

Handbooks of the
FLORA OF
PAPUA NEW GUINEA

Volume III

Edited by

Barry J. Conn



MELBOURNE UNIVERSITY PRESS
on behalf of the
Government of Papua New Guinea
1995

First published 1995

Typeset by Syarikat Seng Teik Sdn. Bhd. in 10/11 pt Times

Printed in Malaysia by SRM Production Services Sdn. Bhd.
for Melbourne University Press, Carlton, Victoria 3053

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National Library of Australia Cataloguing-in-Publication data

Handbooks of the flora of Papua New Guinea. Volume III.

Includes index.

ISBN 0 522 84582 7.

I. Botany—Papua New Guinea. I. Conn, Barry J.

II. Papua New Guinea.

581.995

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Acknowledgements

It is with great pleasure that I am able to acknowledge the contributions, to this volume of the *Flora*, of two Papua New Guinean systematists. Hopefully, this is the beginning of a continued tradition of indigenous contributions to our understanding of the flora of this region. As for the previous volumes of the *Flora*, overseas researchers have provided accounts of several Papuan plant families which are published in this volume. Since most of these accounts were prepared many years ago, I gratefully acknowledge the willingness of all authors to thoroughly revise their manuscripts. I thank the illustrators who skilfully prepared the illustrations presented in this volume. An electronic copy of the final manuscript was carefully prepared by Ms Lori A. Conn (Picnic Point, New South Wales). I gratefully acknowledge the financial assistance provided by UNESCO. Their generous support enabled this volume of the *Flora* to be published.

Over the last few years, the preparation of this volume for publication has been delayed on many occasions. Without the encouragement and commitment of current and former staff of the Melbourne University Press, this publication may never have eventuated. I gratefully acknowledge their full support.

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Introduction

The world-wide loss of biodiversity is increasingly the concern of all people at all levels of society. The loss of resources caused by the over-exploitation of our forests is readily appreciated from a human-centred, materialistic point of view. However, it is not just the loss of resources that are used for food, building, clothing, trade or for spiritual purposes, that is concerning. There is now irrefutable evidence that the loss of biodiversity also affects the inorganic environment, reducing soil fertility and stability, and causing climatic changes (both locally and globally). It is clear that the destruction of tropical rain forests and other tropical communities is an impending disaster. Fortunately, the rate at which the natural communities of New Guinea are being destroyed is much less than in some other tropical areas. However, large areas within these tropical forests are rapidly being modified and even destroyed. Since there is no comprehensive account of the flora of this region, the publication of this third volume of the *Handbooks of the Flora of Papua New Guinea* is an important contribution to the continuing documentation process. One of the aims of the *Flora* is to document the diversity of plants in the region, so that the conservation status of the species which make up the various communities can be monitored more accurately. Without publications like this, it would be extremely difficult to assess the rate of species extinction because information on the species composition of the flora would remain largely unknown. This lack of information is not only of deep concern to all systematists and conservationists, but is also the concern of the political and social communities. It is clearly recognized that a sound conservation strategy for the flora of this region can only be developed and maintained if the documentation of the flora is completed. Although it may be unrealistic to expect to be able to fully document the flora of Papuasia, without a comprehensive understanding of species diversity it will be impossible to know how effective any conservation strategy might be.

The presentation of the descriptive treatments of each plant family follow the format as used in the previous volumes. The distribution of each taxon is summarised according to the 'Geographical regions of Papuasia' of volumes I and II. A glossary of technical terms is provided in volume I.

Abbreviations, Latin Words, Symbols

auct. non . . .	(<i>auctoris non . . .</i>) of a single author not . . .
c.	(<i>circa, circiter</i>) about
cf.	(<i>confer</i>) compare
d.b.h.	diameter at breast height
ed./eds	edition/editions
Ed./Eds	editor/editors
ex	from
f./figs	figure/figures
ibid.	(<i>ibidem</i>) published in the same place
ic.	(icon) illustration
nom. cons.	(<i>nomen conservandum</i>) 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.	(<i>nomen illegitimum</i>) illegitimate name
nom. nud.	(<i>nomen nudum</i>) a name published without a supporting description of the plant, or citation of a type specimen; it is not legitimate
non	not
nov.	(<i>novum</i>) new
pl.	plate
p.p.	(<i>pro parte</i>) in part
sens. lat.	(<i>sensu lato</i>) in the broad sense
sens. str.	(<i>sensu stricto</i>) in the narrow sense
ser.	series
sp.	species (singular)
spp.	species (plural)
subsp.	subspecies
syn.	synonym: a name that has been used for the given taxon, but which is not legitimate
t.	(<i>tabula</i>) plate
T.S.	transverse section
sect.	section
var.	variety
×	by; e.g. 5 × 04 cm: measuring 5 cm long and 4 cm wide
±	more or less
(..)	parentheses are used to enclose the rare states of a character; e.g. petals (5–)6–10 mm long: although the petals are usually 6 to 10 mm long, they are sometimes as short as 5 mm long.
>	more than
<	less than
=	the same as

ARALIACEAE

(excluding SCHEFFLERA)

W. R. Philipson¹

Trees, shrubs, woody climbers or woody epiphytes, armed or not, glabrous or with (often stellate) tomentum; resin ducts present. Branches usually thick with terminal clusters of large spirally arranged (more rarely opposite) leaves. Stipules often united into a ligule or absent. Petiole base usually clasping. Lamina digitately compound, or pinnate, or simple. Inflorescence usually terminal, sometimes axillary; flowers frequently in umbellate or capitula arranged in \pm complex umbels or panicles, sometimes racemose. Calyx small, often a rim, or absent. Petals 3–many, often 5, sometimes calyptrate or tubular, valvate or imbricate. Stamens often equal petals or twice as many, or numerous. Ovary usually inferior, 1–many-locular; ovule solitary, pendulous; raphe ventral. Fruit baccate or drupaceous; embryo small in copious endosperm.

Distribution: About 50 genera with more than 1150 species, distributed mainly in warm parts of both hemispheres, but also in temperate regions. 11 genera occur in New Guinea, all of which extend into the Solomon Islands except the local endemic *Anakasia*, the Malesian endemic *Harmsioplanax*, *Aralia* (which reaches the limit of its range in the Vogelkop Peninsula), and apparently *Arthrophyllum*, though its discovery in the Solomon Islands is to be expected.

Literature: D. G. Frodin (1975), Studies in *Schefflera* (Araliaceae): the Cephaloschefflera complex, *J. Arnold Arbor.* **56**: 427–443. H. Harms (1920), Die Araliaceae Papuasien, *Bot. Jb.* **56**: 374–414; (1938), Neue Araliaceae aus Papuasien, *Bot. Jb.* **69**: 277–283. W. R. Philipson (1970), The Malesian species of *Gastonia*, *Blumea* **18**: 490–505; (1973), A revision of *Harmsioplanax*, *Blumea* **21**: 81–86; (1973), *Anakasia*, a new genus of Araliaceae from west New Guinea, *Blumea* **21**: 87–89; (1976), A synopsis of the Malesian species of *Osmoxylon* (including *Boerlagiodendron*), *Blumea* **23**: 99–119; (1977), A revision of the Malesian species of *Arthrophyllum* Bl., *Gdns' Bull., Singapore* **30**: 299–312; (1978), A synopsis of the Malesian species of *Polyscias*, *Blumea* **24**: 169–172; (1979), Araliaceae-I, *Fl. Males.* **9**: 1–105. P. van Royen (1983), Araliaceae, The alpine flora of New Guinea **4**: 2993–3083.

KEY TO GENERA

1. Petals imbricate
2. Leaves simple, palmately lobed HARMSIOPANAX
2. Leaves pinnately compound
3. Leaves twice (or more) pinnate ARALIA
3. Leaves once pinnate DELARBREA
1. Petals valvate
4. Petals with a narrow base or claw MACKINLAYA

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- 4. Petals with a broad base
- 5. Inflorescence rays 3-fid; central branch shorter bearing 'false fruits', the 2 lateral branches longer with normal flowers OSMOXYLON
- 5. Inflorescence branches not as above
- 6. Ovary with one locule ARTHROPHYLLUM
- 6. Ovary with more than one locule
- 7. Leaves pinnate
- 8. Pedicel not articulate below the flower GASTONIA
- 8. Pedicel articulate below the flower POLYSCIAS
- 7. Leaves not pinnate
- 9. Pedicel articulate below the flower ANAKASIA
- 9. Pedicel not articulate below the flower
- 10. Stamens numerous PLERANDRA²
- 10. Stamens usually 5, uncommonly to 15 or more SCHEFFLERA³

ANAKASIA Philipson

Shrub with large, simple, exstipulate leaves. Inflorescence axillary; rachis bearing racemously arranged umbellules; pedicel short, with an articulation below the flower. Flowers hermaphrodite. Calyx a rim with indistinct teeth. Petals 5 or 6, valvate, triangular. Stamens 5 or 6; filaments thick; anthers dorsifixed. Ovary inferior, broadly obconic, 4–6-locular. Fruit with fleshy exocarp, broadly ovoid, strongly ribbed when dry; pyrenes compressed, crustaceous; endosperm smooth.

Distribution: One species endemic to western New Guinea.

Anakasia simplicifolia Philipson *Blumea* 21: 87 (1973).

Glabrous shrub, 5 m high, with branches marked with prominent lenticels. Leaves crowded at the ends of the branches, sessile or with a very short petiole. Lamina narrowly obovate, up to 135 × 18 cm; narrowed gradually to the base; margin entire or undulate; apex acuminate; midrib prominent; lateral veins arching upwards. Rachis of inflorescence simple or forked, to 70 cm long, at maturity 5 mm thick, bearing small narrowly ovate bracts; peduncles arising from the axils of all but the lowest bracts, 3–4 mm long, elongating to *c.* 15 mm in fruit; umbellules with *c.* 11 minute bracts. Flower buds (when dry) *c.* 3 mm long. Calyx rim with 5 or 6 minute teeth. Petals slightly fleshy, 2 mm long. Stamens 5 or 6, with broad filaments; anthers 4-locular, 0.7–0.8 mm long. Ovary glabrous; disc with a central boss formed by closely adpressed subulate style arms which soon recurve and spread beyond the calyx. Fruit *c.* 20 × 15 mm, obovoid, prominently ridged, with persistent style arms in a terminal depression.

Field characters: Large, simple, narrowly obovate leaves clustered at the ends of the branches. Stem greyish brown with prominent black lenticels. Wood yellowish white. The inflorescence branches are erect in flower and pendulous in fruit. The outer flowers of the umbellules appear not to set seed (functionally male). The corolla is green and soon falls off, the disc yellow, the anthers cream, and the mature fruit blue and aromatic.

Distribution: Western New Guinea: Vogelkop and Fakfak districts.

² Frodin (1975) recommended that *Plerandra* be reduced to the synonym of *Schefflera*—(Ed.).

³ The genus *Schefflera* is omitted from this treatment of the family. Frodin (1975) provided an enumeration (without descriptions) of the 12 New Guinea species of *Schefflera* sect. *Brassia*. (Endl.) Tserg & Hoo (sect. *Cephaloschefflera* Harms p.p.). 17 species which occur in the alpine region of New Guinea are enumerated by van Royen (1983)—(Ed.).

Ecology: Primary forest near sea level, on steep clayey slopes and on limestone hills.

ARALIA L.

Sparingly branched shrub or small tree, with stem prickly. Leaves bipinnate, leaflets serrate; petiole with a ligulate sheathing base. Inflorescence a large terminal panicle of umbellules. Flowers pedicellate, with an articulation. Calyx minutely 5-dentate. Petals 5, imbricate. Ovary c. 5-locular; style free, spreading. Fruit subglobose, 5-angled when dry; exocarp fleshy; endocarp cartilaginous; seed with endosperm smooth.

Distribution: Consists of 55 species in North America and Asia, including the Philippines and Indonesia. One Filipino species reaches western New Guinea.

Literature: C. G. G. J. van Steenis (1948), Notes on Malaysian species of *Aralia*, *Bull. Bot. Gard. Btzg.* ser. 3, **17**: 390. J. Wen (1993), Systematics of *Aralia* (Araliaceae)—Ph.D. dissertation, 1991; (1994), New taxa and nomenclature changes in *Aralia* (Araliaceae), *Novon* **4**: 400–403.

Aralia bipinnata Blanco *Fl. Filip.* 222 (1837).⁴

A. apoensis Elmer (1914).

A shrub or small sparsely branched tree to 7 m high, with prickly stems. Leaves up to 1.2 m or more long, forming large crowns at the ends of the branches, bipinnate, with a pair of leaflets at each division of the rachis, with some prickles, especially on the petiole, or unarmed, the rachis constricted at nodes, the base of the petiole sheathing and ligulate; leaflets sessile or with a short petiolule. Lamina ovate to narrowly ovate, usually 4–5 × 2–2.5 cm, but variable in size; lower surface glaucous, pubescent along the veins and sometimes sparingly between, or almost glabrous throughout; upper surface green, glabrous; base rounded to cordate, usually markedly oblique in lateral leaflets; margin conspicuously crenate; apex acute to acuminate; primary and secondary veins conspicuous. Inflorescence a large terminal panicle 30–70 cm long (or more), the peduncles and also usually the main branches prickly, the whole either almost glabrous or pubescent; peduncle 5–10 cm long, stout; the main rays c. 5–8, clustered at the apex of the peduncle, 25–65 cm long, bearing many short tertiary branches along their length; tertiary branches usually 5–10 cm long, ending in umbel and bearing a small number of lateral umbellules or branches, minute narrowly ovate bracts subtend the branches of the third of higher orders; umbellules with many radiating pedicels (c. 20–30); pedicel 5–10 mm long. Flowers hermaphrodite. Calyx lobes 5, rounded, 0.5 mm long. Petals 5, 1.5 mm long. Stamens 5. Ovary 5-locular; styles subulate, free. Fruit spheroidal, ± 3 × 4 mm, strongly 5-ribbed when dry, with styles persistent and radiating.

Field characters: The spiny stems and bipinnate foliage are distinctive. The undersides of the leaflets are pale or glaucous with a variable amount of pubescence.

Distribution: Frequent on the islands of the Philippines and Taiwan. In Papuaia: known from a few collections in the Vogelkop district of western New

⁴ Wen (1994) recognized two varieties in *A. bipinnata*, with the typical variety occurring in Taiwan, the Philippines and Western New Guinea (Vogelkop and Snow Mountains). She regarded *A. bipinnata* var. *bipinnata* as having glabrous leaflets and pedicels 4.5–10 mm long. *Aralia bipinnata* var. *apoensis* (Elmer) J. Wen is restricted to the Philippines (Wen 1994)—(Ed.).

Guinea, and possibly extending to Swart Valley in Nassau Ranges (Snow Mountains).

Ecology: Montane forest and regrowth, at c. 1500–2000 m altitude.

ARTHROPHYLLUM BI.

Springly branched trees or shrubs, unarmed. Leaves on vegetative shoots spirally arranged, imparipinnate, those on flowering branches often opposite, smaller, or reduced to a single leaflet. Inflorescence branches arising in the axils of the uppermost leaves, the terminal crown of branches falling after fruiting; pedicel not articulated. Flowers hermaphrodite. Calyx an undulate rim. Petals 4 or 5, valvate. Stamens 4 or 5; anthers curved. Ovary 1-locular; disc fleshy with a central sessile stigma. Fruit drupaceous; exocarp leathery; endocarp cartilaginous; seed solitary, pendulous; endosperm deeply transversely ruminant.

Distribution: About 31 species, extending from the Nicobar Islands and Indo-China to the Philippines, New Guinea and New Caledonia. In Papuasias: one species frequently collected from the Star Mountains to Milne Bay; another known from two gatherings in Morobe district; whereas the third occurs in the Schouten Islands (Geelvink) and the Bismarck Archipelago and extends westwards into the Moluccas.

KEY TO SPECIES

1. Inflorescence becoming paniculate by the successive development of branches below the umbellules **A. proliferum**
1. Inflorescence a compound umbel
 2. Leaflets (of leaves on vegetative branches) coriaceous, usually ovate (New Guinea mainland) **A. macranthum**
 2. Leaflets chartaceous or membranous, usually elliptic (islands north of New Guinea mainland) **A. pacificum**

Arthrophyllum macranthum Philipson *Bull. Brit. Mus. (Nat. Hist.) Bot.* 1: 18 (1951). **Fig. 1.**

Tree up to 25 m high, sparsely branched; indumentum on all young parts densely rufous. Leaves crowded at the ends of the branches: leaves of the vegetative stems spirally arranged, imparipinnate, multijugate, articulated at the insertion of the pinnae, up to 100 × 30 cm; of the flower-bearing branches smaller with fewer pinnae, or simple. Petiole stout, up to 40 cm long, clasping base heavily lenticellate, ligule reduced to a rim; petiolules 0.5–2 cm. Leaflet lamina ovate to oblong, up to 16 × 8 cm, coriaceous; base rounded, truncate, or cordate, very rarely cuneate, often oblique; margin entire, revolute; apex obtuse or bluntly apiculate; principal veins arched ascending; the reticulations visible especially on the underside (pinnae of leaves on the flowering branches usually elliptic with a cuneate base). Inflorescence a whorl of specialized leafy branches forming a terminal crown; the main rays up to 60 cm long, bearing pinnate leaves often in opposite pairs and with flowering branches in the upper axils, and ending in a whorl of secondary rays subtended by a whorl of usually simple leaves (bracts); secondary rays c. 10–20 cm long, bearing simple leaves, usually in opposite pairs, and terminating in umbellules or compound umbellules; umbellules with c. 10–15 flowers; pedicel stout, 3–5 mm long, to 10 mm or more in fruit, subtended by minute bracts. Flowers hermaphrodite; buds 5 mm or more long. Calyx an

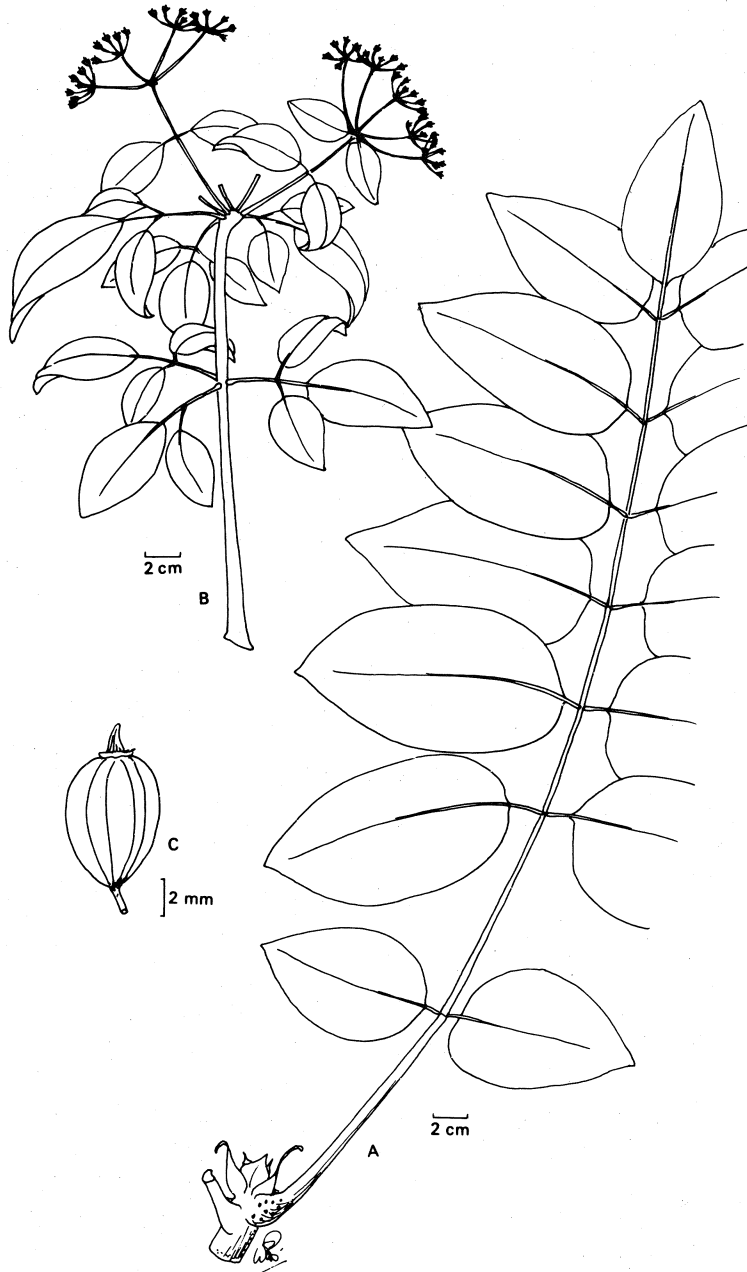


Fig. 1 *Arthrophyllum macranthum* Philipson (A) pinnate leaf (B) flowering branchlet (C) fruit (all NGF 40067)

undulate rim or with 5 indistinct teeth. Petals 5, triangular, c. 4 mm long, fleshy. Stamens 4. Ovary obconical \pm 2.5 mm long, 1-locular; disc fleshy (hemispherical in living material, conical and furrowed when dry); stigma capitate, \pm sessile. Fruit ellipsoid, sometimes slightly oblique, the stylopodium forming a conical beak with the persistent stigma, c. 10–12 \times 8 mm; exocarp fleshy; endocarp cartilaginous.

Field characters: The trees become very different in appearance when flowering or fruiting; the crown of pinnate foliage leaves is surmounted by a tuft of branches which end in inflorescences and bear much smaller leaves. This whole branch system is abscised after fruiting and growth is continued by lateral buds below the crown. The foliage leaves are fleshy, leathery and glossy. The ripe fruit is reddish or purple and glossy. The bark is grey, at first smooth, with many fine scars and lenticels, but small longitudinal fissures develop. There is a golden or brown exudate and a scent of celery. The soft wood is white or straw-coloured.

Distribution: Endemic to New Guinea: collected frequently from the Snow Mountains district of western New Guinea, the West Sepik, Western Highlands, Eastern Highlands, and Morobe districts of northeastern New Guinea, and the Western, Southern Highlands, Central, Northern and Milne Bay districts of Papua.

Ecology: Usually a subcanopy tree of rain forest, ranging from the lower montane zone to mossy subalpine woodland and scrubland. Occasional in secondary growth. Usually occurring above 1000 m altitude (up to 2700 m) but also on the coastal scarp of the Astrolabe Range (c. 830 m altitude).

Notes: Specific characters are difficult to define throughout this genus. This species has a facies readily recognized, mainly due to its sturdy leaves and inflorescences. Of the other two species present in Papuasias one is a more delicate tree (*A. pacificum*) whereas the other (*A. proliferum*) has distinctive inflorescence branching.

Arthrophyllum pacificum Philipson *Gdns' Bull. Singapore* 30: 306 (1977).

A slender tree to 14 m high, glabrous. Leaves of the vegetative stems spirally arranged, pinnate, multijugate, articulated at the insertion of the pinnae, c. 60 \times 24 cm; of the flower-bearing branches smaller with fewer pinnae or simple. Petiole terete, c. 22 cm long, 3–4 mm wide, clasping base, ligule reduced to a rim; petiolules c. 1 cm long. Leaflet lamina elliptic, oblong or ovate, c. 8–10 \times 4–5 cm, rather membranous; base abruptly cuneate, often oblique; margin entire, very slightly revolute; apex obtuse, acute, or slightly apiculate (specimen from Morotai is attenuated). Inflorescence a whorl of specialized leafy branches forming a terminal crown to the vegetative shoots; the main rays 35 cm long bearing small pinnate leaves in opposite pairs and with flowering branches in the axils, ending in a whorl of secondary rays, subtended by a whorl of simple leaves (bracts); secondary rays 10–24 cm long, bearing simple or trifoliate leaves usually in opposite pairs and terminating in umbellules; umbellules with c. 7–12 flowers; pedicel c. 5 mm long at anthesis, elongating slightly in fruit, minute bracts

caducous. Flowers hermaphrodite. Calyx an undulate rim. Petals 5, broadly triangular, 2.5–3 cm long. Stamens 5; anthers reniform. Ovary obconical, 1.5 mm long, 1-locular; disc fleshy, furrowed when dry; stigma \pm sessile. Fruit ellipsoid, fleshy, somewhat oblique, conical beak with persistent calyx and stigma, *c.* 9 \times 5 mm when dry.

Field characters: The bark is light brown and the cut branches exude a clear latex. The flowers are light green with yellow anthers, and the fruit is black.

Distribution: A sterile specimen from Morotai (Moluccas) probably belongs to this species. In Papuaia it occurs in the Geelvink Bay (Japen Islands), Manus and New Britain districts.

Ecology: Primary forest on slopes of mountains, reaching *Nothofagus* mossy forest, at 800–2000 m altitude. Reported as common in most localities where collected.

Notes: A more delicate tree than the preceding, with finer twigs, smaller leaves, and thinner elliptic leaflets.

Arthrophyllum proliferum Philipson *Gdns' Bull. Singapore* 30: 302 (1977).

Medium-sized tree, glabrous. Leaves of the vegetative stems spirally arranged, imparipinnate, multijugate, articulated at the insertion of the leaflets, 90 \times 24 cm; those of the flowering branches usually simple, or smaller with fewer pinnae. Petiole terete, 28 cm long, 5 mm wide, clasping base, ligule reduced to a rim; petiolules 10–15 mm long. Leaflets obovate-oblong, *c.* 16 \times 7 cm, chartaceous; base broadly cuneate to truncate, sometimes oblique; margin entire, slightly revolute; apex acute. Inflorescence terminating specialized plagiotropic shoots, bearing axillary flowering branches and ending in umbellules of a few flowers below which pairs of whorls of branches continue the growth of the inflorescence to produce an elongated panicle of umbellules; pedicel 7–8 mm long (slightly longer in fruit). Flowers hermaphrodite. Calyx an undulate rim, often with 5 indistinct teeth. Petals 5, narrowly triangular, *c.* 3.5 mm long. Stamens 5; filaments *c.* 2 mm long; anthers reniform, *c.* 0.5 mm long. Ovary obconical *c.* 2 mm long, 1-locular; disc fleshy, cushion-like; stigma capitate and \pm sessile. Fruit ovoid, fleshy, capped by the persistent calyx and the enlarged beak-like stylopodium, *c.* 10 \times 5 mm when dry.

Field characters: The thick outer bark is grey-brown, fissured and peeling in small flakes. Wood straw-coloured. Cut stems exude brown latex. The thick petals are yellow-green.

Distribution: Endemic to New Guinea where it is known only from two collections from the Kuper Range, Morobe district.

Ecology: In mid-mountain rain forest, reaching the canopy, on steep slopes, at 300–1200 m altitude.

Notes: The flower and fruit are typical of this well-defined genus, but the branching of the inflorescence is unlike that of all the other species.

DELARBREA Vieill.

Glabrous unarmed shrubs or small trees. Leaves large, imparipinnate; leaflets entire or indistinctly dentate. Inflorescence a large terminal panicle of umbellules; pedicel articulated below the flowers. Flowers hermaphrodite. Calyx lobes 5. Petals 5, imbricate, obovate, narrowed towards the base. Stamens 5; anthers dorsifixed. Ovary 2-locular; disc fleshy, obconic, crowned by 2 erect styles with clavate stigmas. Fruit ovoid with small persistent calyx lobes and recurved style arms; exocarp thin, fleshy, with peripheral oil vesicles; endocarp papery; seeds with endosperm with shallow longitudinal grooves, not ruminant.

Distribution: 3 or 4 species extending from the Lesser Sunda Islands to New Caledonia. One species known in Papuaasia.

Delarbraea collina Vieill. *Bull. Soc. Linn. Norm.* 9: 342 (1865).

