatively distinct geographical and altitudinal separation.

KEY TO SUBSPECIES

1. Indumentum of inflorescence dense (except sometimes for the corolla), red-brown; leaves relatively large (cf. species description); rays 15–20, arising from distinct depressions in a more or less spherical dilation of the peduncle apex; corolla *c.* 50 mm long . . ssp. **strongylophyllum**
1. Indumentum of inflorescence brown or yellow-brown, sparse to dense or absent; leaves mostly small; rays 7–12, arising from shallow depressions in the upper part of the dilated peduncle apex; corolla up to 40 mm long
   2. Calyx tomentose ..... ssp. **rigidiflorum**
   2. Calyx glabrous ..... ssp. **barbellatum**

ssp. **barbellatum** (Blakely) Barlow *Aust. J. Bot.* **22**: 594 (1974).
Loranthus barbellatus Blakely (1922).

Distribution: Papua: coastal lowlands from Port Moresby to Rossel Island, 0–620 m altitude.

ssp. **rigidiflorum** (Krause) Barlow *Aust. J. Bot.* **22**: 594 (1974).
Loranthus rigidiflorus Krause (1922); *L. obtusus* Krause (1922); *Amyema rigidiflora* (Krause) Danser (1929).

Distribution: New Guinea: Vogelkop to Milne Bay, usually from 1000 to 2125 m altitude but rarely down to 70 m.

ssp. **strongylophyllum**

Distribution: New Guinea: in coastal and lowland districts from the Cycloop Mountains (Jayapura district) to the Sepik River, 0–300 (rarely to 600) m altitude.

Amyema tetraflorum (Barlow) Barlow *Aust. J. Bot.* **22**: 595 (1974).
Ungula tetraflora Barlow (1964).

Glabrous except for the inflorescence and flowers sparsely tomentose. Stems smooth, terete, regularly and more or less dichotomously branched. Leaves opposite; petiole terete, 2–4 mm long; lamina broad lanceolate to ovate-lanceolate, 17–25 × 7–12 cm, rounded to slightly cordate at the base, shining above, dull below, acuminate and acute at the apex; venation distinctly pennate with the lateral veins incurved near the margin. Inflorescences borne at the nodes and on the runners; peduncle 2–4 mm long, pedicels 1·5–2 mm long, slightly thinner than the peduncle; flowers in tetrads with all flowers sessile and orientated with 1 flower towards the centre of the inflorescence, 2 lateral and 1 towards the outside; bracts erect, the adaxial 1 narrow, 2·5–3·5 mm long, attenuate and acute, the other 3 broad lanceolate, 2–3 mm long, acuminate and acute, longer than the calyx. Calyx compressed-angular, 1·5–2 mm long; limb erect, 6-toothed, 0·7 mm long. Corolla in the mature bud slender, slightly clavate, 26–32 mm long; petals in the open flower 6, coherent in the lower 4–5 mm, each with a deflexed spur inside 1 mm above the base. Anthers narrow, *c.* 3 mm long; free parts of the filaments **c.** 5 mm long.

Field characters: Distinct from most other Papuasian Loranthaceae in having flowers in tetrads. Among Papuasian species of *Amyema,* only *A. tetraflorum* and *A. brassii* have the corolla gamopetalous.

Distribution: Endemic to New Guinea; Papua, Central district, near Kairuku, in lowlands.

Amyema tetrapetalum (Danser) Barlow *Aust. J. Bot.* **22**: 595 (1974).
Dicymanthes tetrapetala Danser (1940).

Young parts, inflorescence, bracts and calyx shortly brown-tomentose. Stems terete, branched at nearly every node; internodes long. Leaves opposite; petiole **c.** 5 mm long; lamina broad lanceolate, 10–15(−20) × 4–6(−8) cm, gradually attenuate at the base, recurved at the margin, acuminate and acute at the apex; venation pennate with the midrib and lateral veins distinct on both sides. Inflorscences several at the nodes, each consisting of a head composed of 2 opposite triads with all flowers sessile; peduncle 3–6 mm long; central bracts erect, narrow lanceolate, acute, 6 × 2·5 mm; lateral bracts **c.** 6 × 1·5 mm; all bracts often of irregular shape at the apex. Calyx cylindrical, 3 mm long; limb irregular, 0·5 mm long. Corolla in the mature bud very slender, 35–42 mm long, quadrangular, 4-merous. Anthers acute, 3–4 mm long; free parts of the filaments 2·5 times as long.

Field characters: Distinct among New Guinean *Amyema* species in the capitate inflorescence with bracts forming an involucre. Corolla 4-merous.

Distribution: Endemic to New Guinea; Morobe district, 1200–1800 m altitude.

Amyema wichmannii (Krause) Danser *Bull. Jard. Bot. Btzg* **10**: 299 (1929).
Loranthus wichmannii Krause (1922); L. *keysseri* Krause (1929).

Glabrous except for a few cilia on the bract. Stems slightly flattened when very young, soon becoming terete. Leaves opposite; petiole 2–8 mm long, terete or slightly flattened above; lamina very variable, broad lanceolate to nearly orbicular, (1·7–)4–10 × (1–)2–4 cm, lustrous above, dull below, attenuate to contracted at the base, finely undulate and sometimes minutely serrate at the margin, usually acute or obtuse with a small mucro but often rounded at the apex; venation pennate with the venation usually obscure. Inflorescences solitary (or 2) in the axils; peduncle 0·7–1·3 mm wide near the base, dilated to 1–2(–3) mm wide at the apex, (18–)22–32(–45) mm long; rays 9(–12), slightly to strongly divergent, slightly thinner than the peduncle, (4–)6–10 mm long; pedicels of the lateral flowers of the triads (1·5–)2–5 mm long, more or less cigar-shaped; bracts acute, usually with a rounded dorsal protuberance, *c.* 1 mm long. Calyx barrel-shaped or rarely nearly cylindrical; limb 0·2–0·5 mm long, minutely toothed. Corolla in the mature bud slender, strongly clavate, acute or rounded at the apex, (13)-20-28-(32) mm long, 4-merous. Anthers 1–2 mm long; free parts of the filaments 1–4 mm long. Stigma about twice as wide as the style. Fruit barrel-shaped to nearly spherical, *c.* 5 mm long.

Distribution: Endemic to New Guinea; 3 subspecies in highlands, usually 2750–3450 m altitude but rarely down to 2350 m.

Ecology: Common in subalpine communities.

KEY TO SUBSPECIES

1. Leaves spotted below; central flower of the triad usually on a pedicel 2–4 mm long ..... ssp. **wichmannii**

1. Leaves not spotted below; central flower of the triad sessile
   2. Calyx limb *c.* 0·2 mm long; pedicels of the lateral flowers 6–10 mm long; rays of the umbel mostly 6 or more ..... ssp. **purum**
   2. Calyx limb *c.* 0·5 mm long; pedicels of the lateral flowers c. 4 mm long; rays of the umbel 5 ..... ssp. **aggregatum**

ssp. **aggregatum** *Barlow Aust. J. Bot.* **22**: 598 (1974).

Distribution: Papua: known from Milne Bay district.

ssp. **purum** *Barlow Aust. J. Bot.* **22**: 597 (1974)
Loranthus keysseri Krause (1929).

Distribution: New Guinea: in highlands from Star Mountains to Salawaket Range.

ssp. **wichmannii**

Distribution: Endemic to western New Guinea; known from Wissel Lakes and Lake Habbema areas, Snow Mountains district.

DOUBTFUL SPECIES

Amyema curvifolium (Krause) Danser *Bull. Jard. Bot. Btzg* **10**: 294 (1929).
Loranthus curvifolius Krause (1922); *L. heterochromus* Krause (1922); *Amyema heterochromum* (Krause) Danser (1929).

Glabrous except for the inflorescence, calyx and young corolla (tomentose?). Leaves opposite; petiole 1–8 mm long; lamina lanceolate to ovate-lanceolate, widest at or below the middle, 10–23 × 3–6 cm, cuneate rounded or slightly cordate at the base, acute and slightly to strongly acuminate at the apex; venation pennate. Inflorescences arising on the runners (and perhaps also axillary?), each consisting of a single pedicellate flower on an ebracteate peduncle *c.* 0·5–1 mm long (i.e. a flower on a jointed 'pedicel'); pedicel *c.* 0·5 mm long, with a cup-shaped triangular acute bract 2–3 mm long at the apex. Calyx funnel-shaped, 2–2·5 mm long; limb 1·5 mm long, entire or weakly toothed. Corolla in the mature bud 50–55 mm long; petals in the open flower 6, gamopetalous to above the middle. Anthers 5 mm long, about equal to the free parts of the filaments. (Description compiled from those given by Danser, *Bull. Jard. Bot. Btzg* **11**: 330, 337 (1931) of *A. curvifolium* and *A. heterochromum.)*

Distribution: Endemic to New Guinea; recorded only from Felsspitze, Hunstein Mountains, East Sepik district.

Notes: Known only from the type collections of *Loranthus curvifolius* and *L. heterochromus,* which have apparently been lost, and no other collections like them have been gathered since. If the interpretation of the characters is correct, and if the descriptions were not based on mixed materials, *Amyema curvifolium* is a very unusual and distinct species, by reason of its reduced inflorescence of a single flower and 6-merous gamopetalous corolla. It is possible, however, that the corolla is in fact choripetalous, because Danser interpreted partly open corollas of choripetalous species as gamopetalous in the cases of *A. hastifolium* and *A. seemenianum* ssp. *melastomifolium. A. curvifolium* would then be similar to *A. finisterrae* and *A. hastifolium* in

inflorescence structure, and especially to the latter in the occurrence of inflorescences on the runners. It is quite different, however, in its larger, 6-merous flowers and its much longer leaves.

AMYLOTHECA Tiegh.

Glabrous aerial stem-parasitic shrubs with runners and opposite penninerved leaves. Inflorescence axillary, primarily a subumbellate raceme of several decussate pairs of dichasia (triads) with the central flowers sessile and the lateral flowers pedicellate, but through reduction sometimes a simple raceme or even a 2-flowered simple umbel; bracts primarily single under each flower but sometimes more in reduced inflorescences. Corolla 6-merous, inflated in the mature bud; petals in the open flower united to the middle or higher. Anthers linear, basifixed; pollen trilobate. Style articulate 1·5–5 mm above the base; style base pyramidal.

Distribution: 5 species distributed in Papuasia, eastern Australia and Melanesia. 2 species occur in Papuasia, both confined to the New Guinea mainland.

KEY TO SPECIES

1. Corolla less than 40 mm long ..... **A. dictyophleba**
1. Corolla more than 40 mm long ..... **A. acuminatifolia**

Amylotheca acuminatifolia Barlow *Aust. J. Bot.* **22**: 545 (1974).

Bark distinctly and densely lenticellate and minutely furrowed. Petiole obscure, winged, up to 0·5 cm long; lamina broad lanceolate, 12–20 × 2·5–7 cm, slightly shining above, dull below, attenuate at the base, recurved at the margins, acuminate and acute at the apex; venation distinctly reticulate on both sides. Inflorescenes 1 or 2 in the axils; axis bearing usually 2 or 3 pairs of triads, 6–10 mm long; peduncles of the triads 1–3(–6) mm long; pedicels of the lateral flowers of the triads up to 5 mm long; bracts spreading, acute *c.* 1 mm long. Calyx narrow cylindrical, 3–4 mm long; limb erect, entire, 1 mm long. Corolla in the mature bud robust, not or slightly inflated at the base, clavate and acute or obtuse at the apex, 45–65 mm long; petals in the open flower united into a tube 25–35 mm long. Anthers 5–7 mm long, about equal to the free parts of the filaments. Style articulate 2–3 mm above the base, persistent on the fruit; stigma globular, 3 times as wide as the style. Fruit ellipsoidal, *c.* 12 mm long.

Distribution: Endemic to western New Guinea; in highlands, known from Wissel Lakes and Lake Habbema areas, Snow Mountains district, 1650–2850 m altitude.

Ecology: This is the only species of *Amylotheca* which occurs in montane habitats. The other species occur in lowland forests.

Amylotheca dictyophleba (F. Muell.) Tiegh. *Bull. Soc. Bot. Fr.* **41**: 262 (1894) **Fig. 49.**

Loranthus dictyophlebus F. Muell. (1860); *Aciella dictyophleba* (F. Muell.) Tiegh. (1895); *Elytranthe dictyophleba* (F. Muell.) Engl. (1897).

Petiole obscure, winged, 2–8 mm long; lamina lanceolate to elliptical, (6–)8–12 × 2–4(–6) cm, usually shining above, dull below, attenuate to contracted at

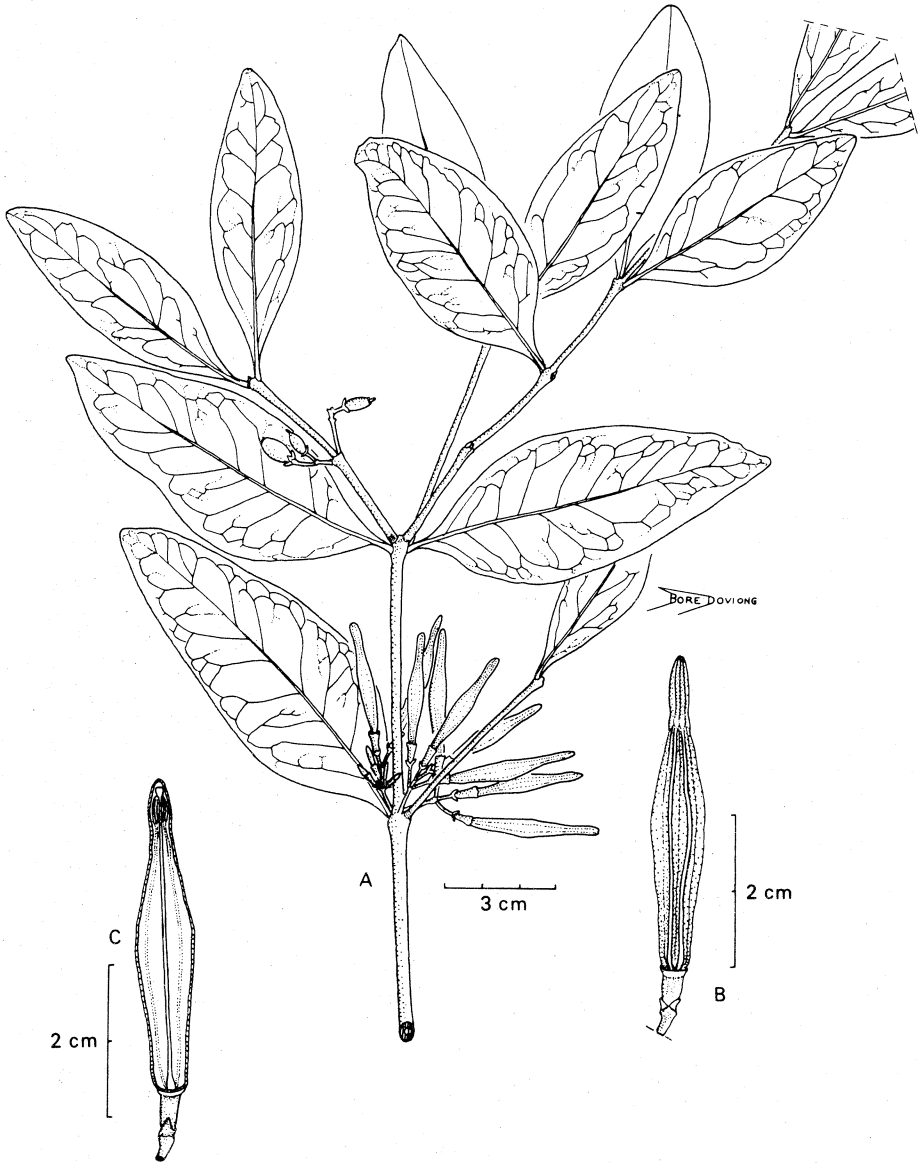

Fig. 49 **Amylotheca dictyophleba** (F. Muell.) Tiegh. (A) twig with flowers and young fruit (B) flower-bud (C) longitudinal section of flower-bud

the base, acute to rounded at the apex; venation distinctly reticulate on both sides. Inflorescences 1–3 in the axils; axis bearing 1–6 decussate, more or less subumbellate pairs of triads or single flowers, 5–12(–20) mm long; peduncles of the triads or single flowers (3–)5–7(–10) mm long; pedicels of the lateral flowers of the triads (when present) 2–4 mm long; bracts single under the flowers or sometimes 2 or 3 where the triads are reduced to single flowers, triangular, acute, 1 mm long. Calyx narrow cylindrical; limb obscure, 0·3 mm long. Corolla in the mature bud clavate, acute at the apex, (28–)32–38 mm long; petals in the open flower united to about the middle. Anthers 3–4 mm long, slightly longer than the free parts of the filaments. Style articulate 2–3 mm above the base. Fruit globular, 10–12 mm in diameter.

Distribution: Eastern Australia, in coastal districts from Cape York to the Illawarra district, New South Wales. In Papuasia known only from the Western district of Papua, in lowlands.

CECARRIA Barlow

Aerial stem-parasitic shrubs with opposite curvinerved leaves. Inflorescence an axillary simple 2-flowered umbel (rarely produced into a 4-flowered simple raceme or spike); bracts solitary under each flower. Corolla 6-merous; petals in the open flower separating to the base. Stamens nearly equal; anthers dorsifixed, versatile. Style articulate very close to the base.

Distribution: A monotypic genus with a disjunct sporadic distribution in the Philippines and Papuasia.

Cecarria obtusifolia (Merr.) Barlow in Barlow & Wiens *Brittonia* **25**: 34 (1973) **Fig. 50.**

Phrygilanthus obtusifolius Merr. (1906); *P. novoguineensis* Krause (1922); *Muellerina obtusifolia* (Merr.) Barlow (1962); *M. novoguineensis* (Krause) Barlow (1962).

Glabrous. Stems terete, smooth. Petiole obscure, 2–6 mm long; lamina spathulate to obovate, 2–5·5 × 2–4·5 cm, dull on both sides, attenuate at the base, rounded at the apex; venation distinct on both sides. Inflorescences several developing successively in the axils; peduncle 6–9 mm long (or when the inflorescence is prolonged into a raceme up to 20 mm long); pedicels 1–3 mm long (or sometimes some flowers sessile, especially the lower ones when the inflorescence is prolonged into a raceme); bracts spreading, rounded, 1 mm long. Calyx barrel-shaped 1·5–2 mm long; limb erect, entire, 0·5–1 mm long. Corolla in the mature bud 10–14 mm long, weakly clavate; petals in the open flower weakly reflexed near the middle, each with a ridge or hood about 1 mm long inside at the apex. Anthers ovoid, 1·5 mm long, with a short sterile tip; free parts of the filaments *c.* 2 mm long. Style persistent on the fruit for some time, eventually articulate *c.* 0·5 mm above the base. Fruit almost spherical, *c.* 8 mm long.

Field characters: Distinguished from all other Papuasian Loranthaceae by the versatile anthers.

Distribution: Philippines, from Luzon to Mindanao. In Papuasia, northeastern New Guinea, New Britain and the Solomon Islands, 200–1200 m altitude.

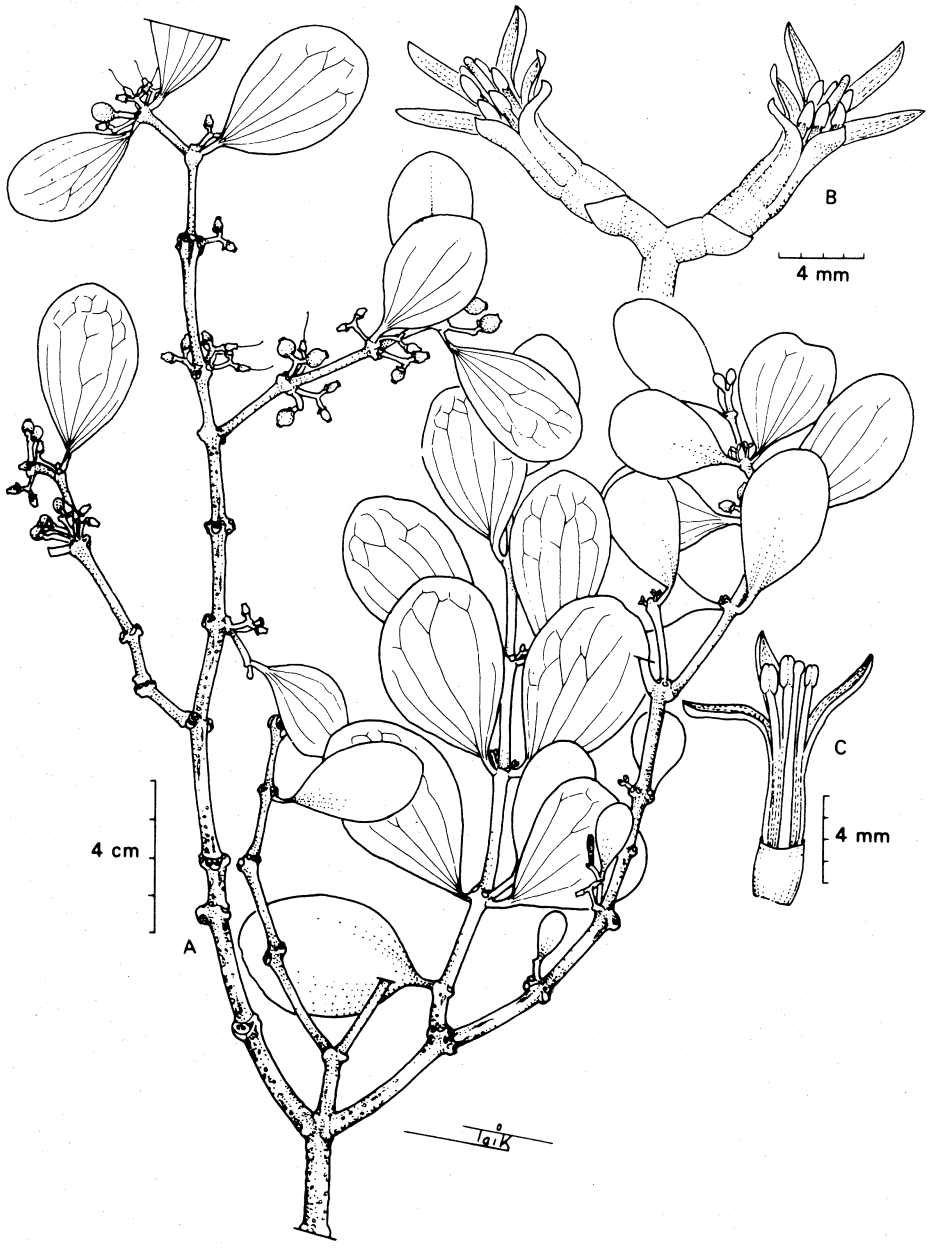

Fig. 50 **Cecarria obtusifolia** (Merr.) Barlow (A) twig with flowers and fruit (B) inflorescence (C) flower with nearer petals and stamens removed

DACTYLIOPHORA Tiegh.

Aerial stem-parasitic shrubs with runners and opposite (rarely ternate) penninerved leaves. Inflorescence consisting of 1–4 whorls of dichasia (triads), the whorls arranged in racemose order on a short common axis; triads with the central flower sessile and lateral flowers pedicellate; bracts single under each flower. Corolla mostly 6-merous; petals in the open flower free to the base and each petal usually with a deflexed spur inside just above the base. Anthers linear, basifixed, immobile, 4-locular. Style articulate at the base.

Distribution: 3 species confined to Papuasia except for a single record from Cape York Peninsula, Queensland. The genus occurs predominantly in lowlands.

KEY TO SPECIES

1. Leaves mostly more than 12 cm long, acuminate and acute at the apex; first internode of the inflorescence less than 1 cm long ..... **D. verticillata**
1. Leaves mostly less than 12 cm long, rounded or acute and more or less attenuate at the apex but not acuminate; first internode of the inflorescence more than 1 cm long
2. Leaves opposite or ternate, rounded at the apex; axis of the inflorescence robust (2–3 mm thick); peduncles of the triads 5–8 mm long; triads at the second node 8–10 ..... **D. novae-guineae**
2. Leaves opposite, attenuate and acute or shortly rounded at the apex; axis of the inflorescence slender (*c.* 1 mm thick); peduncles of the triads 8–10 mm long; triads at the second node (where present) *c.* 4 ..... **D. salomonia**

Dactyliophora novae-guineae (F.M. Bail.) Danser *Bull. Jard. Bot. Btzg* **10**: 307 (1929). **Fig. 51.**

Loranthus novae-guineae F.M. Bail. (1902).

Glabrous except for the inflorescence, calyx and usually the corolla shortly brown-tomentose. Stems terete, enlarged at the nodes. Leaves opposite or rarely scattered-ternate; petiole distinct, 0·8–2 mm long; lamina elliptical to ovate, usually widest in the middle (rarely below), 5–10(–15) × (3·5–)5–7(–12) thick, attenuate or contracted at the base, more or less undulate at the margin when dry, rounded or obtuse at the apex; venation distinctly pennate on both sides with the midrib prominent on the underside. Inflorescences (as seen) solitary in the leaf axils; axis 2–3 mm thick, usually with 2 or more triad-bearing nodes crowded closely above the first; first internode (10–)15–20 mm long; second internode 4–10 mm long; third internode 1–4 mm long; triads 8–12 at the first node, 8–10 at the second node, (4–)6–8(–10) at the third node; peduncles of the triads 5–8 mm long, 1–1·5 mm thick; pedicels of the lateral flowers of the triads 2 mm long; bracts spreading, narrow, acute, 1 mm long. Calyx cylindrical, 3 mm long; limb truncate, 0·5 mm long. Corolla in the mature bud (25–)30–36 mm long; petals in the open flower 6, each with a deflexed spur inside (3–)6 mm above the base. Anthers 4–6 mm long, longer the free parts of the filaments. Fruit urceolate, probably 8 mm long at maturity.

Distribution: Endemic to New Guinea; Vogelkop and eastern Papua, in coastal lowlands.

Ecology: Usually in mangrove communities.

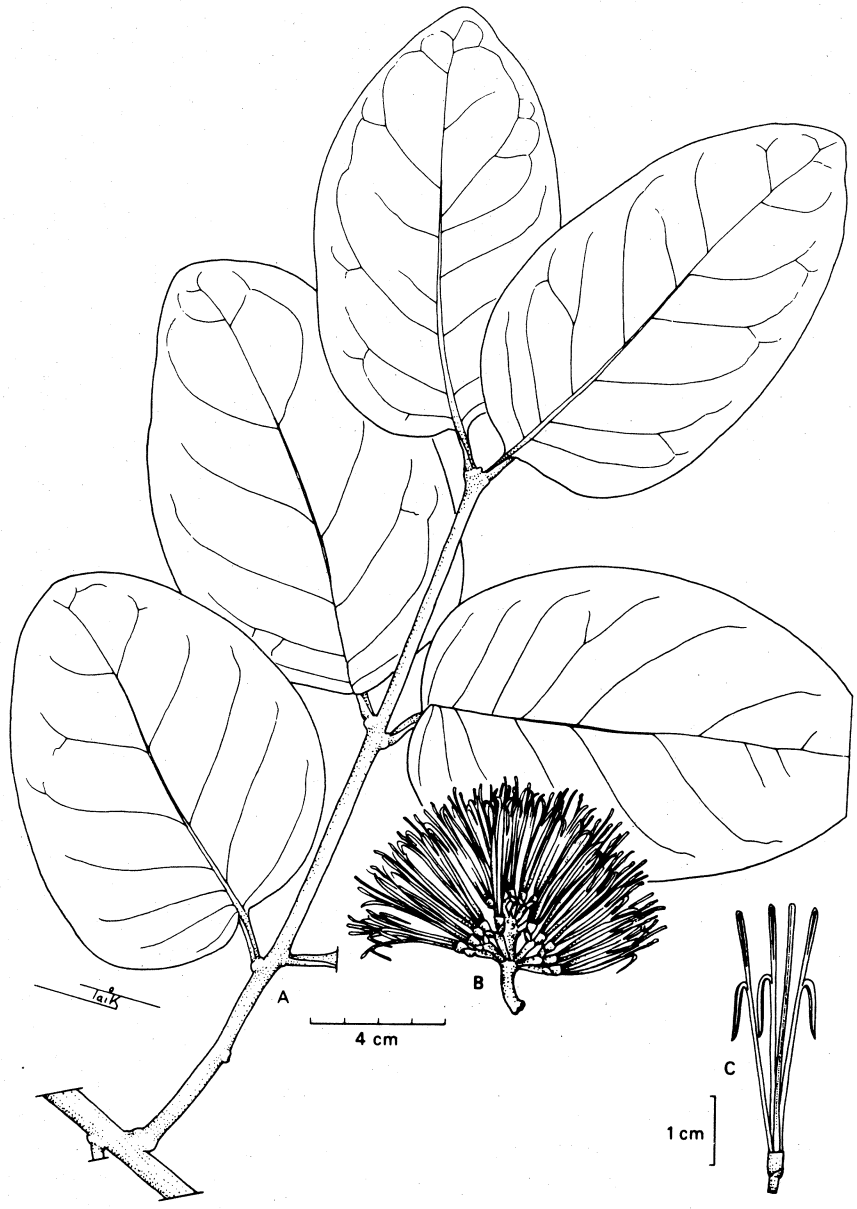

Fig. 51 **Dactyliophora novae-guineae** (F. M. Bail.) Danser (A) twig (B) inflorescence (C) open flower

Dactyliophora salomonia Danser *J. Arnold Arbor.* **16**: 206 (1935).

Glabrous except for the inflorescence, calyx and young corolla shortly brown-tomentose. Stems slender, smooth, slightly flattened when young. Leaves opposite; petiole slender, 1·5–3 cm long; lamina ovate, 8–12 × 4–7 cm, thin, truncate or weakly cordate at the base, undulate at the margin when dry, attenuate and acute or shortly rounded at the apex but not acuminate; venation distinctly pennate on both sides and prominent on the lower side. Inflorescences (as seen) 1 or 2 in the leaf axils; axis slender, with 1 or 2 triad-bearing nodes; first internode 15–30 mm long; second internode (when present) *c.* 4 mm long; first node bearing 8–10 triads; second node (when present) bearing *c.* 4 triads; peduncles of the flowers of the triads slender, 1·5–3 mm long; bracts narrow, acute, 1 mm long. Calyx cylindrical, 2·5 mm long; limb irregular, 0·5 mm long, folded inwards. Corolla in the mature bud slender, 25–40 mm long; petals in the open flower 6, with or without a spur inside *c.* 4 mm above the base. Anthers *c.* 3 mm long, usually about equal to the free parts of the filaments but in 1 collection seen almost sessile. Fruit ellipsoidal, 8 mm long.

Distribution: Endemic to the Solomon Islands; known from Guadalcanal and San Cristobal, 100–1200 m altitude.

Dactyliophora verticillata (Scheff.) Tiegh. *Bull. Soc. Bot. Fr.* **41**: 550 (1894).

Dendrophthoe verticillata Scheff. (1876); *Loranthus verticillatus* (Scheff.) F. Muell (1897) nom. illeg. non Ruiz & Pav.; *L. globiflorus* Bl. (1898); *L. basiflorus* Krause (1922); *L. kaniensis* Krause (1922); *L. thespesiae* Krause (1922); *Dactyliophora basiflora* (Krause) Danser (1929); *D. thespesiae* (Krause) Danser (1929); *Amyema speciosa* Danser (1931).

Glabrous except for the inflorescence, calyx and corolla shortly brown- or white-tomentose. Stems terete; internodes usually more than 10 cm long; nodes enlarged when older. Leaves opposite; petiole distinct, 1–2·5 cm long; lamina oblong to ovate, (8–)12–30 × (3–)4–12 cm, contracted truncate or slightly cordate at the base, undulate at the margins when dry, acuminate and acute at the apex; venation distinctly pennate on both sides with the midrib raised on the under side. Inflorescences scattered on the runners and solitary in the leaf axils; axis terete, enlarged at the nodes, 1·5–2 mm thick, triad-bearing nodes 1–4, usually 2 or 3; first internode 3–8 mm long; second, third and fourth internodes (when present) 2–4 mm long; triads *c.* 10 at the first node (more when successive nodes are contracted together), *c.* 8 (rarely up to 12) at second node, *c.* 10 at the third node, 4–6 at the fourth node (when present); penduncles of the triads 3–5 mm long, 1 mm thick; pedicels of the lateral flowers of the triads 1–2 mm long; bracts acute, 1 mm long. Calyx barrel- to funnel-shaped, 2·5–3·5 mm long; limb 0·5–0·7 mm long, truncate or weakly toothed, folded inwards. Corolla in the mature bud slender, weakly clavate, (25–)30–50 mm long; petals in the open flower 5–8 (usually 6), each with a deflexed spur inside (3–)6 mm above the base. Anthers 2·5–5 mm long, equal to or longer than the free parts of the filaments.

Distribution: New Guinea, from Vogelkop to eastern Papua; New Britain; Bougainville. Also known from Cape York Peninsula, Queensland. Mostly in lowlands, 0–350 m altitude, rarely recorded at higher altitudes up to 1150 m.

DECAISNINA Tiegh.

Aerial stem-parasitic shrubs with runners and opposite penninerved leaves. Inflorescence axillary, a raceme of several decussate pairs of dichasia (triads) with all flowers sessile or the lateral flowers shortly pedicellate; bracts single under each flower. Corolla in the mature bud uniformly slender; petals in the open flower 6, free or shortly united at the base. Anthers narrow, acute, basifixed; pollen trilobate. Style articulate at or above the base.

Distribution: About 30 species, extending from the Philippines to northern Australia and Tahiti. Of the 9 species occurring in Papuasia, 6 are endemic, 1 extends to Cape York Peninsula, Queensland, 1 extends to the adjacent Indonesian islands, and 1 extends to both of these areas.

KEY TO SPECIES

1. Corolla less than 10 mm long ..... **D. micranthes**
1. Corolla more than 10 mm long
 2. Petals eventually free to the base (sometimes long coherent for 1–3 mm)
  3. Corolla mostly 35–45 mm long, red; lamina 5–7 cm long, more or less shining above ..... **D. forsteriana**
  3. Corolla mostly 20–26 mm long, pale-coloured; lamina 8–14 cm long, dull on both sides ..... **D. djamuensis**
 2. Petals united in the lower 1–8 mm
  4. Lamina rounded at the base, sessile ..... **D. papuana**
  4. Lamina attenuate or contracted at the base, more or less distinctly petiolate
   5. Lamina shining above, dull below
    6. Lamina 5–7(–10) cm long, attenuate at the base; corolla mostly less than 30 mm long ..... **D. parvifolia**
    6. Lamina (5–)8–18(–25) cm long, contracted to slightly cordate at the base; corolla more than 30 mm long ..... **D. hollrungii**
   5. Lamina dull, with the same texture on both sides
    7. Lateral flowers of the triads on pedicels *c.* 1 mm long; inflorescence axis *c.* 1 cm long ..... **D. pedicellata**
    7. Lateral flowers of the triads sessile or nearly so; inflorescence axis more than 3 cm long
     8. Fruit tomentose; young stems green, flattened and usually double-edged ..... **D. stenopetala**
     8. Fruit glabrous; young stems dark-coloured, very slightly flattened and soon becoming terete ..... **D. triflora**

Decaisnina djamuensis (Krause) Barlow *Aust. J. Bot.* **22**: 536 (1974).

Loranthus djamuensis Krause (1922); *Elytranthe mamberamica* Krause (1923); *Amylotheca djamuensis* (Krause) Danser (1931).