D. lauterbachii Harms (1900).

Sparsely branched shrub to 5 m high, with the leaves clustered at the ends of the branches. Leaves imparipinnate, *c.* 70–100 × 30–40 cm. Petiole *c.* 17–20 cm long, terete, lenticellate, with a heavily lenticellate clasping base with membranous margin; rachis not articulated; leaflets alternate or in pairs, *c.* 7 on each side; petiolules *c.* 1 cm long. Lamina narrowly ovate, ovate-oblong or elliptic, *c.* 17–20 × 4–6.5 cm; base truncate, rounded or cuneate, usually oblique; margin entire; apex gradually tapered to an acute point. Inflorescence a terminal panicle of umbellules; rachis up to 60 cm long, bearing well-spaced secondary branches 6–25 cm long, bracts caducous; tertiary branches *c.* 2–8 cm long, terminating in a circlet of broadly ovate bracts (mostly caducous) surrounding the umbellules; umbellules *c.* 2 cm diameter at anthesis with *c.* 30–40 flowers; pedicel *c.* 5 mm long (elongating to 10–15 cm in fruit), pustulate. Calyx lobes obtuse, united below into a tube. Petals 1.5 × 0.75 mm, keeled within. Stamens 1 mm long; disk and styles *c.* 1 mm high at anthesis. Fruit a fleshy ovoid berry, 16 × 10 mm.

Field characters: The ripe fruit is purplish black.

Distribution: Lesser Sunda Islands, Moluccas & Aru Islands to New Caledonia. In Papuaasia it occurs on Kar Kar Island and in the Finisterre Range (Madang district), in New Britain in the Bismarck Archipelago, and on Guadalcanal and San Cristobal in the Solomon Islands.

Ecology: Lower montane forest to 1000 m altitude. In New Britain abundant with *Pometia pinnata* and *Calophyllum* species.

Vernacular names: 'Berobero', 'bebero' (Kwara'ae, Solomon Islands) (note: also used for *Polyscias guilfoylei*).

GASTONIA Comm. ex Lamk.

Trees with thick unarmed branches. Leaves large, imparipinnate, exstipulate. Inflorescence of umbellules arranged racemosely or in verticils on strong inflorescence branches; pedicel not articulated below the flowers. Flowers hermaph-

rodite. Calyx a minute rim. Corolla of 5–13 free petals or calyprate, fleshy, valvate. Stamens variable in number (usually 14 to numerous, rarely fewer); filament short, stout; anthers triangular, dorsifixed. Ovary inferior, broadly obconic, 7–22-locular; disc fleshy with styler processes arising from its centre. Fruit a spherical berry (strongly ribbed when dry) with an indistinct calyx rim, a flattened disc, and a prominent stylopodium bearing a ring of radiating stigmatic arms; exocarp fleshy; endocarp crustaceous; seed with endosperm smooth.

Distribution: About 10 species extending from Madagascar, the Seychelles and Mascarenes and Malesia: throughout Papuasia.

KEY TO SPECIES

1. Corolla with free petals; ovary locules and style arms usually fewer than 10; whole plant glabrous; leaflets usually entire or sparsely crenate; main inflorescence branches borne along an elongated axis with caducous bracts; the peduncles of the umbellules mostly aggregated into pseudowhorls **G. serratifolia**
1. Corolla calyprate; ovary locules and style arms usually more than 10; young parts with scurfy tomentum, persisting on the ovary and bracts; leaflets strongly crenate; main inflorescence branches borne subumbellately on a short axis with persistent bracts; the peduncles of the umbellules scattered **G. spectabilis**

Gastonia serratifolia (Miq.) Philipson *Fl. Males.* ser. 1, 9: 68 (1979).

Arthrophyllum serratifolium Miq. (1861); *Gastonia papuana* Miq. (1863); *Tetraplasandra paucidens* Miq. (1863); *Polyscias papuana* (Miq.) Seem. (1865); *Tetraplasandra solomonensis* Philipson (1951).

Shrub or small tree, sometimes epiphytic, up to 20 m high, crown sparsely branched with leaves imparipinnate, up to 80 × 20 cm. Petiole *c.* 13 cm long, terete, with clasping base; rachis articulated; leaflets in *c.* 10 pairs; petiolules up to 1 cm long. Lamina oblong, ovate or narrowly ovate, middle-leaflets 8–18 × 2.5–8 cm, chartaceous; base broadly cuneate; margin entire and subrevolute, or with a few obscure (more rarely several prominent) crenations; apex rounded and bluntly apiculate or tapering and acute; midrib prominent. Inflorescence terminal, glabrous, with a stout primary axis 15–25 cm long, bearing scattered or clustered branches along its length and ending in an umbel of *c.* 10 rays; bracts caducous; secondary branches 30–40 cm long, bearing numerous subverticillate peduncles along their length and ending in an umbel; peduncles *c.* 3 cm long, somewhat longer in fruit; pedicel 10–25 mm long, forming umbellules of *c.* 10 flowers. Flower buds (when dry) *c.* 7 × 3 mm. Calyx rim entire, undulate. Petals 5–9, slightly fleshy, fully separated. Stamens variable in number, 14–55 (rarely fewer); filaments short; anthers broad and irregularly lobed, variable in size. Ovary glabrous, smoothly rounded below, 6–12-locular; disc with a prominent rim and, at anthesis, a central boss formed by closely adpressed subulate style arms. Fruit *c.* 9 × 7 mm (without styles), the flattened stylopodium ending in a ring or double row of radiating subulate stigmatic arms, black when ripe, the fleshy exocarp enclosing compressed crustaceous pyrenes.

Field characters: There may be a clear bole of 15 m before the first branches. The outer bark is light brown, with small oblong brittle scales; inner bark, leaves and inflorescences with copious sticky exudate. Wood soft, white. The petals are various, described as purple, light green and white.

Distribution: In Peninsula Malaysia and Java (only on offshore islands), in Sarawak (only on offshore islands), Sumatra, Lesser Sunda Islands, Borneo, Celebes, Philippines, Moluccas; in Papuasia restricted to western New Guinea (Vogelkop, Geelvink Bay, Jayapura and Digul districts) and the Solomon Islands, as yet, not collected from Papua New Guinea.

Ecology: Primary and secondary forest and in open country, usually at low altitudes and often on the shore and sea-cliffs, but ascending to 1000 m altitude.

***Gastonia spectabilis* (Harms) Philipson *Blumea* 18: 494 (1970). Fig. 2.**

Peckeliopanax spectabilis Harms (1926); *Gastonia boridiana* Harms (1938).

Tree up to 40 m high, crown sparsely branched with the leaves crowded at the ends of the branches, unarmed, all young parts with scurfy tomentum (more evident in dried material). Leaves imparipinnate, up to 80 × 39 cm. Petiole *c.* 15 cm long, terete with a clasping base; rachis articulated with some tomentum persisting at the joints; leaflets *c.* 11 pairs; petiolules 2–8 mm long. Lamina oblong or elliptic, middle-leaflets 10–15 × 4–6 cm, chartaceous when dry; base rounded or truncate; margin prominently crenate; apex narrowed to a blunt apiculus. Inflorescence on forks well below the leaves, when in bud covered with large scurfy scales, and when mature with radiating branches forming clusters ± 130 cm diam. Primary axis short (5–10 cm long) with persistent bracts; secondary branches numerous radiating, up to 65 cm long, bearing small, persistent, scurfy bracts, and with peduncles scattered along their length and clustered in a terminal umbel; peduncles 1.5–5 cm long, pedicel 5–15 mm long, forming umbellules of ± 5–12 flowers. Flower buds ± 8 × 5 mm when dry (fresh ± 12 × 8 mm). Calyx rim entire. Petals 6–12, very fleshy, incompletely separated (often splitting into *c.* 5 lobes). Stamens 25–66 (often ± 35); filaments short; anthers broad and irregularly lobed, variable in size. Ovary with short dense indumentum, smoothly rounded below, (10–) *c.* 16–22-locular; disc at anthesis with a prominent rim and a central boss formed by closely adpressed subulate styles. Fruit *c.* 8 × 10 mm (dry and without styles), the flattened disc with an elliptical ring of radiating subulate stigmatic arms; the fleshy exocarp enclosing compressed crustaceous pyrenes.

Field characters: Tall tree to 40 m high with a clear bole; branches regularly whorled or forked; sometimes with buttresses up to 1 m high and 2 m wide. Outer bark brown with prominent pustular lenticels and small shallow fissures; exudate abundant, clear, aromatic; wood soft. The terminal inflorescences are overtopped by shoots arising below them. Several flushes of growth occur as an inflorescence matures, so that at anthesis the inflorescences are situated in forks well below the leafy crown, with a succession of young inflorescence buds in higher forks. Flowers cream; stamens yellow; ripe fruit dark red-brown.

Distribution: Endemic to Papuasia: rather frequent and collected throughout New Guinea, New Ireland and also in the Solomon Islands.

Ecology: Primary and secondary rain forest, and in cultivated areas, at 200–2000 m altitude.

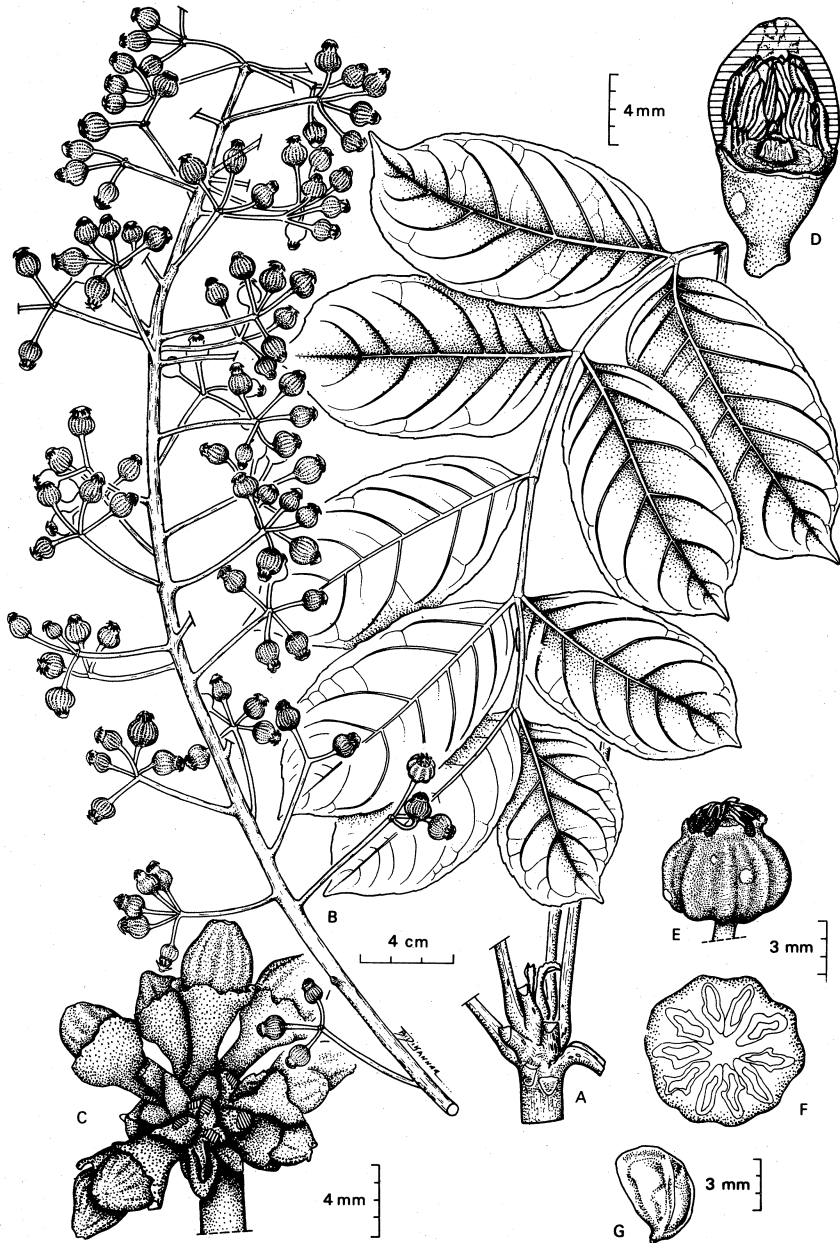


Fig. 2 *Gastonia spectabilis* (Harms) Philipson (A) pinnate leaf (B) infructescence (A & B: *BSIP 12124*) (C) flower buds (D) flower bud with perianth removed to show stamens and gynoecium (C & D: *NGF 25871*) (E) fruit (F) fruit—transverse section showing developing seeds (G) seed (E–G: *BSIP 12124*)

HARMSIOPANAX Warb.

Sparingly branched or single-trunked, often monocarpic spiny trees. Leaves large, simple, palmately lobed, often peltate. Inflorescence a large terminal panicle, with small, racemously arranged umbellules; pedicel with 2 subulate bracteoles, not jointed below the flower. Flowers hermaphrodite or in the basal umbellules of a branch male. Calyx a minute rim. Petals 5, free, imbricate, with a broad base. Stamens 5, dorsifixed, versatile, introrse. Ovary inferior, densely bristly, 2-locular; disc conical, deeply cleft between the 2 subulate styles. Fruit consisting of 2 dry mericarps, each 3-ribbed and bearing a persistent slightly hooked style.

Distribution: 3 species; one extending from Java to Celebes and Timor, the other 2 endemic to Papuaasia.

KEY TO SPECIES

1. Upper surface of leaves uniformly setulose; umbellules spherical, pedunculate, with no obvious involucre **H. harmsii**
1. Upper surface of leaves with many (or rarely few) larger spines among the setulose hairs; umbellules cup-shaped, with an evident involucre **H. ingens**

Harmsiopanax harmsii K. Sch. ex K. Sch. & Laut. *Fl. Schutzgeb. Nachtr.* 329 (1905). **Fig. 3.**

Tree up to 8 m high, with a slender trunk, often monocarpic. Young stems covered with bristles, hairs, and spines, the old stems with smooth bark with small rounded lenticels and numerous spines. Leaves large, in terminal clusters. Petiole \pm 50 cm long, 0.5 cm thick at base, terete with clasping base, densely covered with bristles, woolly hairs and spines. Lamina rounded, c. 30 \times 40 cm, deeply palmately lobed; lower surface very densely woolly and with many bristles; upper surface densely covered with evenly spaced bristles of varying size (larger on the main veins), adpressed and directed towards the leaf margin, often with woolly hairs inserted on their enlarged bases; base cordate, with 5–9 lobes, each with broad sinuses between them; margin unevenly and sharply dentate; apex acute. Inflorescence a terminal panicle with numerous leaf-like bracts soon falling; the principal branches with some spines, rather sparsely covered with bristles and hairs; the ultimate branches slender and tomentose, bearing linear bracts c. 4 mm long subtending pedunculate umbellules; peduncles up to 5 mm long, slender, tomentose, bearing 2 minute bracts; umbellules spherical, 4–5 mm diameter on flower, the outer bracts not forming a distinct involucre. Flowers hermaphrodite, maturing in basipetal succession, the lower bracts of a branch either with sterile umbellules or lacking flowers; up to 60 flowers in an umbellule, each subtended by a narrowly ovate ciliolate bract \pm 1 mm long, and borne on a glabrous pedicel c. 1.25 mm long; bracteoles 2, subulate. Calyx rim fringed with many lacerate filaments. Petals ovate, c. 1 mm long. Stamens with filaments c. 0.1 mm long; anthers c. 0.5 mm long. Ovary covered with cilia which lengthen as the fruit ripens. Mericarps with rounded ribs, long ciliate, crowned with the divergent styles.

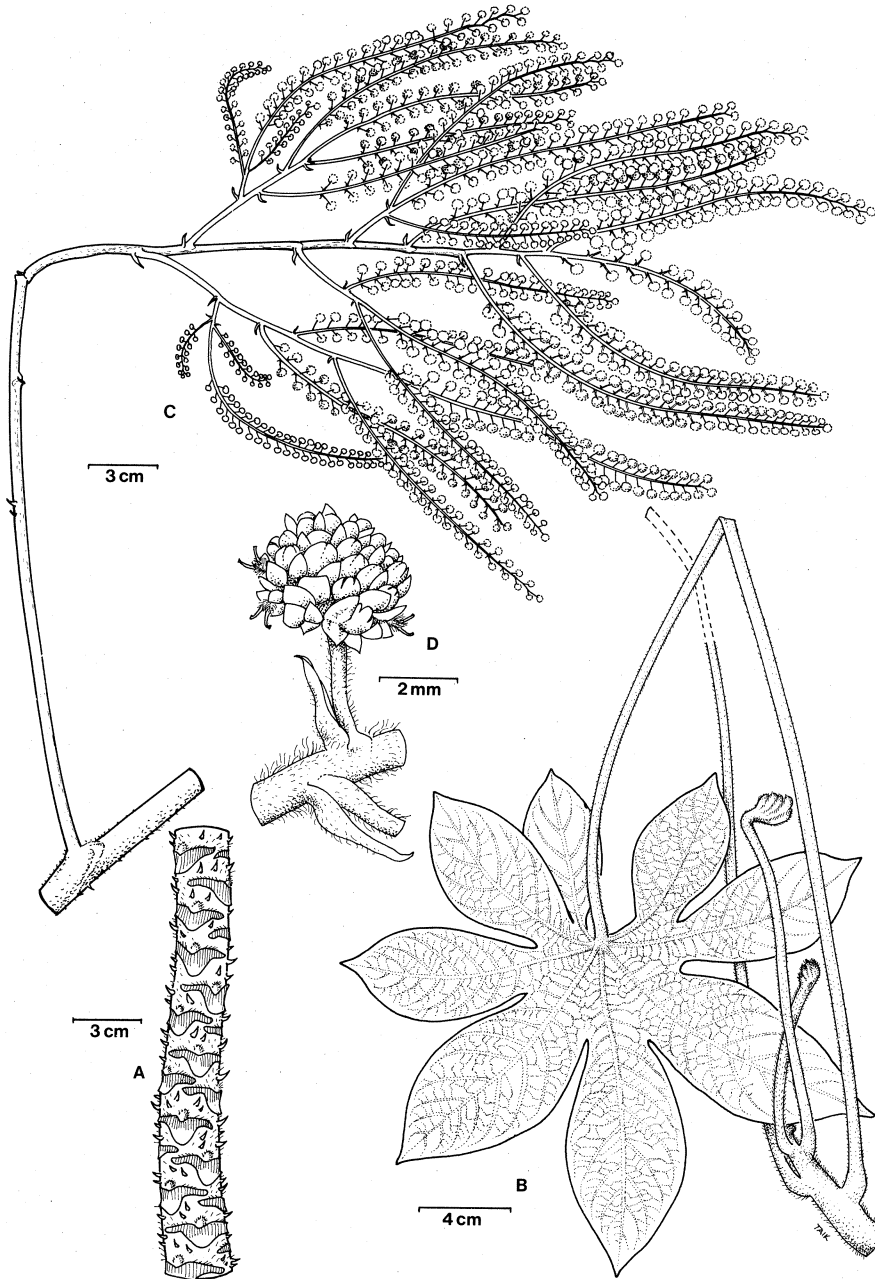


Fig. 3 *Harmsioplanax harmsii* K. Sch. ex K. Sch. & Laut (A) branch with spines (B) immature and mature leaves (C) inflorescence (D) detail of head-like flower cluster (all NGF 43930)

Field characters: Often with a slender single stem, or sparsely branched; bark pale grey-brown with many small round lenticels and spiny; wood straw-coloured with a broad central pith. Flowers creamy green.

Distribution: Endemic to New Guinea: frequent in the Morobe district, less frequent in the West Sepik, Madang and Western Highlands districts of northeastern New Guinea; also in the Central district of Papua.

Ecology: Occurs on forested hills, grassy slopes and roadsides, at 100–1800 m altitude.

Harmsioplanax ingens Philipson *Blumea* 21: 84 (1973).

Unbranched tree up to 18 m with a thick or sometimes slender trunk, densely covered (except towards the base of large specimens) with long, sharp, upwardly directed spines, and marked leaf scars, monocarpic. Leaves large, in a terminal cluster. Petiole up to 1 m long and 3 cm thick, terete with a clasping base, covered with woolly hairs and bearing many spines. Lamina usually peltate, rounded, up to 1 m diam., deeply palmately lobed, the lobes usually with minor lobes and coarsely dentate; lower surface with few to many long spines and usually clothed with a fawn or greyish woolly tomentum of branched hairs, or densely furnished with bristles usually with woolly hairs on their bases, or occasionally glabrous between the spines except for a few bristles; upper surface bearing few to many long spines, especially on the midrib and principal veins, between which the surface is often rugose and glabrous except for the remains of a tomentum of branched hairs, or with many bristles often with woolly hairs on their bases; apex acute. Inflorescence a very large terminal panicle, up to 5 × 5 m, leafless or with lobed bracts c. 10–20 cm long; the principal branches spiny, especially below, the ultimate branches slender, tomentose, bearing linear bracts ± 1 cm long subtending pedunculate or sessile umbellules; peduncles elongating as fruit ripens, up to 4 mm long, rather stout, tomentose, bearing 1 or 2 minute bracts; umbellules bowl-shaped, 4–10 mm diameter, enlarging slightly in fruit, with an involucre of c. 8 ovate bracts, 2–4 mm long and ciliolate distally. Flowers hermaphrodite, maturing in basipetal succession, 8–20 in an umbellule each subtended by an involucral bract or a narrower receptacular bract and borne on a glabrous pedicel 1–2 mm long. Calyx rim fringed with many lacerate filaments. Petals ovate, 1–2 mm long. Stamens with filaments 2–3.5 mm long; anthers 0.5–0.8 mm long. Ovary covered with cilia which lengthen as the fruit ripens. Mericarps with rounded ribs, long ciliate, crowned with the divergent styles.

Field characters: A single-trunked monocarpic tree bearing immense inflorescences. The bark is grey-brown with many needle-like spines and leaf-scars. The degree of hairiness of the leaves and the stature of the plants is variable. The wood is soft, white, and with a wide pith.

Distribution: Endemic to New Guinea: frequent from the Snow Mountains district of western New Guinea to the Morobe district of northeastern New Guinea and the Northern and Central districts of Papua. Two subspecies occur, one mainly on the central Highlands, the other in eastern and southern parts of New Guinea.

KEY TO SUBSPECIES

1. Umbellules regularly and \pm continuously disposed along the branches of the inflorescence, pedunculate or sessile, usually with fewer than 20 flowers subsp. **ingens**
1. Umbellules disposed irregularly along the branches, singly or in small groups, sessile, usually with more than 20 flowers subsp. **moniliformis**

subsp. **ingens**

Umbellules \pm 6–10 m diam., shortly pedicellate or rarely sessile, disposed regularly and \pm continuously along the inflorescence branches; flowers *c.* 12–16(–20) per umbellule; floral parts larger than in subsp. *moniliformis*. Fruiting head \pm 6–10 mm diam.

Distribution: Snow Mountains district of western New Guinea; West Sepik, Western and Eastern Highlands and Morobe districts of northeastern New Guinea, and the Southern Highlands and Central districts of Papua.

Ecology: A conspicuous component of mossy subalpine forest, usually 2000–3600 m altitude, but occasionally lower.

subsp. **moniliformis** Philipson *Blumea* **21**: 86 (1973).

Umbellules *c.* 5 mm diam., sessile, disposed irregularly along the branches, singly or in small groups with bare spaces intervening; flowers usually *c.* 20–30 per umbellule; floral parts smaller than in subsp. *ingens*. Fruiting head \pm 5 mm diam.

Distribution: Morobe district in northeastern New Guinea and the Northern and Central districts of Papua.

Ecology: Open grassland and sparse scrub, especially in secondary regrowth in old gardens, at 1500–2000 m altitude.

MACKINLAYA F. Muell.

Glabrous unarmed shrubs. Leaves either unifoliolate or digitately compound, the 1–3 central leaflets sometimes digitately lobed or compound. Petiole base encircling the stem. Inflorescence terminal (but often overtopped by lateral branches) either a compound umbel, or the ultimate branches cymose; pedicel articulated below the flower. Flowers male or hermaphrodite. Calyx lobes 5 or 6. Petals 5 or 6, clawed. Stamens 5 or 6; anthers subglobose. Ovary 2-locular; disc prominent; styles 2, subulate, free, recurved in fruit. Fruit strongly compressed, 2-seeded, with a furrow between the seeds; exocarp leathery; endocarp cartilaginous; seeds with endosperm smooth.

Distribution: 5 species extending from Celebes and the Philippines to Queensland (Australia) and the Solomon Islands. 3 occur in Papuasia, of which 2 are endemic to that region.

KEY TO SPECIES

1. Ultimate branches of inflorescence in irregular cymes **M. celebica**
1. Ultimate branches of inflorescence in umbellules
2. Primary rays of the inflorescence many (30–50) **M. radiata**
2. Primary rays of the inflorescence c. 15 or fewer **M. schlechteri**

Mackinlaya celebica (Harms) Philipson *Bull. Brit. Mus. (Nat. Hist.) Bot.* 1: 8 (1951).

M. amplifolia Hemsley (1909); *Anomopanax arfakensis* Gibbs (1917); *Polyscias cibaria* C. T. White & Francis in Lane Poole (1925); *Anomopanax vari-aefolius* C. T. White (1929).

Shrub or small sparsely branched tree to 6 m high. Leaves very variable in size and complexity. Petiole up to 52 cm long, 1–2 cm wide, terete, striate, with a membranous base ensheathing the stem; leaflets 5 (rarely 3) or the central petiolule (or the central 3 petiolules) frequently divided to bear 3 or 5 leaflets; lateral petiolules short (\pm 1–2 cm), the 3 central ones longer (up to 12 cm). Lamina elliptic to ovate, up to 48 \times 22 cm; base abruptly attenuated into the petiole or subcordate; margin entire, denticulate or coarsely serrate, especially near the apex, membranous; apex acuminate or gradually narrowed, acute; lamina of the terminal leaflet sometimes deeply 3-lobed, or with 3–5 separate leaflets of which the lateral are markedly oblique at the base. Inflorescence a terminal compound umbel, very variable in size, either entirely of male flowers, or with male and hermaphrodite flowers; peduncle terete, striate, stout, up to at least 30 cm long, bearing narrowly ovate bracts below the rays; primary rays \pm 9–18, 10–20 cm long, striate, with distal small linear bracts; secondary rays \pm 5–10, 3–6 cm long, dividing (often repeatedly) either umbellately or in an irregular cymose manner, the central ray frequently more strongly developed. Flowers male or hermaphrodite. Calyx lobes 5, triangular, \pm 1 mm long. Petals 5, obovate, \pm 1.5 mm long. Stamens with filaments \pm 1.5 mm long; anthers small. Ovary obconic, 1–2 mm long, narrowly turbinate in male flowers, ovoid and quickly swelling in female flowers. Fruit up to 25 \times 30 mm, rotund, compressed, constricted in the mid-axis, the 2 halves frequently unevenly developed.

Field characters: The leaves are extremely polymorphous and have a strong, parsley-like odour. The apparently lateral inflorescences are leaf-opposed on a sympodial axis. The leaf-sheath, the nature of the petals and the 2-seeded fruit all recall the Umbelliferae, but the succulent fruits which do not split into mericarps are more typical of the Araliaceae. The flowers are creamy-white and the fruits blue to purple with a glaucous bloom.

Distribution: Central and southern Philippines and Celebes. In Papuasias it occurs throughout mainland New Guinea and New Britain, and extend to the Solomon Islands. This species has not been collected in the Moluccas (except for the Aru Islands).

Ecology: In rain forest, montane forest, and secondary growth from sea level to 1450 m altitude.

Mackinlaya radiata Philipson *Bull. Brit. Mus. (Nat. Hist.) Bot.* 1: 6 (1951).

Slender shrub to 5 m high. Leaves digitately compound. Petiole c. 20 cm long, terete, finely striate, base membranous, sheathing; leaflets 5, or the central peti-

olule bearing 3 leaflets, the lateral petiolules short (1–1.5 cm long), the 3 central longer (6–8 cm long, or the mid-petiolute to 11 cm long). Lamina of the lateral leaflets elliptic or ovate, up to 20 × 12 cm; base abruptly attenuated into the petiole; margin entire or denticulate near the apex, membranous; apex gradually narrowed, acute: lamina of the central leaflet similar or deeply 3-lobed, or with 3 separate leaflets of which the lateral are strongly oblique at the base. Inflorescence a terminal compound umbel; peduncle terete, striate, stout, from 20 cm to considerably longer, 4–6 mm diam., bearing narrowly ovate bracts below the rays; primary rays numerous (\pm 30–50), 9–18 cm long, slender, striate, with distal minute, linear, caducous bracts; secondary rays (pedicels) numerous (35–130), filiform, 1–2 cm long. Flowers male on the periphery of each umbellule, the central hermaphrodite. Calyx lobes 5, narrowly triangular, *c.* 0.5 mm long. Petals 5, obovate, *c.* 1 mm long. Ovary narrowly obconic in male flowers, ovoid in hermaphrodite flowers, \pm 0.7 mm long. Fruit ovate, compressed (mature fruit not known).

Field characters: The vegetative characters are similar to some forms of the previous species. The regular and numerous umbel-rays and pedicels are striking.

Distribution: Endemic to New Guinea. Infrequently collected from the Idenburg River in western New Guinea and the East Sepik district of northeastern New Guinea.

Ecology: Montane rain forest and mossy forest, at 900–1200 m altitude.

Mackinlaya schlechteri (Harms) Philipson *Bull. Brit. Mus. (Nat. Hist.) Bot.* 1: 7 (1951).

Anomopanax schlechteri Harms (1905); *A. versteegii* Harms (1905); *Mackinlaya versteegii* (Harms) Philipson (1951); *M. brassii* Philipson (1951); *M. klossii* Philipson (1951); *M. subulata* Philipson (1951).

Slender shrub to 6 m high. Leaves 1–3 foliolate. Petiole < 10 cm long, occasionally up to 20 cm (especially on compound leaves), terete and striate, base sheathing, membranous. Lamina elliptic, obovate, or oblong, occasionally irregularly lobed, up to 28 × 12 cm but usually much smaller; base cuneate or truncate (lateral leaflets often oblique); margin entire or dentate near apex, membranous or chartaceous; apex shortly acuminate, acute. Inflorescence a terminal compound umbel, often overtopped by a lateral branch at its base; peduncle terete, striate, \pm 10–20 cm long, bearing small narrowly ovate bracts below the rays; primary rays 6–15, \pm 4–7 cm long, striate, with minute distal caducous bracts; secondary rays (pedicel) \pm 10–20, filiform or rather rigid, usually 5–12 mm long. Male flowers towards the outside of the umbellules. Calyx lobes 5, triangular to subulate, 0.5–1 mm long. Petals 5, obovate. Ovary narrowly turbinate in male flowers, obconic or ovoid, *c.* 0.7 mm long in hermaphrodite. Fruit large (15 × 22 mm), compressed, rotund, constricted above and below on the central axis, with styles persistent and recurved.

Field characters: The great majority of specimens have at least some of their leaves unifoliate. In a very few specimens the regularity of the compound umbel is lost, with the ultimate branches appearing cymose. These specimens may represent hybrids with the equally common *M. celebica*. The leaves are aromatic and

the cut stem exudes an irritant sticky sap. The plant is reported to be poisonous and to have a number of medical uses. The flowers are white and the fruit mauve to purple with a glaucous bloom.

Distribution: Endemic to New Guinea and the Bismarck Archipelago. Frequently collected from the Snow Mountains district of western New Guinea to Eastern Highlands district of northeastern New Guinea. Also in New Britain.

Ecology: Rain forest and montane forest, at 600–2300 m altitude.

OSMOXYLON Miq.

Shrubs or trees, unarmed, glabrous or tomentose. Leaves palmately lobed or simple. Petiole base sheathing, ligulate, with one to several crests (absent in *O. miquelii*). Inflorescence a terminal compound umbel; rays each ending in three branches; the central branch bearing a head or umbellule of sterile berry-like pseudofruits; the lateral branches bearing a head or umbellule of hermaphrodite flowers, each pedicel not articulated below the flower. Calyx a rim or absent. Corolla lobed above, tubular below. Stamens 4–30. Ovary inferior, 1–many-locular. Fruit a fleshy drupe with 1–many compressed pyrenes.

Distribution: About 50 species extending from Borneo, the Philippines and Taiwan, through Micronesia, Melanesia, Celebes and Moluccas, to the New Hebrides. All the 10 species here recognized from Papuasias are endemic to the region (except that *O. insidiator* also occurs in the Aru Islands). Several species not treated here occur in the Solomon Islands (refer Appendix for treatment of Solomon Islands species and for additional notes on New Guinean species).

KEY TO SPECIES

1. Leaves simple, without lobes
 2. Petiole base without crests **O. miquelii**
 2. Petiole base with a single collar-like crests
 3. Leaf with lamina broadly ovate **O. spathipedunculatum**
 3. Leaf with lamina narrowly ovate **O. lanceolatum**
1. Leaves palmately lobed
 4. Petiole crests long-pectinate **O. pfeilii**
 4. Petiole crests fimbriate or undulate
 5. Fertile flowers pedicellate **O. novoguineense**
 5. Fertile flowers sessile or subsessile
 6. Leaf-lobes narrowly ovate or pinnatifid with narrow lobes **O. geelvinkianum**
 6. Leaf-lobes elliptic, sometimes irregularly lobed
 7. Stamens 4 (or 5) **O. micranthum**
 7. Stamens 6 or more
 8. Flower buds large (\pm 9–12 mm long); primary rays of inflorescence very strong **O. insidiator**
 8. Flower buds smaller (\pm 4–6 mm long); primary rays of inflorescence more tenuous
 9. Heads of fertile flowers globose **O. sessiliflorum**
 9. Heads of fertile flowers \pm discoid at anthesis **O. boerlagei**

Osmoxylon boerlagei (Warb.) Philipson *Blumea* 23: 112 (1976).

Eschweilera boerlagei Warb. (1891); *Boerlagiodendron warburgii* Harms (1894); *B. boerlagei* (Warb.) Harms (1920).

Small tree, unbranched or sparingly branched, reaching 24 m high, glabrous, at least when mature. Large leaves forming terminal crowns. Petiole up to 1 mm long, stout (1–2 cm diam.), broadly channelled above, with a sheathing, heavily lenticellate base prolonged as a strong stipular ligule up to 7 cm long, and with lacerate crests encircling the lower part of the petiole. Lamina up to 1.2 m across, with 5–7 strong ribs radiating from the top of the petiole; deeply lobed almost to the base of these ribs, the lobes in turn deeply lobed and incised, the central lobes especially strongly pinnatisect or digitately tripartite; margin undulate or indistinctly serrate; apices acute. Inflorescence terminal (or overtopped by a lateral leafy branch), a large compound umbel, bowl-shaped with a slightly convex top, up to 60 cm diameter; peduncle *c.* 10 cm long, stout, with narrowly ovate bracts below and among the very numerous radiating primary rays; outer primary rays *c.* 20 cm long at anthesis (elongating in fruit), inner rather shorter, woody, bearing 2 caducous bracts at the apex, each ray ending in three branches; the central branch *c.* 4 cm long, bearing an umbel of *c.* 20 sterile bacciform flowers (*c.* 8 mm diam. when dry) with rigid pedicel *c.* 1.5 cm long, and pseudofruits 5- or 6-locular; the 2 lateral branches *c.* 9 cm long at anthesis, articulated about the middle, terminating in a button-like head of usually 20–30 sessile flowers and surrounded by ovate bracts that soon fall leaving a bowl-shaped involucre, *c.* 1.5 cm diameter. Calyx rim obsolete. Petals *c.* 13, bud flat-topped, angled, minutely pubescent, apparently falling as a calyptra. Stamens 8–13. Ovary shortly turbinate, angled, glabrous, 10–14-locular; disc flat, with a central double row (or ellipse) of pustulate stigmas. Fruits spreading to form a \pm spherical head obscuring the involucre, each *c.* 9×7 mm (when dry) with prominent persistent stigmas.

Field characters: The large crown of deeply incised leaves surrounds a strong terminal inflorescence. The crests on the petioles are prominent. The bark is yellow-grey with shallow fissures and many pale lenticels. The flowers are reddish brown and the fruit purplish black and succulent.

Distribution: Endemic to New Guinea, throughout the northern half of the island from Vogelkop to the Huon Gulf; also in the Southern Highlands and Central districts of Papua.

Ecology: In primary forest and secondary growth from near sea level to 1800 m altitude.

Osmoxylon geelvinkianum Becc. *Malesia* 1: 196 (1877).

Eschweilera geelvinkianum (Becc.) Boerl. (1886); *E. elegans* Ridl. (1916); *Boerlagiodendron elegans* (Ridl.) Harms (1920); *B. stenolobum* Harms (1920).

A shrub with few slender branches, reaching 3 m high, glabrous. Leaves clustered near the ends of the branches. Petiole up to 22 cm long, usually shorter, 2–3.5 mm wide, narrowly channelled above, with a sheathing base prolonged as a membranous stipular ligule up to at least 4 cm long and with fimbriate or \pm entire crests encircling the lower part of the petiole. Lamina up to 30 cm diam. (usually 20 cm or less), very deeply 5–11-lobed, or with distinct digitately arranged leaflets linear-narrowly ovate to narrowly obovate, entire or irregularly pinnatifid with narrow finely-tapering lobes; base gradually narrowed; margin serrate; apex narrowly caudate; leaves below the inflorescence sometimes

reduced to a single leaflet. Inflorescence terminal hemispherical, usually 12–20 cm in diameter; peduncle up to 1 cm long, with caducous narrowly ovate bracts mostly clustered below the primary rays, 1–2 cm long; primary rays rather few, spaced, 2.5–5 cm long, slender, bearing 2 caducous narrowly ovate bracts at the apex, up to 1.5 cm long, each ray ending in three branches; the central branch c. 4–6 mm long bearing a whorl of narrowly ovate caducous bracts and an umbel of c. 7–12 sterile globose or ovoid bacciform flowers (c. 7 mm diameter when dry), with pedicel \pm 5 mm long and pseudofruits 6–9-locular; the 2 lateral branches c. 3–4 cm long at anthesis, articulated about the middle, terminating in a small head of 10–20 sessile or subsessile flowers. Calyx rim obsolete. Corolla splitting into c. 4 irregular lobes above, tubular below, c. 2.5 mm long. Stamens 10–14, exerted, 3 mm long; anthers small. Ovary cylindrical, c. 2 mm long, 10–16-locular; disc with a central raised boss formed by the pustulate stigmas. Fruit globose, fleshy, ribbed (when dry), c. 10 mm diameter.

Field characters: The narrow leaf segments, almost or quite separated at their bases, are characteristic, even though variable in outline. The flowers are orange-coloured or reddish and the succulent fruits are purple-black.

Distribution: Endemic to New Guinea, extending from the Vogelkop to the East Sepik district of northeastern New Guinea and the Western district (from the Fly River area and east to the Nomad area) of Papua.

Ecology: Primary forest, along creeks and river banks, flood resistant, from near sea level to 550 m altitude.

Osmoxylon insidiator Becc. *Malesia* 1: 195 (1877).

O. carpaphagarum Becc. (1877); *Eschweilera insidiatrix* (Becc.) Boerl. (1886); *E. carpaphagarum* (Becc.) Boerl. (1886); *Boerlagiodendron insidiator* (Becc.) Harms (1894); *B. carpaphagarum* (Becc.) Harms (1894); *B. pachycephalum* Harms (1910).

Small tree to 12 m high, young parts with uniform scurfy tomentum. Large leaves forming terminal crowns. Petiole up to 80 cm long, stout (1–2 cm diameter), broadly channelled above with a sheathing base prolonged as a strong stipular ligule c. 9 cm long, and with moderately developed irregular (not fimbriate) crests encircling the lower part of the petiole. Lamina up to 85 cm diameter, with 5–7 strong ribs radiating from the top of the petiole, subglabrous when mature or showing remnants of the tomentum; deeply lobed almost to the base of these ribs, the lobes in turn deeply lobed and incised, the median often digitately tripartite; margin irregularly and remotely serrate; apices long acuminate. Inflorescence a terminal hemispherical compound umbel, c. 15 cm high by 30 cm diam.; peduncle short, stout (15–20 mm diameter), with narrowly ovate bracts 4–6 cm long below and among the numerous (15–20) primary rays; primary rays 6–10 cm long, mostly 5–12 mm wide, rigid, bearing 2 narrowly ovate bracts (2–3 cm long) at the apex, each ray ending in three branches; the central branch c. 1.5 cm long, bearing an umbel of c. 30 sterile bacciform flowers (5–12 mm diameter when dry), the pseudofruits and their pedicels \pm rufous tomentose; pedicel 10–12 mm long, and pseudofruits 6-locular, surrounded by an involucre of short ovate bracts (3–8 mm long); the 2 lateral branches c. 6 mm long at anthesis, rigid, slightly flattened, to 8 mm broad, bearing a pair of bracts (c. 15 mm long) about the middle,

terminating in a subglobose head 3.5–4 cm diameter of *c.* 30–40 sessile flowers, and surrounded by an involucre of ovate bracts *c.* 10–14 mm long. Calyx rim fimbriate. Petals irregularly 4 or 5-lobed, 7–8 mm long, connate below to form a fleshy tube, pubescent on the outer surface. Stamens usually 15–26; filaments



Fig. 4 *Osmoxylon micranthum* (Harms) Philipson flowering branchlet (source unknown)

strap-like, projecting beyond the corolla; anthers *c.* 4 mm long. Ovary shortly turbinate, 2–4 mm long, angled, furfuraceous, usually 13–25-locular; disc flat, with a central boss formed of the pustulate stigmas. Fruits in a compact spherical head, the individual drupes angled by mutual pressure, and bearing the persistent stigmas on the exposed face, *c.* 10–14 mm long, the numerous pyrenes compressed and flat, cartilaginous.

Field characters: The crown of leaves is very similar to that of *O. boerlagei* but the inflorescence is smaller with very stout rigid branches. The bark is grey-brown, with many lenticels; the wood is soft and white; the flowers reddish-brown and the succulent fruit purple.

Distribution: Endemic to New Guinea and the Aru Islands, from Waigeo Island and the Vogelkop throughout the southern half of the island; also in Morobe district of northeastern New Guinea.

Ecology: Primary rain forest, and secondary growth, frequently beside streams, from sea level to 350 m altitude.

Osmoxylon lanceolatum Philipson *Blumea* 23: 104 (1976).

A small to medium tree with few branches, reaching 16 m high, glabrous. Many leaves clustered towards the ends of the branches. Petiole 8–15 cm long, terete, with a small triangular base, bearing a short stipular ligule, *c.* 2 mm long and extending around the base of the petiole as a collar. Lamina narrowly obovate, to 33 × 7.5 cm; base narrowly cuneate; margin entire; apex acute or slightly apiculate; midrib prominent, lateral veins arched ascending, 2–3 cm apart. Inflorescence a terminal compound umbel, almost sessile, saucer-shaped, bracts caducous; primary rays *c.* 15, *c.* 10 cm long, flattened, 4–5 mm broad, bearing three branches at the apex; central branch 5–6 cm long, the apex expanded and bearing a spherical head of usually 8–12 sessile sterile bacciform flowers *c.* 5 × 5 mm (when dry), pseudofruits 1- or 2-locular; the 2 lateral branches *c.* 5 cm long at anthesis, with an articulation immediately above the base, bearing 2 helmet-shaped bracts which fall to reveal the terminal head of usually 8–10 flowers, sessile on an expanded receptacle with an involucre rim *c.* 7 mm diameter. Calyx rim obsolete. Corolla known only in bud, *c.* 2.5 mm long. Stamens *c.* 5. Ovary gibbous, *c.* 1.5 mm high, 4-locular. Fruit depressed-globose, grey.

Field characters: The simple narrowly ovate leaves and the lax inflorescence are very distinctive. The smooth bark is pale grey, the wood soft and straw-coloured. The plant is strongly aromatic.

Distribution: Endemic to central and southern New Ireland (Bismarck Archipelago).

Ecology: Understorey tree in ridge-top forest on limestone, at 750–850 m altitude.

Osmoxylon micranthum (Harms) Philipson *Blumea* 23: 115 (1976). **Fig. 4.**

Boerlagiodendron micranthum Harms (1920); *B. sayeri* Harms (1920); *Eschweilera gawadensis* Baker (1923); *Boerlagiodendron tricolor* Philipson (1951).

A sparsely branched shrub to 8 m high, sometimes trailing or semi-scandent, the young parts uniformly setulose, buds without cataphylls. Leaves in terminal clusters. Petiole up to 30 cm long, rather narrow (2–4 mm diameter), becoming sparsely setulose, channelled above, with a sheathing base prolonged as a membranous stipular ligule up to 3 cm long, and with a number of lacerate crests encircling the lower part of the petiole. Lamina deeply 3–5- (or 7)-lobed, or below the inflorescence sometimes simple; surfaces becoming sparsely setulose to subglabrous; base cordate or emarginate; the central lobe up to 30 cm long, the lobes oblong, narrowly ovate or broadly elliptic; margin entire or irregularly lobed or incised, or with small sub-lobes, sinuses between the lobes broad and rounded; apices long cuspidate, acute. Inflorescence a terminal compound umbel, often appearing subterminal by growth of a leafy branch at the base of the peduncle; peduncle short (1–2 cm long), heavily setulose, occasionally with a flowering ray arising from the axils of the bracts on or below the peduncle, bearing distally many narrowly ovate bracts 5–10 mm long, primary rays 12–18, 10–20 mm long, setulose, with 2 narrowly ovate bracts at the apex, each ray ending in three branches; the central branch very short (2–3 mm long) bearing a subglobose umbel of many (c. 40) small sterile bacciform flowers (c. 1.5×1 mm) with filamentous pedicel c. 2 mm long, and pseudofruits with 1 or 2 locules each with one abortive ovule; the 2 lateral branches c. 2 cm long, with 2 minute bracts about their middle, setulose, terminating in a head of c. 20 sessile flowers surrounded by an involucre of small rounded bracts. Calyx rim obsolete. Corolla 4- (or 5)-lobed, united below, c. 2 mm long. Stamens 4 (or 5); filaments ribbon-like elongating beyond the corolla-tube at anthesis, 3–4 mm long; anthers small. Ovary shortly subcylindric, c. 1 mm high, faintly angled, glabrous, usually 4-locular (rarely 1–3-locular); disc fleshy, rising slightly to the central stigmas. Fruit an ellipsoid drupe; pyrenes cartilaginous, 1–5; seeds with smooth endosperm.

Field characters: The leaves and inflorescences are more delicate than in other New Guinean species. The inflorescence branches are often red or purple and the flowers either orange or reddish with yellow anthers. The fruits are purple-black. The number of locules in the ovary is extremely variable.

Distribution: Endemic to New Guinea: extending from the Snow Mountains district of western New Guinea to the Morobe district of northeastern New Guinea, and the Central, Northern and Milne Bay districts of Papua.

Ecology: In primary forest from the foothills to montane mossy forest, often in swampy or deeply shaded situations, at 700–2400 m altitude.

Osmoxylon miquelii Boerl. *Ann. Jard. Bot. Btzg.* **6**: 125 (1887).

O. amboinense Miq. (1863), p.p.; *Gastonia simplicifolia* Zipp. ex Boerl. (1887).

Sparsely branched tree, 15 m high. Leaves glabrous, simple, subcoriaceous; stipules small forming a bicuspid ligule. Petiole long (to 19 cm long), swollen distally. Lamina oblong-elliptic, 22–36 \times 9–12 cm; base subrounded; margin entire to undulate; apex subrounded or mucronulate; midrib prominent below, secondary veins arched-ascending and uniting, c. 10–20 mm apart. Inflorescence a terminal umbel, sessile, with many (28–32) radiating rigid, angular, trifid

branches *c.* 7 cm long to first joint. Central branches unknown. The lateral branches *c.* 5 cm long, articulate near base. Flowers 20–30, sessile on the expanded ends of the inflorescence branches. Corolla and stamens unknown. Berries crowded, subrotund, *c.* 4 mm diameter (dry), mostly 8–10-locular; seeds with slightly ruminant endosperm.

Field characters: Known only from one imperfect collection.

Distribution: Endemic to New Guinea. The collector, Zipellius, gives no precise locality, but most likely from vicinity of Triton Bay, Fakfak district, Irian Jaya.

Osmoxylon novoguineense (Scheff.) Becc. *Malesia* 1: 197 (1877). **Fig. 5.**

Trevisia insignis sensu Seeman (1866), non Miq. (1864); *T. novo-guineensis* Scheff. (1876); *Eschweilera novoguineensis* (Scheff.) Boerl. (1886); *Boerlagiodendron novoguineense* (Scheff.) Harms (1894); *B. lauterbachii* Harms (1900).

Tree or shrub, unbranched or sparingly branched, reaching 16 m high, the young parts rufous furfureous, becoming glabrous. Large leaves forming terminal crowns. Petiole up to 1 m long, stout (1–2 cm broad), flattened above, with a sheathing base prolonged as a strong stipular ligule up to 7 cm long, and with fimbriate crests encircling the lower part of the petiole. Lamina up to 1.2 m diameter, with 5–7 strong ribs radiating from the top of the petiole; base deeply lobed almost to the base of the ribs, the lobes in turn deeply lobed and incised, the central lobes especially being strongly pinnatisect or digitately tripartite; margin serrate; apices acute: upper leaves associated with inflorescences may be smaller, more simply lobed, or entire. Inflorescence terminal, a large compound umbel, bowl-shaped, up to 35.5 cm diameter. Main axis up to 10 cm long, stout, with narrowly ovate caducous bracts (*c.* 4 cm long) below and among the numerous (usually 50–70) primary rays; primary rays mostly 12–15 cm long at anthesis, *c.* 3 mm thick, bearing 2 caducous bracts (10 mm long) at the apex, each ray ending in three branches; the central branch *c.* 2 cm long, bearing an umbel of *c.* 20–40 sterile bacciform flowers (*c.* 6 mm diameter when dry) with pedicel *c.* 10 mm long, and pseudofruits 2–6-locular; the 2 lateral branches *c.* 4–6 cm long, with 2 opposite or subopposite bracts about the middle, terminating in a subspherical umbel 2.5–3 mm diameter of 30–50 flowers; pedicel mostly 8–10 mm long. Calyx rim obsolete, undulate. Petals with irregular erect lobes, tubular below. Stamens 6–10 exerted. Ovary turbinate, somewhat angled; glabrous, 6–14-locular; disc flat with a central double row of pustulate stigmas. Fruits on stiff radiating pedicels, ovoid or spherical, fleshy, ribbed (when dry).

Field characters: The following features are similar to that of *O. boerlagei* but the pedicellate flowers distinguish it from that series. The fawn bark is marked with many lenticels; the wood is soft and straw-coloured; an orange-coloured exudate flows from the cut stems.

Distribution: Endemic to New Guinea, extending from Salawati and the Vogelkop to Milne Bay, Morobe and the Bismarck Archipelago. Refer Appendix for discussion of this species.

Ecology: Primary and secondary-growth forests, from sea level to 1600 m altitude.

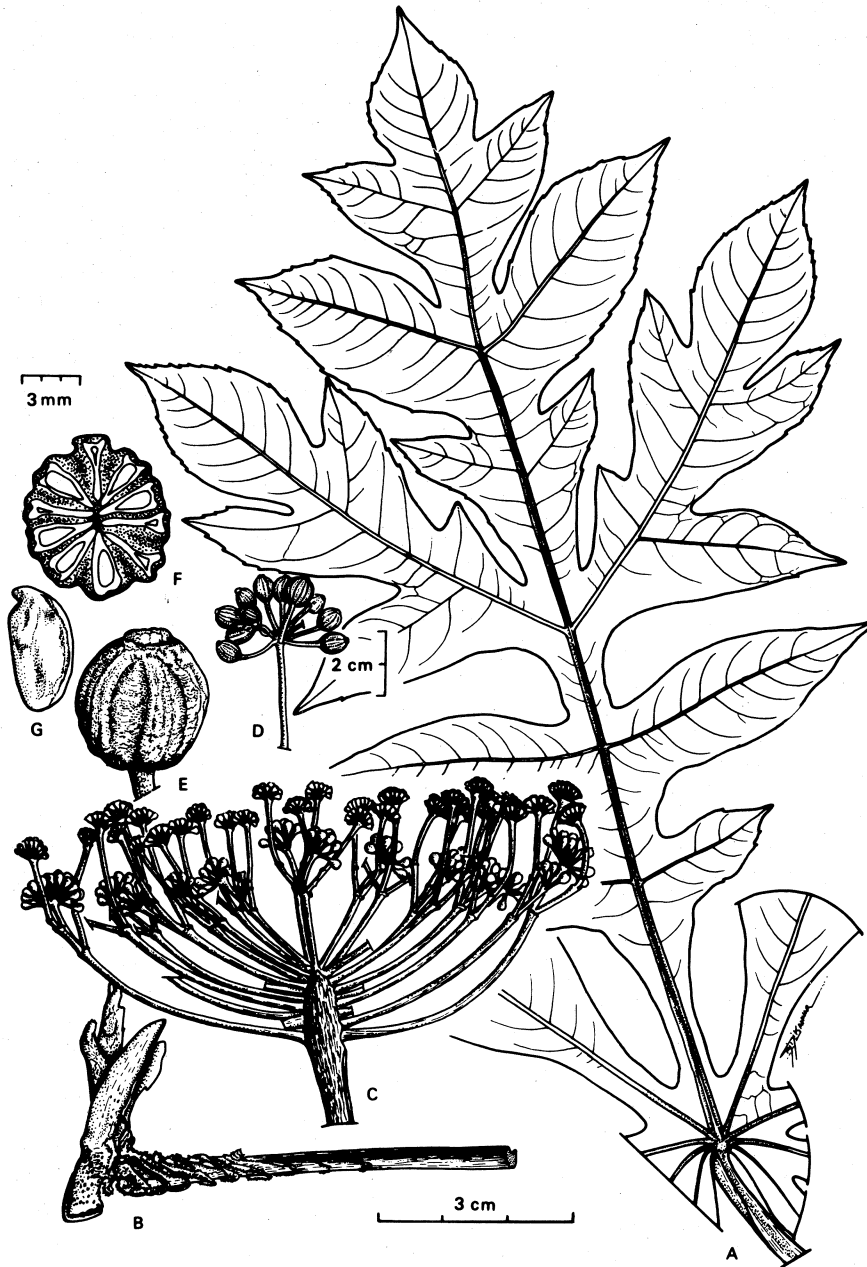


Fig. 5. *Osmoxylon novoguineense* (Scheff.) Becc (A) middle lobe of leaf (B) base of petiole (C) inflorescence (A–C: LAE 53073) (D) ultimate fruiting umbel (E) fruit (F) fruit—transverse section showing developing seeds (G) seed (D–G: NGF 16688)

Osmoxylon pfeilii (Warb.) Philipson *Blumea* 23: 109 (1976).

Eschweilera pfeilii Warb. (1891); *Boerlagiodendron pfeilii* (Warb.) Harms (1894).