Glabrous except for the young stems and leaves sparsely or densely covered with irregular brown scales. Stems slightly flattened but not double-edged when young, soon becoming terete. Petiole *c.* 1 cm long; lamina narrowly ovate to ovate, 8–14 × (2·5–)4–7 cm, dull on both sides, attenuate to abruptly contracted at the base, rounded at the apex but sometimes slightly attenuate; venation usually obscure except for the midrib (lateral veins sometimes distinct in thinner old leaves). Inflorescences 1 or 2 in leaf axils; axis more or less terete but enlarged at the nodes, bearing 6–9 pairs of triads, 3–6 cm long; peduncles of the triads 1–3 mm long; lateral flowers of the triads almost sessile but the pedicels 1–3·5 mm long in fruit; bracts rounded, more or less imbricate, 2·5 mm long. Calyx cylindrical to slightly urceolate, 3·5 mm long; limb flaring, entire, thin, 1 mm long. Corolla in the mature bud (15–)20–26

mm long, pale-coloured; petals in the open flower usually free to the base but sometimes coherent in the lower 3 mm for some time after anthesis. Anthers 2·5 mm long, slightly longer than the free parts of the filaments. Style articulate (0·5–)1·5–2 mm above the base, persistent on the fruit. Fruit urceolate, crowned by the persistent calyx limb.

Distribution: Endemic to Papuasia; New Guinea, from Biak (Geelvink Bay) to the Ramu River (Madang district), and New Britain, mostly in lowlands, 0–1050 m altitude.

Decaisnina forsteriana (Schult.) Barlow *Aust. Nat. Univ. Publ.* BG/3, 185 (1972).

Loranthus forsterianus Schult. (1830); *Dendrophthoe forsteriana* (Schult.) G. Don (1834); *Treubella forsteriana* (Schult.) Tiegh, (1894) nom. illeg.; *Elytranthe forsteriana* (Schult.) Engl. (1897); *Amylotheca forsteriana* (Schult.) Danser (1929).

Glabrous or rarely with a very sparse and scattered tomentum at the bases of the leaves. Stems slender, more or less flattened and double-edged when very young, soon becoming terete. Petiole slender, 1–2 cm long; lamina ovate, 5–7(–9) × 2·5–4 cm, more or less shining above, dull below, attenuate at the base, recurved at the margin, acute to rounded at the apex; venation distinct on both surfaces, pennate but sometimes with the lower lateral veins almost curvinervous. Inflorescences usually solitary in the axils; axis angular, usually bearing 4 pairs of triads, 2–3 cm long, *c.* 2 mm thick; peduncles of the triads 4–6 mm long; pedicels of the lateral flowers of the triads (0·5–) × 1–2 mm long; bracts irregular in shape, often serrate, often truncate, 1–1·5 mm long. Calyx cylindrical, (2–)3–3·5 mm long; limb entire or irregularly split, spreading, 1 mm long. Corolla in the mature bud (25–) 35–45 mm long; petals in the open flower usually separating to the base but sometimes coherent in the lower 1 mm or rarely more. Anthers transversely septate, 2–3(–5) mm long, usually slightly shorter than the free parts of the filaments. Style articulate *c.* 0·5 mm above the base. Fruit nearly globular.

Distribution: Widely distributed in the Pacific from Fiji to the Marquesas, and thus attaining the widest distribution over oceanic islands of all Loranthaceae. In Papuasia known only from Santa Isabel, Solomon Islands, 730 m altitude.

Decaisnina hollrungii (K. Sch.) Barlow *Aust. J. Bot.* **14**: 434 (1966). **Fig. 52.**

Loranthus hollrungii K. Sch. (1889); *Amylotheca hollrungii* (K. Sch.) Tiegh. (1894); *A. angustifolia* Tiegh. (1895); *Elytranthe hollrungii* (K. Sch.) Engl. (1897); *Loranthus oxycladus* K. Sch. & Laut. (1901); *L. versteegii* Laut. (1910); *Elytranthe versteegii* (Laut.) Krause (1922); *E. pallidiflora* Krause (1922); *E. leucantha* Krause (1922); *E. longifolia* Krause (1922); *E. neurophylla* Krause (1922); *E. macropoda* Krause (1922); *E. peekelii* Krause (1922); *E. schlechteri* Krause (1922); *Amylotheca versteegii* (Laut.) Danser (1929); *A. longifolia* (Krause) Danser (1929); *A. schlechteri* (Krause) Danser (1929); *A. salomonia* Danser (1936); *A. versteegii* var. *clementianum* Danser (1938).

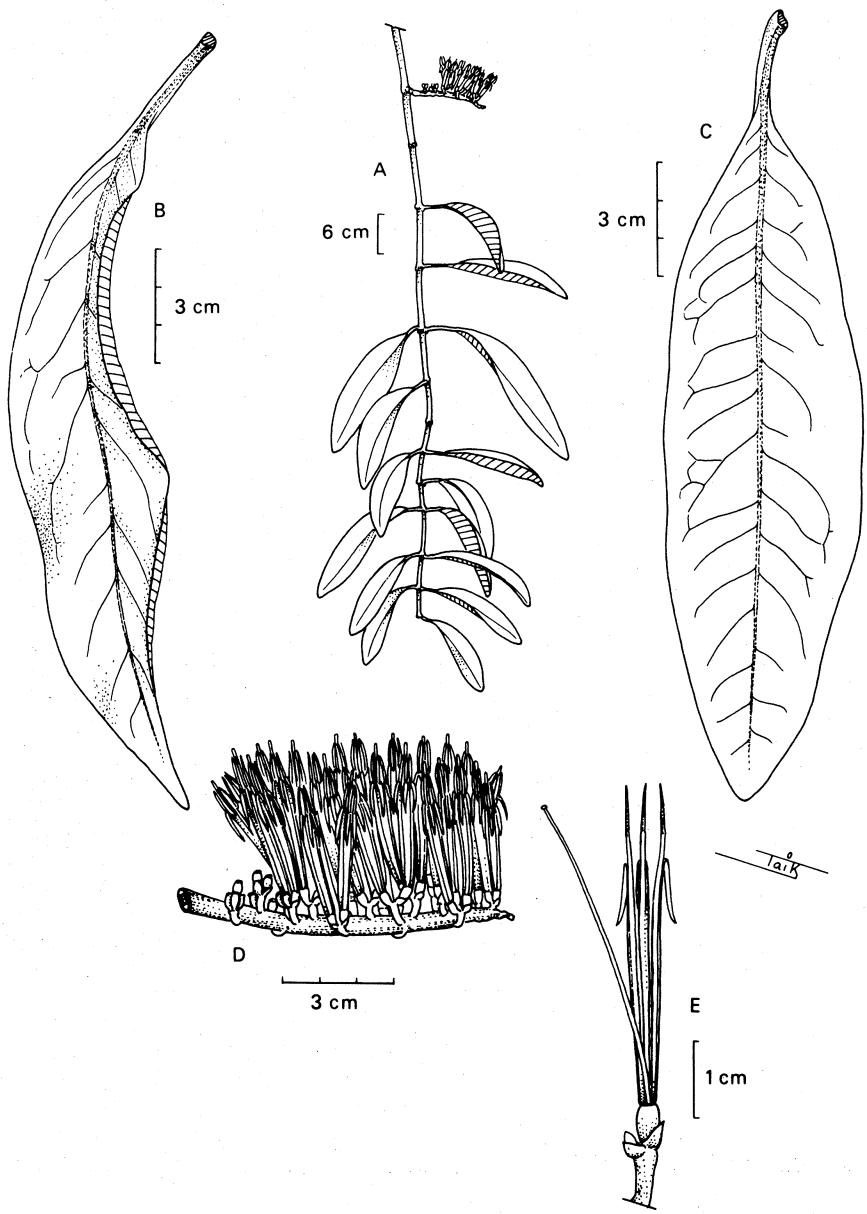

Fig. 52 **Decaisnina hollrungii** (K. Schm.) Barlow (A) branch (B) leaf (C) leaf, flattened (D) inflorescence (E) flower

Glabrous or more frequently with the undersides of the leaves shortly and sparsely brown-tomentose, rarely with the tomentum denser and extending to the petioles, young stems and inflorescences. Stems flattened and angular to winged when young, terete to strongly quadrangular when older. Petiole distinct, 5–30 mm long; lamina lanceolate to ovate (mostly broad lanceolate to narrow ovate), (5–)8–18(–25) × (1·5–)4–8(–12) cm, mostly lustrous or shining above, dull below, (attenuate to) abruptly contracted to slightly cordate at the base, recurved at the margin, acute or obtuse at the apex; venation pennate, obscure or distinct but with the midrib prominently raised below. Inflorescences mostly 1 or 2 in the axils; axis very variable, bearing triads in 5-14 pairs distributed all the way along the axis, enlarging in fruit and reaching 12 cm in length; peduncles of the triads 1·5–8 mm long; lateral flowers of the triads usually sessile but sometimes on pedicels up to 2 mm long; bracts mostly obtuse, *c.* 1·5 mm long. Calyx narrow cylindrical, 2·5–5 mm long; limb variable at the margin, up to 2 mm long. Corolla in the mature bud (25–)30–40(–60) mm long; petals in the open flower coherent in the lower 1–8 mm. Anthers 3-4(-6) mm long, equal to or slightly longer than the free parts of the filaments. Style articulate close to the base. Fruit almost globular.

Field characters: Decaisnina hollrungii is one of the most polymorphic loranth species in Papuasia. Because there is no regular geographic pattern in distribution of variants, no distinction of subspecies or varieties has been made. The only indication of ecogeographic divergence lies in the relatively small parts, particularly leaves, of collections from higher elevations. Many entities treated as species by earlier workers with limited materials at their disposal merge in the seemingly continuous range of variability of the species. Some of the extreme variants approach other species in the genus, and may perhaps be introgressive forms. Specimens from the Solomon Islands, including the type of *D. angustifolia,* show some characters of *D. forsteriana* and some from New Guinea are close to *D. djamuensis* or *D. parvifolia.* A species diagnosis which includes all of the extreme variations becomes almost meaningless, and the above description, although broad, may not adequately cover all forms. It is not expected, therefore, that the key or description will be adequate for all collections of *Decaisnina.*

Distribution: Throughout Papuasia, in many different communities, mostly from 0 to 2000 m altitude but occasionally found up to 2900 m. Also in North Queensland.

Ecology: Locally abundant in many areas, it has a 'weedy' character, being found commonly on cultivated hosts and in disturbed habitats.

Decaisnina micranthes (Danser) Barlow *Aust. J. Bot.* **22**: 540 (1974).
Amylotheca micranthes Danser (1936).

Glabrous or the young stems sparsely brown-tomentose. Young and mature stems terete. Petiole *c.* 1 cm long; lamina oblong-lanceolate to elliptical, 6–8 × 2·5–4 cm, dull on both sides, contracted at the base, marginate when young, more or less rounded at the apex but the larger leaves somewhat acuminate; venation pennate with the midrib distinct and the lateral veins faintly

visible on both sides. Inflorescences mostly solitary in the axils; axis usually bearing 5 pairs of triads, 2–3 cm long in flower, elongating in fruit; peduncles of the triads *c.* 1 mm long but reaching 2·5 mm in fruit; lateral flowers of the triads almost sessile; bracts rounded, spreading, 1 mm long. Calyx cylindrical, 2 mm long; limb irregularly split, 0·3 mm long. Corolla in the mature bud 6–7 mm long; petals in the open flower separating to the base. Anthers 1·5 mm long, longer than the free parts of the filaments. Style articulate 1–1·5 mm above the base leaving a nipple which persists on the fruit. Fruit urceolate, crowned by the persistent calyx limb, 5 mm long.

Field characters: Distinct from all other Papuasian *Decaisnina* species, and from almost all other Papuasian Loranthaceae, by the very short corolla.

Distribution: Endemic to Papuasia; known only from Biak Island.

Decaisnina papuana (Danser) Barlow *Aust. J. Bot.* **22**: 540 (1974).
Amylotheca papuana Danser (1938).

Glabrous. Stems flattened and double-edged when young, terete when older. Leaves sessile; lamina elliptical, *c.* 8 × 4–5 cm, somewhat shining above, dull below, rounded but not cordate at the base, obtuse or rounded at the apex; venation pennate with the midrib prominent below. Inflorescences several at the nodes; axis bearing only 1 or 2 pairs of triads, *c.* 2–4 mm long; peduncles of the triads *c.* 1 mm long; lateral flowers of the triads almost sessile; bracts thin, acute or obtuse, forming an involucre around each triad, 2–2·5 mm long. Calyx cylindrical, *c.* 2·5 mm long; limb thin and flaring, 1 mm long. Corolla not seen in mature bud, probably 30 mm long. Other parts not seen.

Distribution: Endemic to New Guinea; known only from Isuarava, Central district, 1360 m altitude.

Decaisnina parvifolia (Danser) Barlow *Aust. J. Bot.* **22**: 541 (1974).
Amylotheca parvifolia Danser (1931).

Glabrous. Stems flattened and double-edged when young, often remaining angular when older. Petiole *c.* 1 cm long; lamina broad lanceolate to elliptical, 5–7(–10) × 2–2·5(–6) cm, shining above, dull below, gradually attenuate at the base, recurved at the margins, acute or obtuse at the apex; venation pennate with the midrib prominent below and other venation obscure. Inflorescences solitary in the axils; axis terete, bearing 6–7 pairs of triads, *c.* 3 cm long; peduncles of the triads 1–2 mm long; pedicels of the lateral flowers of the triads 0·5 mm long; bracts triangular, spreading, rounded at the apex, 1–1·5 mm long. Calyx narrow cylindrical, 2·5 mm long; limb entire or irregularly split, spreading, 0·7 mm long. Corolla in the mature bud slender, 25–30 mm long; petals in the open flower coherent in the lower 4–5 mm. Anthers 3 mm long, acuminate at the apex; free parts of the filaments equal to or longer than the anthers, sometimes flattened and wider than the anthers. Style articulate *c.* 0·5 mm above the base.

Distribution: Endemic to western New Guinea; in highlands from Vogelkop to Wissel Lakes (Snow Mountains), 1400–2400 m altitude.

Decaisnina pedicellata (Danser) Barlow *Aust. J. Bot.* **22**: 541 (1974).
Amylotheca triflora var. *pedicellata* Danser (1938).

Glabrous. Young and old stems terete, slightly enlarged at the nodes. Petiole obscure, 3–5 mm long; lamina broad lanceolate to elliptical, more or less falcate, 7–10 × (1·5–)2–3·5 cm, dull on both sides, attenuate at the base, slightly acuminate but finally obtuse or rounded at the apex; venation pennate, distinct with many lateral veins visible on both sides. Inflorescences solitary in the axils; axis slender, bearing *c.* 4 pairs of crowded triads, *c.* 1 cm long; peduncles of the triads slender, *c.* 2 mm long; pedicels of the lateral flowers of the triads *c.* 1 mm long; bracts spreading, acute or truncate, sometimes weakly toothed, 1 mm long. Calyx narrow cylindrical, 2·5 mm long; limb entire, undulate, spreading, 0·5 mm long. Corolla in the mature bud very slender, 0·5 mm long; petals in the open flower coherent in the lower 2–3 mm. Anthers *c.* 1·5 mm long; free parts of the filaments *c.* 5 mm long. Style articulate *c.* 1 mm above the base.

Distribution: Endemic to Papua; recorded only from the Sogeri Plateau, Central district, 400–600 m altitude.

Decaisnina stenopetala (Oliv.) Barlow *Aust. J. Bot.* **22**: 543 (1974).
Loranthus stenopetalus Oliv. (1877); *Amylotheca stenopetala* (Oliv.) Danser (1929).

Young stems, inflorescence and calyx sparsely to moderately shortly white- or brown-tomentose, the tomentum persisting on the fruits. Young stems smooth, usually flattened and often double-edged or quadrangular below the nodes, eventually becoming terete. Petiole *c.* 1 cm long; lamina elliptical to ovate, usually broadest below the middle, 10–15 × 4–8 cm, thin, somewhat glaucous and dull on both sides, undulate to punctate along the veins, contracted at the base, weakly acuminate but finally acute to rounded at the apex; venation pennate, distinct on both sides. Inflorescences solitary to few in the axils; axis slender, bearing usually 5 or 6 well-spaced pairs of triads, 4–8 cm long; peduncles of the triads slender, 2–4 mm long; lateral flowers of the triads almost sessile; bracts spreading, rounded, 1 mm long. Calyx cylindrical, 2 mm long; limb erect, regularly or irregularly divided into truncate lobes, 0·7 mm long. Corolla in bud slender (not seen mature), not inflated at the base in the specimens seen, probably *c.* 25 mm long. Fruit small (*c.* 5 mm diameter), urceolate, truncate, crowned by the short persistent calyx.

Distribution: Celebes, Flores, Moluccas; in Papuasia; Vogelkop and Bombarai Peninsula and adjacent islands (Waigeo, Japen, Woham), 0–620 m altitude.

Decaisnina triflora (Span.) Tiegh. *Bull. Soc. Bot. Fr.* **42**: 436 (1895).
Loranthus triflorus Span. (1841); *Treubella triflora* (Span.) Tiegh. (1894) nom. illeg.; *Decaisnina beccarii* Tiegh. (1895) nom. nud.; *Elytranthe triflora* (Span.) Engl. (1897); *Amylotheca triflora* (Span.) Danser (1929).

Glabrous or rarely the inflorescence axis sparsely tomentose. Stems very slightly flattened and double-edged near the top when young, very soon becoming terete. Petiole 0·8–1·5 cm long (rarely shorter, lamina rarely sessile and somewhat cordate at the base); lamina elliptical, 6–9(–11) × 3–5(–6) cm,

dull on both sides or slightly lustrous above, contracted at the base, usually rounded (rarely weakly acuminate) at the apex; venation pennate, distinct on both sides. Inflorescences solitary to few in the axils; axis terete, bearing 4–5(–9) pairs of triads, 3–4(–9) cm long; peduncles of the triads 3–6 mm long; lateral flowers of the triads sessile; bracts broad, usually imbricate, mostly acute, often irregularly toothed, 1–1·5 mm long. Calyx cylindrical, 2–3 mm long; limb erect, entire or irregularly split, up to 1 mm long. Corolla in the mature bud 25(–35) mm long; petals in the open flower united at the base for *c.* 4 mm. Anthers *c.* 3 mm long, slightly shorter than the free parts of the filaments. Style articulate *c.* 0·5 mm above the base. Fruit nearly globular, truncate, 5 mm long.