Tree, developing a crown when mature, up to 16 m high, glabrous when mature, young parts slightly setulose. Leaves in terminal clusters. Petiole up to 60 cm long, c. 6 mm broad, channelled above, with a sheathing base prolonged as membranous stipular ligule 2–4 cm long, and with many pronounced long-setose crests encircling the lower part of the petiole. Lamina up to 75 cm diameter, deeply 7–11-lobed; base cordate or emarginate; the lobe narrowly ovate to narrowly elliptic-oblong, narrowed towards the sinuses and tapered to an attenuated apex; margin sharply and remotely serrate, sinuses broadly rounded. Inflorescence a terminal compound umbel, hemispherical, to 20 cm diameter; peduncle short (2–3 cm long); primary rays numerous (30–40), 4–5 cm long, glabrous, with obsolete bract at the apex, each ending in three branches; the central branch \pm 10 mm long, bearing a subglobose umbel of c. 20 small sterile bacciform flowers (1–1.5 mm diameter) with each pedicel mostly 3–4 mm long, with no clear articulation but 1 or 2 obsolescent bracts, terminating in a head of usually 12–16 subsessile flowers (pedicel c. 1 mm long, becoming longer in fruit) surrounded by an inconspicuous involucreal rim. Calyx rim obsolete. Corolla 5-lobed, 1.5 mm long in bud. Stamens 5. Ovary subcylindric, angled, 1.5 mm long at anthesis, 5–16-locular; disc with a central boss formed by the united pustulate stigmas. Fruit spherical, fleshy, c. 8 mm diameter, ribbed (when dry), the stigmatic boss persistent and prominent; pyrenes cartilaginous.

Field characters: Distinguished from other Papuasian species by the long setae on the crests of the petioles. The bark is grey-brown and pustular; the wood soft and straw-coloured. The flowers are orange-coloured and the ripe fruits dark red-violet.

Distribution: Endemic to the Bismarck Archipelago, occurring in both New Britain and New Ireland.

Ecology: In primary rain forest, from near sea level to 600 m altitude.

Osmoxylon sessiliflorum (Laut.) Philipson *Blumea* 23: 113 (1976).

Boerlagiodendron sessiliflorum Laut. (1910).

A small tree, up to 18 m high, glabrous when mature, or tomentum persistent on the inflorescence. Leaves crowded at the end of the branches. Petiole to 60 cm long, with the clasping base prolonged as a stipular ligule up to 6 cm long, and with few or several strong or weak crests around the base of the petiole; margin undulate or fimbriate. Lamina to 50 cm long; base cordate, palmately 5–9-lobed; lobes extending to near the base, elliptic, coarsely serrate, often irregularly lobulate; apex acute; sinuses rounded. Inflorescence a terminal compound umbel; peduncle to c. 4 cm long, bearing narrowly ovate bracts to 2.5 cm long, caducous or persistent, occasionally with some bristles on back, primary rays usually 20–30, c. 9 cm long, \pm pubescent, bearing opposite caducous or rarely persistent bracts at the apex; central branch variable in length (12–18 mm), bearing an umbellule or head 1–2.5 mm diameter of sterile bacciform flowers (c. 5 mm diameter), with pseudofruits 4–8-locular, subtended by minute bracts, pedicel variable in length (5–18 mm long); lateral branches 3–7 cm long, articulated near

the middle, terminating in a globose head of 20–30 sessile flowers (or pedicel 1.5 mm long), bracts between the flowers very small. Calyx rim obsolete. Corolla few- to many-lobed, tubular below, 1.5–4 mm long in bud. Stamens 6–17. Ovary 5–18-locular. Fruit a globose head of drupes; drupes c. 10 × 6 mm, obovoid, ribbed (when dry).

Field characters: The globular spherical heads distinguish this species in Papuasia, though several species in the Moluccas and the Philippines share this character. The bark is light brown and the wood cream-coloured; inflorescence branches purple, flowers red and the succulent fruits black.

Distribution: Endemic to New Guinea, extending from the Vogelkop to the East Sepik and the Western districts, and then apparently absent until the Milne Bay and the Papuan Islands districts.

Ecology: Rain forest, especially along muddy river banks, from sea level to 100 m altitude.

Osmoxylon spathipedunculatum (Philipson) Philipson *Blumea* **23**: 103 (1976).

Meryta spathipedunculata Philipson (1951).

Glabrous tree to 20 m high, with spreading branches. Leaves crowded at the ends of the branches. Petiole to 14 cm long with a small base bearing a stipular ligule and a rim-like collar around the base of the petiole. Lamina obovate, 17–30 × 10–15 cm; base attenuate; margin entire; apex obtuse; midrib prominent, secondary veins arched and uniting, 15–20 mm apart. Inflorescence a terminal compound umbel; primary rays c. 12, stout, compressed, 9–17 cm long, bearing three branches at the apex; central branches and sterile flowers unknown; the 2 lateral branches 9–14 cm long with an articulation 10–20 mm from base, bearing helmet-shaped bracts which fall to reveal the terminal head of c. 12 sessile flowers on an expanded receptacle, with an involucrel rim c. 10 mm diameter. Calyx rim obsolete. Corolla split in 5 lobes above, tubular below. Stamens 5. Ovaries subcylindric, ± 9-locular; disc raised in the centre to the pustulate stigmas. Drupes in a spherical head, globose, ± 12 mm diameter, c. 9-ribbed (when dry), crowned with the prominent persistent confluent stigmas.

Field characters: The simple paddle-shaped leaves are characteristic of this species.

Distribution: Endemic to the Bougainville district (Papua New Guinea) and throughout the Solomon Islands (refer Appendix for notes on distribution of this species).

Ecology: In rain forest, at 800–1200 m altitude.

PLERANDRA A. Gray⁵

Slender trees, glabrous, unarmed. Leaves digitately compound, with stipular sheath; leaflets entire. Inflorescence axillary below the leaves, a compound umbel, pedicel not articulated below the ovary. Outer flowers of umbellules often male, the central hermaphrodite. Calyx a continuous rim. Petals 5, either separate or ± calyptate, fleshy, valvate. Stamens numerous in one or more series;

⁵ Frodin (1925) merged this genus with *Schefflera*, regarding the high stamen numbers as a derived condition, with the less specialized species occurring in Fiji—(Ed.).

filaments filiform, inserted near the base of the oblong introrse anthers. Ovary \pm 10–15-locular; disc fleshy with the styler processes connate or partially free above. Fruit ovoid or subglobose, ribbed (when dry); exocarp fleshy; endocarp crustaceous; seeds compressed, with endosperm smooth.

Distribution: About 12 species extending from New Guinea and the Bismarck Archipelago to Fiji. 2 species endemic to New Guinea, the Bismarck Archipelago and Bougainville. Other species occur in the remainder of the Solomon Islands but are not included here.

KEY TO SPECIES

1. Leaflets less than 18 cm long; peduncles not thickened at apex; peripheral male flowers few or absent **P. solomonensis**
1. Leaflets considerably longer than 18 cm; peduncles thickened at apex with many peripheral male flowers **P. stahlia**

Plerandra solomonensis Philipson *Bull. Brit. Mus. (Nat. Hist.) Bot.* 1: 10 (1951).

Slender tree to 10 m high, glabrous, unarmed. Leaves crowded at the ends of the branches. Petiole to 24 cm long but usually shorter, with a stipular sheath *c.* 1 cm long; leaflets \pm 7; petiolules usually 1–2 cm long. Lamina obovate, midleaflet to 18 \times 6 cm; base narrowed; margin undulate and subrevolute; apex acute or subacuminate; midrib prominent below, lateral veins obscure. Inflorescence a compound umbel; peduncle short; primary rays *c.* 5, stout, to 28 cm long; pedicel *c.* 10 to *c.* 20 per umbellule, 4 cm long. Flowers either all hermaphrodite or the outer males, buds *c.* 20 mm long. Calyx rim undulate. Petals 5, thick, 1 cm long. Stamens with filaments thread-like. Ovary turbinate, *c.* 10-locular, \pm 10 \times 7 mm; disc with short conrescent styles. Fruit ellipsoid, 28 \times 15 mm, obscurely furrowed, calyx persistent.

Field characters: Distinguished from *P. stahlia* by its smaller foliage, and the fewer male flowers on the periphery of the umbellules.

Distribution: Endemic to the Bougainville district (Papua New Guinea) and the Solomon Islands, as far south as the Guadalcanal district⁶.

Ecology: Frequent in rain forest, to 1000 m altitude.

Plerandra stahlia Warb. *Bot. Jb.* 18: 203 (1894).

Slender tree, up to 25 m high, glabrous, unarmed with few erect branches. Leaves large, clustered at the ends of the thick branches, up to 2 m long. Petiole *c.* 1 m long, *c.* 2.5 cm wide, flattened above, green mottled with dark streaks, and with a heavily lenticellate, clasping, stipular sheath, ligule *c.* 7 cm long; leaflets usually 9–13; petiolules 1–10 cm long. Lamina obovate (rarely narrowly obovate), midleaflet up to 75 \times 24 cm; base gradually narrowed into the petiolule; margin entire; apex rounded or with an obscure apiculum; midrib prominent, lateral veins pinnate, widely spaced and arched ascending. Inflorescence a globular compound umbel, axillary below the leaves; peduncle short (*c.* 5 cm) bearing usually 7–10 rays, 20–60 cm long; bracts narrowly ovate, *c.* 5 cm long, caducous;

⁶ As circumscribed here, this taxon includes the distinct species *P. brassii* Philipson (1951) (Frodin, pers. comm.). *Plerandra brassii* (restricted to Solomon Islands) has a broad disc between stylopodium and calyx rim, whereas *P. solomonensis* (restricted to Bougainville) has fruits similar to *P. stahlia*, in that both have a broad stylopodium and narrow disc—(Ed.).

umbellules (or condensed racemes) with many flowers maturing in centripetal sequence, the outer male, early caducous leaving crowded scars on the thickened rachis, the central hermaphrodite. Male flowers with pedicel 2–5 cm long; calyx a continuous undulate rim; petals *c.* 8–10 mm long, falling to reveal very numerous stamens; filaments thread-like, *c.* 10 mm long; anthers *c.* 1.5 mm long. Ovary and stylar disc rudimentary. Hermaphrodite flowers each with pedicel longer (5–15 cm long), *c.* 12–30 per umbellule; calyx a narrow undulate rim; petals 8–15 mm long forming a hemispherical bud, falling to reveal very numerous stamens (*c.* 150) similar to those of the male flowers. Ovary subcylindric, tapering below, 13–20 × 8–12 mm at anthesis, *c.* 13-locular; disc with short crescent styles. Fruit a large ellipsoid berry, *c.* 30 × 20 mm, ridged when dry, and with a prominent apical rim and stylopodium; exocarp fleshy; endocarp crustaceous.

Field characters: The large spherical inflorescences emerge below the large compound leaves, and the clusters of large fruits are pendulous. The bark is at first smooth and grey-white with prominent leaf-scars, later becoming brown with corky lenticels. Wood soft, white or straw-coloured, with a wide pith. Copious sticky exudate. Flowers greenish white, massed anthers yellow. Fruit glossy black.

Distribution: Endemic to Papuasia. Collected in northeastern New Guinea from West and East Sepik districts and Morobe district; in Papua from Northern, Milne Bay and Papuan Islands districts; in the Bismarck Archipelago from Manus, New Ireland and New Britain; in the Solomon Islands from Bougainville to Malaita.

Ecology: Common in lowland rain forest, often on swampy alluvium but also on drier slopes and in disturbed forest.

POLYSCIAS J. R. & G. Forst.

Shrubs or trees, unarmed, glabrous, or furfuraceous. Leaves imparipinnate or 2–3 pinnate (rarely unifoliate) with an elongated or short sheathing base. Inflorescence terminal often large, flowers arranged in umbellules, capitula, or inflorescence racemose; pedicel articulated below the ovary. Calyx a rim with an undulate or dentate margin. Petals 4 or 5. Ovary 4 or 5 (–8 or more)-locular; styles either free and recurved (at least in fruit) or joined to form a beak-like stylopodium; exocarp fleshy; endocarp chartaceous; seeds with endosperm surface uneven, fissured, or rarely smooth.

Distribution: About 100 species throughout the tropics of the old world (including Australia) and the Pacific Islands. 20 species in Papuasia, 9 being endemic, and 3 known only in cultivation.

KEY TO SECTIONS

1. Leaf-sheath elongated, extending along the petiole for *c.* 1/4 of its length 1. Sect. POLYSCIAS
1. Leaf-sheath short or obsolete, restricted to the base of the petiole
 2. Style arms spreading, at least in fruit
 3. Flowers arranged racemously 2. Sect. GELIBIA
 3. Flowers arranged in umbellules or capitula 3. Sect. EUPTERON
 2. Style arms erect, fused, forming a beak in fruit
 4. Inflorescence large, ± as long as the leaves 4. Sect. KISSODENDRON

4. Inflorescence much shorter than the leaves 5. Sect. PALMERVANDENBROEKIA

1. Sect. POLYSCIAS

Aromatic, glabrous shrubs or small trees, often cultivated. Leaf-sheath elongated along petiole 1/3–1/4 of its length. Styles spreading, at least in fruit.

Distribution: Polynesia, Queensland and Malesia (introduce to Southeast Asia).

KEY TO SPECIES

1. Leaves 2- or 3-pinnate **P. fruticosa**
 1. Leaves imparipinnate or unifoliolate
 2. Ovary 2-locular (or predominantly so)
 3. Main inflorescence branches diffusely branched **P. macgillivrayi**
 3. Main inflorescence branches with verticils of short branches **P. verticillata**
 2. Ovary variable, but many flowers with more than 2 locules
 4. Leaflets orbicular or reniform; leaves unifoliolate or trifoliolate **P. scutellaria**
 4. Leaflets ovate, oblong, or elliptic (cultivated forms often lacinate or narrowly ovate); leaves with 3 or more pairs of leaflets
 5. Leaf margin sharply serrate (lamina often rhomboidal and variegated with light yellow) **P. guilfoylei**
 5. Leaf margin entire, or obscurely dentate (lamina ovate-oblong or elliptic) . . . **P. cumingiana**

Polyscias cumingiana (Presl) F.-Vill. *Nov. App.* 102 (1880).

Paratropia cumingiana Presl (1851); *Polyscias rumphiana* Harms (1894);

Polyscias sorongensis Gibbs (1917); *Polyscias pinnata* Harms (1921), non Forst. (1775).

A shrub or small tree to *c.* 4 m high, unbranched or with few branches bearing spirally arranged leaves towards their ends, glabrous, unarmed. Leaves imparipinnate, up to 100 cm long. Petiole to 20 cm long, terete, with a sheathing base *c.* 5–6 cm long; rachis articulated; petiolules to 30 mm long. Lamina ovate-oblong or elliptic, 10–30 × 2–13 cm; base rotund, truncate or broadly cuneate, often oblique; margin entire or minutely and distantly dentate (sometimes pinnatilobed or almost pinnatipartite); apex attenuated or acuminate; midrib and lateral veins evident. Inflorescence a large terminal panicle, or with flowering branches also in the axils of the upper leaves; primary axis up to 140 cm long with secondary branches up to 120 cm long, bearing umbellules in an irregularly branched system towards their extremities, peduncles of the umbellules with one or more pairs of small bracts; umbellules with 10–20 flowers; pedicel 4–8 mm long. Stamens 4 or 5 (or 6), 2 mm long. Ovary turbinate, subglobose, fleshy, 3–5 mm in diameter (when dry).

Field characters: Large pinnate leaves with pale green oblong leaflets and long sheathing base to the petiole.

Distribution: Cultivated throughout the region, and also apparently growing as part of the indigenous vegetation in northern districts.

Ecology: Often cultivated as an ornamental or hedge shrub or for culinary use; also in rain forest and in secondary growth. Usually at low altitudes, but ascending to 1700 m altitude.

Notes: Cultivated forms with narrowly ovate leaflets or dissected foliage occur (e.g. *P. filucifolia*).

Polyscias fruticosa (L.) Harms in Engl. & Prantl *Nat. Pflanzenfam.* **3**, 8: 45 (1894).

Panax fruticosus L. (1762) (as 'fruticosum'); *Nothopanax fruticosus* (L.) Miq. (1855) (as 'fruticosum').

A shrub or small tree to 5 m high, with branches bearing spirally arranged leaves towards their ends, glabrous, unarmed. Leaves tripinnate, variable in size to *c.* 75 cm long. Petiole up to 25 cm long, terete, with a sheathing base to 5 cm long; rachis articulate; pinnae to *c.* 25 cm long. Leaflets shortly petiolate, very variable in shape and size, oblong or linear-narrowly ovate, or 1–2 × 0.5–4 cm, ± deeply serrate or lobed, or irregularly pinnatisect; base cuneate, truncate or subcordate; apex attenuate, acuminate or rounded; midrib and lateral veins evident. Inflorescence a diffuse terminal panicle; primary axis up to *c.* 60 cm long with secondary branches mostly in verticils at intervals along its length; secondary branches up to 30 cm long bearing umbellules in an irregularly branched system towards their extremities; umbellules with 12–20 flowers; pedicel *c.* 3 mm long. Calyx a minute rim. Petals 5, 2 mm long. Stamens 5. Ovary turbinate, *c.* 1 mm high, 2- or 3(or 4)-locular; styles at first erect, later spreading. Fruit subglobose fleshy, *c.* 5 mm diameter (when dry).

Field characters: The leaf with sharply serrate leaflets is characteristic of this species. The elongated sheathing base of the petiole occurs in all the species of this section.

Distribution: Cultivated throughout Papuaia, and in other parts of the Indo-Pacific tropics.

Ecology: Grown at low and moderate altitudes (to ± 1000 m) as an ornamental or hedge shrub and for culinary use.

Notes: The foliage of this plant is extremely variable in size and form. Occasional specimens have leaves so much reduced that they are simply pinnate or unifoliate when they approach forms of *P. cumingiana*. The inter-relations of this and the other cultivated species of this will be understood only after intensive biosystematic study of the many cultivars.

Polyscias guilfoylei (Cogn. & Marché) L. H. Bailey *Rhodora* **18**: 153 (1916).

Aralia guilfoylei Cogn. & Marché (1874).

A shrub to 3 m high, with few branches bearing spirally arranged leaves towards their ends, glabrous, unarmed. Leaves imparipinnate, with 3 or 4 pairs of leaflets, *c.* 60 cm long. Petiole *c.* 18 cm long, terete, with a sheathing base 3–4 cm long; rachis swollen at the insertion of the leaflets; petiolules *c.* 15–25 mm long. Lamina rotund, oblong or rhomboidal, *c.* 10–14 × 6–7 cm, rather thin and flaccid, sometimes rugose; margin sharply serrate to broadly cuneate (often decurrent on the petiole), often oblique, midrib and laterals evident. Inflorescence a diffuse terminal panicle; primary axis short (*c.* 3–4 cm long) with one or few lateral flowering branches, terminating in an umbel of long much-branched rays; lateral branches and rays *c.* 40–50 cm long, with secondary branches (*c.* 5–8 cm long) singly or mainly in subverticils along their length and in a terminal umbel; secondary branches with one or more pairs of small bracts and ending in umbellules with a few lateral tertiary branches also ending in umbellules; umbellules

with *c.* 8–12 flowers; pedicel *c.* 8–10 mm long. Calyx a minute rim. Petals 5, *c.* 2.5 mm long. Stamens 5; filaments 2 mm long; anthers oblong, 1.5 mm long. Ovary turbinate, *c.* 1 mm high, usually 3-locular; styles at first erect, but soon elongating and recurved. Fruit fleshy, globose, *c.* 4 × 5 mm.

Field characters: Recognisable by the shape, texture and serrations of the leaflets, which are usually variegated with whitish or yellowish blotches near the margin.

Distribution: Cultivated throughout the region, but less commonly than other cultivated species of this section. Generally throughout the tropical Pacific.

Ecology: Usually grown as a hedge plant. Flowers only when left untrimmed or when growing as an escape from cultivation.

Vernacular names: 'Berobero', 'bebero' (Kwara'ae, Solomon Islands) (note: also used for *Delarbrea collina*).

Polyscias macgillivrayi (Seem.) Harms in Engl. & Prantl *Nat. Pflanzenfam.* 3, 8: 45 (1894). **Fig. 6.**

Nothopanax macgillivrayi Seem. (1865).

A shrub or small tree to 15 m high, with few branches bearing terminal clusters of large leaves, glabrous, unarmed. Leaves imparipinnate, up to at least 1 m long, uppermost leaves smaller. Petiole *c.* 15 cm long, terete, with a sheathing base extending for 6–10 cm along the petiole; rachis articulated; petiolules *c.* 10–15 mm long. Lamina oblong, often broader near the base (lower and the terminal pinnules more ovate) 20–25 × 8–10 cm, slightly succulent when fresh; base rounded, truncate or subcordate; margin entire, revolute, or occasionally minutely dentate; apex rounded and shortly apiculate; midrib and widely spaced laterals prominent. Inflorescence a large terminal panicle; primary axis stout, rather short (3–10 cm long), often bearing reduced leaves or cataphylls basally, and a few lateral inflorescence branches, terminating in an umbel of long diffusely branched rays; lateral branches and rays *c.* 40–50 cm long, with secondary branches 6–12 cm long, borne singly or in subverticils along their length; the secondary branches with numerous tertiary branches bearing lateral and terminal umbellules (or the branching may be of a high order); umbellules with *c.* 6–12 flowers; pedicel delicate, *c.* 33 mm long. Calyx a minute rim. Petals 5, *c.* 2.5 mm long. Stamens 5; filaments delicate, 1.5 mm long; anthers oblong, 1.5 mm long. Ovary turbinate in bud, 1.5 mm long, rapidly becoming rotund, compressed with prominent veins, 2-locular; styles 2, divergent. Fruit fleshy, black, compressed, *c.* 5 × 6 mm; styles persistent, recurved.

Field characters: The pinnate leaves with elongated petiolar sheaths and the diffusely branched panicle with delicate pedicels and compressed 2-seeded fruits.

Distribution: This species occurs in Papuasias and Queensland, Australia. In Papuasias it has been collected from the Morobe (Musi Island), Northern, Milne Bay, Papuan Islands, New Britain and the Solomon Islands.

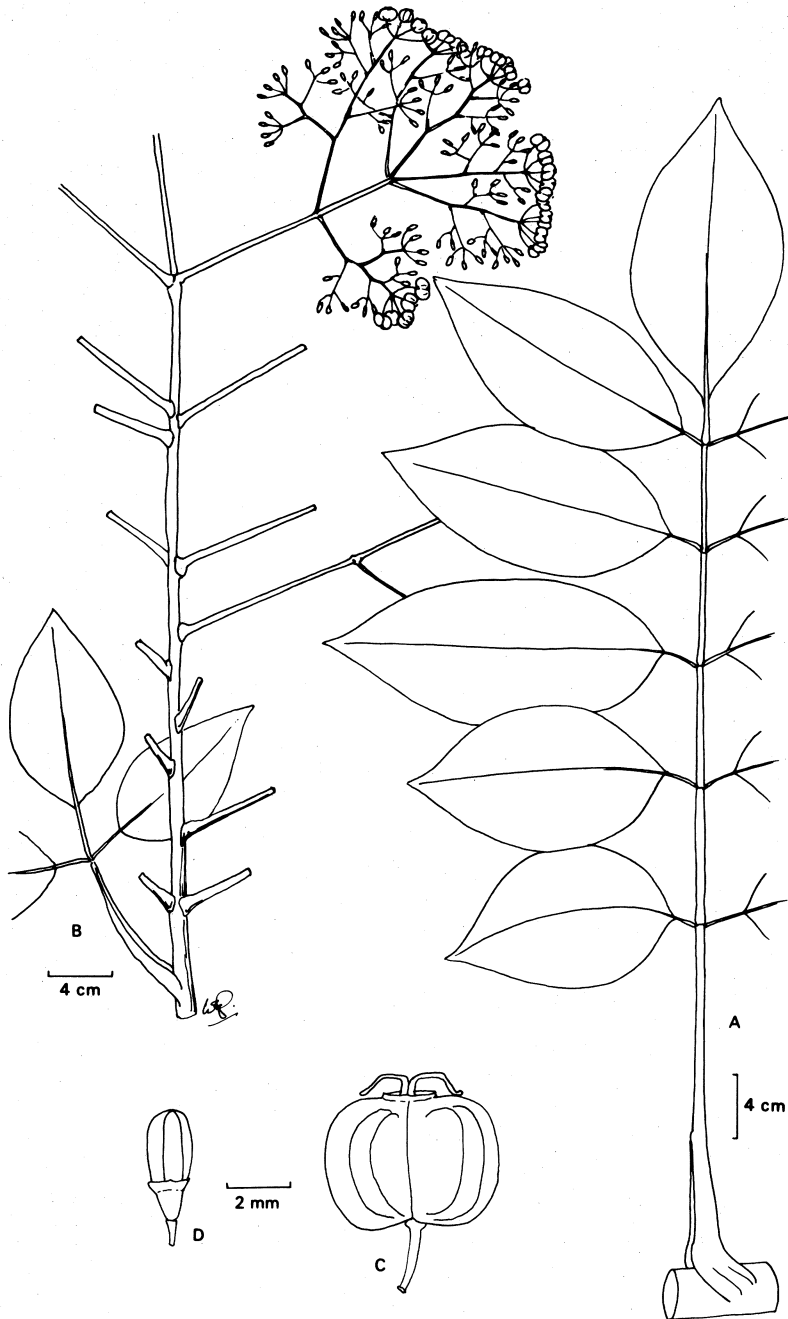


Fig. 6. *Polyscias macgillivrayi* (Seem.) Harms (A) pinnate leaf (B) partial inflorescence (C) fruit (D) flower bud (all Brass 24389)

Ecology: Strand vegetation and maritime rain forest, often behind mangrove.

Polyscias scutellaria (Burm. f.) Fosberg *Univ. Hawaii Occ. Pap.* **46**: 9 (1948).

Crassula scutellaria Burm. f. (1768); *Nothopanax scutellarius* (Burm. f.) Merr. (1917) (as 'scutellarium').

A shrub or small tree to 6 m high, with branches bearing spirally arranged leaves towards their ends, glabrous, unarmed. Leaves simple or trifoliolate, variable in size. Petiole often *c.* 6 cm long, but as long as 28 cm, terete with a sheathing base 1–6 cm long. Lamina rotund or reniform, often *c.* 8 cm across but as wide as 28 cm; base \pm cuneate; margin usually serrate or becoming sublobed towards the apex, in larger leaves the serrations often inconspicuous; apex rounded; midrib and lateral veins evident. Inflorescence a diffuse terminal panicle; primary axis usually long (up to 1 m long), with secondary branches (mostly in verticils) at intervals along its length; secondary branches 15–30 cm long, bearing umbellules in an irregularly branched system towards their extremities; umbellules with *c.* 8–16 flowers; pedicel *c.* 3 mm long. Calyx a minute rim. Petals 4 or 5, *c.* 2 mm long. Stamens 4 or 5; anthers oblong, 1 mm long. Ovary turbinate, *c.* 1 mm high, (2- or)3- or 4-locular; styles at first erect, later recurved. Fruit subglobose, fleshy, *c.* 5 mm diameter when dry.

Field characters: This species is usually readily distinguished by its simple, orbicular, saucer-shaped leaves, but plants with some or all of their leaves trifoliolate occur.

Distribution: Introduced. Cultivated throughout the region. Extends through the tropical Pacific region.

Ecology: Grown at low and moderate altitudes (800 m) as an ornamental or hedge shrub and for culinary use.

Polyscias verticillata Stone *J. Arnold Arbor.* **47**: 272 (1966).

A small tree to 7 m high, with few branches bearing spirally arranged leaves towards their ends, glabrous, unarmed. Leaves imparipinnate, up to 1 m long. Petiole 24–30 cm long, terete, with a sheathing base *c.* 6–7 cm long; rachis articulated; petiolules 5–20 mm long. Lamina oblong, often broader near base, 16–27 \times 5–13 cm; base subcordate or truncate, often oblique; margin entire, slightly revolute or sparsely denticulate; apex acuminate; midrib and lateral veins evident. Inflorescence a large terminal panicle; primary axis stout, rather short, with broad cataphylls, bearing several secondary branches *c.* 50 cm long, radiating in a subumbel, with numerous tertiary branches borne in well defined verticils and in a terminal umbel; bracts triangular, *c.* 8 mm long, caducous, tertiary branches 4–7 cm long with small bracts near the middle; umbellules with *c.* 10–15 flowers; pedicel 1–4 mm long. Calyx a minute rim. Petals 5, *c.* 2.5 mm long. Stamens 5; anthers oblong, *c.* 1–1.5 mm long. Ovary turbinate, *c.* 1 mm long, 2-locular; styles 2, at first erect, later recurved. Fruit rotund, fleshy, black, compressed, *c.* 4 \times 7 mm (when dry); styles persistent.

Field characters: Leaves similar to *P. macgillivrayi*, but the short verticillate branching of the inflorescence is characteristic.

Distribution: Restricted to Papuaia where it occurs in the Madang (Bagabag Island), Manus, New Britain and New Ireland districts, and the Solomon Islands.

Ecology: Usually near the beach or in lowland forest, to 140 m altitude.

2. Sect. GELIBIA Philipson

Tree with bipinnate leaves. Inflorescence racemose. Style arms free and divergent after anthesis.

Distribution: 1 species, New Guinea and Queensland, Australia.

Polyscias elegans (C. Moore & F. Muell.) Harms in Engl. & Prantl *Nat. Pflanzenfam.* **3**, 8: 45 (1894). **Fig. 7.**

Panax elegans C. Moore & F. Muell. (1858); *Nothopanax elegans* (C. Moore & F. Muell.) Seem. (1866); *Polyscias branderhorstii* Harms (1910); *Gelibia branderhorstii* (Harms) Hutchinson (1967); *Gelibia elegans* (C. Moore & F. Muell.) Hutchinson (1967).

A tree to 20 m high, with a spreading crown of thick branches bearing terminal clusters of large, young parts with fawn to grey scurfy tomentum, unarmed. Leaves bipinnate, becoming glabrous, up to 110 × 50 cm or larger. Petiole *c.* 13 cm long, terete with a slightly clasping base; rachis articulated; petiolules up to *c.* 5 mm long. Lamina ovate or elliptic, *c.* 6 × 3 cm, chartaceous to somewhat leathery; base cuneate; margin entire and slightly revolute; apex with an obtuse apiculum; midrib prominent, lateral veins rather obscure. Inflorescence a large, terminal panicle, tomentum persistent especially on the pedicels; primary axis stout, *c.* 30 cm long, bearing secondary axes along its length and in a terminal subumbellate cluster, bracts caducous; secondary axes 20–30 cm long, bearing tertiary axes (*c.* 10 cm long) along their length; flowers borne racemously along the tertiary axes, each on a pedicel 1–2 mm long. Calyx a minute rim. Petals 5, oblong, rather fleshy, spreading at anthesis and soon falling. Stamens 5; filaments short; anthers 2 mm long, soon falling. Ovary scurfy, at first turbinate, globose at anthesis, *c.* 5 × 5 mm and irregularly ribbed (when dry).

Field characters: The large bipinnate leaves and the panicle of racemously arranged flowers are most distinctive.

Distribution: New Guinea and Queensland, Australia. In New Guinea this species is known from the Digul and Central districts.

Ecology: Gallery and secondary growth forest in monsoon regions, at low altitudes (up to 300 m).

3. Sect. EUPTERON Philipson

Trees or shrubs with imparipinnate or bipinnate leaves. Flowers in umbellules or capitula. Style arms divergent, at least in fruit.

Distribution: 4 species occur in Papuaia, but the section probably includes the majority of the genus in other parts of the old-world tropics.

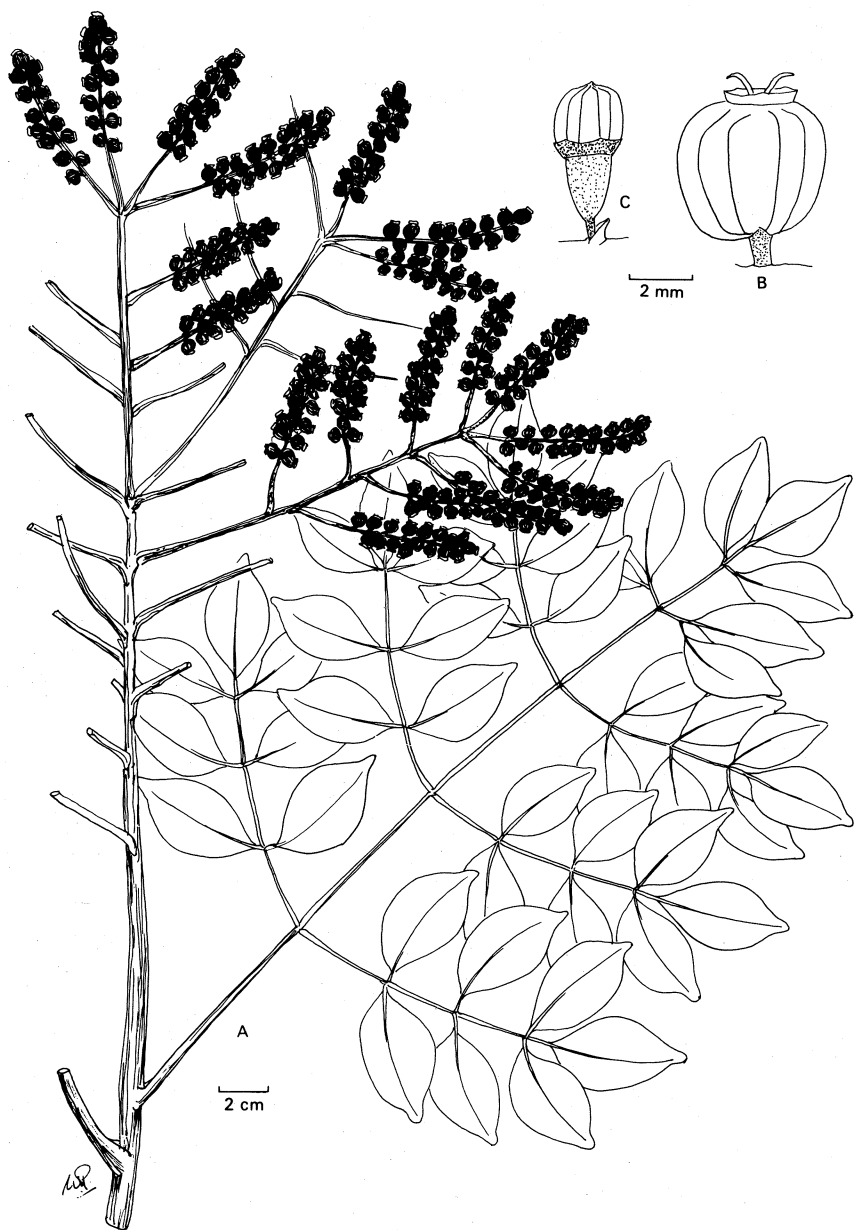


Fig. 7. *Polyscias elegans* (C. Moore & F. Muell.) Harms (A) fruiting branchlet (B) fruit (C) flower bud (source unknown)

KEY TO SPECIES

- 1. Flowers in capitula **P. nodosa**
- 1. Flowers in umbellules
 - 2. Umbellules arranged racemously along the principal rays
 - 3. Leaf margin crenate **P. ledermannii**
 - 3. Leaf margin entire (rarely with few minute dentations) **P. belensis**
- 2. Umbellules in a short corymbose compound umbel **P. philipsonii**

Polyscias belensis Philipson *Bull. Brit. Mus. Nat. Hist. Bot.* 1: 13 (1951).

A tree to 14 m high; branches bearing terminal clusters of large leaves, glabrous, unarmed. Leaves imparipinnate, up to 80 cm long. Petiole *c.* 12–16 cm long, terete, base slightly dilated; rachis articulated; leaflets subsessile or with a petiolule to 1 cm long. Lamina elliptic to narrowly elliptic, *c.* 12 × 3.5–6 cm, subcoriaceous; base cuneate; margin entire or sparsely denticulate, slightly revolute, narrowed to an obtuse apex; midrib prominent, laterals *c.* 12. Inflorescence a terminal panicle; primary axis stout, *c.* 18–22 cm long, bearing many secondary branches along its length and in a subumbellate cluster at its apex, with bracts caducous; secondary axes mostly 22–35 cm long, bearing umbellules racemously along their length, with bracts triangular, *c.* 3 mm long; peduncles *c.* 1.5–3 cm long. Flowers *c.* 10 per umbellule; pedicel 5–6 mm long. Calyx a minute rim. Petals 4, oblong. Stamens 4; filaments very short; anthers oblong, 2 mm long. Ovary turbinate, 1.5–2 mm high (at flowering), 4- or 5-locular; disc flat; styles 4 or 5, free, at first erect, later divergent. Fruit unknown.

Field characters: The inflorescence is similar to that of *P. ledermannii*, but the ovate leaflets are distinctive. The plant has an odour like celery.

Distribution: Restricted to New Guinea where it is known from the Snow Mountains (Bele River near Lake Habbema) and Morobe (Mt Kaindi and Aseki area) districts.

Ecology: Infrequent tree in montane forest and regrowth, at 1450–2650 m altitude.

Notes: In the type (from western New Guinea), the leaflet margin is entire, but in the three gatherings from Morobe there are some dentations, and it is possible that these collections are not conspecific.

Polyscias ledermannii Harms *Bot. Jb.* 56: 409 (1921). **Fig. 8.**

P. forbesii Bak. f. (1923); *P. clemensiana* Harms (1938).

A tree to 28 m high, with few thick branches bearing terminal clusters of large leaves, glabrous, unarmed. Leaves imparipinnate, up to 1.3 m long. Petiole to *c.* 16 cm long, terete, base slightly dilated; rachis articulated; petiolules *c.* 2–4 cm long. Lamina narrowly ovate or oblong-narrowly ovate, *c.* 10–20 × 2–4 cm, papyraceous; base truncate or rounded, often oblique; margin crenulate; apex acuminate; midrib prominent, lateral veins numerous, faint. Inflorescence a terminal panicle; primary axis stout, *c.* 15 cm long, bearing crowded secondary axes along its length and in a subumbellate cluster at its apex, with bracts triangular,

c. 3 mm long, caducous; secondary axes 20–30(–40) cm long; umbellules borne racemously along the secondary axes (often in subverticils) on peduncles 2–5 cm long, usually bearing 2 minute bracts. Flowers *c.* 8–12 in an umbellule; pedicel *c.* 5 mm long. Calyx a minute rim. Petals *c.* 2.5 mm long. Stamens 5. Ovary turbinate, 2 mm high, 3- or 4-locular; disc rising to the central styles. Fruit globose, 4–5 mm diameter (when dry), 3 or 4 ribbed; styles 3 or 4, divergent and persistent.

Field characters: Pinnate leaves with narrowly ovate crenate leaflets, and the umbellules arranged racemously along the rays of the inflorescence. It has an odour of celery.

Distribution: Endemic to New Guinea, frequently occurring from the Vogelkop to Milne Bay districts.

Ecology: In rain forest, gallery forest and secondary growth. Usually above 1500 m (to 3000 m), but occasionally as low as 500 m altitude.

Notes: A common small tree. Carr estimated the height of one specimen as 90 ft (28 m), but most are considerably smaller. The close resemblance of this species to *P. murrayi* (F. Muell.) Harms of Queensland is no doubt the basis of the report of that plant from New Guinea (Boerl. *Handl.* 1: 647 (1890)).

Polyscias nodosa (Bl.) Seem. *J. Bot. Lond.* 3: 181 (1865).

Aralia nodosa Bl. (1826).

A tree to 25 m high, unbranched or with few thick branches, bearing tufts of long leaves at their ends, young parts scurfy-tomentose, unarmed. Leaves imparipinnate, multijugate, becoming glabrous or minutely villose on the nerves beneath, up to 2(–3) m long. Petiole *c.* 30 cm long, terete, to 2 cm thick, with a short sheathing base; rachis strongly articulated; leaflets sessile. Lamina ovate-oblong, commonly 15 × 4 cm, or larger, chartaceous; base truncate; margin slightly crenate; apex ± apiculate. Inflorescence a large terminal panicle (sometimes with additional flowering branches in the axils of the upper leaves), tomentum ± persistent; primary axis stout, *c.* 1.5 m long, bearing secondary axes along its length, with bracts triangular, *c.* 5 mm long; secondary axes *c.* 20–40 cm long; capitula borne racemously along the secondary branches on peduncles *c.* 6–15 mm long. Flowers *c.* 8–12 in a capitulum. Calyx a minute rim. Petals 5, triangular, *c.* 2 mm long. Stamens 5; anthers broad and flat, rising to the 5 central erect styles. Fruit subglobose, 5-ribbed (when dry); styles spreading and reflexed.

Field characters: Long pinnate leaves forming tufts at the ends of thick branches. The flowers and fruits in small capitula arranged racemously along the inflorescence branches.

Distribution: Infrequent in coastal localities in New Guinea, but abundant in Indonesia and the Philippines. Specimens from Bougainville may not be conspecific.

Ecology: Open thickets and rain forest, at low altitudes and on small islands.

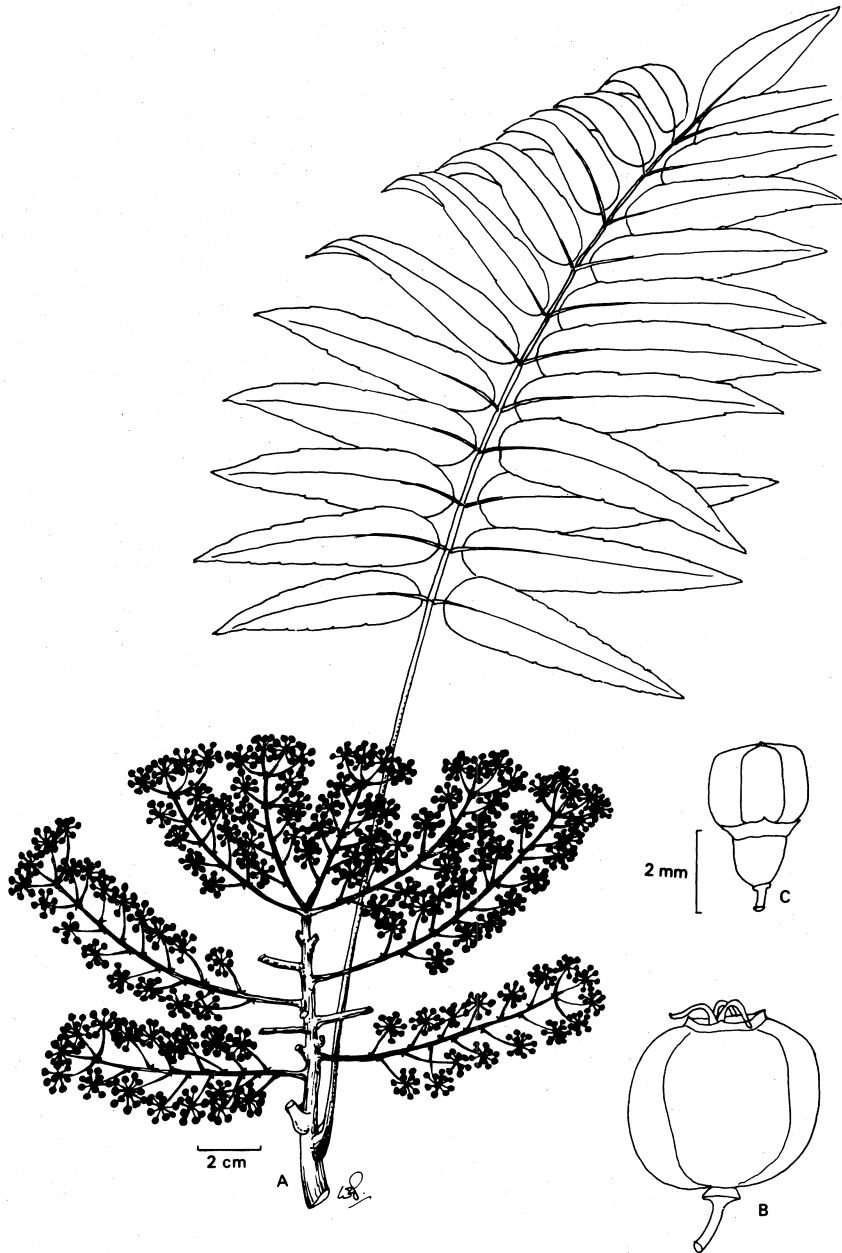


Fig. 8. *Polyscias ledermannii* Harms (A) flowering branchlet (B) fruit (C) flower bud (source unknown)

Polyscias philipsonii Bernardi *Ber. Schweiz. Bot. Ges.* **74**: 364 (1966).

Polyscias fraxinifolia Philipson (1951), non Harms (1894).

A sympodial unbranched shrub or epiphyte to 2 m high, with leaves spirally arranged towards the apex, glabrous, unarmed, new shoots arising below the inflorescence. Leaves imparipinnate, or occasionally 3 leaflets inserted together, or the leaves bipinnate, up to 35 cm long. Petiole to 10 cm long, terete, with a very short sheathing base; rachis articulated; petiolules to 7 mm long. Lamina variable in size and shape, broadly or narrowly elliptic, up to 9 × 4.5 cm, but usually smaller; base cuneate or rounded; margin minutely setose-crenulate; narrowed to the apex or apiculate; midrib prominent, lateral veins few, arched-ascending. Inflorescence a terminal corymb; peduncle short (1–2 cm long), sometimes bearing a reduced leaf or cataphyll distally; primary rays *c.* 5, subequal, mostly 3–4.5 cm long, bearing terminal compound umbels (occasionally with a lateral umbel); ultimate umbellules with 6–12 flowers; pedicel *c.* 4 mm long. Calyx a minute rim with indistinct teeth. Petals 5, triangular, *c.* 2 mm long. Stamens 5; anthers oblong, 1 mm long. Ovary turbinate, *c.* 2 mm high, 5-locular; disc fleshy and rising to the central erect styles. Fruit fleshy, globose, 5-ribbed (when dry), *c.* 4 × 6 mm; styles persistent and recurved.

Field characters: The short corymbose inflorescence is similar to those of Sect. *Palmervandenbroekia*, but the free recurved style arms exclude it from that section.

Distribution: Endemic to western New Guinea where known from the Idenburg River area, Jayapura district.

Ecology: In mossy forest at 1800 m altitude, and on an exposed slope at 2150 m altitude.

4. Sect. KISSODENDRON Philipson

Trees or shrubs with pinnate or bipinnate leaves. Umbellules arranged in diffuse panicles. Style arms fused, forming a beak-like projection on the fruit.

Distribution: 5 species in New Guinea, three of which extend to Queensland (Australia), and one to the Moluccas.

KEY TO SPECIES AND VARIETIES

1. Leaves bipinnate **P. bipinnata**
1. Leaves imparipinnate
 2. Leaflets in 3 or 4(or 5) pairs **P. zippeliana**
 2. Leaflets in > 5 pairs
 3. Fruits rotund, *c.* 8 mm broad **P. royenii**
 3. Fruits ovoid, *c.* 4–5 mm broad
 4. Base of leaflets cuneate **P. schultzei**
 4. Base of leaflets truncate, subcordate, or rounded **P. australiana** var. **disperma**

Polyscias australiana (F. Muell.) Philipson *Blumea* **24**: 171 (1978).

Hedera australiana F. Muell (1864); *Kissodendron australianum* (F. Muell.) Seem. (1865)

var. **disperma** (F. Muell.) Philipson *Blumea* **24**: 171 (1978).

Kissodendron australianum var. *dispermum* F. Muell. (1877).

A small tree, often unbranched, the young parts brown furfuraceous; branches unarmed, with leaves arranged spirally towards their ends. Leaves imparipinnate, multijugate, to 1 m long. Petiole *c.* 25 cm long, terete, with a short sheathing base; rachis articulated; petiolules to 15 mm long. Lamina broadly ovate or oblong, broadest near the base, up to 14 × 6 cm, ± coriaceous; base rounded, truncate or subcordate, oblique; margin entire, slightly revolute; upward attenuate to an obtuse apex, or with an obtuse apiculum; midrib and lateral veins prominent. Inflorescence a diffuse terminal panicle (sometimes also with flowering branches in the axis of the upper leaves); peduncle short, terminating in several primary rays, reduced leaves subtending the principal branches; primary rays *c.* 50 cm long, bearing verticils of secondary branches along their length and ending in a compound umbel; umbellules of usually 10–15 flowers; pedicel mostly 8–10 mm long. Calyx an undulate rim. Petals 5, *c.* 1.5 mm long. Stamens 5, *c.* 1 mm long. Ovary turbinate, 2-locular; disc fleshy, rising to a low conical stylopodium. Fruit ovoid, fleshy, 6 × 4 mm (when dry), crowned by the persistent calyx and beak-like stylopodium (2 mm long).

Field characters: Distinguished from *P. schultzei* by the leathery leaflets with a truncate base, and from *P. royenii* by the smaller fruits.

Distribution: Endemic to western New Guinea, occurring in the Vogelkop and Digul districts.

Ecology: Primary rain forest at low altitudes and also in lower montane forest at 1750 m altitude.

Polyscias bipinnata (Gibbs) Philipson *Blumea* **24**: 170 (1978).

Kissodendron bipinnatum Gibbs (1917).

A small tree, the young parts brown furfuraceous; branches unarmed with spirally arranged leaves towards their ends. Leaves bipinnate, 70 × 68 cm. Petiole 26 cm long, terete with a short sheathing base; rachis with a pair of leaflets at each articulation; petiolules up to 1.3 cm long. Lamina narrowly oblong or ovate, 6–12 × 2.5–4(–5) cm; base broadly cuneate or rounded; margin entire, irregularly undulate, slightly revolute; apex attenuated; midrib prominent. Inflorescence a diffuse terminal panicle (sometimes also with flowering branches in the axils of the upper leaves); peduncle *c.* 6 cm long, terminating in 3 primary rays; primary rays 40–50 cm long, bearing verticils of pairs of secondary branches along their length and ending in a compound umbel; umbellules of 10–15 flowers; pedicel *c.* 10 mm long. Calyx an undulate rim. Petals 5, *c.* 2.5 mm long. Stamens 5; filaments 1 mm long; anthers 1.2 mm long. Ovary turbinate, 2- or 3-locular; disc with a central stylopodium 1 mm long. Fruit ovoid, fleshy, 5 × 3 mm (when dry), crowned by the calyx rim and the beak-like stylopodium; stigmas minutely capitate.

Field characters: The individual leaflets are similar to those of *P. schultzei* but their bipinnate arrangement is distinctive.

Distribution: Endemic to western New Guinea, occurring in the Anggi Lakes area, Vogelkop district.

Ecology: Montane forest, at c. 2000 m altitude.

Polyscias royenii Philipson *Blumea* **24**: 170 (1978).

A small tree usually c. 5(–15) m high, monocaulous sympodial, persistently rufous-furfuraceous, unarmed, with leaves spaced along the upper part of the stem. Leaves imparipinnate, with c. 9 pairs of leaflets, up to at least 100 cm long. Petiole to 30 cm long, terete, with a short sheathing base; rachis articulated; petiolule of midleaflets 8–20 mm long. Lamina normally oblong-ovate, broadest near the base, up to 24 × 11 cm, coriaceous; base truncate to subcordate, often oblique; margin entire, irregularly undulate, slightly revolute; apex attenuate or apiculate; midrib prominent, vein-reticulation furfuraceous below and depressed above (rugose), raised. Inflorescence a terminal panicle, flowering branches also often present in the axils of the uppermost leaves; the rachis up to 60 cm long with verticils of secondary branches subtended by caducous unifoliate bracts and a terminal compound umbel; the lower secondary branches up to 50 cm long, with verticillate tertiary branches and terminal compound umbels; umbellules with 10–20 flowers; pedicel c. 8 mm long, furfuraceous. Calyx a furfuraceous rim, with 5 small teeth. Petals 5, strap-shaped, c. 3 mm long, soon falling. Stamens 5. Ovary subcylindric, furfuraceous, c. 3 mm long, 2(or 3)-locular; disc fleshy, forming a projecting conical stylopodium 2 mm long; stigmas 2, adpressed at anthesis. Fruit rotund, compressed, with prominent ribs (when dry), 7–9 × 8–10 mm, crowned by the prominent persistent calyx and a short stout beak-like stylopodium; stigmas short, divergent.

Field characters: A species readily characterised by its thick leathery leaflets, large rigid furfuraceous inflorescence, and large compressed black fruits with a glaucous bloom.

Distribution: Endemic to New Guinea where it is known from the Cyclops Mountains of western New Guinea to the Eastern Highlands district of north-eastern New Guinea.

Ecology: Terrestrial or epiphyte in primary or secondary montane forest, at 1200–2400 m altitude.

Polyscias schultzei Harms *Bot. Jb.* **56**: 410 (1921). **Fig. 9.**

P. gjellerupii Harms (1921).

A shrub or small tree, often unbranched and usually 4–20 m high, but attaining a height of 26 m, young parts densely brown furfuraceous; branches unarmed, with spirally arranged leaves towards their ends. Leaves imparipinnate, to 80 cm long, with c. 8–11 pairs of leaflets. Petiole up to 35 cm long, terete, with a short sheathing base; rachis articulated; petiolules c. 8 mm long. Lamina narrowly ovate, oblong or elliptic up to 14(–17) × 4–5 cm; base broadly cuneate, oblique; margin entire; apex attenuate or acuminate; midrib prominent. Inflorescence a diffuse repeatedly compound umbel, with reduced leaves ± persistent at the nodes; peduncle usually rather short (c. 5 cm long) ending in a group of several primary rays (and sometimes with one or more lateral rays); primary rays 50–60 cm long, with verticils and a terminal umbel of secondary rays which in turn are

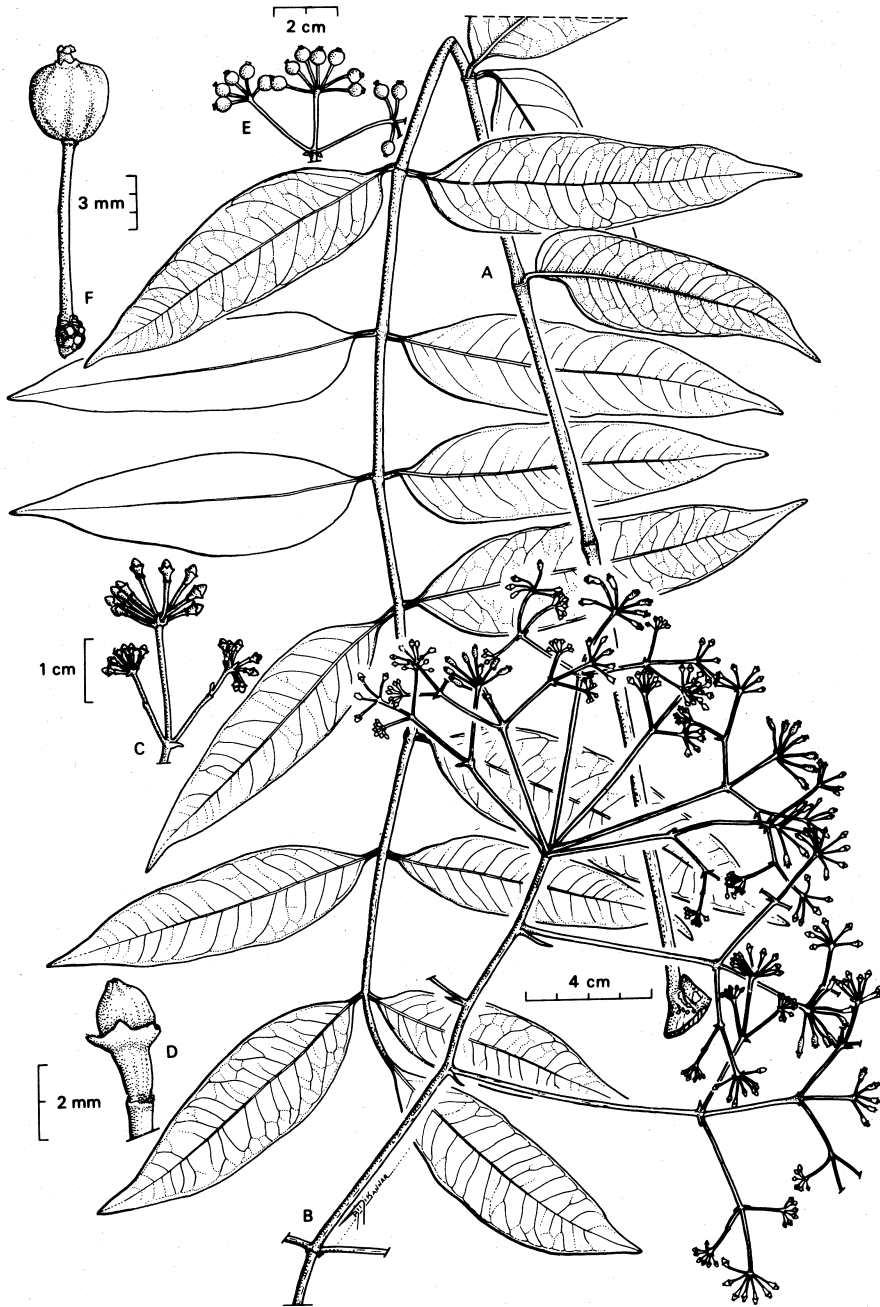


Fig. 9. *Polyscias schultzei* Harms (A) pinnate leaf (NGF 8458) (B) partial inflorescence (C) ultimate branchlets of inflorescence (D) flower bud (B-D: Philipson & Kairo 3660) (E) ultimate branchlet of infructescence (F) fruit (E & F: NGF 8458)

branched; umbellules with generally 5–10 flowers; pedicel fine, mostly 5–8 mm long (elongating in fruit to 12–15 mm). Calyx a minute rim with 4 or 5 small teeth, usually glabrous but occasionally furfuraceous. Petals 4 or 5, c. 3 mm long. Stamens 4 or 5, 2 mm long. Ovary \pm cylindric, glabrous or occasionally furfuraceous, c. 2 mm long, 2-locular; disc fleshy, forming a blunt stylopodium. Fruit ovoid, fleshy, c. 5 mm long, crowned by the inconspicuous calyx and the projecting beak-like stylopodium (c. 2 mm long); stigmas slightly divergent or capitate.