Distribution: Lesser Sunda Islands, Moluccas, North Queensland; in Papuasia widely distributed in New Guinea, relatively common in highlands from 1300 to 2300 m altitude but occasionally found down to 230 m.

DENDROPHTHOE Mart.

Aerial stem-parasites; runners usually present; leaves alternate or scattered (less frequently opposite); venation pennate. Inflorescence a simple axillary raceme or spike (sometimes reduced to a simple 2-flowered umbel or to a single anxillary flower); bracts single under each flower. Corolla in the mature bud usually inflated, curved; petals in the open flower 5, gamopetalous and forming a tube irregularly divided into lobes. Anthers basifixed, immobile, 4-locular; pollen trilobate.

Distribution: About 30 species distributed from tropical Africa to Australia, with the largest centre of development in western Malesia. Of the 4 species which occur in Papuasia, 3 are rather localized endemics in New Guinea and the other extends to India and northern Australia.

KEY TO SPECIES

1. Filaments of the stamens stellate-hairy; young shoots, inflorescences and flowers densely rusty-tomentose ..... **D. trichanthera**
1. Filaments of the stamens glabrous; young shoots, inflorescences and flowers glabrous or sparsely to densely white- or light brown-tomentose
   2. Corolla less than 20 mm long ..... **D. gjellerupii**
   2. Corolla more than 25 mm long
      3. Leaves thick, rounded at the apex, widest above the middle; whole plant entirely glabrous ..... **D. pelagica**
      3. Leaves variable but usually thin, obtuse at the apex, widest below the middle; shoots and inflorescences usually white-tomentose ..... **D. falcata**

Dendrophthoe falcata (L. f.) Ettingsh. *Denks. Akad. Wiss. Math.-Nat.* **32:** 52 (1872). **Fig. 53.**

Loranthus falcatus L. f. (1781); *L. longiflorus* Desr. (1789); *L. lauterbachii* K. Sch. (1901); *L. dolichocladus* K. Sch. (1905).

Glabrous except for the young shoots, inflorescences and flowers (especially the calyces) sparsely to densely white- or brown-tomentose. Petiole distinct, 0·5–1·5 cm long; lamina variable but mostly broad lanceolate to ellipti-

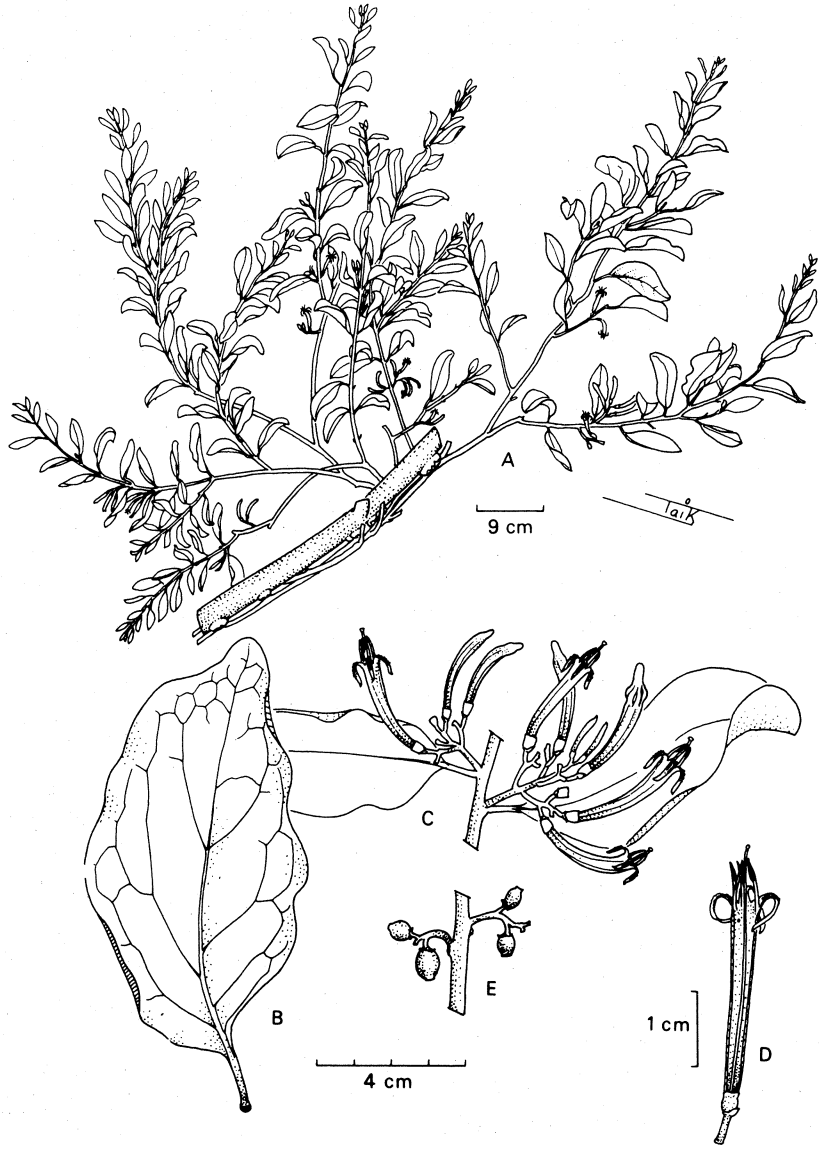

Fig. 53 **Dendrophthoe falcata** (L.f.) Ettingsh. (A) living plant (B) leaf (C) inflorescences (D) longitudinal section of flower (E) infructescences

cal, mostly widest in the middle, (3–)6–12(–15) × (1–)3–5(–7) cm, attenuate at the base, obtuse or shortly rounded at the apex; venation distinct or obscure. Inflorescences solitary to few in the axils; axis very variable in length (at one extreme *c.* 2 mm long and bearing 2 or 3 flowers, at the other extreme 40 mm long and bearing 12 flowers); pedicels slender, 2–4(–6) mm long; bracts acute or rounded, *c.* 1 mm long. Calyx urceolate, 2–3 mm long; limb truncate or shortly toothed, *c.* 1 mm long. Corolla in the mature bud usually acute, (20–)30–40 mm long; petals in the open flower gamopetalous for three-quarters of their length. Anthers 3–5 mm long, about equal to the free parts of the filaments. Fruit urceolate, widest near the base, 8–14 mm long.

Distribution: Common from India to Queensland; in Papuasia, very common throughout in coastal lowlands, less frequent at higher altitudes but recorded up to 1800 m.

Ecology: Common in settled areas on introduced hosts and in disturbed habitats.

Dendrophthoe gjellerupii (Laut.) Danser *Bull. Jard. Bot. Btzg* **10:** 309 (1929).
Loranthus gjellerupii Laut. (1912).

Glabrous except for the young shoots, inflorescences and flowers (especially the corollas) white-tomentose. Petiole 5–12 mm long; lamina elliptical to ovate, 5–8 × 3–5 cm, attenuate at the base, obtuse at the apex. Inflorescences several in the axils; axis up to 20 mm long, bearing up to 8 flowers; pedicels slender, 2–3 mm long. Corolla in the mature bud 10–15(–20) mm long; petals in the open flower spathulate, strongly reflexed *c.* 2–3 mm from the apex. Anthers 1 mm long; free parts of the filaments 2 mm long. Fruit 3–5 mm long with the white tomentum persistent.

Distribution: Endemic to New Guinea; known from near Jayapura and in Central district, Papua, 0–400 m altitude.

Notes: Dendrophthoe gjellerupii is very close to *D. falcata,* differing in the very short corollas and in the strong reflexion of the corolla lobes. If further collections show a continual range of variation between these 2 species, *D. gjellerupii* may be better treated at subspecific or varietal level.

Dendrophthoe pelagica Barlow *Aust. J. Bot.* **22:** 609 (1974).

Entirely glabrous. Petiole 3–8 mm long; lamina obovate, 2–6 × 1–3 cm, gradually attenuate at the base, rounded at the apex; venation distinct on both sides. Inflorescences 1 or 2 in the axils; axis 5–10 mm long, 2–4(–5) flowered; pedicels slender, 4–6 mm long; bracts spreading, rounded, 1 mm long, with a short acute tip. Calyx narrow cylindrical, 2–3 mm long; limb thin, entire, flaring, 1 mm long. Corolla in the mature bud 32–26(–40) mm long. Anthers 3·5 mm long; free parts of the filaments 1·5–2 times as long.

Distribution: Cape York Peninsula, Queensland; in Papuasia known only from Western district, Papua, in coastal lowlands.

Ecology: Apparently confined to mangrove communities, parasitic principally on *Rhizophora.*

Dendrophthoe trichanthera Barlow *Aust J. Bot.* **22**: 609 (1974).

Young parts, undersides of the leaves, inflorescences and flowers densely rusty-tomentose; filaments of the stamens and the inside of the corolla tube sprinkled with white (or brown) stellate hairs; otherwise glabrous. Petiole 5–10 mm long; lamina ovate, 3–7 × 1·5–3·5 cm, contracted at the base, obtuse at the apex; all venation visible on the upper surface and the midrib prominent on the under-surface. Inflorescences 1 or 2 in the axils; axis up to 1 cm long, bearing 4–6 flowers; pedicels 3–5 mm long, dilated towards the apex; bracts spreading, rounded but usually with an acuminate tip, 1·5 mm long. Calyx cylindrical, 3–4 mm long; limb erect, truncate, 1 mm long. Corolla in the mature bud robust, narrowed into a neck above the inflated part and clavate at the apex, 25–30 mm long. Anthers 3 mm long; free parts of the filaments *c.* 5 mm long. Fruits (not seen mature) urceolate, *c.* 10 mm long, with the calyx limb persistent at the apex.

Field characters: Differs from the widespread *D. falcata* in the nature of the indumentum, and especially in the presence of the stellate hairs on the filaments of the stamens.

Distribution: Endemic to New Guinea; southern border areas of western New Guinea and Papua, 0–300 m altitude.

DISTRIANTHES Danser

Aerial stem-parasitic shrubs with runners; leaves opposite; venation pennate. Inflorescences axillary or on the runners, capitate, consisting of two sessile dichasia (triads) at the apex of a common peduncle; central bracts of the triads enlarged and foliaceous, enclosing the flowers and connate at the margins over them during development; lateral bracts small, narrow. Corolla 6-merous, regular, gamopetalous. Anthers basifixed, immobile.

Distribution: A monotypic genus endemic to New Guinea.

Distrianthes molliflora (Krause) Danser *Bull. Jard. Bot Btzg* **10**: 312 (1929). **Fig. 54.**

Loranthus molliflorus Krause (1922); *L. spathatus* Krause (1922); *L. lamii* Krause (1923); *Distrianthes spathata* (Krause) Danser (1929); *D. lamii* (Krause) Danser (1929).

Young vegetative parts shortly brown-tomentose; inflorescences and flowers sparsely to densely brown stellate-tomentose or (the calyx and corolla especially) clothed with silky hairs up to 2 mm long; other parts glabrous. Stems robust, terete, slightly to strongly enlarged at the nodes. Petiole up to 1 cm long; lamina broad lanceolate to elliptical, 12–25 × 4–12 cm, usually lustrous above and dull below, attenuate to contracted at the base, recurved at the margin, acute and usually acuminate at the apex; venation distinct on both sides and usually raised below. Inflorescences few in the axils and on the runners; peduncle funnel-shaped, *c.* 2 mm long, 2–4 mm wide and flat at the apex; central bracts broad lanceolate, acute, 12–30 (–40) × 4–12 mm, strongly united at the margins, often with the sutures not visible, later separating nearly to the base or splitting irregularly; lateral

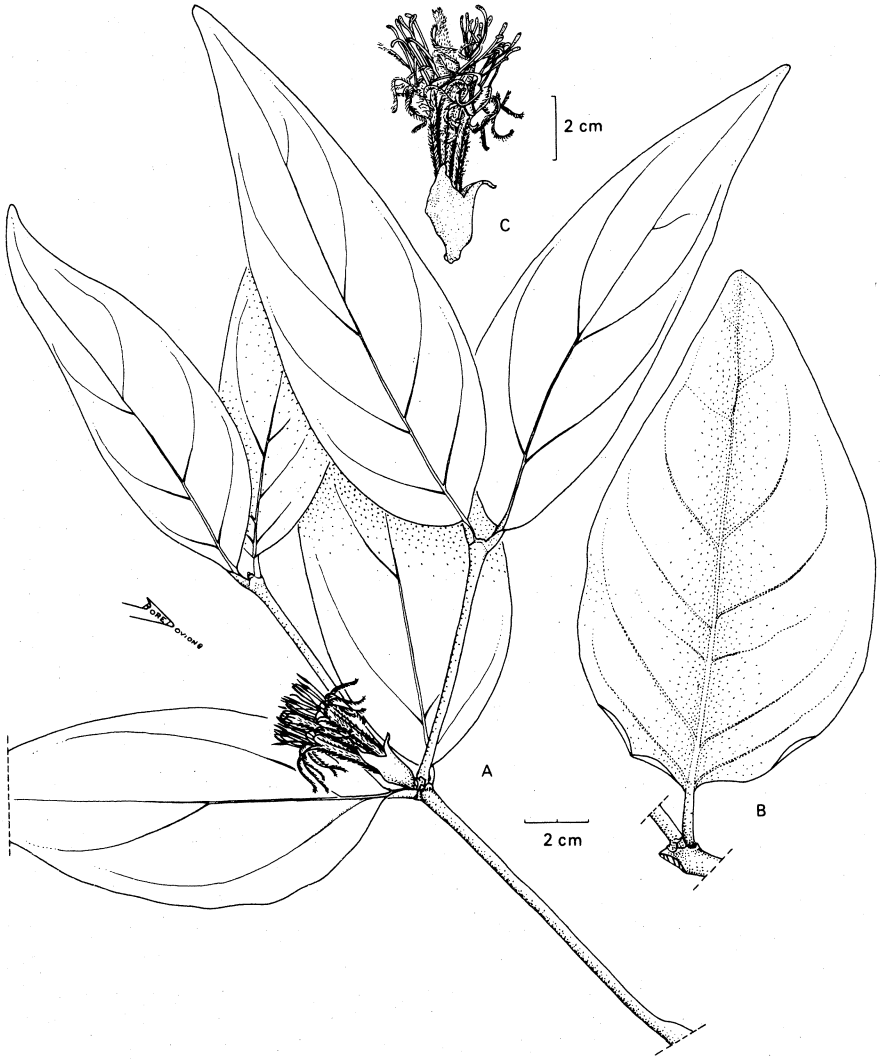

Fig. 54 **Distrianthes molliflora** (Krause) Danser (A) twig with inflorescence (B) leaf (C) flower

bracts narrow-triangular, acute, 1–10 × 0·5 mm. Calyx broadly campanulate, 2–3 mm long, 2 mm wide; limb very short and obscured by silky hairs. Corolla in the mature bud slender, 40–65 mm long, acute; petals in the open flower united in the lower 12–50 mm. Anthers 3–4 mm long; free parts of the filaments 2 or 3 times as long.

Distribution: Endemic to New Guinea; known from the Doorman River, Jayapura district, to the Garaina area, Morobe district, 130–1500 m altitude.

LEPEOSTEGERES (Bl.) Bl ex Schult. f.

Aerial stem-parasites with runners and opposite penninerved leaves. Inflorescence a pedunculate capitulum with the flowers enclosed in an involucre of 3–12 pairs of decussate imbricate bracts; peduncle dilated at the summit into a flat receptacle bearing 15–50 flowers arranged in decussate sessile dichasia (triads); flowers pedicellate or sessile; bracts other than those of the involucre small and scale-like or absent. Corolla 6-merous, the lobes becoming S-shaped at the point of reflexion before the corolla opens; petals in the open flower usually united almost to the middle. Anthers linear, basifixed, immobile, 4-locular. Style articulate above the base.

Distribution: About 10 species distributed from the Malay Peninsula to New Guinea, with the greatest concentration of species in western Malesia. 1 species is endemic to Papuasia.

Lepeostegeres deciduus Barlow *Aust. J. Bot.* **22**: 550 (1974). **Fig. 55.**

Glabrous. Stem internodes terete or angular below, flattened and double-edged above. Leaves opposite; petiole winged distally, 5–8 mm long; lamina elliptical to broad ovate, thin, 6–12 × 4–7 cm, shortly attenuate at the base, rounded at the apex; venation distinctly pennate. Inflorescences solitary in the axils; peduncle 4–5 mm long, 5–7 mm wide at the apex; flowers about 20, crowded and sessile on the flat apex of the peduncle, actually arranged in 6 or 7 triads in decussate pairs and sometimes with a central triad; involucral bracts deciduous, usually in 3 pairs; outermost pair ovate, *c.* 15 × 12 cm; innermost pair oblong, *c.* 20 × 5 mm, subtending the outer triads; other bracts narrow lanceolate, as long as the calyx, or reduced to scales, usually visible subtending both whole triads and lateral flowers. Calyx angular by mutual pressure; limb *c.* 1 mm long, erect, membranous. Corolla in the mature bud slender, weakly clavate, thickened at the point of reflexion *c.* 9 mm below the apex, acute, 35–40 mm long; petals in the open flower united in the lower 18–24 mm. Anthers 4–6 mm long; free parts of the filaments slightly shorter. Stigma twice as wide as the style. Fruit ellipsolidal, *c.* 8 mm long.

Field characters: Unique among Papuasian Loranthaceae in having a capitate inflorescence of sessile flowers with the several involucral bracts deciduous.

Distribution: Endemic to New Guinea; Eastern Highlands, 1520–2000 m altitude.