Field characters: A widespread and frequently collected species recognized by the multijugate leaves, with rather small thin attenuate leaflets that each have a cuneate base. The flowers are white to yellowish and the fruits black. The grey bark exudes a small amount of gummy sap; the wood is white.

Distribution: This species occurs in the Moluccas (Morotai), New Guinea and Queensland, Australia. In New Guinea it occurs throughout most of the island, from the Vogelkop Peninsula and Japen Island (Geelvink Bay district) to Edie Creek (Morobe district) and Mafulu (Central district).

Ecology: Usually in lower and mid-montane rain forest (with *Castanopsis*, *Nothofagus*, *Lithocarpus*); also in regrowth. Ascends to 2400 m altitude, usually above 1200 m, but descends to near sea level.

Polyscias zippeliana (Miq.) Val. *Bull. Dep. Agr. Ind. Neerl.* **10:** 42 (1907).

Panax zippelianus Miq. (1863) (as 'zippeliana'); *Nothopanax zippelianus* (Miq.) Seem. (1866) (as 'zippelianum'); *Polyscias caroli* Harms (1920).

A shrub usually c. 1.5 m high, but reaching 5 m, with few branches, bearing leaves spirally arranged near their ends, glabrous except a slightly rufous tomentum on young parts, unarmed. Leaves imparipinnate, with 3 or 4 pairs of leaflets, up to c. 60 cm long. Petiole to 17 cm long, terete, with a very short sheathing base; rachis articulated; petiolules 5–15 mm long. Lamina oblong, ovate or elliptic; 6–13 \times 3.5–6 cm, papyraceous; base cuneate, often oblique; margin entire, slightly revolute; apex attenuate or apiculate; midrib and few lateral veins evident. Inflorescence a terminal panicle, often appearing lateral by rapid growth of a bud at its base; branches rather fine and wiry; rachis often angled at the nodes, up to c. 60 cm long; secondary branches borne singly at wide intervals and in a few-rayed terminal umbel, c. 20 cm long, bearing umbellules on side branches and terminally; umbellules with c. 10–15 flowers; pedicel 5–10 mm long. Calyx a minute rim. Petals 5, broadly oblong, c. 2 mm long. Stamens 5; filaments 1 mm long; anthers oblong, 1 mm long. Ovary turbinate, 2 mm high, 2-locular; disc fleshy, rising to the central fused styler column. Fruit ovoid, crowned by the prominent stylopodium with a capitate stigma, c. 7 \times 4 mm (when dry).

Field characters: The pinnate leaves with 3(or 4) pairs of leaflets are distinctive.

Distribution: This species occurs in New Guinea, Aru Islands and Cape York Peninsula (Queensland, Australia). In New Guinea it is known from the Sepik, Digul and Western districts.

Ecology: Forest in savannah country, with *Melaleuca* and *Acacia*.

5. Sect. PALMERVANDENBROEKIA Philipson

Trees or shrubs with imparipinnate leaves. Umbellules arranged in short corymbose compound umbels. Style arms fused, forming a beak-like projection on the fruit.

Distribution: Endemic to New Guinea where it is known from the Vogelkop Peninsula, Cyclops Mts (Jayapura district)(both western New Guinea) and from Mt Bosavi (Western district, Papua).

KEY TO SPECIES

1. Pedicel tomentose (at anthesis)
2. Inflorescence a compact regular compound umbel with rigid rufous branches (Vogelko and Cyclops Mts) **P. sleumeri**
2. Inflorescence more open, less regularly branched, with branches becoming \pm glabrous (Mt Bosavi, Papua) **P. jacobsii**
1. Pedicel glabrous (at anthesis)
3. Flower-buds narrowly ovoid; stylopodium at anthesis c. 2 mm long (Vogelkop, Arfak Mts) **P. palmervandenbroekii**
3. Flower-buds ovoid; stylopodium at anthesis c. 1 mm long (Vogelkop, Nattoti Range and Aifait River) **P. vogelkopensis**

Polyscias jacobsii Philipson *Blumea* 24: 171 (1978).

A shrub to 3 m high, monocaulous sympodial, young parts furfuraceous, unarmed, with leaves spaced along the upper part of the stem. Leaves imparipinnate, 4 or 5 pairs of leaflets (leaves of juveniles smaller with fewer leaflets), c. 45 cm long. Petiole to 12 cm long, terete, with a short sheathing base; rachis articulated; petiolules 10–15 mm long. Lamina oblong or elliptic, c. 12 \times 4 cm, chartaceous; base truncate or cuneate; margin entire, irregularly undulate, slightly revolute; apex attenuate or caudate; midrib prominent. Inflorescence a terminal compound umbel (stem growth renewed by a bud between the inflorescence and the uppermost leaf); peduncle 1–4 cm long (sometimes bearing a unifoliate leaf about the middle with an axillary flowering branch), ending in an umbel of 2–4 primary rays; primary rays sometimes subtended by 1 or 2 unifoliate leaves, c. 4 cm long, ending in 2 or 3 tertiary rays which may branch again before ending in umbellules; umbellules with 6–10 flowers; pedicel c. 8 mm long, scurfy; flower buds with an apical umbo. Calyx a rim with 5 acute teeth. Petals 5, attenuate. Stamens 3; anthers 1.5 mm long. Ovary subcylindric, furfuraceous, 4 mm high, 2-locular; disc forming a projecting conical stylopodium (1.5 mm long at anthesis); stigmas 2. Fruit rotund, compressed, 8 \times 9 mm, crowned by the small calyx and persistent stylopodium (2 mm long) with subcapitate stigmas.

Field characters: Similar to *P. sleumeri* but with a more open inflorescence becoming \pm glabrous at fruiting.

Distribution: Endemic to New Guinea: known from Mt Bosavi, Western district.

Ecology: On old well-drained volcanic soil in primary mixed forest, mostly on ridges and upper slopes, at 1600–2100 m altitude.

Polyscias palmervandenbroekia Bernardi *Candollea* 26: 16 (1971).

Palmervandenbroekia papuana Gibbs (1917), non *Polyscias papuana* (Miq.) Seem. (1865) [= *Gastonia serratifolia* (Miq.) Philipson]

A shrub c. 1.5 m high, sparsely branched, glabrous, unarmed, with leaves spaced along the upper part of the stem. Leaves imparipinnate, with 3–5 pairs of leaflets, up to 13 cm long. Petiole to 4 cm long, slightly channelled above, with

a very short sheathing base; rachis articulated; petiolules absent or to 5 mm long. Lamina narrowly ovate, obovate to elliptic, 1.2–4 × 0.8–2 cm, coriaceous to chartaceous; base cuneate; margin entire, revolute; apex attenuate (sometimes emarginate) to apiculate; midrib prominent, lateral veins obscure. Inflorescence a terminal simple or compound umbel; peduncle slender, *c.* 2 cm long; primary rays (when present) few, *c.* 1 cm long; umbellules of *c.* 10 flowers; pedicel 3–6 mm long, glabrous; flower buds narrowly ovoid, acute, variable in length (3–6 mm long). Calyx a rim with 5 broad teeth. Petals 5, attenuate, 5–8 mm long. Stamens 5; filaments *c.* 3 mm long; anthers *c.* 1 mm long. Ovary turbinate, striate, 2 mm high, 2-locular; disc projecting as a conical stylopodium (2 mm long); stigmas 2. Fruit ovoid, compressed, 6 × 5 mm, crowned by persistent calyx and the beak-like stylopodium (2 mm long) with small divergent stigmas.

Field characters: Pinnate leaves with small leathery leaflet. The long and narrowly ovate petals, and prominent stylopodium are characteristic.

Distribution: Endemic to western New Guinea, occurring in the Arfak Mountains, Vogelkop district.

Ecology: In summit heath vegetation (in *Tristania-Dacrydium* scrub) and *Nothofagus* forest, at 1900–2400 m altitude.

Polyscias sleumeri Philipson *Blumea* 24: 171 (1978).

A shrub usually *c.* 1–1.5 m high, monocaulous sympodial, young parts red-furfuraceous, unarmed, with leaves spaced along the upper part of the stem. Leaves imparipinnate, with 3 or 4 pairs of leaflets (leaflets occasionally in threes), *c.* 35 cm long. Petiole to 9 cm long, terete, with a very short sheathing base; rachis articulated; petiolules 8–15 mm long. Lamina oblong, ovate or elliptic, up to 16 × 6 cm, chartaceous; base rounded to cuneate; margin entire, irregularly undulate, slightly revolute; apex attenuate or apiculate; midrib prominent. Inflorescence a terminal compound umbel, red-furfuraceous (stem growth renewed by a bud between the inflorescence and the uppermost leaf); peduncle 3–6 cm long, bearing scars of caducous reduced leaves, occasionally with a lateral umbellule, and ending in an umbel of *c.* 7 primary rays; primary rays 1–2.5 cm long, sometimes with a minute bract near the middle; umbellules with 10–20 flowers; pedicel 2–3 mm long, densely scurfy. Calyx a rim with 5 broad teeth. Petals 5, broadly oblong, 3–4 mm long. Stamens 5; filaments 2 mm long; anthers 1 mm long. Ovary turbinate, 2 mm high, 2-locular; disc fleshy, forming a projecting conical stylopodium (2 mm long); stigmas 2, adpressed at anthesis. Fruit rotund to ovoid, compressed, 5–6.5 mm, crowned by the prominent persistent calyx and the beak-like stylopodium (2 mm long), with stigmas not prominent.

Field characters: Recognized by the large leaflets, combined with the compact inflorescence that has rufous branches and pedicels.

Distribution: Endemic to western New Guinea where it is known from the Vogelkop Peninsula (Ije River) and Jayapura district (Cyclops Mts).

Ecology: Undergrowth in primary forest, at 450–1000 m altitude.

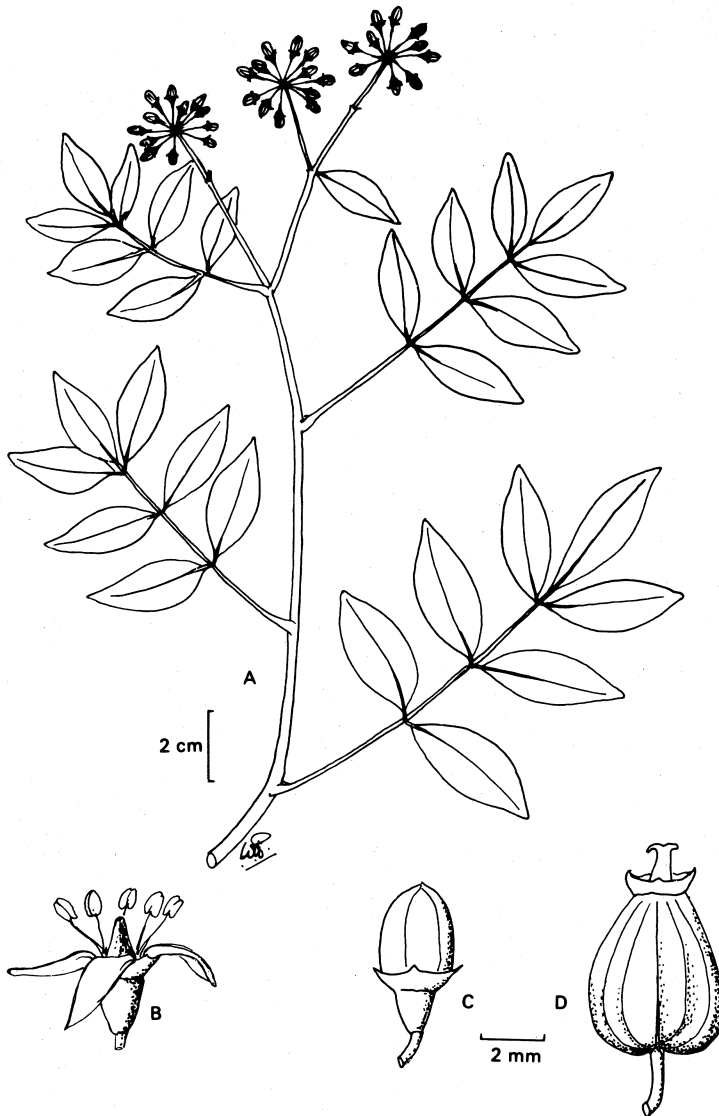


Fig. 10. *Polyscias vogelkopensis* Philipson (A) flowering branchlet (B) flower (C) flower bud (D) fruit (van Royen & Sleumer 7887)

***Polyscias vogelkopensis* Philipson *Blumea* 246: 171 (1978). Fig. 10.**

A shrublet usually under 1 m high, and often monocaulous sympodial, young parts slightly furfuraceous, but soon becoming glabrous, unarmed, with leaves spaced along the upper part of the stem. Leaves imparipinnate, with 3 or 4 pairs of leaflets (leaflets occasionally in threes), variable in size. Petiole 2–7 cm long, slightly channelled above, with a short inconspicuous sheathing base; rachis

articulated; petiolules 2–8 mm long. Lamina elliptic or ovate, 3–12 × 1.2–4 cm, chartaceous; base broadly to narrowly cuneate; margin entire, irregularly undulate (occasionally with isolated dentations), slightly revolute; apex attenuate or apiculate; midrib prominent. Inflorescence a terminal small compound umbel; peduncle up to 8 cm long, occasionally with a lateral or basal umbellule, ending in c. 2 or 3 primary rays (sometimes subtended by a reduced leaf); primary rays 1–2 cm long; umbellules with c. 10–15 flowers; pedicel c. 3–6 mm long, glabrous; flower buds ovoid, obtuse. Calyx a rim with 4 or 5 broad undulations. Petals 4 or 5, broadly oblong, 4 mm long. Stamens 4 or 5; filaments 3 mm long; anthers 1 mm long. Ovary turbinate, 2 mm high, 2-locular; disc fleshy, rising to a conical stylopodium (1 mm long); stigmas 2, adpressed at anthesis. Fruit ovoid, compressed, 5 × 4 mm, crowned by persistent calyx and the prominent beak-like stylopodium; stigmas inconspicuous.

Field characters: A delicate subshrub, often unbranched. Similar to *P. palmervandenbroekii* but leaves not so coriaceous and the flower buds ovoid and obtuse, not narrowly ovoid.

Distribution: Endemic to the Vogelkop district of western New Guinea where it is known from the Nettoti Range and Aifat River.

Ecology: Primary submontane forest, dominated by *Nothofagus*, *Castanopsis*, and conifers; in heath vegetation; or in open places, at 1200–2000 m altitude.

INSUFFICIENTLY KNOWN SPECIES

Polyscias roemeriana Harms *Bot. Jb.* **56**: 411 (1921).

I have seen no authentic specimens of this species. Evidently it is related to *P. palmervandenbroekia* by reason of its connivent styles, its short inflorescence, and its small leaflets. However, bipinnate leaves are not known in that species.

EXCLUDED GENUS

Meryta Forst.

Meryta colorata F. M. Bail. *Qld. Agric. J.* **3**: 283 (1898); Harms *Bot. Jb.* **56**: 384 (1920). The type specimen of this species cannot be located, but the original description does not seem to relate to a member of the Araliaceae, and certainly not to a *Meryta*.

DROSERACEAE

B. J. Conn¹

Small perennial or annual, terrestrial or aquatic, insectivorous herbs. Primary roots often reduced, base of stem with adventitious roots, sometimes a subterranean tuber or small rhizome present. Leaves spiral, sometimes whorled, often in a basal rosette, with pedicellate glands, marginal glands longest. Stipules present or absent. Inflorescence lateral or terminal, cymose, racemose or solitary. Bracts present or absent. Bracteoles absent. Flowers actinomorphic, bisexual. Calyx (4- or) 5-merous, \pm imbricate; sepals \pm connate at the base, persistent. Corolla (4- or) 5-merous, \pm imbricate in bud; petals free, marcescent, persistent. Stamens hypogynous, 5, free, alternipetalous, persistent; filaments filiform; anthers bilocular, opening with 2 longitudinal slits, extrorse; pollen tricolpate or triporate. Gynoecium of 3–5 carpels; ovary superior, unilocular; placentation parietal; ovules usually many, anatropous, bitegmic; styles 3–5 (as many as placentas), free or connate, simple or divided; stigmas terminal, dry. Fruit a loculicidal capsule, 3–5-valved, surrounded by persistent calyx. Seeds numerous, small, spindle-shaped, endospermic; embryo straight; cotyledons straight.

Distribution: There are 4 genera with c. 100 species in the family. *Drosera* is widely distributed in both temperate and tropical regions, with its main development in Australia. There are 7 species in Papuasias. The other 3 genera (*Aldrovanda*, *Dionaea* and *Drosophyllum*) are monotypic and have not been reported from Papuasias. *Aldrovanda* extends from Europe through Asia to Australia, once collected in Timor. *Dionaea* occurs in southeastern N. America and *Drosophyllum* occurs in southwestern Europe and Morocco.

Ecology: The family shows a great tolerance to ecological variation. *Aldrovanda* is aquatic, whereas the very diverse genus *Drosera* is found from the very dry areas of central Australia to the humid tropics of Malaysia and Papuasias, and also in the temperate and cold regions of the world. In *Drosera*, small insects are trapped by sticky pedicellate glands of the leaf lamina. The exudate from these glands breaks down protein, and absorption of essential amino acids by the plants is possible. In *Aldrovanda*, a more specialized trapping mechanism has been developed to trap zooplankton. *Dionaea* also has an active trap-mechanism using its leaves.

Literature: C. G. G. J. van Steenis (1953), *Droseraceae, Fl. Males.*, ser. 1, 4: 337–381; (1953), *Miscellaneous Notes, Acta Bot. Neer.*, 2, 3: 304; (1955),

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Miscellaneous Notes, *Nova Guinea Bot.* n.s. 6: 279; (1958), *Fl. Males.*, ser. 1, 4: 377–381. R. Erickson (1968), *Drosera, Aldrovanda*, Plants of Prey in Australia, 13–53, 87 & 88. N. G. Marchant, H. I. Aston & A. S. George (1982), Droseraceae, in A. S. George (Ed.), *Fl. Austral.* 8: 9–66.

DROSERA L.

Terrestrial, mostly perennial herbs. Stem often reduced, or long and erect, or scrambling. Leaves spiral, simple, all in a basal rosette, or some or all cauline; glandular hairs present; stipules, when present, often multilobed. Inflorescence simple or branched, mostly bracteate; flowers white, pink or purple. Calyx inner surface glabrous. Corolla with prominent veins; petals ovate to obovate-spathulate; after anthesis the petals tend to stick together with anthers and stigmas to form a hood over the fertilized ovary and capsule. Stamens as many as petals. Styles 2–5, simple, once, twice or repeatedly divided. Seeds ellipsoid or fusiform, black.

Distribution: Over 90 species distributed discontinuously throughout the world, the largest development being centred in Australia. Seven species recognized in Papuasia. So far, *Drosera* has not been recorded from the Solomon Islands.

Ecology: In Papuasia, generally growing on bare, exposed, damp areas as found in grasslands, savannah, peat bogs and swamplands. Soils acidic, usually of fine texture, often sandy; in general, poor oligotrophic soils.

Literature: B. J. Conn (1980), A review of *Drosera* in Papuasia, *Brunonia* 3: 209–216; (1981), The *Drosera peltata*—*D. auriculata* complex, *J. Adelaide Bot. Gard.* 3: 91–100; (1983), Droseraceae, in P. van Royen, The alpine flora of New Guinea, 4: 2527–2530. See also under family.

KEY TO SPECIES

1. Stem distinct with internodes elongated
 2. Cauline leaves \pm peltate, \pm orbicular or lunate
 3. Stipules present; bracts absent **D. banksii**
 3. Stipules absent; bracts present **D. peltata**
 2. Cauline leaves linear, not peltate **D. indica**
1. Stem reduced, hence the leaves in a basal rosette
 4. Leaves with eglandular (densely pubescent) and glandular indumentum, glandular hairs restricted to upper surface of lamina; peduncle, pedicel and calyx pubescent; bracts absent **D. petiolaris**
 4. Leaves with glandular indumentum only; peduncle and pedicel glabrous or glabrescent, calyx glandular, never pubescent; bracts present
 5. Bracts 3-partite; styles (4 or)5, each divided only at apex **D. burmanni**
 5. Bracts simple; styles 3(or 4), each divided to the base into two arms
 6. Lamina obovate-spathulate; seeds ellipsoid, 0.3 mm long; bracts linear-ovate, 1–2.5 mm long, width at base 0.3–0.4 mm long **D. spatulata**
 6. Lamina semi-orbicular; seeds fusiform, at least 0.8 mm long; bracts ligulate, 4–5 mm long, 1–1.3 mm wide **D. rotundifolia** subsp. **bracteata**

Drosera banksii R. Br. ex DC. *Prodr.* 1: 319 (1824).

Stem erect, unbranched, up to 20(–25) cm long, glabrous basally, sparsely hairy from above base to distal parts; trichomes multicellular, c. 0.5 mm long.

Presence or absence of tubers unknown. Stipules membranous, divided from near the base into two lobes, each lobe \pm ovate, 1–2.5 mm long, 0.2–0.3 mm wide at the base, narrower on the basal part of the stem and on young plants, margin fimbriate. Leaves all cauline, petiolate. Petiole 5–8 mm long, spreading or recurved, eglandular hairy, red. Lamina usually peltate, sometimes subpeltate, \pm orbicular, diameter 1–1.5 mm, red; lower surface glabrous; upper surface with glandular trichomes *c.* 1.5 mm long. Inflorescences lateral, often also terminal, ascending, up to 6 cm long, with eglandular hairs *c.* 0.5 mm long, sparse at base, dense distally; up to *c.* 7-flowered; pedicels 1–3.5 mm long; bracts absent. Sepals ovate-elliptic to obovate-elliptic, *c.* 2.4 mm \times 1 mm; outer surface densely covered by eglandular trichomes up to 1 mm long. Petals *c.* 4 mm long, white. Staminal filaments slender, *c.* 1.5 mm long; anthers 0.2 mm long. Pistil glabrous; ovary subglobular to obovoid, 1 mm long, 3(or 4)-lobed distally; styles 3(or 4), *c.* 1.2 mm long, divided into two slender arms 0.4–0.5 mm above the base; stigmas laterally flattened, *c.* 0.3 mm long. Capsule \pm globular to ellipsoid, 1.5 mm long; seeds ellipsoid to cylindrical-ellipsoid, 0.8 \times 0.5 mm, surface appearing slightly ridged but otherwise smooth.

Distribution: Occurs in scattered localities in northern Australia and the Western district of Papua.

Ecology: In open *Banksia dentata* savannah, with *Melaleuca*, *Acacia* and *Eucalyptus*, at an altitude of 20 m.

Notes: This species has close affinities with *D. peltata* both having a distinct stem and peltate leaves. However, *D. peltata* differs in the absence of stipules, the presence of bracts and in the absence of non-glandular indumentum on the vegetative parts.

***Drosera burmanni* Vahl Symb. Bot. 3: 50 (1794). Fig. 11F & G.**

Stem reduced. Roots fibrous. Stipules 2–6(–8) \times 1 mm, (5–)6(–7)-lobed, subulate. Leaves adpressed to the soil in a flat basal rosette. Petiole very short or absent. Lamina broadly cuneate-obovate to obovate, 6–16 \times 3–7 mm, light green; margin fimbriate with pedicellate glandular hairs. Inflorescence a terminal one-sided raceme; peduncles 1 or 2, erect, 9–24 cm long, compressed, glabrous, red, (3–)4–18-flowered; pedicels (1–)2–3(–4) mm long, glabrous; bracts 3-partite, outer lobes 0.3–0.5 \times 0.1 mm, inner lobe 1–1.2 mm long, point of attachment of bracts 0.5 mm wide. Sepals ovate, 2–3 \times 1–1.5 mm; outer surface tuberculate with fine glandular trichomes, diameter of tubercles *c.* 0.1 mm; apex obtuse. Petals obovate, 3–4 \times 0.5 mm, white or pink. Staminal filaments *c.* 2–4 mm long; anthers 0.4 mm long. Styles 5, each 0.5–0.7 mm long; apex often split into short lobes. Capsule 1.5 \times 1 mm. Seeds \pm ellipsoid, 1.2 \times 0.3–0.5 \times 0.2 mm, finely scrobiculate.

Distribution: India to south Japan, throughout most of Malesia, Micronesia and widespread across northern and northeastern Australia. In Papuaia it has been collected from the Vogelkop, Geelvink Bay, West Sepik, Western and Papuan Islands districts.

Ecology: Associated with open grass and sedge plains, or savannah with *Melaleuca*, *Acacia* and *Eucalyptus*. It occurs in damp situation at low altitudes up to 170 m; often coastal. Soils usually with a thin sand layer on top of clay.

Notes: *Drosera burmannii* and *D. spatulata* are often difficult to distinguish, especially after anthesis. In all material studied, it was found that the two species could be distinguished on the basis of the bracts, and, to a lesser extent on the surface of the calyx. In *D. burmannii* the bracts are 3-partite (in New Guinea material) and calyx tuberculate, whereas *D. spatulata* has simple bracts and calyces which are sparsely covered with minute glandular trichomes.

The specific epithet is frequently misspelt as 'burmannii'.