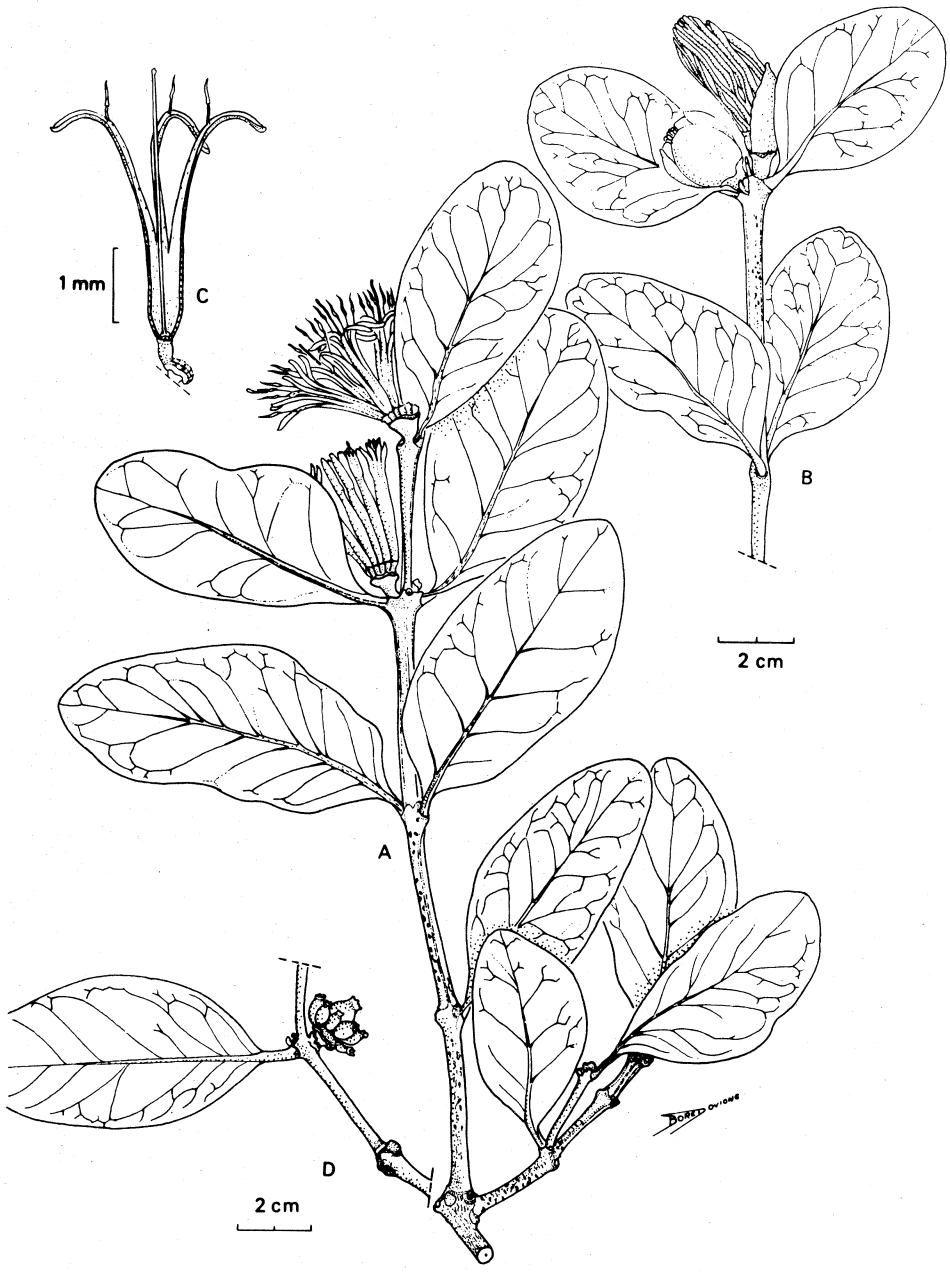

Fig. 55 **Lepeostegeres deciduus** Barlow (A) twig with inflorescences (B) twig with immature inflorescences showing bracts (C) open flower with front section cut away (D) part of twig with fruit

MACROSOLEN (Bl.) Bl. ex Schult. f.

Aerial stem-parasitic shrubs with runners and opposite penninerved leaves. Inflorescence an axillary raceme or spike (rarely an umbel or head), sometimes with a basal involucre of a few small scales; bracts 3 under each flower. Corolla 6-merous, inflated and 6-alate in the middle; petals in the open flower united to the middle or higher. Anthers linear, basifixed, immobile, 4-locular. Style articulate above the base.

Distribution: About 25 species distributed from Southeast Asia to New Guinea, with the greatest concentration of species in the western part of the range. One of these species occurs in Papuasia.

Macrosolen cochinchinensis (Lour.) Tiegh. *Bull. Soc. Bot. Fr.* **41**: 122 (1894). **Fig. 56.**

Loranthus cochinchinensis Lour. (1790); *Elytranthe cochinchinensis* (Lour.) G. Don (1834); *E. suberosa* Laut. (1912); *E. acutifolia* Krause (1922); *E. ledermannii* Krause (1922); *E. torulosa* Krause (1922); *E. verrucosa* Krause (1922); *E. spathulifolia* Krause (1922); *E. diversifolia* Krause (1922); *E. bruynii* Krause (1923); *E. leucophloea* Krause (1923); *Macrosolen suberosus* (Laut.) Danser (1929).

Glabrous and very rarely glaucous. Petiole 3–10(–15) mm long, flat or channelled above; lamina broad lanceolate to ovate (rarely narrower or broader), (4–)7–10(–16) × (1–)3–5(–10) cm, usually somewhat shining above, dull below, gradually to abruptly contracted at the base or very rarely slightly cordate, slightly recurved at the margins, usually acute and more or less acuminate at the apex but often rounded; venation pennate with the midrib distinct below and other venation only faintly visible. Inflorescences solitary or few in the axils; peduncle longitudinally ridged, slender, often with an involucre of 1–3 sterile bracts at the base or on the peduncle, bearing (1–)2–4(–5) flowers, 4–8(–12) mm long; pedicels 0–3 mm long; bracts acute, spreading, 1–2 mm long. Calyx funnel-shaped; limb truncate or weakly 6-toothed, 0·3–0·5 mm long. Corolla in the mature bud strongly 6-alate and inflated in the middle, 9–14(–23) mm long; petals in the open flower united into a campanulate tube 4–8(–12) mm long with the lobes strongly reflexed. Anthers 1–1·5 mm long, *c.* one-third the length of the free parts of the filaments. Style articulate near the base, leaving almost no nipple on the fruit. Fruit globular.

Distribution: Southern China and Himalayas to Malesia. In Papuasia 2 varieties in New Guinea.

KEY TO VARIETIES

1. Leaves broad lanceolate to ovate, more than 2 cm wide, acute to rounded at the apex, often somewhat acuminate but not strongly so ..... var **cochinchinensis**
1. Leaves lanceolate, less than 2 cm wide, acute and acuminate at the apex ... var. **lanceolatus**

var. **cochinchinensis**

Distribution: Throughout the species range. In Papuasia: New Guinea,

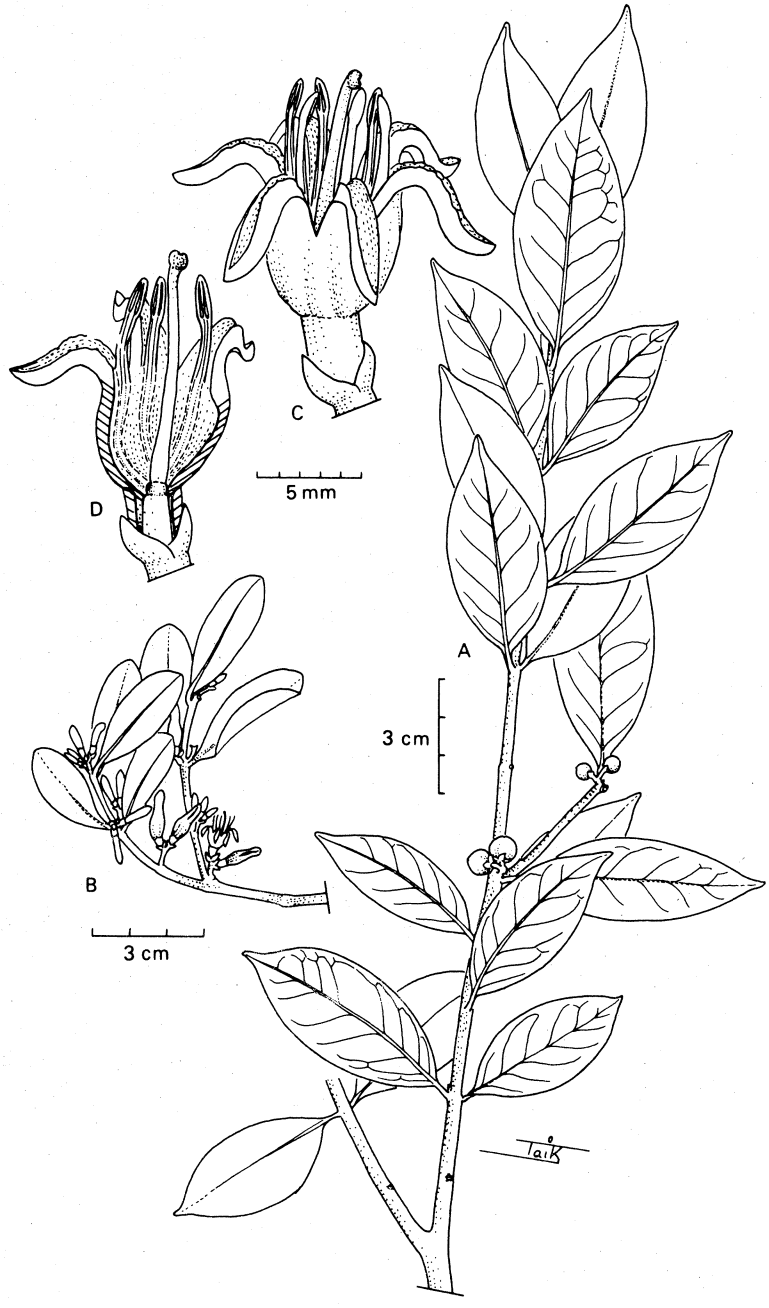

Fig. 56 **Macrosolen cochinchinensis** (Lour.) Tiegh. (A) branch with fruit (B) twig with flowers (C) flower (D) flower with front section cut away

from Vogelkop to Sogeri Plateau, mainly 0–1600 m altitude but rarely up to 2350 m.

var. **lanceolatus** Barlow *Aust. J. Bot.* **22**: 556 (1974).

Distribution: Celebes; in Papuasia: Eastern Highlands of New Guinea, 1750–2350 m altitude.

Notes: Intermediates between the typical variety and var. *lanceolatus* occur, and have been recorded from Cycloop Mountains.

PAPUANTHES Danser

Aerial stem-parasitic shrubs with runners; leaves opposite, penninerved. Inflorescence capitate, consisting of (8–)12(–15) flowers in 2 rows at the apex of a common peduncle and enclosed between 2 large foliaceous bracts which are connate at the margins over them during development; each flower on a short articulate pedicel with a single small bract at the apex of the distal segment, immediately below the flower, and occasionally with a similar small bract at the apex of the proximal segment. Corolla 6-merous, nearly regular; petals in the open flower gamopetalous to well above the middle. Anthers basifixed, immobile.

Distribution: A monotypic genus endemic to New Guinea.

Papuanthes albertisii (Tiegh.) Danser *Bull. Jard. Bot Btzg* **11**: 360 (1931). **Fig. 57.**

Diplatia albertisii Tiegh. (1894); *Loranthus albertisii* (Tiegh). Engl. (1897).

Glabrous. Stems terete, enlarged at the nodes, distinctly lenticellate, much branched. Leaves opposite, usually with a seemingly superposed arrangement through the extreme contraction of every second internode and the reduction of every second pair of leaves to scales; sessile or rarely with a terete petiole a few mm long; lamina ovate, 8–20 × 5–12 cm, rather thickly coriaceous, dull on both sides, truncate rounded or rarely slightly cordate at the base, obtuse at the apex; venation pennate with the midrib and the lateral veins visible on both sides. Inflorescence a head of (8–)12(–15) flowers arranged in 2 rows on the flattened apex of a stout peduncle 6 mm long and 3·5 mm wide; involucral bracts ovate to orbicular, 25–40 × 20–25 mm, connate at the margins in the lower third, obtuse or rounded at the apex; flowers on pedicels 1·5–2 mm long which are articulate above the middle and with a bract at the apex and rarely a bract below the articulation; these bracts acute, *c.* 1·5 mm long. Calyx campanulate to funnel-shaped, 3–4 mm long; limb entire. Corolla in the mature bud 40–65 mm long; petals in the open flower 6, gamopetalous to above the middle. Anthers *c.* 3 mm long, equal to the free parts of the filaments. Fruit urceolate, up to 15 mm long; fruiting pedicels greatly enlarged and thickened.

Field characters: Distinguished from all other Papuasian Loranthaceae by the capitate inflorescence of about 12 pedicellate gamopetalous flowers in 2 rows between enlarged foliaceous bracts.

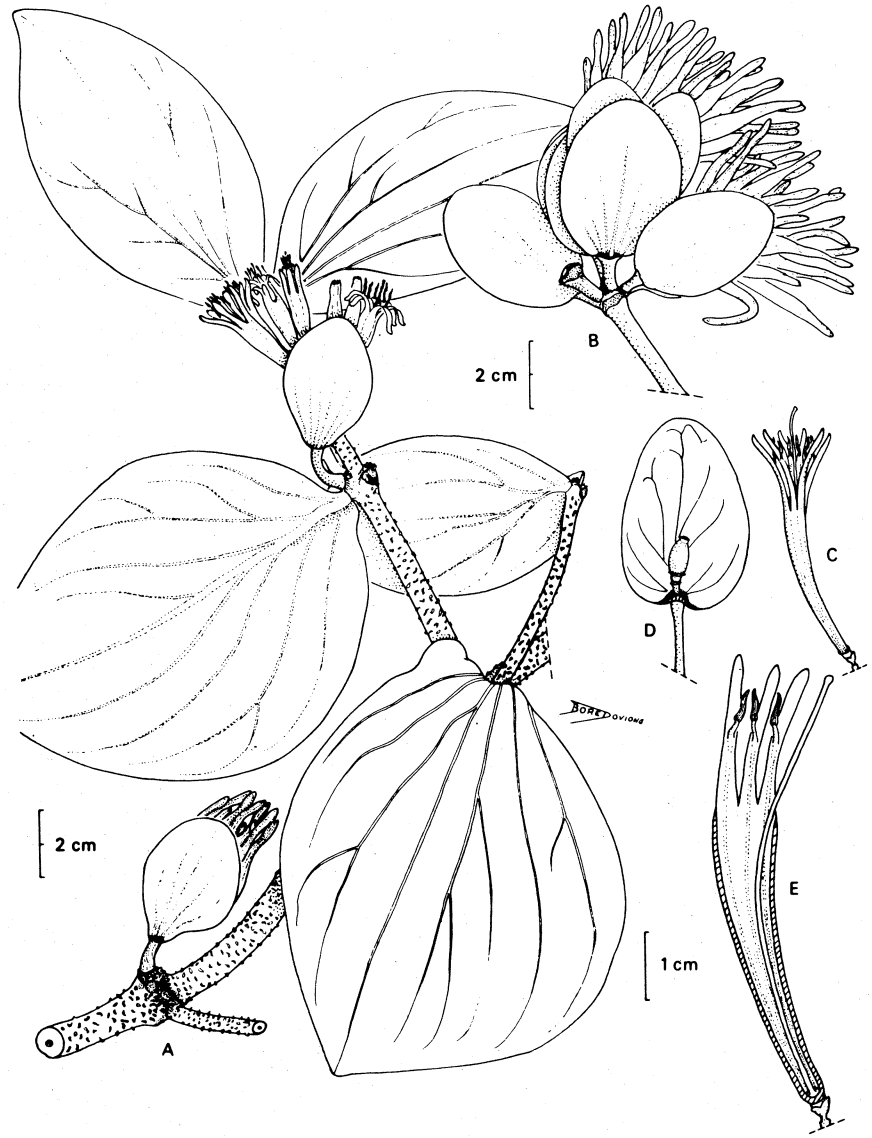

Fig. 57 **Papuanthes albertisii** (Tiegh.) Danser (A) flowering twig (B) inflorescences (C) flower (D) flower with front section cut away (E) fruit and bract, after front bract removed

Distribution: Endemic to New Guinea; known from the upper reaches of the Fly River and its tributaries, Western district, and from a nearby tributary of the Digul River, Digul district, 20–800 m altitude; also from the Menyamya area, Morobe district, 1300–1600 m altitude.

SOGERIANTHE Danser

Aerial stem-parasitic shrubs with runners. Leaves opposite; venation pennate but somewhat curvinerved. Inflorescence axillary, primarily a solitary flower on a short pedicel at the apex of a short peduncle, i.e. on an articulate 'pedicel', but sometimes with the 'pedicel' apparently non-articulate owing to reduction of the penduncular segment. Bracts 2 or 3 under the flower (the peduncular segment ebracteate), free or variously united. Corolla gamopetalous, 6-merous, regular. Anthers basifixed, immobile.

Distribution: 4 species, endemic to Papuasia and distributed eastwards from Huon Gulf to the Solomon Islands.

KEY TO SPECIES

1. Bracts 2, free, broadly imbricate, almost enclosing the calyx, 2–4 × 2–3 mm, 'pedicel' 0·5–2 mm long ..... **S. sessiliflora**
1. Bracts 3, free or variously united or reduced to an obsolete limb (sometimes apparently 2 due to fusion of bracts), up to 1·5 mm long.
2. 'Pedicel' articulate above the middle, 4–7 mm long; bracts free or 2 of them partly or wholly united ..... **S. sogerensis**
2. 'Pedicel' not articulate; bracts united at the margins into a shallow, entire or 3-lobed cup (sometimes obsolete)
3. 'Pedicel' 3–8 mm long; calyx limb 0·5–1 mm long; bracteal cup usually truncate, 0·7 mm long ..... **S. versicolor**
3. 'Pedicel' usually 2–3 mm long; calyx limb 1–2 mm long; bracteal cup 3-lobed, 1–1·5 mm long ..... **S. cupuliformis**

Sogerianthe cupuliformis Barlow *Aust. J. Bot.* **22**: 601 (1974).

Glabrous except for the pedicel, bracteal cup and calyx shortly brown-tomentose. Petiole winged, obscure or virtually absent; lamina ovate, 6–15 × (2–)4–7 cm, attenuate at the base, acuminate and acute at the apex. Inflorescences several to many at the nodes; pedicel not articulate, (1–)2–3(–4) mm long; bracts 3, 1–1·5 mm long, united at the margins into a shallow, more or less 3-lobed cup. Calyx cylindrical or barrel-shaped, 2–3 mm long; limb membranous, entire or denticulate, often rolled inwards, up to 2 mm long. Corolla in the mature bud 24–32 mm long, inflated in the middle, clavate at the apex; petals in the open flower gamopetalous to the middle or slightly higher. Anthers 2–4 mm long, shorter than or rarely equal to the free parts of the filaments. Fruit ellipsoidal, crowned by the persistent calyx limb.

Distribution: Papuan Islands (D'Entrecasteaux Islands and Louisiade Archipelago) and the Solomon Islands, 5–900 m altitude.

Sogerianthe sessiliflora (Danser) Danser *Verh. Akad. Wet. Amst. afd. Natuurk.* **29**: 106 (1933).

Amyema sessiliflora Danser (1931); *Loranthus hedraeanthus* Krause (1935); *Sogerianthe ferruginea* Danser (1938).

Glabrous or rarely the young stems, undersides of the leaves, inflorescences and flowers rusty-tomentose. Leaves nearly sessile or with a petiole up to 1 cm long; lamina broad lanceolate to ovate, 6–14 × 3–5 cm, attenuate at the base, acuminate and acute (rarely obtuse) at the apex. Inflorescences several at the nodes; 'pedicel' 0·5–2 mm long, usually visibly articulate near the middle but often with the part below the articulation obsolete and thus apparently not articulate; bracts 2, free, conspicuous, orbicular, acuminate and acute, broadly imbricate and more or less enclosing the calyx, 2–4 × 2–3 mm. Calyx cylindrical or barrel-shaped, 2–3 mm long; limb membranous, erect, entire or denticulate, up to 2 mm long. Corolla in the mature bud robust, cylindrical, 25–35 mm long; petals in the open flower gamopetalous to just below the middle. Anthers 3–4 mm long, slightly longer than the free parts of the filaments. Fruit urceolate, 10 mm long, crowned by the persistent calyx limb.

Distribution: Eastern New Guinea east of longitude 147° E., New Britain and Solomon Islands (Guadalcanal), 0–2230 m altitude.

Sogerianthe sogerensis (S. Moore) Danser *Verh. Akad. Wet. Amst. afd. Natuurk.* **29**: 106 (1933). **Fig. 58.**

Elytranthe sogerensis S. Moore (1923); *Amyema sogerensis* (S. Moore) Danser (1929); *Loranthus sogerensis* (S. Moore) Engl. & Krause (1935).

Glabrous or the pedicel, bracts, calyx and rarely the corolla sparsely and shortly tomentose. Petiole more or less winged, 0·5–1 cm long; lamina elliptical to ovate, 5–12 × 3–7 cm, attenuate or contracted at the base, more or less acuminate, acute to shortly rounded at the apex. Inflorescences several to many at the nodes; 'pedicel' 4–7 mm long, articulate above the middle; bracts 3, usually with 2 of these partly or completely fused (when there are apparently only 2 bracts) and slightly imbricate with the third, acute, 1–1·5 mm long. Calyx cylindrical, 2 mm long; limb membranous, erect, 1–1·5 mm long. Corolla in the mature bud inflated in the middle, clavate and truncate at the apex, 25–35(–45) mm long; petals in the open flower gamopetalous to about the middle. Anthers 3–4 mm long, about equal to the free parts of the filaments. Fruit ellipsoidal to nearly globular, *c.* 8 mm long, crowned by the persistent calyx limb.

Distribution: Endemic to New Guinea; from the Herzog Range (Morobe district) southeastwards, 15–1950 m altitude, but mostly between 500 and 1500 m.

Sogerianthe versicolor Danser *J. Arnold Arbor.* **16**: 207 (1935).

Sogerianthe trilobobractea Danser (1940).

Glabrous or sometimes the pedicel, calyx and young corolla sparsely tomentose. Stems conspicuously lenticellate. Petiole 0·8–1·5(–2) cm long; lamina narrow ovate to ovate, up to 15 × 6 cm but often much smaller, attenuate at the base, usually acuminate and acute at the apex. Inflorescences few to many at the nodes; pedicel not articulate, 3–8 mm long, with a collar of fused bracts at the apex; bracteal collar usually membranous, truncate and 0·7 mm long but occasionally 3-lobed and rarely obsolete. Calyx funnel-shaped, 2·5 mm long; limb erect, truncate, 0·5–1 mm long. Corolla in the

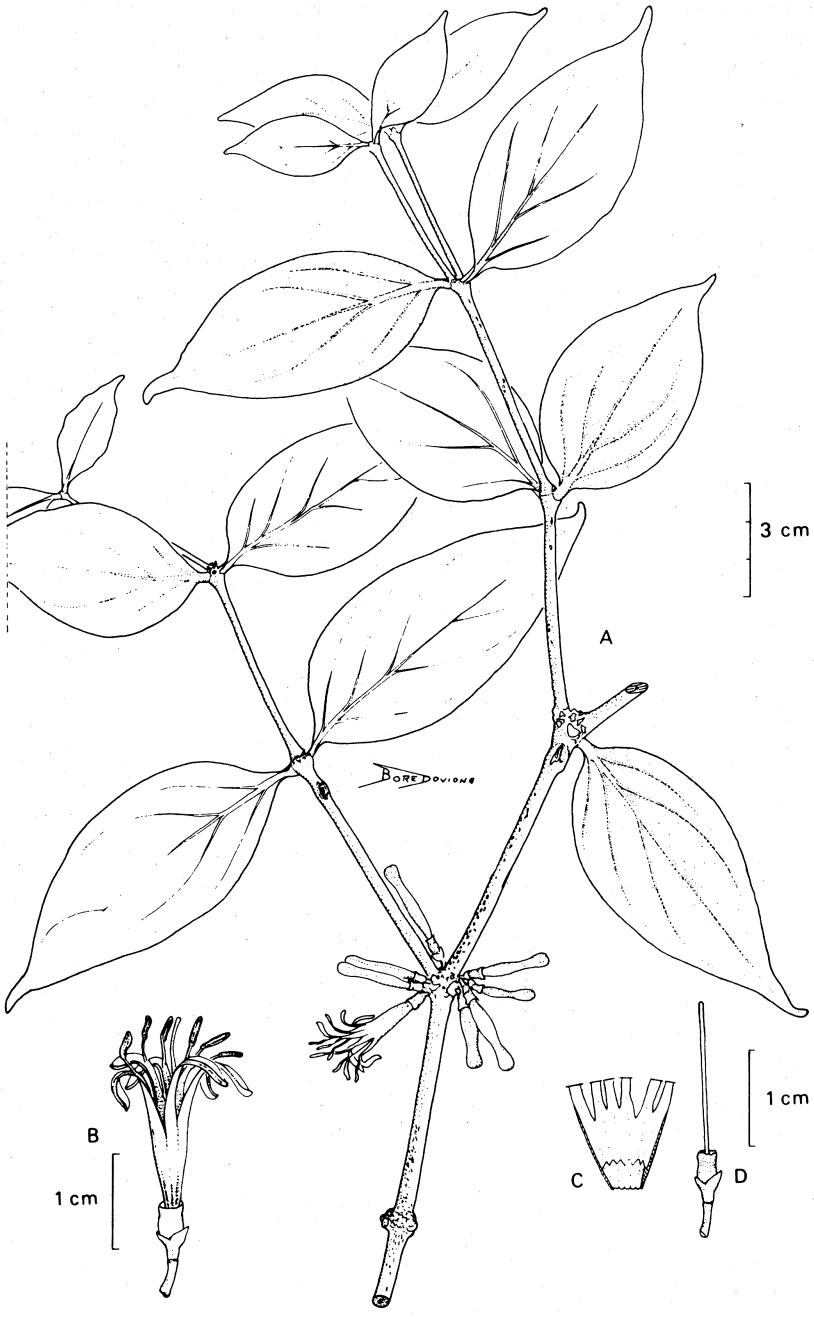

Fig. 58 **Sogerianthe sogerensis** (S. Moore) Danser (A) flowering twig (B) flower (C) lower part of corolla opened out (D) calyx with style

mature bud slender, 15–25 mm long; petals in the open flower gamopetalous to the middle or higher. Anthers *c.* 2·5 mm long, slightly longer than the free parts of the filaments. Fruit ellipsoidal, 6 mm long.

Distribution: Solomon Islands, 0–600 m altitude.

TETRADYAS Danser

Aerial stem-parasitic shrubs with opposite leaves. Inflorescence a sessile axillary head without an involucre, composed of many subsessile dyads and triads developing successively; bracts single under each flower. Characters of the mature flowers not known.

Distribution: A monotypic genus endemic to Papuasia and known only from the Central district of Papua.

Tetradyas perfoliata Danser *Bull. Jard. Bot. Btzg* **11**: 362 (1931).

Glabrous. Stems slightly double-edged below each node but otherwise terete, smooth, branching at every node. Leaves opposite, sessile, the leaves of each pair fused at the margins in the lower 1·5–2 cm into a cup-like sheath around the stem; lamina ovate, *c.* 10 × 6 cm, obtuse to rounded at the apex; venation distinctly pennate on both sides. Inflorescences apparently axillary at the apices of short determinate lateral stems, consisting of head-like clusters of almost sessile dyads and triads of almost sessile flowers, with the dyads and triads apparently developing successively in each inflorescence; peduncle of each triad or dyad very short but enlarging to about 1 mm long in fruit; pedicels of the flowers minute but enlarging to *c.* 1·5 mm long in fruit; bracts single below each flower, membranous, acute, imbricate, together enveloping the triad or dyad, *c.* 3 mm long. Flowers only seen in very young bud. Fruit ellipsoidal, not seen mature.

Field characters: Distinct from all other Papuasian Loranthaceae by the cup-like pairs of connate leaves.

Distribution: Endemic to New Guinea; recorded only from the Central district of Papua, 960 m and 1500 m altitude.

Notes: This very distinct species is only known from 2 collections and has not been found since 1935.

STACKHOUSIACEAE

W. R. Barker

Small herbaceous annuals or perennials, with laterally branched single main root. Stems and branches sulcate-striate. Leaves alternate, simple, entire, sessile, with tiny cylindrical stipule on either side of base. Flowers solitary or arranged in spike-like racemes or panicles, with or (extra-Papuasia) without bracts, bisexual. Calyx tube adnate to a cup-shaped herbaceous torus; lobes 5, arising from torus rim. Petals 5, mounted on torus rim between the calyx lobes, free (extra-Papuasia) or fused in the middle and free at either end, thus forming a tube. Stamens 5, arising from torus rim, free; anthers basifixed, dehiscing by slits. Gynoecium superior, consisting of (2–)3–5 carpels; ovules basifixed; style ± basal or (extra-Papuasia) terminal, simple with (2–)3–5 subulate stigmatic lobes. Fruits consisting of 2–5 indehiscent 1-seeded nutlets (cocci) borne on persistent calyx, torus and style.

Distribution: The family consists of 3 genera, 2 of which are monotypic and Australian. The genus *Stackhousia* is mainly confined to Australia, but extends into New Zealand, Malesia and parts of Micronesia.

Literature: R. Pampanini and G. Bargagli-Petrucci, (1905), Monographia della famiglia delle Stackhousiacee, *Bull. Herb. Boiss.* ser. 2, **5**: 901–16, 1045–60, 1145–60; (1906), **6**: 39–44. J. Mattfeld, (1942), Stackhousiaceae, in A. Engler and K. Prantl, *Die Natürlichen Pflanzenfamilien* ed. 2, **20b**: 240–54. F. I. Brouwer, (1948), Stackhousiaceae, *Fl. Males.* ser. 1, **4**: 35–6.

STACKHOUSIA Sm.

Usually erect, rarely (extra-Papuasia) mat-forming perennials or annuals. Flowers tribracteate. Petals fused in the middle, free at either end, thus forming a tube. Stamens 3 long and 2 short, with filiform filaments and introrse oblong anthers. Gynoecium consisting of (2–)3(–5) carpels; style ± basal. Cocci same number as carpels or fewer by abortion, with usually coriaceous, rarely woody pericarp.

Distribution: 20–30 species throughout Australia, with 1 species endemic to New Zealand, and another, the single Papuasian representative, spreading from Australia into Malesia and parts of Micronesia.

Stackhousia intermedia F. M. Bail *Qld Agric. J.* **3**: 281 (1898). **Fig. 59.**

S. tenuissima Pamp. var. *ramosa* Steen. (1927); *S. viminea* auct. non Sm.: Volk. (1902); *S. viminea* var. *micrantha* auct. non Benth.: Laut. (1905).

Slender erect annual herb (13–)17–55(–75) cm high, with stem simple or with suberect branches in axils to high above ground level. Cotyledons deci-

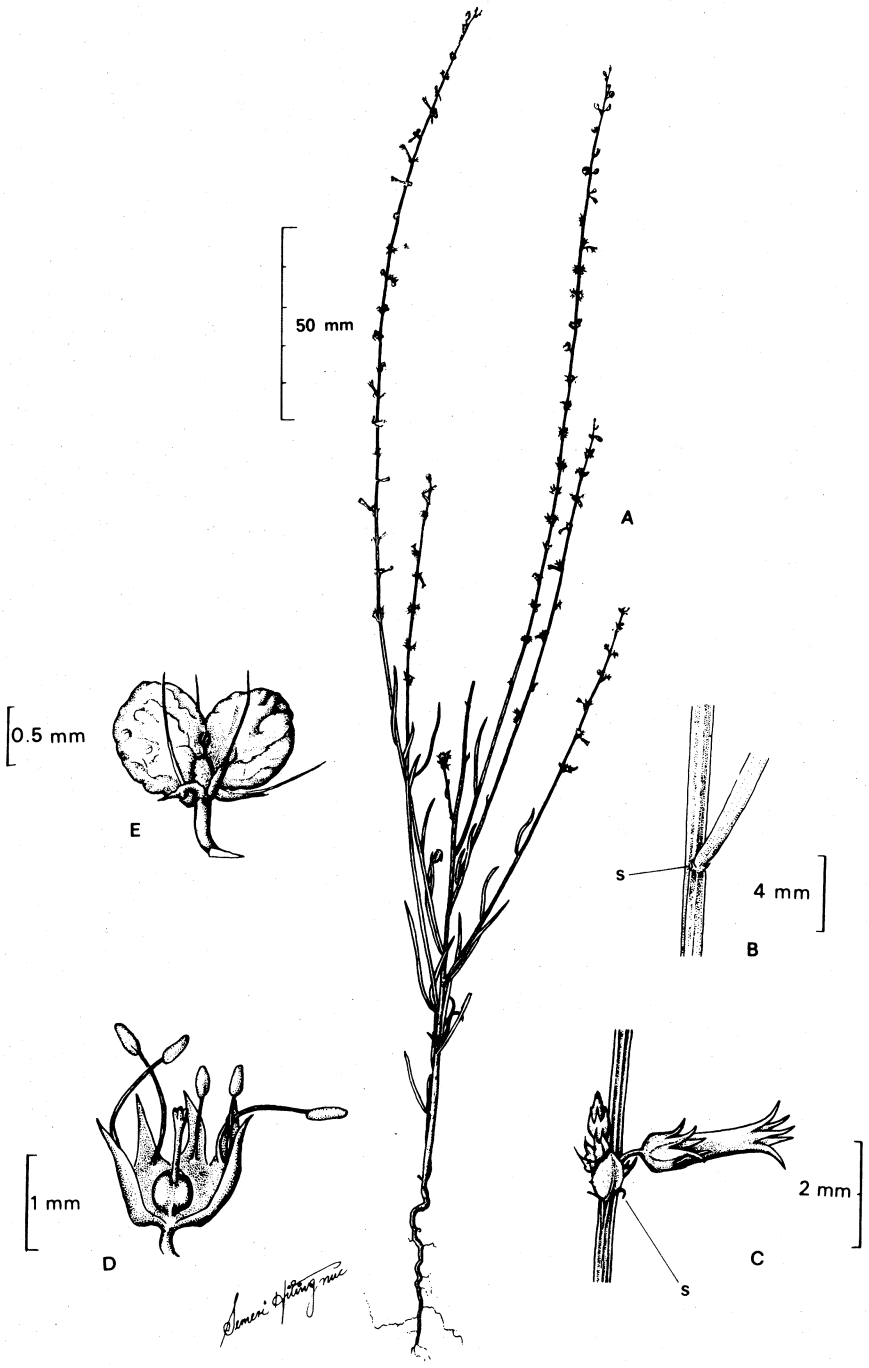

Fig. 59 **Stackhousia intermedia** F. M. Bail. (A) plant (B) leaf-base showing stipule (C) flower-cluster (D) flower, after removal of corolla, opened to show parts (E) fruit

duous, present or absent at flowering, narrow spathulate, *c.* 5 mm long, obtuse. Leaves ascending, linear, the longest leaves (1–)2–3(–5) cm long, usually in middle part of stem, with leaves shorter proximally and distally, obtuse in lowest part, grading to acute and acuminate higher up; stipules up to 0·5 mm long. Inflorescences spike-like panicles up to 30(–35) cm long, with dense clusters of 2–5 tribracteate flowers arranged sparsely along the filiform axis. Bract 1 per flower, triangular, acuminate or caudate, fimbriate-dentate, that of first flower of cluster 1·0–1·4 mm long, the distal ones shorter; bracteoles 2, similar to bracts, those of first flower of cluster 0·5–1·3 mm long, distal ones shorter. Pedicels 0·5–1·5 mm long. Calyx (1·0–)1·2 mm long, the teeth triangular, two-thirds to three-quarters the length of calyx, acuminate, irregularly dentate. Corolla 2·5–3·2 mm long when lobes spreading, pale green, greenish-yellow or pale yellow; lobes narrow triangular or linear, 1·0–1·2(–1·3) mm long, acuminate, entire, finally spreading. Stamens: 3 longer stamens reaching just past base of corolla lobes, 2 shorter stamens reaching just past middle of corolla tube; anthers oblong, 0·4–0·5(–0·6) mm long, 0·2(–0·3) mm broad, with base emarginate, apex obtuse. Gynoecium with 3(–5) carpels. Cocci 2–3(–4), obovoid or broadly so, (1·2–)1·4–1·8 mm long, 1·1–1·6 mm broad, rugose-reticulate.