***Drosera indica* L. *Sp. Pl.* 1: 282 (1753).**

Stem simple, erect, flexible, compressed, 18–24 cm long, glabrous to very sparsely covered with shortly pedicellate hairs. Roots fibrous. Stipules absent. Leaves cauline, linear, with pedicellate glandular hairs 1–6 mm long. Petiole 5–14 mm long. Lamina 20–55 × 0.5–1 mm, same width as petiole; lower leaves recurved, supporting; central leaves spreading; upper leaves ascending. Inflorescence lateral, racemose, spreading to ascending, 2–5 cm long, with shortly pedicellate hairs less than 0.1 mm long, tending to becoming glabrous; peduncles 1–4, 10–45 mm long, compressed, 2–6-flowered; pedicels 10–12 mm long, compressed; bracts narrowly linear, 0.5–2 mm long. Sepals ovate to narrowly oblong, 2–5 × 0.5–0.1 mm, green; outer surface with trichomes *c.* 0.03 mm long; interspersed among the trichomes are shortly pedicellate, red, glandular hairs *c.* 0.1 mm long; apex acute. Petals ovate to cuneate-obovate, 4–5 × 1.5 mm, purple-pink (paler on outer surface). Staminal filaments *c.* 1.2 mm long; anthers hastate, 0.5–0.8 mm long, yellow. Styles 3, each 2.4–5 mm long, once-divided from the base to form six thickened ascending arms; stigmas papillose. Capsule broadly obovoid. Seeds ellipsoid, 0.5–0.6 × 0.5 mm, scrobiculate, apiculate.

Distribution: Tropical Africa, Sri Lanka to Japan, Malaysia and Australia. In Papuaasia it has been collected from the Digul, Western, Gulf and Central districts.

Ecology: Associated with open grass and sedge plains on usually sandy soils, also occurring in damp depressions in *Eucalyptus*, *Melaleuca* and *Acacia* savannah; at altitudes up to 45 m.

Notes: The New Guinea populations of this species are not as robust as the Australian populations (see Marchant & George, in Marchant *et al.* 1982, p. 15).

***Drosera peltata* Thunb. *Dissert.* 2: 295 (1797).**

subsp. ***peltata***. Fig. 11A–D.

Stem erect, simple (sometimes branched), 3–25 cm high, compressed, glabrous, red, developed from a globose subterranean tuber, up to 2.5 × 1.5 mm; vertical stolon 3–6 cm long. Stipules absent. Leaves red; lower surface glabrous; upper surface with petiolate glandular hairs, marginal hairs longer, 1–6 mm long. Basal leaves mostly in a flat rosette, often reduced, not peltate, 4–12 mm long; petiole compressed, up to 0.3 mm wide, (wider than petiole of cauline leaves); lamina orbicular to spatulate-flabellate, *c.* 4 mm wide. Cauline leaves peltate,

4–11 mm long, the upper ones often in groups of 2–6, petiole (2–)5(–9) mm long, spreading or recurved, glabrous, lamina orbicular to broadly crescent-like, 2–2.5 mm wide. Inflorescence terminal, a 1-sided raceme, ascending, 3.5–7.5 cm long; peduncle (0.5–)2–3(–4.5) cm long, compressed, glabrous, (2–)4–6(–8)-flowered; pedicels 4–12 mm long, compressed, glabrous, becoming hairy at the base of the calyx; bracts narrowly ovate or ovate, 1 mm long, margin entire (ovate bracts usually serrate). Sepals ovate-elliptical, 2.5 × 0.5–1 mm; outer surface sparsely hairy to glabrescent; margin serrate. Petals obovate, 3–4 × 1.5 mm, white; apex obtuse. Staminal filaments 3 mm long; anthers 0.4 mm long. Styles 3, each c. 0.8 mm long, sometimes upper half several times divided. Capsules ovoid-ellipsoid, 2.4–2.8 × 1.2 mm. Seeds ellipsoid, 0.3–0.4 mm long, scrobiculate, apiculate.

Distribution: This subspecies of *D. peltata* occurs from Sri Lanka and Nepal, throughout Southeast Asia, to Japan and Australia. In Papuaia it is common in the mountains of New Guinea, being found in the Vogelkop, Snow Mountains, West Sepik, Western Highlands, Southern Highlands and Eastern Highlands districts.

Ecology: Generally found in wet tussock subalpine-alpine grasslands and in alpine moss fields. It occurs on sandy soils, which are often peaty, at medium to high altitudes (1650–4000 m). Flowering and fruiting from January to August.

Notes: In Papuaia only subsp. *peltata* is found. The other subspecies, subsp. *auriculata* (Backh. ex Planchon) Conn, is restricted to Australia and New Zealand. In subsp. *peltata* the seeds are ± narrowly ellipsoid, occasionally oblong-cylindrical, 0.3–0.5 mm long, with basal unbranched part of style 0.1–0.2(–0.3) mm long, sepals 2–4 mm long, hairy or glabrous, and petals 5–6 mm long. In subsp. *auriculata* the seeds are narrowly linear (in outline) to oblong-cylindrical, 0.5–1 mm long, the basal unbranched part of style 0.3–0.5 mm long, the sepals 3–6 mm long, glabrous, and the petals are 5–8 mm long.

Marchant & George (in Marchant *et al.* 1982) maintain *D. peltata* as a species distinct from *D. auriculata*. However, they appear to accept the morphological variability within these taxa as presented by Conn (1981).

***Drosera petiolaris* R. Br. ex DC. *Prodr.* 1: 318 (1824).**

Stem reduced. Roots fibrous. Leaves adpressed to the soil in a convex basal rosette, red, old leaves persistent. Petiole narrowly ovate, slightly constricted towards the apex, 3–5 cm long, densely covered with white plumose hairs, (appearing fulvous in dried herbarium material). Lamina semi-orbicular, 0.5–1 mm long; surface fimbriate with glandular hairs. Stipules (not always obvious) ovate, 5–8 × 0.5–2 mm, hyaline; margin entire. Inflorescence terminal, 1–7 cm long; peduncles 1–3, erect, 0.5–11.5 cm long, pubescent; pedicels 1 mm long; bracts absent. Sepals obovate-subspathulate, 5–7 mm long, pale to deep pink. Staminal filaments 2–2.8 mm long; anthers 0.5 mm long. Styles 3, each 1.5–2 mm long, divided 2–5 times near apex; stigma club-shaped, c. 0.4 mm long. Capsule ellipsoid, 1 mm long. Seeds ellipsoid, 0.5–0.6 × 0.2–0.3 mm, scrobiculate.

Distribution: Outside tropical northern Australia this species is only known from the Western district of Papua.

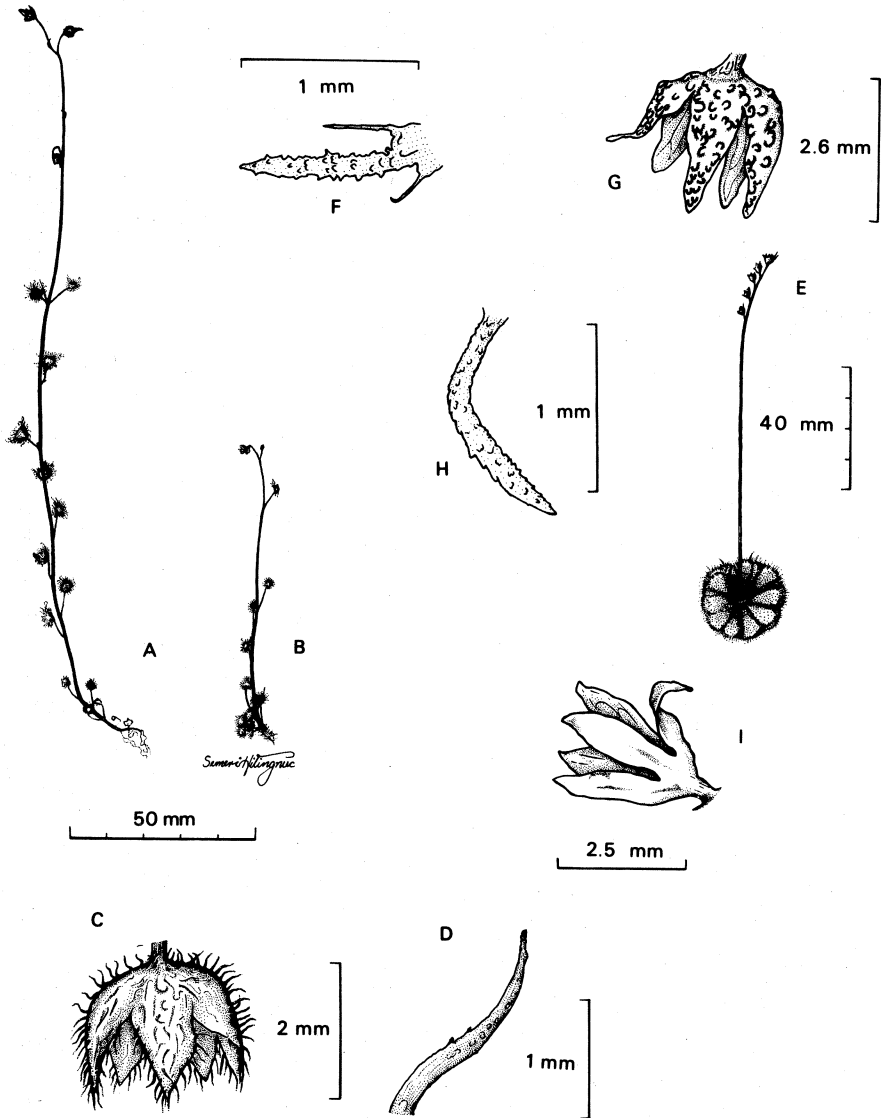


Fig. 11 *Drosera peltata* Thunb. subsp. *peltata* (A) habit (Kalkman 4663) (B) habit (Schodde 1870) (C) calyx (Kalkman 4663) (D) floral bract (Schodde 1870) *Drosera burmanni* Vahl. (E) habit (F) floral bract (G) calyx (all three Pullen 7163) *Drosera spatulata* Labill. (H) floral bract (I) calyx (H & I: LAE 51255)

Ecology: Associated with grass and sedge plains, and in savannah with *Banksia*, and probably *Melaleuca*, *Acacia* and *Eucalyptus*. It grows in sandy soils in periodically dry climatic conditions at low altitude (up to 30 m above sea level).

Drosera rotundifolia* L. *Sp. Pl.* 1: 28 (1753).**subsp. ***rotundifolia

Distribution: Northern Hemisphere, from arctic region to California and Alabama in North America, throughout Europe to the Mediterranean, and in Asia through Siberia to Japan.

subsp. ***bracteata* Kern & Steen. *Nova Guinea Bot.* ns. 4: 279 (1955).**

Stem reduced. Root system unknown. Leaves adpressed to the soil in flat basal rosette, 0.7–7 cm diam. Stipules 5–8 mm long, fused half way, upper half divided into several subsetaceous lobe. Petiole compressed. Lamina semi-orbicular, 4–10 × 5–18 mm, with glandular hairs on upper surface, marginal hairs up to 0.3 mm long. Inflorescence terminal; peduncle solitary, erect, 0.5–2 cm long, glabrous, 3–10-flowered; pedicels up to 8 mm long; bracts ligulate, concave, 4–5 × 1–1.3 mm, minutely glandular-denticulate, apex broadly rounded. Sepals oblong, 3.5–5 × 0.8–1.5 mm, minutely glandular-denticulate. Petals spathulate, 4–6 × 0.8–1.5 mm, white. Staminal filaments 4–4.5 mm long; anthers 0.4–0.5 mm long. Ovary ellipsoid, 3 mm long; styles 3, each 1.5–2 mm long, each arm once divided; stigma club-shaped. Seeds narrowly fusiform, at least 0.8 mm long, with an elongate testa.

Distribution: In Papuaia, once collected (*Versteegh BW 3076*—type) from the Wissel Lakes in swamp near Arupa (Snow Mountains district).

Ecology: Growing in the wet conditions of a *Sphagnum* swamp, at an altitude of c. 1750 m.

***Drosera spatulata* Labill. *Nov. Holl. Pl. Sp.* 1: 79, t. 106 (1805). Fig. 11H & I.**

Stem reduced. Roots fibrous. Leaves adpressed to the soil in a flat basal rosette. Stipules membranous, 3–5 × 0.5–1 mm, 3-partite; lobes unequal, subulate. Petiole up to 2 mm wide. Lamina obovate-spathulate, 7–10 × 2.5–5 mm; margin fimbriate with pedicellate glandular hairs 0.5–2 mm long. Inflorescence terminal, a 1-sided raceme, 2.5–9 cm long; peduncles 1–5, ascending, compressed, 2–5.5 cm long, glabrescent, 1–12-flowered; pedicels erect, 0.2–0.5 mm long, glabrescent with sparsely distributed short glandular hairs; bracts linear-ovate, 1–2.5 mm long, point of attachment 0.2–0.4 mm wide, sparsely covered with minute glandular trichomes. Sepals ovate-oblong, 2.5–3 × 0.5–1 mm, appearing glabrous (although sparsely covered with minute glandular trichomes), red; apex subacute to obtuse. Staminal filaments c. 3 mm long. Styles 3, each 0.5–0.8 mm long, once divided from the base to form six blunt ascending segments. Seeds ellipsoid, 0.3 mm long.

Distribution: This species occurs from southern Japan, Formosa, China through Malesia, eastern and southern Australia, to New Zealand. In Papuaia it had been collected from the New Britain and Western districts.

Ecology: It occurs on damp open mountain heath at 1400 m altitude (Mt Ulawun, New Britain); in the Western district, it is associated with savannah, open grass and sedge plains at c. 10 m altitude.

Notes: The specific epithet is frequently misspelt as 'spatulata'.

ERYTHROXYLACEAE

B. J. Conn¹ & K. Kerenga²

Trees or shrubs. Leaves simple, alternate, stipulate. Inflorescences terminal, axillary, solitary or in up to 20-flowered clusters. Flowers bisexual, actinomorphic. Calyx and corolla 5-merous. Petals with ligulate appendage ('ligule'). Stamens 5 + 5, united basally to form a small tube; ovary 1-3-locular, only 1 ovule developed. Fruit a drupe. Seed \pm endospermous; embryo erect, with cotyledons flat to plano-convex.

Distribution: The family is made up of about 250 species in genera that occur exclusively in the tropics. *Aneulophus*, *Nectaropetalum* and *Pinacopodium* are restricted to Africa, whereas *Erythroxylum* occurs throughout the tropics with its greatest development in South America. *Erythroxylum* is the only genus occurring in Papuasia.

Notes: The family Erythroxylaceae has close affinities with the Linaceae and the Malpighiaceae.

Literature: O. E. Schulz (1907), Erythroxylaceae, *Pflanzenreich* **29**: 1-63; (1931), Erythroxylaceae, *Nat. Pflanzenfam.* **2**, **19a**: 130. J. P. D. W. Payson (1958), Erythroxylaceae, *Fl. Males.* ser. 1, **5**: 543-522. B. J. Conn (1983), Erythroxylaceae in B. D. Morley & H. R. Toelken (Eds), 'Flowering plants in Australia' (Rigby: Adelaide), p. 206.

ERYTHROXYLUM

Trees. Stipules intrapetiolar, \pm ovate, early caducous, leaving a mostly oblique scar. Leaves elliptic to obovate, glabrous; margin entire. Inflorescences axillary, usually many-flowered, sometimes uniflorous. Flowers pedicellate. Calyx campanulate; lobes imbricate in bud. Staminal filaments equal or unequal; anthers ellipsoid, equal or unequal, dehiscence latrorse by slits. Ovary \pm ovoid; styles usually 3, erect, free or partly connate, or stigmas sessile; ovules pendulous, anatropous.

Distribution: *Erythroxylum* contains nearly 200 species with its greatest diversity occurring in South America. Only 2 species occur in Papuasia.

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Ecology: Occurring in both primary and secondary forests, usually absent from areas subject to dry seasons.

Uses: The leaves of *E. coca* Lam. and *E. novogranatense* (Morris) Hieron. (both South American species) contain the valuable alkaloid cocaine that is used as a stimulant and as an anaesthetic, especially in eye-surgery. The two Papuan species are of little economic value; however, they produce hard, durable timber that is sometimes used as fence posts.

Notes: Schulz (1907) subdivided this very homogeneous genus into 19 sections based primarily on stipule characteristics. Only Section *Coelocarpus* is represented in Papuasia. Payens (1958) reported that an undescribed flower gall was found on some New Guinea material of *E. ecarinatum*.

KEY TO SPECIES

1. Stipules with 2 longitudinal keels on dorsal surface, (2-)4-8(-9) mm long; leaf apex \pm rounded, often emarginate; inflorescence 1-5(-8)-flowered; styles usually present; fruit 3-angled in cross-section, 3-locular, fertile locule smaller than the two sterile ones; cotyledons thin **E. cuneatum**
1. Stipules not keeled, sometimes slightly keeled basally, (4-)7-15(-25) mm long; leaf apex mostly acuminate; inflorescence (2-)6-10(-20)-flowered; styles usually absent; fruit elliptic in cross-section, 1-locular; cotyledons thick **E. ecarinatum**

Erythroxylum cuneatum (Miq.) Kurz *J. As. Soc. Beng.* **43(2):** 135 (1874); Payens *Fl. Males.* ser. 1, **5:** 548, figs 1j, 2-4 (1958).

Small to large trees, 2.5-25(-30) m high. Branches often with small lenticels; branchlets \pm terete, laterally flattened distally. Stipules narrowly triangular-ovate, (2-)4-8(-9) mm long, *c.* 2 mm wide at base, usually curved distally, distinctly bicarinate. Leaves petiolate. Petiole 2-6(-9) mm long. Lamina elliptic, oblong-elliptic or obovate, (3-)5-11(-18) \times 2-3(-7) cm; base cuneate to acute; apex obtuse, rounded, often \pm emarginate; midrib raised on lower surface, mostly sunken on upper surface, veins faint. Inflorescences 1-5(-8)-flowered; flowers faintly scented; pedicels 4-10 mm long, distally broadened. Calyx 1.5-2 mm long; lobes triangular, 0.5-1 mm long, apex acute. Petals 2.5-3(-4) mm long, \pm white to yellow; ligule 3-lobed, 1-1.5 mm long; claw often distinctly narrowed basally, *c.* 1 mm long. Staminal tube 1-1.5 mm long; filaments equal in length, 1.5-3 mm long; anthers 0.4-0.5 mm long. Ovary *c.* 2 mm long, often truncate distally, 3-locular; styles 3, rarely 2, 1-2 mm long, shortly connate or connate only at base; stigma \pm globular, often flattened distally, *c.* 0.4 mm long. Drupe \pm ovoid to cylindrical-ovoid, trigonous when dry, 7-12 mm long, often slightly curved, red, fertile locule mostly smaller than the sterile ones. Seed flattened, 4-8 mm long; embryo flattened, slightly curved or straight, 4-8 mm long, 0.5-1.5 mm wide; cotyledons linear and very thin, 2.5-6 mm long.

Field characters: The two species of *Erythroxylum*, that occur in Papuasia, have similar bark and wood features. Outer bark whitish brown to greyish brown, corky, smooth to slightly longitudinally fissured, somewhat flaky; inner bark reddish brown to pink or pinkish brown. Sapwood white, heartwood brown and hard.

Distribution: Occurring throughout Southeast Asia; from Burma, Indonesia, Philippines, and from western New Guinea (the islands of Misool and Waigeo). As yet, not recorded for mainland New Guinea.

Ecology: Primary or secondary forest communities, at altitudes from sea level to 900 m. Flowering mostly from September to February; fruiting March to September.

Notes: It is frequently difficult to distinguish between herbarium material of this species and *E. ecarinatum*. The presence of bicarinate stipules in *E. cuneatum* and absence of keels on the stipules of *E. ecarinatum* are the most useful characters for distinguishing these two species. An occasional specimen of *E. ecarinatum* has faintly ridged stipules, but these should not be confused with the strongly keeled stipules of *E. cuneatum*. Furthermore, the bicarinate stipules are usually shorter than the ecarinate ones (mostly 4–8 mm long compared with mostly 7–15 mm long in the latter).

The apex of the leaf lamina is mostly \pm rounded, often emarginate, in *E. cuneatum*, whereas it is mostly acuminate in *E. ecarinatum*. However, occasionally *E. cuneatum* has leaves that are similar to the other species. Other useful supplementary characters for differentiating these two species are: *E. cuneatum* has brachystylous flowers with equal stamens, whereas *E. ecarinatum* has the style reduced or absent and stamens mostly unequal in length, rarely equal; the inflorescence is fewer-flowered (usually 1–5) for *E. cuneatum*, whereas *E. ecarinatum* usually has 6–10-flowered inflorescences; and the ovary is 3-loculate in *E. cuneatum*, but 1-loculate in *E. ecarinatum*.

Vernacular name: 'Mies' (Manikiong, western New Guinea).

Erythroxylum ecarinatum Burck *Ann. Jard. Bot. Btzg* **11**: 191 (1893); Payson *Fl. Males.* ser. 1, **5**: 547, f. 1a–i (1958). **Fig. 12.**

E. ecarinatum Burck var. *ledermannii* O. E. Schulz (1924); *E. salomonense* C. T. White (1950).

Small to large trees, (3–)10–37 m high. Branches frequently with large lenticels; branchlets \pm terete. Stipules ovate-subulate, (4–)7–15(–25) mm long, (1–)2–4(–5) mm wide at base, usually curved, rarely slightly ridged at the base. Leaves petiolate. Petiole 4–5(–8) mm long. Lamina narrowly elliptic to oblong-elliptic, (3.5–)7–10(–17) \times (1–)2–4(–5) cm; base \pm cuneate or acute; apex acuminate with acumen up to c. 1 cm long, rarely acute to obtuse; midrib slightly raised on lower surface, level to slightly raised on upper surface, veins mostly faint. Inflorescences (2–)6–10(–20)-flowered; flowers with or without scent; pedicels 5–10 mm long, distally broadened. Calyx 1.5–2 mm long; lobes triangular, 0.5–1 mm long, apex acute. Petals 3–4(–5) mm long, \pm white to yellow in bud; ligule 3-lobed, 1–1.5 mm long; claw c. 1 mm long. Staminal tube 1–1.5 mm long; filaments unequal in length, those opposite calyx lobes 0.5–1 mm long, those opposite petals 1–1.5 mm long; anthers 0.6–0.8 mm long, often those opposite petals smaller, 0.4–0.5 mm long. Ovary c. 2 mm long, tapering distally to sessile stigmas, 1-locular; stigmas 3, rarely 2, obovoid, up to c. 0.7 mm long. Drupe subglobose to \pm ovoid. Seed without endosperm; embryo \pm ovate, 6–9 (–15) mm long, 3–5(–6) mm wide; cotyledons large and thick, 5–7 mm long.

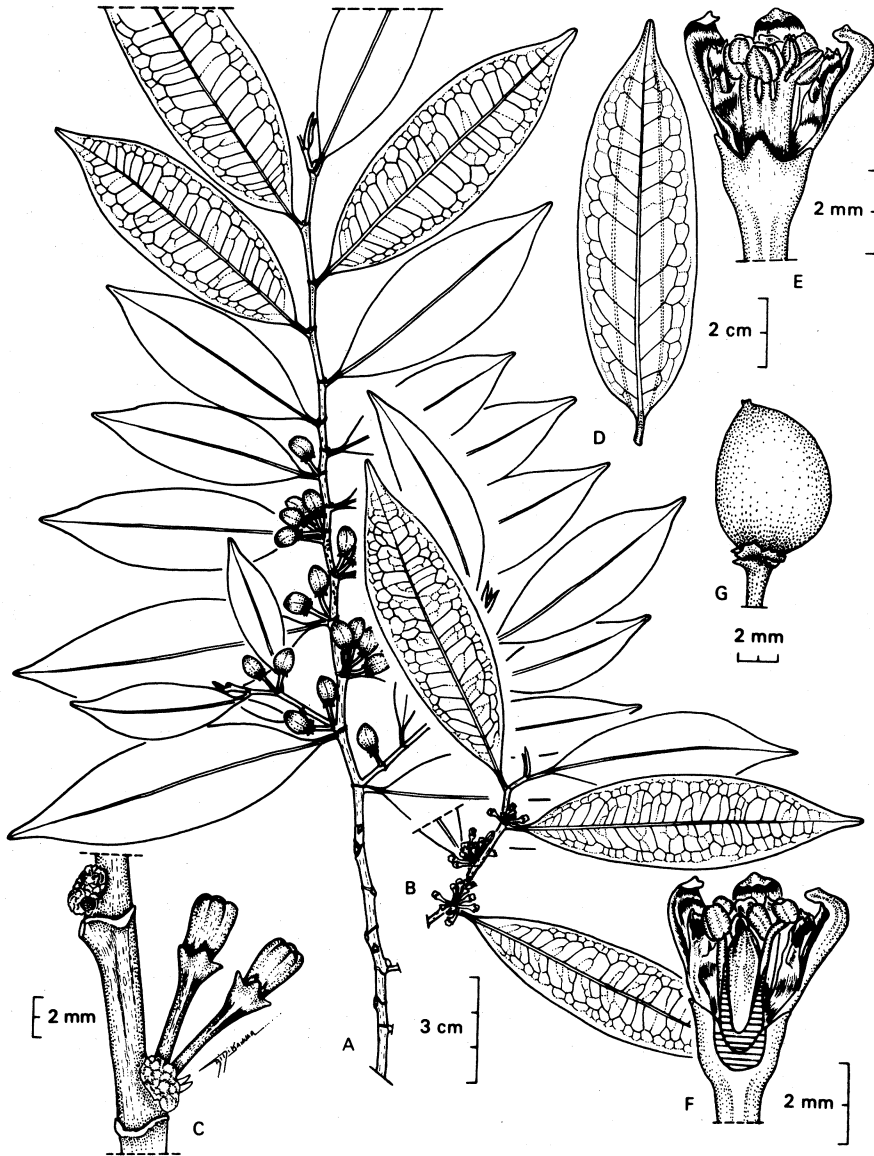


Fig. 12 *Erythroxylum ecarinatum* Burck. (A) fruiting branchlet (NGF 33591) (B) flowering branchlet (NGF 33618) (C) flower buds (Craven & Schodde 705) (D) leaf showing fold lines (Pullen 6396) (E) detail of flower with nearest two petals removed (F) detail of flower with one sepal, two petals and three stamens removed (E & F: Craven & Schodde 705) (G) fruit (NGF 33591)

Field characters: see *E. cuneatum*.

Distribution: Occurring from eastern Malesia, through Papuasia to northern Queensland (Australia). In Papuasia it is widespread and has been collected from all regions except the Sepik and Manus districts.

Ecology: Found in both primary and secondary forests, usually with a scattered distribution, at altitudes from sea level (although never coastal) to 200 m. Flowering and fruiting January to December.

Vernacular names: 'Malmala 'aufisi' (Kwara'ae, Kolombangara, Solomon Islands); 'vipi' (Vella Lavella, Solomon Islands); 'kokobiro' (Mangalese), 'iko' (bush Mekeo, both Central district).

GUTTIFERAE

Subfam. *Calophylloideae*

P. F. Stevens¹

Shrubs to trees. Leaves opposite, rarely alternate, without ordinary stipules; latex glands either dots or lines. Inflorescences lateral or terminal, cymose. Flowers nearly always regular, hermaphroditic or unisexual. Sepals and petals sometimes not clearly separated, arrangement various. Stamens numerous, rarely few, free or variously fused, often in bundles opposite the petals; anthers often with glands. Ovary superior, 1–12-carpellate; ovules anatropous, variable in number and position; styles free or fused; stigma variably developed. Fruit a drupe, berry, or capsule, with variants. Seeds large to small, sometimes arillate; testa thin or thick, woody or fleshy; endosperm reduced, at most little; embryo various.

Distribution: About 40 genera and 1200 species, mainly in the tropics.

Notes: The Papuan genera belong to three different subfamilies: Hypericoideae—*Hypericum* (sometimes placed in a separate family, the Hypericaceae); Calophylloideae—*Calophyllum*, *Kayea*, *Mammea*, *Mesua*; Clusiodeae—*Garcinia* (including *Tripetalum*, *Septegarcinia* and *Pentaphalangium*).