Distribution: In Papuasia it is known from the Jayapura, East Sepik, Morobe, Western, Central, Northern, Milne Bay and Papuan Islands districts. It is probably more widely spread, occurring in the grasslands of other mainland districts which border the sea. Grasslands of the Bismarck Archipelago and the Solomon Islands should also be investigated for the presence of the species, although it may be truly absent from there. Elsewhere in Malesia occurring in the Moluccas, north Celebes, Sumatra and Philippines; also northern and eastern Australia, and Micronesia, in the Caroline Islands.

Ecology: Common or locally plentiful from sea level to 1350 m altitude, in savannah or old man-induced grasslands. It is often found in disturbed habitats such as tracksides, and once found in mown grass of an airfield.

STAPHYLEACEAE

W. R. Barker

Trees or shrubs. Leaves usually opposite and imparipinnate, rarely (extra-Papuasia) alternate or simple; stipulate. Flowers usually bisexual, rarely (extra-Papuasia) unisexual, actinomorphic, small, in panicles or (extra-Papuasia) racemes; sepals 5, imbricate in bud; petals 5, free, imbricate in bud, alternate with sepals, about as long as or slightly longer than sepals stamens 5, free, alternate with petals with anthers fixed at middle, 2-celled, loculicidal; intrastaminal disc a thick low ring; gynoecium superior, carpels 2–3(–4), free or united, ovules 1 to many in each cell, placentation axile, styles as many as carpels, free or fused and then finally free. Fruit a berry or (extra-Papuasia) an inflated capsule; seeds few, with scanty endosperm and straight embryo.

Distribution: 5–6 genera totalling about 50 species in East Asia, Malesia and the northern temperate and tropical Americas. Only 1 genus is represented in Malesia (including Papuasia).

Literature: J. Krause, (1942), Staphyleaceae, in A. Engler and K. Prantl, *Die Natürlichen Pflanzenfamilien ed. 2,* **20b**: 255–321. B. L. van der Linden, (1960), Staphyleaceae, *Fl. Males.* ser. 1, **6**: 49–50.

TURPINIA Vent., *nom. cons.*

Trees or (extra-Papuasia) shrubs; twigs with cylindrical pith; indumentum when present of simple hairs. Leaves opposite, decussate, usually imparipinnate, rarely lacking terminal leaflet or (elsewhere) simple; stipules 2 at each node, interpetiolar, usually caducous leaving permanent annular scar, rarely (elsewhere) persistent; 2 small raised stipels, sometimes fused, on leaf rachis at base of petiolule; leaflet margin crenate to serrate. Flowers bisexual in axillary racemes or panicles or (elsewhere) terminal racemes; sepals free, ± perigynous; anthers often apiculate; disc crenate; ovary with (2–)3(–4) carpels, fused (at least in Papuasia), the styles and upper one-third of the ovary only narrowly so and quickly becoming free after anthesis; ovules 1 to many in each cell. Fruit a ± fleshy indehiscent ± globular berry, hard when dry, slightly (2–)3(–4)-lobed, sometimes with horn-like conical style remnants; 1 to many seeds in each cell. Seed with large hilum and endosperm present.

Distribution: About 30 species; tropical Asia, northwards to South China, Taiwan and southern Japan; Malesia, to Papuasia; Central and tropical South America. In Papuasia the genus is represented by a single endemic species.

Turpinia pentandra (Schltr) v.d. Linden, *Nova Guinea* **10**: 212 (1959). **Fig. 60.**

Kaernbachia pentandra Schltr (1914); *K. brachypetala* Schltr (1914); *Turpinia versteeghii* Merr. & Perry (1941); *T. papuana* Merr. & Perry (1941); *T. brachypetala* (Schltr) v.d. Linden (1959); *T. papuana* Harms (1942) nom. illeg.

Trees to 30(–33) m tall. Leaves stipulate; stipules triangular, 4–9 mm long, 2–5 mm wide, glabrous or pubescent, caducous early, leaving annular scar at each node; rachis (including petiole) (7–)9–22(–27) cm long, grooved above; petiolules (1–)3–10(–12) mm long, grooved above, with prominent bilobed or fused stipellae at the base; leaflets (3–)5–7(–11), the distal pair often lacking, the terminal leaflet rarely lacking; blade usually ± oblong-elliptic, rarely ovate, often broadly so, (5–)8–15(–25) × (2–)3–8·5(–15) cm, coriaceous to chartaceous, usually glabrous throughout, rarely glaucous to shortly pubescent below, midrib and main veins slightly raised above, prominent below; base usually rounded to obtuse, rarely shallowly cordate; margin serrulate, shallowly crenulate, or ± entire, narrowly recurved when dried; apex ± abruptly long slender acuminate to shortly so, rounded to obtuse behind. Inflorescences axillary panicles 7–25(–40) cm long, often branched from the base, axes sparsely to densely short-pubescent, the initial branches subtended by caducous stipules, subsequent branches and pedicels subtended by small ciliate bracts. Flowers with pedicels bearing 2 caducous bracteoles at base; sepals broadly oblong to triangular, 1·2–2·5 mm long, ciliate, green, white or reddened; petals slightly longer than sepals, oblong, glabrous to ciliate, white, cream or reddened; stamens glabrous, almost as long as sepals, with anthers globular to oblong, apiculate, 0·5–1·2 mm long, cream or yellow; gynoecium shorter than calyx, ribbed, green, glabrous, with fused stigmas forming serrate disc, ovules (?2–)4–10 in each locule. Fruit a ± globular berry, slightly 3-lobed, to 2·5 cm or more diameter, with pericarp hard, to 6 mm thick when dried, green, yellow, brown, reddish or pale purple, with summit horned when young, flat with 3 radial lines joining style vestiges when mature; seeds 1 to several in each locule, ± flattened, angled, irregularly broad oblong, to 5 mm long, smooth, with long hilum.

Field characters: Usually buttressed to *c.* 2·5 m, fluted above; bole straight or irregular, to 21 m long, diameter to 60(–100) cm at breast height or above buttresses; crown large and spreading to long and narrow, sometimes with heavy crooked branches. Branchlets with cylindrical pith. Outer bark light to dark grey to brown, usually vertically furrowed, rarely smooth or exfoliating in small scales. Under bark pale green, yellow-brown or light brown. Inner bark white to cream, at least often flecked with orange or brown, to brown or red-brown; with pleasant smell. Wood: sapwood and heartwood not differentiated; white to cream, ± soft to moderately hard. Leaves usually mid- to dark green and glossy, rarely light green, yellowed or dull above, usually paler green, rarely glaucous, beneath.

Distribution: Endemic to Papuasia. Known from the Vogelkop (Arfak Mountains, east of Sorong), Geelvink Bay (Japen Island) and Jayapura (inland along Idenburg River) districts of western New Guinea; and from the West Sepik (Hindenburg Range), Madang (Kar Kar Island, Aiome), Morobe, Western Highlands and Eastern Highlands districts of northeastern New

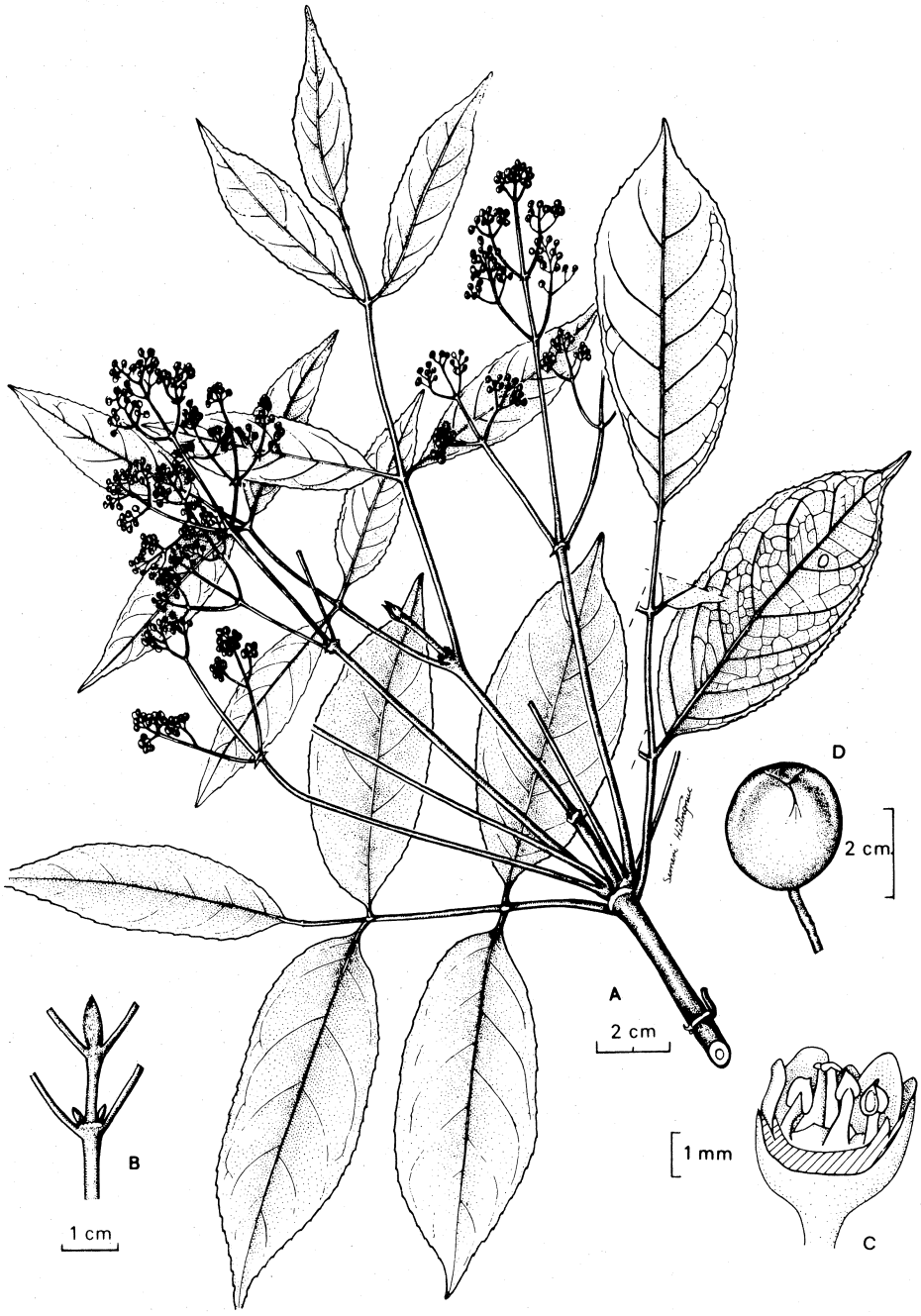

Fig. 60 **Turpinia pentandra** (Schltr) v.d. Linden (A) branch with inflorescences (B) twig-tip with leaf-buds (C) flower with nearer parts removed (D) fruit

Guinea; Southern Highlands, Central, Milne Bay (Mt Suckling complex) and Papuan Islands (Rossel Island) district of Papua; New Britiain and New Ireland (Danfu River valley) districts of the Bismarck Archipelago.

Ecology: Common, from sea level to 2800 m altitude, in lowland rainforest and in lower to middle mountain rainforest, often associated with *Castanopsis, Lithocarpus* or *Nothofagus;* in primary and secondary forest, rarely as a canopy tree, also in disturbed situations, often in the open; on ridges, slopes, flat areas or along streams.

Uses: 1 herbarium specimen collected from Woitape, Central district by G. F. McVeigh has the note: 'leaves eaten with leaf of *Zingiber* by women; allegedly prevents conception'. The wood is not durable.

Note: Turpinia has been considered previously to comprise 2 closely related endemic species in Papuasia. On the basis of the many collections now available the characters used of leaflet size, ovule number and presence or absence of stylar remnants on the summit of the fruit (a product of the maturity of the fruit) show little correlation and intergrade. There is some tendency for leaflets to be thicker, narrower and more deeply serrulate with higher altitude, but correlation is insufficient to warrant infraspecific classification.

STYRACACEAE

J. R. Croft

Evergreen shrubs or trees, often lepidote or stellate-tomentose. Leaves simple, alternate, entire to serrate; stipules absent. Flowers bisexual, actinomorphic, in terminal or axillary leafy or leafless racemes or panicles. Calyx campanulate or cupular, margin entire or shortly lobed. Petals mostly connate basally, mostly white or cream; valvate or imbricate. Stamens equal in number and alternate to petals, or double the number of petals, mostly adnate to corolla; anthers linear, basifixed, dehiscing introrsely by longitudinal slits. Disc absent. Ovary superior to inferior, 1–5-locular, 1 to many axile ovules in each loculus; style solitary, columnar to filiform; stigma minute or 3–5-lobed. Fruit a berry, or capsular, or drupaceous, 1- to many-seeded.

Distribution: About 12 genera with 190 species in tropical and temperate regions, mostly in the northern hemisphere, rare in Africa. *Styrax* and *Bruinsmia* are the only genera found in Papuasia, each with 1 species.

Literature: J. Hutchinson, (1967) Styracaceae, *The Genera of Flowering Plants* **2**, 34–9. C. G. G. J. van Steenis, (1949), Styracaceae, *Fl. Males.* ser 1, **4**(2):49–56, f1–12.

KEY TO GENERA

1. Petiole flat above, leaf margin serrate; pedicel articulate; ovary and fruit glabrous, 5-locular; style 5-angular with 5-lobed stigma; corolla imbricate, berry with many small, glabrous, reticulate-foveolate, angular seeds ..... BRUINSMIA
1. Petiole deeply sulcate above, leaf margin notched to serrulate; pedicel not articulate; ovary and fruit stellate-tomentose, 3-locular; style 3-angular with minute or indistinctly 3-lobed stigma; corolla valvate (in Papuasia); berry with 1–2 large, stellate tomentose, minutely pustular, ± ellipsoid seeds (in Papuasia) ..... STYRAX

BRUINSMIA Boerl. & Koord.

Evergreen trees. Leaves and twigs lepidote and tomentose, glabrescent. Leaves serrate, petiole flattened above. Flowers solitary in terminal and axillary, often leafy, thyrses or panicles, bisexual, actinomorphic; pedicel articulate. Calyx broadly campanulate or cup-shaped, margin truncate or shortly 5-dentate; petals 5, briefly connate basally, imbricate; stamens 10, equal or subequal, briefly connate basally and adnate to base of corolla, anthers 2-locular, filaments flattened; ovary superior, fused basally to the calyx, glabrous, imperfectly 5-locular with many axile ovules in each loculus; style solitary, simple, columnar, 5-angular; stigma capitate or 5-lobed. Fruit a hard berry, glabrous, style base ± persistent; seeds numerous, small, angular, reticulate-foveolate.

Distribution: A genus of 1 or 2 species, from Assam through Malesia to mainland New Guinea. *Bruinsmia styracoides* is the Papuasian representative.

Bruinsmia styracoides Boerl. & Koord. *Nat. Tijd. N. L.* **53**: 68 (1893). **Fig. 61.**
B. celebica Koord. (1898).

Evergreen tree, 12–32(–37) m tall, generally unbuttressed. Twigs ± flattened and angular, especially below branches and petioles, lepidote and hairy, glabrescent, 3–5 mm diameter. Leaves alternate, spirally arranged to almost distichous, elliptic to ovate, 8–18 × 3–8 cm, chartaceous, margin serrate, apex acuminate, base rounded, sparsely hairy and lepidote along veins and midrib, with sparsely hairy domatia in some vein axils, midrib and veins ± flat above, prominent beneath; lateral veins 7–10 pairs, looping; petiole 8–15 mm long, 1–1·5 mm diameter, flattened above, angular beneath, decurrent into twigs; stipules absent. Flowers bisexual, in terminal lepidote and hirsute thyrses 8–20(–25) cm long, often with a leaf or several in the inflorescence; pedicels 1–2 mm long, articulate. Calyx broadly campanulate, 3–4 mm diameter and 1·5–2·5 mm high, shortly 5-dentate, densely stellate-tomentose outside, tomentose inside. Corolla cream to white, sometimes pinkish; lobes imbricate in bud, silvery tomentose outside and inside, ovate, ± 4 × 9 mm, apex acute. Stamens 10, 3–5 mm long, briefly connate basally and adherent with petals; anthers 2–3 mm long; filaments flattened, glabrous or hairy inside and laterally. Ovary free for the most part, 5-locular with many axile ovules in each loculus, broadly wide-ovoid, ± 2 × 3 mm, glabrous; style solitary, 5-angular, 3–4 mm long; stigma capitate with 5(–6) short lobes. Fruit a glabrous berry, broadly ovoid to globose, to 10 mm diameter, style or at least base of style persistent. Seeds numerous, ± 1·5 mm long, flattened, irregularly tetrahedral, glossy dark red-brown, reticulate-foveolate.

Field characters: Bole straight, bowed or twisted to 24 m long and 70 cm diameter; narrow buttresses to 2 m high and 1 m wide may be present. Crown generally small and open. Leaves dull, dark green above, mid-green below, veins yellowish; old leaves red. Bark light brown or grey to dark brown, or grey-black, smooth to vertically and horizontally fissured to cracked, or rarely rough or flaky; underbark red to red-brown or orange brown; inner bark to 12 mm thick, pink grading to straw or white next to sapwood; no odours or exudates reported. Heartwood brownish-pink to reddish-cream, of moderate weight and hardness, sapwood cream or white, soft and not sharply delimited from heartwood.

Distribution: Scattered populations from Java, Sumatra, Sulawesi (Celebes) and the New Guinea mainland from Vogelkop Peninsula to Milne Bay.

Ecology: Lowland rainforest from 30 to 1100 m altitude. Mostly on well-drained areas, often on ridges and steep slopes, although once found in 'open forest bordering sago swamp'. Mostly associated with regrowth or disturbed forest conditions. It is a gregarious species and tends to be locally common. It flowers and fruits apparently throughout the year, both often being present on the same tree.

Uses: Although often a large tree the wood is not durable and is not used

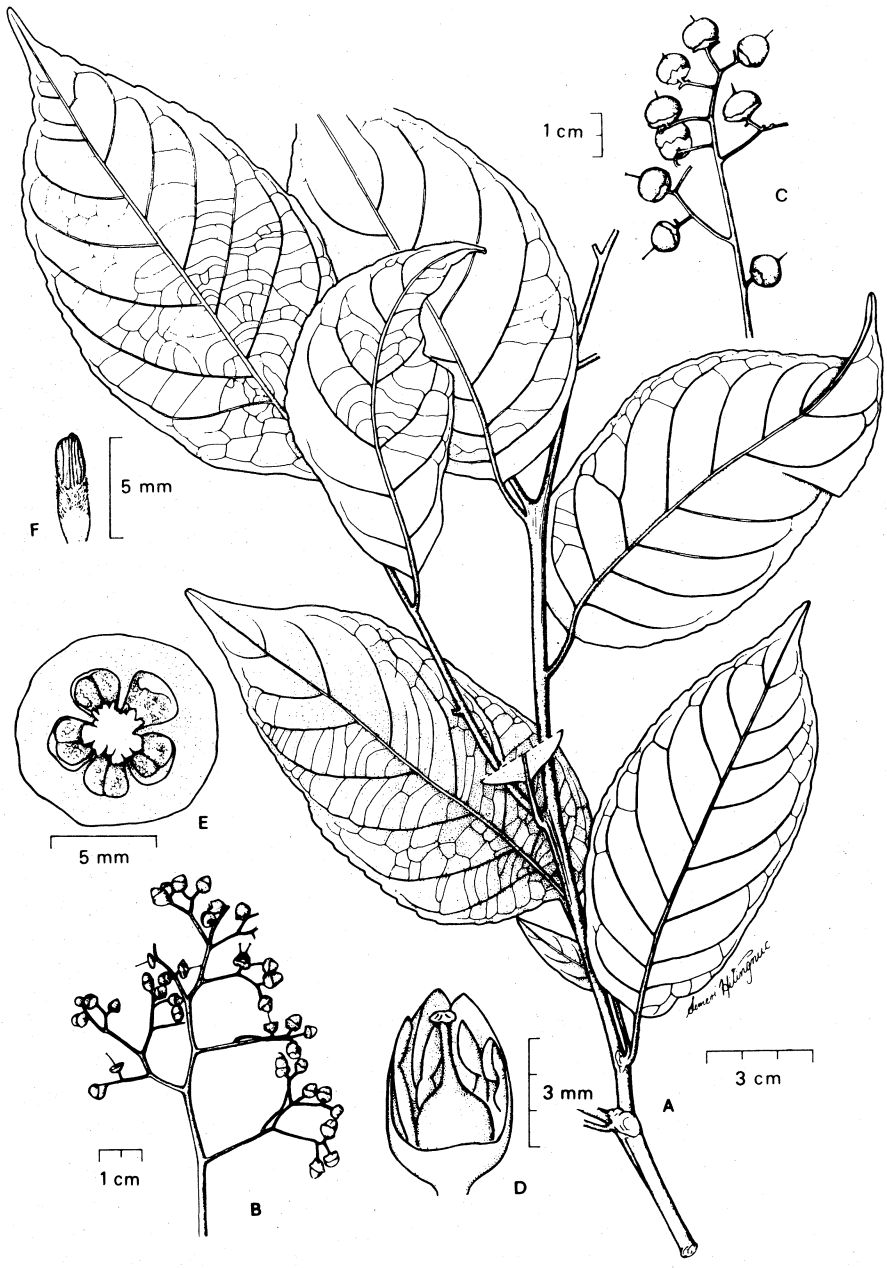

Fig. 61 **Bruinsmia styracoides** Boerl. & Koord. (A) leafy twig (B) part of inflorescence, mostly in bud (C) young fruit (D) flower with nearer parts removed (E) transverse section of fruit (F) stamen

commercially. The scattered nature of the populations means the tree is not often encountered in logging operations.

STYRAX L.

Evergreen shrubs or trees. Innovations lepidote or stellate-tomentose, indumentum usually ± persistent on twigs and undersides of leaves. Leaves entire to serrate, petiole sulcate. Flowers solitary, mostly pendulous, in axillary and terminal racemes or leafy panicles, bisexual, actinomorphic, pedicel not articulate. Calyx campanulate to cup-shaped, margin truncate or shortly 5-dentate. Corolla with 5 free imbricate or valvate lobes. Stamens 10, adnate to corolla tube; anthers 2-locular; filaments flattened. Ovary superior, fused basally to calyx, densely stellate-tomentose, imperfectly 3-locular with several ovules in each loculus; style solitary, simple, 3-angular, filiform, stigma punctiform or indistinctly 3-lobed. Fruit tomentose, globular or oblong, hard and indehiscent, or dehiscent with 3 valves, or drupaceous; seeds 1–2, large, ± ellipsoid.

Distribution: A genus of about 160 species in tropical and temperate regions of Europe, Asia, Malesia and America. *Styrax agreste* is the only species in Papuasia.

Styrax agreste (Lour.) G. Don *Gen. Hist.* **4**: 5 (1837). **Fig. 62.**

Cyrta agrestis Lour. (1790); *Styrax warburgii* Perk. (1907); *S. ledermannii* Perk. (1928).

Evergreen shrub or tree, 1–12 m tall, mostly unbuttressed. Twigs ± terete, 1–3 mm diameter, stellate-tomentose, glabrescent. Leaves spirally arranged to almost distichous, papery to thin chartaceous, ovate to lanceolate or elliptic, 2·5–13 × 1–6 cm, apex acute to acuminate, base acute to attenuate, margin serrulate to shallowly nicked, glabrescent with a few stellate hairs persisting along the midrib; midrib sulcate above, prominent below; lateral veins 6–8 pairs, looping, ± flat above, prominent below, hairy domatia present in lateral vein axils; petiole 4–7 mm long, rounded below, sulcate above; stipules absent. Flowers bisexual, pendent in terminal stellate-tomentose often leafy racemes, 2–12 cm long; pedicels 4–7 mm long, not articulated, extending to 10 mm long in fruit. Calyx cup-shaped, 3–5 mm wide, margin with 5 shallow teeth, externally stellate-tomentose, internally glabrous. Corolla white, tube 2–3 mm long, lobes ovate to lanceolate, 6–8 mm long, valvate in bud, outside densely stellate-tomentose, inside tomentose apically, marginally and along the veins. Stamens 10, 5–8 mm long, adnate to corolla tube; filament flattened, ± 3 mm long, hirsute at the base inside and laterally; anthers 3–4 mm long, stellate-tomentose. Ovary ± free, 3-locular with several ovules in each loculus, ± 2 × 2·5 mm, densely stellate-tomentose; style solitary 3-angular, 6–10 mm long; stigma indistinctly 3-lobed. Fruit a densely stellate-tomentose oblong-ellipsoid berry, often curved or oblique, to 8 × 18 mm, with an apical beak 1–3 mm long. Seeds 1–2 with several deep grooves, tapered at both ends, minutely pustular, stellate-lepidote, ± 6 × 10 mm.

Field characters: A slender much branched twiggy shrub or tree. Bole to 2 m long, rarely more than 10 cm diameter. Steep plank-like buttresses to 0·6 m

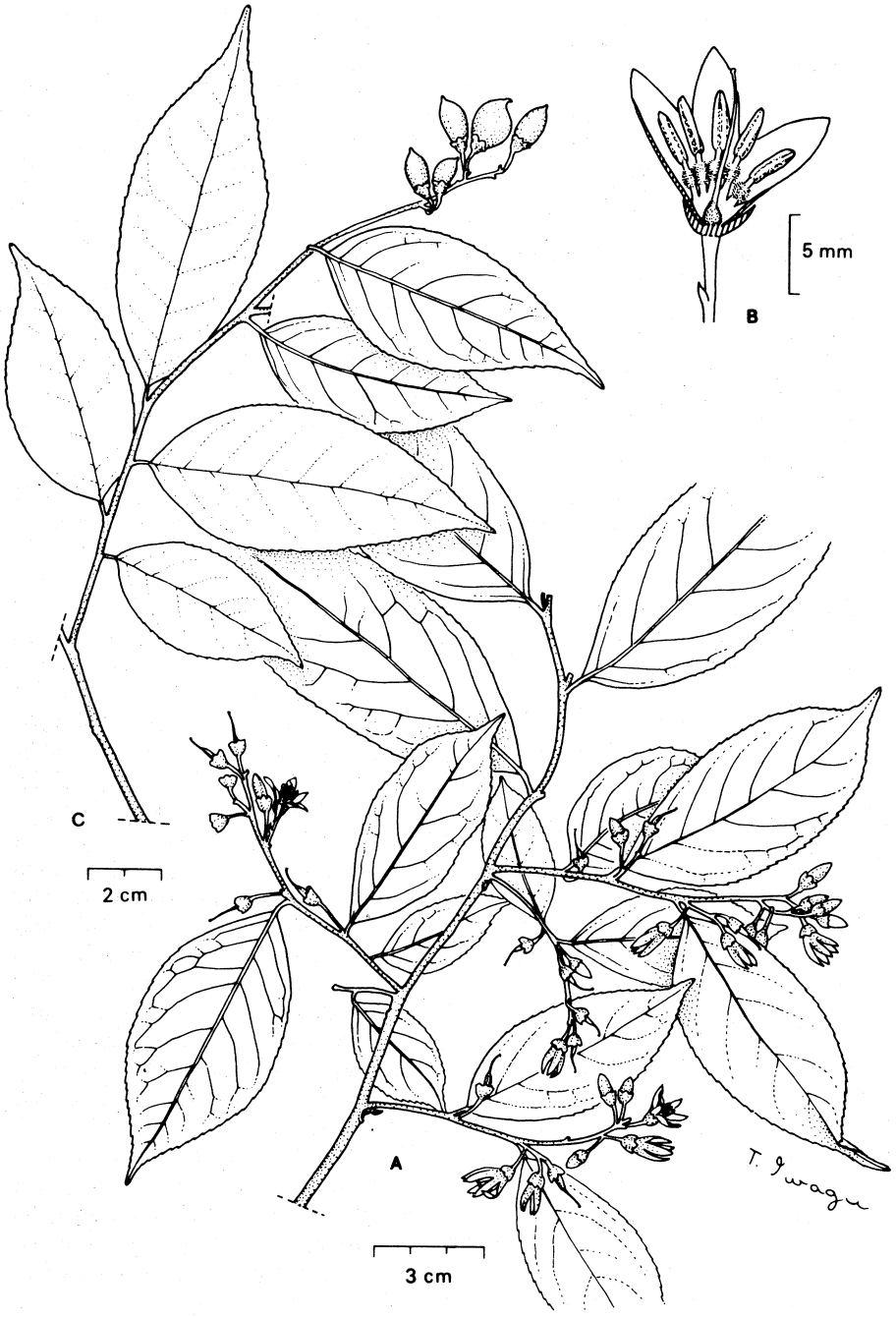

Fig. 62 **Styrax agreste** (Lour.) G. Don (A) leafy twig with flowers (B) flower with nearer parts removed (C) leafy twig with fruit

may be present, but are mostly lacking. Leaves glossy, light green below, dark or light green above. Bark mostly smooth, grey to grey-brown, dark brown or red-brown, sometimes shallowly fissured or scaly, inner bark pale brown to cream sometimes with a slight clear exudate; no odour. Wood moderately hard, white or cream with no delimitation between sapwood and heartwood. Flowers often scented.

Distribution: Southern China and Hainan through Borneo, Sulawesi (Celebes), the Moluccas, New Guinea and the Bismarck Archipelago to the Solomon Islands and Micronesia.

Ecology: In the undergrowth of primary and secondary forests, usually scarce, sometimes locally common, from the strand vegetation to 1400 m altitude, although mostly occurring below 500 m. In the region of the Fly River it is common as a shrub in swampy areas or bordering lakes. In the Bismarck Archipelago and the Solomon Islands it is common as a tree at the higher altitudes in well-drained areas such as *Nothofagus* forests. Flowers and fruit can be expected throughout the year, often on the same plant.

Uses: This small tree is of no commercial value.

EXCLUDED SPECIES

Styrax ceramensis Warb. (1891) = *Diospyros sp.*

Styrax glabrata Warb. (non Scholl.) = *Diospyros sp.*
See van Steenis (1949).

Appendix

CENSUS OF FAMILIES OF FLOWERING PLANTS AND GYMNOSPERMS FOR PAPUA NEW GUINEA

Acanthaceae
Aizoaceae
Alangiaceae
Alismataceae
Amaranthaceae (1)
Amaryllidaceae
Anacardiaceae
Annonaceae
Apocynaceae
Aponogetonaceae
Aquifoliaceae
Araceae
Araliaceae
Araucariaceae
Aristolochiaceae
Asclepiadaceae
Balanophoraceae
Balsaminaceae
Batidaceae
Begoniaceae
Bignoniaceae
Bixaceae (2)
Bombacaceae (2)
Boraginaceae
Bromeliaceae
Burmanniaceae
Burseraceae
Butomaceae
Byblidaceae
Callitrichaceae
Campanulaceae
Cannaceae
Capparidaceae
Caprifoliaceae
Cardiopteridaceae
Caricaceae
Caryophyllaceae
Casuarinaceae
Celastraceae
Centrolepidaceae
Ceratophyllaceae
Chenopodiaceae (2)
Chloranthaceae
Clethraceae
Cochlospermaceae (2)
Combretaceae (1)
Commelinaceae
Compositae
Connaraceae
Convolvulaceae
Coriariaceae (2)
Cornaceae
Corsiaceae
Corynocarpaceae (1)
Crassulaceae
Cruciferae
Crypteroniaceae
Cucurbitaceae
Cunoniaceae
Cupressaceae
Cycadaceae
Cyperaceae
Daphniphyllaceae (2)
Datiscaceae (1)
Dichapetalaceae
Dilleniaceae
Dioscoreaceae
Dipterocarpaceae
Droseraceae
Ebenaceae
Elaeagnaceae
Elaeocarpaceae(2)
Elatinaceae
Epacridaceae
Ericaceae
Eriocaulaceae
Erythroxylaceae
Euphorbiaceae
Eupomatiaceae (1)
Fagaceae
Flacourtiaceae
Flagellariaceae
Gentianaceae
Geraniaceae
Gesneriaceae
Gnetaceae
Gonystylaceae
Goodeniaceae
Gramineae
Guttiferae
Haemodoraceae
Haloragaceae
Hamamelidaceae (2)
Hanguanaceae
Hernandiaceae (2)
Himantandraceae (1)
Hydrocharitaceae
Icacinaceae
Iridaceae
Juglandaceae (2)
Juncaceae
Juncaginaceae
Labiatae
Lauraceae
Lecythidaceae
Leeaceae
Leguminosae
Lemnaceae
Lentibulariaceae
Liliaceae
Linaceae

Loganiaceae
Loranthaceae (2)
Lythraceae
Magnoliaceae (1)
Malpighiaceae
Malvaceae
Marantaceae
Melastomataceae
Meliaceae (1)*
Menispermaceae
Monimiaceae
Moraceae
Moringaceae
Musaceae
Myoporaceae
Myricaceae
Myristicaceae (1)†
Myrsinaceae
Myrtaceae
Najadaceae
Nepenthaceae
Nyctaginaceae
Nymphaeaceae
Ochnaceae (1)
Olacaceae
Oleaceae
Onagraceae
Opiliaceae
Orchidaceae
Orobanchaceae
Oxalidaceae
Palmae
Pandanaceae
Passifloraceae
Pentaphragmataceae
Philydraceae
Phytolaccaceae
Pinaceae
Piperaceae
Pittosporaceae
Plantaginaceae
Plumbaginaceae
Podocarpaceae
Podostemaceae
Polygalaceae
Polygonaceae(1)
Pontederiaceae
Portulacaceae
Potamogetonaceae
Primulaceae
Proteaceae
Rafflesiaceae
Ranunculaceae
Restionaceae
Rhamnaceae
Rhizophoraceae
Rosaceae
Rubiaceae
Rutaceae
Sabiaceae
Santalaceae
Sapindaceae
Sapotaceae
Saurauiaceae
Saxifragaceae
Scrophulariaceae
Simaroubaceae
Solanaceae
Sonneratiaceae
Sparganiaceae
Stackhousiaceae (2)
Staphyleaceae (2)
Stemonaceae
Sterculiaceae
Stylidiaceae
Styracaceae (2)
Symplocaceae
Taccaceae
Theaceae
Thymelaeaceae
Tiliaceae
Trimeniaceae
Triuridaceae
Tropaeolaceae
Turneraceae
Typhaceae
Ulmaceae
Umbelliferae
Urticaceae
Valerianaceae
Verbenaceae
Violaceae
Vitaceae
Winteraceae
Xyridaceae
Zannichelliaceae
Zingiberaceae
Zygophyllaceae

Numerals in brackets indicate treatment in Vol. I or Vol II

* *Chisocheton* only

† excluding *Horsfieldia.*

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(Page numbers of illustrations are in bold type)

BOTANICAL NAMES

COMMON AND VERNACULAR NAMES