Literature: C. Lauterbach (1922), Beiträge zur Flora von Papuasien. IX. 80 Die Guttiferen Papuasien, *Bot. Jb.* **58**: 1–49. A. C. Smith (1941), Studies of Papuan Plants III, *J. Arnold Arbor.* **22**: 343–374.

KEY TO GENERA

1. Herbs or small shrubs; leaves sessile HYPERICUM²
1. Usually large shrubs or trees; leaves with a petiole
2. Ovary with a sessile stigma; anthers with very short free filaments GARCINIA²
2. Ovary with well-developed style; anthers with well-developed filaments
3. Leaves with close-set parallel veins CALOPHYLLUM
3. Leaves with reticulate venation
4. Flowers borne singly or in groups in the axils of leaves or on leafless parts of the stem; stigmas broad
5. Terminal bud aborting; flowers single; fruit capsular MESUA
5. Terminal bud prominent, functional; flowers in small groups; fruit drupaceous .. MAMMEA
4. Flowers borne along an inflorescence axis; stigmas minute and punctiform KAYEA

Subfamily CALOPHYLLOIDEAE

Shrubs to trees. Leaves opposite or alternate, coriaceous (in Papuasias); latex glands dots or lines. Inflorescence lateral or terminal; bracts present, deciduous

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² Not dealt with in this volume.

or not, bracteoles often absent. Flowers regular, hermaphroditic or unisexual. Sepals and petals sometimes not clearly separated, up to 14, or sepals 4 or 5, decussate or imbricate, and petals 4 or 5, decussate, imbricate, or contorted. Stamens numerous, usually free. Ovary superior, 2–5-carpellate; ovules anatropous, basal or apical, usually 1–12; styles fused, rarely free; stigma often very prominently developed. Fruit a drupe, drupe-like, berry-like or a capsule. Seeds large to small; cotyledons well developed, sometimes fused; aril absent.

Distribution: 11 genera and about 450 species, mostly in the American and Indo-Malesian tropics.

CALOPHYLLUM L.

Evergreen trees or shrubs; axillary branches in some non-Papuasian species with basal scales. Terminal buds in Papuasian species without bud-scales (aborting). Lamina with veins numerous, parallel, alternating with latex canals. Young parts of the plant and the terminal resting leaves (in particular) hairy, hairs with many cells, unbranched or \pm star-shaped. Inflorescence axillary (in Papuasias), usually with a prominent axis, sometimes subumbellate. Flowers pedicellate; bracts deciduous; bracteoles absent. Plants hermaphroditic or unisexual. Tepals 4–8 (in Papuasias), outer 2 (or 4) often rather thicker and smaller than the others. Stamens numerous; filaments slender; anthers eglandular. Ovary with a single, basal ovule; style often twisted; stigma peltate, with margin \pm irregularly fringed. Fruit drupe-like; inside the stone is a \pm well-developed corky layer.

Field characters: The outer bark separates from the inner bark fairly easily and in those species which have been seen the inner surface of the outer bark is shiny and apparently characteristically coloured. The inner bark is usually meat-red towards the outside becoming paler towards the cambium, it is often lamellated. Latex is present. The surface of the wood is often corrugate and with boat-shaped fissures; heart and sapwood are usually distinguishable, the former being dark red-brown and the latter paler.

Distribution: About 190 species, from East Africa and Madagascar to the West Indies and tropical America (about 10 species); Malesia is the centre of diversity of the genus. In Papuasias, almost 50 species.

Notes: The venation of the leaf enables one to recognize the genus *Calophyllum* very easily. Although at first sight all species appear to have almost identical leaves, on careful examination each species can be seen to have a distinctive leaf type. The density measurements of the lateral veins have been quantified rather than calling them 'dense', 'far apart', etc., since that would not be accurate enough for identification. If the veins are described as being 'distinct', it means that they are easy to see. When measuring venation density, care must be taken not to confuse latex canals with veins. Latex canals alternate with the veins and run parallel to them, but are usually less conspicuous. The angle of divergence of the veins is measured relative to the midrib.

All measurements and descriptions are taken from dried plants, except where mention is made otherwise. Tepals shrink considerably on drying and the final

form of the midrib and the prominence of the venation is sometimes rather different in dried and fresh leaves.

More detailed descriptions of the Papuan species of *Calophyllum* will be found in Stevens (1974, 1980). Although for its size the island of New Guinea does not have a notably large number of species of the genus, most of the species growing there are restricted to the island, or also occur on some of the surrounding islands. The Papuan species are mostly very different from those growing in West Malesia, and it is especially interesting to see that many Papuan species have bluish-blackish fruits, and/or angled stones, and those species that do not have angled stones quite often have basal plugs in the stones that are pushed out during germination. There is considerable variation in the method of germination, the number of seedling leaves, the colour and arrangement of leaves on the stem, and how the axis of the young plant is held (erect, or inclined to one side). This means that very often even young plants of *Calophyllum* can be readily identified to species.

Species of *Calophyllum* may be good timber trees, species like *C. euryphyllum*, *C. peekelii*, *C. carrii* var. *longigemmatum* (in particular) form fine trees. On the Bismarck Archipelago and in the Solomon Islands species of *Calophyllum* can become major components in the forest, a trend culminating in the remarkable forests of Manus Islands which are over 50% *Calophyllum*, mostly *C. euryphyllum*. These forests grow in soils of all types, a situation apparently without parallel elsewhere in the whole Malesian-Pacific region.

Literature: P. F. Stevens (1974), A review of *Calophyllum* L. (Guttiferae) in Papuasia, *Austral. J. Bot.* **22**: 349–411; (1980), A revision of the Old World species of *Calophyllum* (Guttiferae), *J. Arnold Arbor.* **61**: 117–699. T. C. Whitmore (1967), Notes on the systematy of Solomon Islands plants and some of their New Guinea relatives, I–VII, *Gdns' Bull., Singapore* **22**: 1–21.

KEY TO SPECIES

1. Lamina 32–45 × 9–11 cm, with 3–5 veins per 5 mm; twigs strongly angled (poorly known species) **C. macrophyllum**
1. Lamina smaller, usually with less dense venation; twigs strongly angled or not
2. Terminal bud strongly flattened transversely, leaf-lamina clearly visible (hairs much branched or stellate)
3. Lamina (2.4–)6.5–17(–22) cm long; ovary tomentose; outer pair of tepals 5 mm long; anthers in staminate flower 2.3–5.5 mm long **C. papuanum**
3. Lamina to 12.5 cm long; ovary glabrous; outer pair of tepals < 5 mm long; anthers in staminate flower 1.5–2.7 mm long
4. Lamina subacute to rounded at apex, 2.5–5.5(–9.5) cm long; tepals 8, or rarely 7; anthers in staminate flower 0.7–1.7 mm long **C. pauciflorum**
4. Lamina acute to acuminate at apex, 3.4–12.5 cm long; tepals 4–8; anthers in staminate flower 1.8–2.6 mm long **C. vexans**
2. Terminal bud not strongly flattened transversely, leaf-lamina not clearly visible
5. Terminal bud < 4 mm long, or sometimes apparently absent
6. Terminal bud apparently absent, underdeveloped internode below it 3–7(–13) mm long; lamina with 5–7 veins per 5 mm, angle of divergence of venation 45–60° **C. savannarum**
6. Terminal bud present, underdeveloped internode below it inconspicuous; venation not as above
7. Lamina gradually long-pointed at apex
8. Lamina with 6–8 veins per 5 mm **C. bifurcatum**
8. Lamina with (7–)9–16 veins per 5 mm **C. caudatum**

7. Lamina retuse to subabruptly long-pointed at apex
9. Lamina broadly rounded to cordate at base **C. parvifolium**
9. Lamina other than broadly rounded to cordate (an occasional leaf broadly rounded) at base
10. Lamina with 5-9(-11) veins per 5 mm; fruit 5-7 mm long, the stone wall c. 0.1 mm thick, not angled **C. novoguineense**
10. Lamina with (8-)10 or more veins per 5 mm; if fruit < 1 cm long then the stone wall c. 0.2 mm thick, angled
11. Lamina 2.2-5.5 × 0.5-1.5 cm; fruit with angled stone **Calophyllum sp. 1**
11. Lamina 2.7-9 × 1.2-4.5 cm; fruit with rounded stone
12. Lamina c. 2 × longer than broad; fruit drying wrinkled, stone wall 1.3-1.5 mm thick **C. morobense**
12. Lamina c. 3 × longer than broad; fruit drying smooth, stone wall 0.2-0.3 mm thick **C. confusum**
5. Terminal bud > 4 mm long, always present
13. Midrib on upper surface of lamina raised, often not clearly distinct from lamina, surrounding lamina also raised
14. Twigs 5-7 mm across; lamina ovate, 2-2.5 times longer than broad; trunk with stilt-roots, the sap clear yellow, sticky **C. suberosum**
14. Twigs (1.5-)3-5 mm across; lamina elliptic to oblong (rarely subovate), (2-)2.5-3 times longer than broad; trunk without stilt-roots, the sap opaque yellow, fluid (not sticky) **C. persimile**
13. Midrib on upper surface of lamina raised or not, clearly distinct from lamina, surrounding lamina not raised
15. Lamina usually > 9 cm long, with 5-9 veins per 5 mm, venation distinct; pedicel 1.5-4.5 cm long; inflorescence axis 2.5-15 cm long **C. inophyllum**
15. Lamina < 9 cm long or if > 9 cm then venation not distinct on upper surface, or if venation distinct on upper surface then pedicel usually < 1.5(-2) cm long and/or inflorescence axis < 2.5 cm long
16. Midrib on upper surface of lamina broadly depressed, at least in bottom 1/3; margin not raised; terminal bud plump, conspicuous
17. Lamina narrowly ovate to elliptic, usually drying shiny; midrib and venation notably richer brown than rest; stone with basal plug **C. neo-ebudicum**
17. Lamina narrowly elliptic to obovate; midrib and venation not notably different in colour from rest; stone without basal plug (fruit not known in *C. carrii*)
18. Lamina obovate, ± retuse at apex, thickened margin 0.3-1 mm wide; tepals (6-)8 **C. carrii**
18. Lamina usually ± elliptic, ± rounded to acute at apex, thickened margin variable; tepals 4-6
19. Lamina often < 2.5 times longer than broad; midrib on upper surface 0.25-0.6 mm wide at midpoint; terminal bud 0.5-1(-1.3) cm long **C. sil**
19. Lamina at least 2.5 times longer than broad; midrib on upper surface 0.2-1.6 mm wide at midpoint; terminal bud (0.8-)1-2.7 cm long **C. laticostatum**
16. Midrib on upper surface of lamina 5 raised; margin raised even near base; terminal bud plump or not
20. Inflorescence reduced to a solitary flower; flower bud pointed; outer pair of tepals with hairs on both surfaces (lamina ovate, long-acuminate with (13-)16-19(-22) veins per 5 mm) **C. insularum**
20. Inflorescence with > one flower; flower bud (where known) not pointed; outer pair of tepals nearly always glabrous inside
21. Lamina usually broadly rounded to heart-shaped at base; petiole < 8 mm long
22. Terminal bud to 5.5 mm long, probably not functional; axillary shoot with basal scars; lamina long-pointed at apex (flower not known) **C. bifurcatum**
22. Terminal bud at least 5 mm long, functional; axillary shoot lacking basal scars; lamina acute at apex
23. Uppermost pair of axillary buds 1/3-1/2 length of terminal bud, erect and conspicuous; inflorescence branches conspicuous, c. 1/3 or more of length of main axis; fruit < 1.5 cm long, stone wall < 0.3 mm thick **C. brassii**
23. Uppermost pair of axillary buds shorter, ± spreading, inconspicuous; inflorescence branches, if any, relatively shorter; fruit > 1.5 cm long, stone wall at least 1 mm thick (some presently unidentifiable sterile material from Irian Jaya keys out here)

24. Lamina with 4–7 veins per 5 mm, with venation distinct; stone not angled, with basal plug **C. waliense**
24. Lamina with 9–17 veins per 5 mm, with venation subobscure; stone angled, lacking a basal plug **C. goniocarpum**
21. Lamina rarely broadly rounded at base; petiole often > 8 mm long
25. Twigs 3.5–6.5 mm across, almost square or \pm 4-winged, often drying blackish; lamina thickly coriaceous **C. peekelii**
25. Twigs usually thinner, if as thick then not almost square or winged, usually drying brownish; lamina thickly coriaceous or not
26. Lamina retuse to acute at apex
27. Lamina usually < 8 cm long
28. Lamina with 6–11(–14) veins per 5 mm; inflorescence with terminal flowers 5 in groups of five; ripe fruit not known, but probably with angled stone **C. heterophyllum**
28. Lamina with 9–20 veins per 5 mm; inflorescence with terminal flowers in groups of three; fruit with rounded stone
29. Internodes 0.4–2 cm long; hairs on terminal bud with several branches, often branched at apex; inflorescence lacking persistent leafy bracts; fruit with outer layer 1.5–3 mm thick, \pm compact **C. collinum**
29. Internodes 1–6 cm long; hairs on terminal bud with at most 1 or 2 branches, not branched at apex; inflorescence usually with persistent leafy bracts; fruit with outer layer thin and disorganized by air spaces **C. hirasimum**
27. Lamina usually > 8 cm long
30. Hairs often \pm persistent over entire lower surface of lamina; uppermost pair of axillary buds 3–10(–14) mm long, spreading, conspicuous; fruit 2.8–6 cm long **C. euryphyllum**
30. Hairs very rarely persistent on lower surface of lamina; uppermost pair of axillary buds erect to spreading, rarely so conspicuous; fruit < 3.2 cm long
31. Lamina with 4–10(–12) veins per 5 mm, venation usually distinct on at least one surface
32. Terminal bud 0.8–2 cm long; internodes (0.7–)1.5–10 cm long; lamina (5.5–)10–28 cm long **C. leleanii**
32. Terminal bud 0.6–1(–1.2) cm long; internodes 0.5–3(–5) cm long; lamina 4.5–15 cm long
33. Lamina 8.5–15 cm long, venation on the upper surface distinct; terminal flowers not umbellate **Calophyllum sp. 2**
33. Lamina 4.5–9.5 cm long, venation of the upper surface \pm obscure; terminal flowers often appearing umbellate **C. heterophyllum**
31. Lamina with (6–)10 or more veins per 5 mm, venation often 5 obscure on one or both surfaces
34. Lamina usually rather thinly coriaceous, margin closely undulate; uppermost pair of axillary buds \pm adpressed to terminal bud, conspicuous; inflorescence branched; fruit with thick compact outer layer **C. soulattri**
34. Lamina not as above; uppermost pair of axillary buds variable; inflorescence unbranched or with inconspicuous lateral branches; outer layer of fruit often not compact
35. Inflorescence lacking axis; fruit c. 5 mm long (poorly known species) **C. rufinerve**
35. Inflorescence with axis; fruit at least 1.5 cm long
36. Inflorescence axis, pedicel, and back of outer tepals mealy-hairy; flower with 8 tepals; fruit with stone not angled **C. obscurum**
36. Inflorescence glabrous or pubescent, back of outer tepals glabrous; flower with 4–12 tepals; fruit with stone angled
37. Lower surface of lamina subsersistently tomentose; pedicel tomentose, 2.5–6 mm long **C. trachycaule**
37. Lower surface of lamina with inconspicuous indumentum; pedicel glabrous, 5–9 mm long (to 18 mm long in fruit) **C. goniocarpum**
26. Lamina acute to long-pointed at apex
38. Terminal bud 1.6–3.3 cm long; midrib on lower surface of lamina strongly angled **C. robustum**

38. Terminal bud to 1.5 cm long; midrib on lower surface of lamina rounded to subangled
39. Lamina usually thinly coriaceous, margin closely undulate; inflorescence branched; fruit spherical, the outer layer thick, compact, the stone thin, unmarked (uppermost pair of axillary buds usually erect and conspicuous) **C. soulattri**
39. Lamina not as above; inflorescence usually unbranched; fruit not as above
40. Inflorescence without axis; pedicel pilose; fruit c. 0.5 cm long (poorly known species) **C. rufinerve**
40. Inflorescence with axis; pedicel usually glabrous; fruit (0.7–)1 cm or more long
41. Indumentum densely tomentose, persisting on terminal bud, stem, lower lamina surface (frequently), inflorescence axis and pedicel
42. Lamina with 4–9 veins per 5 mm, usually drying different colours above and below; fruit < 1 cm long **C. bicolor**
42. Lamina with 12–20 veins per 5 mm, drying almost the same colour above and below; fruit > 2 cm long **C. trachycaule**
41. Indumentum usually other than tomentose, pedicel and lower lamina surface glabrous or almost so
43. Lamina very coriaceous, margin almost flat, midrib narrowed gradually from base, sharply raised, venation obscure on both surfaces, or fairly distinct only below; fruit ellipsoid, stone sharply pointed at apex **C. acutiputamen**
43. Lamina not as above; fruit spherical to ellipsoid, stone at most bluntly pointed at apex
44. Flower (where known) with 8 or more tepals and/or fruit with basal plug
45. Terminal bud 0.2–0.5 cm long; lamina with midrib 0.1–0.2(–0.3) mm wide at midpoint **C. morobense**
45. Terminal bud (0.4–)0.6–1.6 cm long; lamina with midrib (0.1–)0.2–0.5(–0.8) mm wide at midpoint
46. Midrib on upper surface of lamina rather narrow and \pm raised even at base, midrib and veins not notably browner than rest of lamina **C. streimannii**
46. Midrib on upper surface of lamina broad and \pm depressed at base, midrib and veins notably browner than rest of lamina **C. neo-ebudicum**
44. Flower (where known) with c. 4 tepals and/or fruit lacking basal plug
47. Lamina with 12–22 veins per 5 mm; outer layer of fruit developing air spaces, stone clearly angled **C. piluliferum**
47. Lamina with (6–)8–12(–16) veins per 5 mm; outer layer of fruit rarely developing air spaces, stone at most obscurely angled
48. Petiole 0.6–0.8 mm across; lamina with midrib on upper surface 0.1–0.15 mm wide at midpoint **C. confusum**
48. Petiole 1–1.5 mm across; lamina with midrib on upper surface 0.3–0.6(–0.7) mm wide at midpoint **C. vexans**

Calophyllum acutiputamen P. F. Stevens *Austral. J. Bot.* 22: 359, f. 1 (1974).
Fig. 13.

Tree c. 20 m high, d.b.h. 70 cm. Twigs slightly flattened, 2–2.5 mm across, 4-angled and with two additional raised lines, drying dark brown, with subadpressed hairs when young; internodes 0.5–3(–5.5) cm long; uppermost pair of axillary buds \pm pointed, to 1 mm long, erect and adpressed to terminal bud; terminal bud conical, 4.5–9 mm long, with subadpressed, brown hairs, underdeveloped internode to 1 mm long. Petiole 0.5–1.2 cm long, \pm glabrous when mature. Lamina elliptic to subobovate, (3.5–)5.5–8 \times 1.4–2.4 cm, very coriaceous; base cuneate; margin not undulate and not to slightly recurved; apex acute, sometimes almost rounded; midrib transiently puberulent above, subpersistently puberulent below, above narrowed gradually from base, raised, 0.3–0.35 mm wide at midpoint, below raised, angled; venation on both surfaces not distinct, or fairly distinct below, slightly raised, 9–11(–13) veins per 5 mm, angle of divergence 55–60°. Inflorescences unbranched, axis 0.5–1 cm long, with sparse, subadpressed hairs, lowest internode c. 4 mm long; 3–5-flowered; bracts unknown;

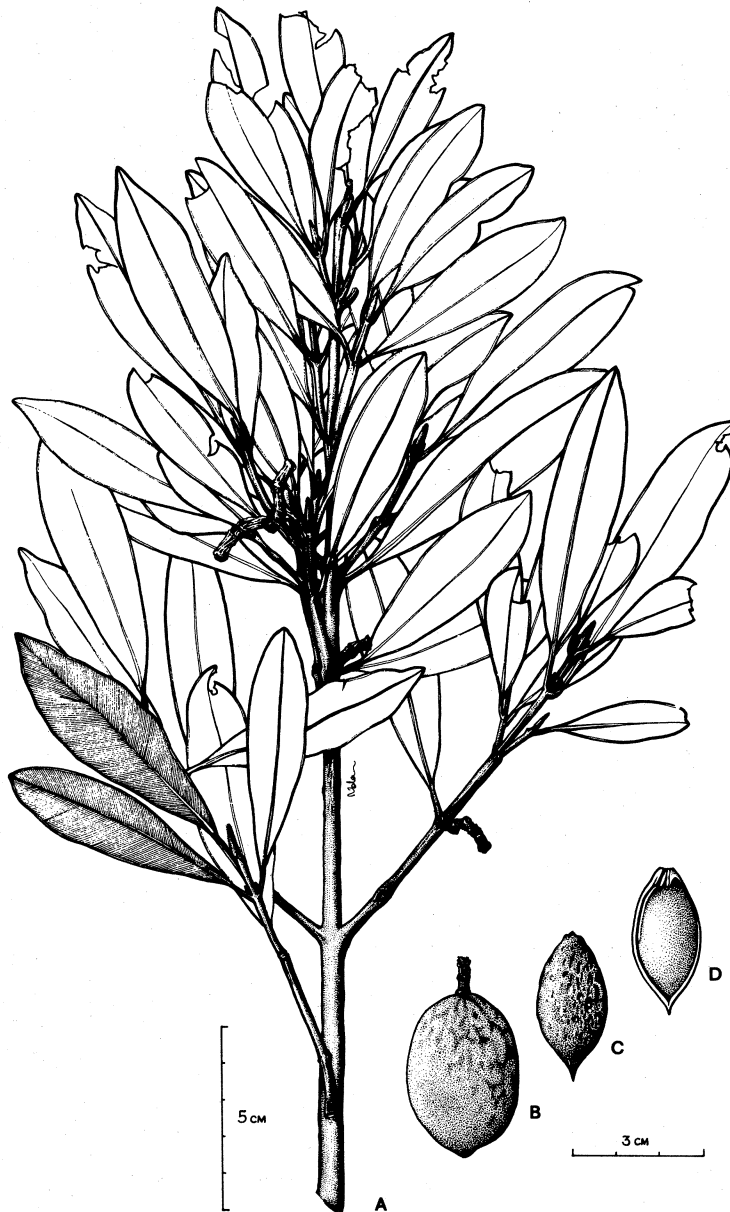


Fig. 13 *Calophyllum acutiputamen* P. F. Stevens (A) branchlet (B) fruit (C) seed (D) seed with part of testa removed (all Brass 28325)

pedicels *c.* 2 mm long, in fruit 5–6 × 3 mm, sparsely puberulent. Flower buds only known, flower ? hermaphrodite. Tepals 8; outer 4 tepals to 4 × 5 mm, sparsely puberulent on the back. Stamens *c.* 60; anthers *c.* 1.2 mm long. Fruit ellipsoid, 4–4.3 × 2.6–2.8 cm; apex ± pointed; surface drying brown, with shallow, longitudinal corrugations; outer layer *c.* 3.5 mm thick, with large air spaces developing. Stone ± ellipsoid, *c.* 3.5 × 1.5 cm; apex sharply pointed; walls 0.8–1.2 mm thick, thinner to one side of base, ± smooth, unmarked; spongy layer thin.

Field characters: Outer bark dark brown; underbark red; inner bark pinkish brown; latex not milky.

Distribution: Known only from Rossel Island (Papuan Islands district).

Ecology: Canopy tree on ridges in colline forest, at 300–700 m altitude. Flower buds in March, submature fruit in October.

Notes: *Calophyllum acutiputamen* can be recognized by its more or less conical terminal bud; its elliptic, flat-drying leaves with obscure venation, at least above; and its relatively large (*c.* 4 cm long), ellipsoid fruits. The outer layer of the fruit is almost disorganized by air spaces although the skin is practically smooth; the stone is very sharply pointed at the apex.

Calophyllum bicolor P. F. Stevens *J. Arnold Arbor.* **61:** 536, f. 33 (1980).

C. caudatum sensu P. F. Stevens (1976), non Kan. & Hat. (1942).

Tree 17–30 m high, d.b.h. to 48 cm. Twigs slightly flattened, 1.5–2.5 mm across, slightly 4-angled to rounded, drying brown to dark brown, yellowish brown when older, often persistently brown-tomentose to pubescent; internodes 1–2(–4) cm long; uppermost pair of axillary buds 0.5–1.5 mm, suberect; terminal bud plump, 4–7 mm long, with brown-tomentose indumentum, underdeveloped internode to 2.5 mm long. Petiole 2–7 mm long, subpersistently tomentose. Lamina ovate to elliptic, (2–)4–8(–13) × (1–)1.5–3(–4) cm, coriaceous; base rounded or truncate to cuneate; margin slightly undulate and not or slightly recurved; apex acute to long-pointed; pubescent-tomentose on midrib on both surfaces and sparsely pubescent-tomentose over entire lower surface; midrib above generally gradually narrowed from base, raised (flat at base), 0.2–0.4 mm wide at midpoint, below raised, striate; venation rather obscure above, distinct below, raised, 4–9 veins per 5 mm, angle of divergence 50–65°. Inflorescences unbranched, axis 0.3–1.6 cm long, pubescent-tomentose, lowest internode 3–5(–10) mm long; 3–5-flowered; bracts not known; pedicels 0.3–1.6 cm long, pubescent to subtomentose. Flower ? hermaphroditic. Tepals 4, to 4 × 2.8 mm. Stamens *c.* 40; filaments to 2.5 mm long; anthers 0.7–1 mm long. Ovary 1.2–1.5 mm long; style *c.* 2 mm long; stigma *c.* 1.1 mm across. Fruit ovoid to ellipsoid, 7–11 × 5–9 mm; apex pointed, surface drying brown, ± smooth to slightly wrinkled; outer layer *c.* 0.2 mm thick, with large air spaces developing. Stone ± ovoid, 6–9 × 4.5–7.5 mm; apex rounded; wall < 0.2 mm thick, smooth, unmarked; spongy layer thin.

Field characters: Trunk without buttresses; outer bark yellowish to yellowish grey, or grey and brown mottled, smooth when young, becoming fissured and scaly, the inner surface dark straw- to straw-coloured; underbark brownish red; inner bark pale red to pink; latex yellow, brown (sometimes ? colourless), clear, rarely milky, sticky.

Distribution: Occurs in the Western district of New Guinea, the Aru Islands and Queensland (Australia).

Ecology: Seasonally inundated or well-drained rain forest, at 3–100(–250) m altitude. In the Western district it occurs in *Melaleuca* forest, or forest with *Melaleuca* and *Acacia*; sometimes in secondary forest. Flowering March, June and August. Fruiting February, May, June, September and October; ripe fruit deep blue to black.

Notes: *Calophyllum bicolor* is a distinctive species recognizable by the dense hairs that persist on the twigs, lower surface of the lamina, inflorescence axis, and pedicels, and by its small to medium-sized, ovate or sometimes elliptic lamina that commonly dries different colours on the two surfaces. The flowers have 4 tepals that have no hairs on the back, and the fruit has a thin outer layer and a thin-walled stone.

Calophyllum bicolor can readily be distinguished from *C. caudatum*, with which I had earlier confused it (Stevens 1976). It has a longer terminal bud and much more distinct veins on the lower surface of the lamina than does *C. caudatum*. It is perhaps most similar to *C. novoguineense*; both species apparently grow in the Kiunga area (Western district), and careful studies are needed to see if they can be distinguished on bark and/or seedling and young plant differences.

Calophyllum bifurcatum P. F. Stevens *J. Arnold Arbor.* 61: 545, f. 33b & c (1980).

? Tree. Twigs slightly flattened, 1–1.4 mm across, 4-angled, soon becoming rounded, drying brown, hairy when young; internode 2–4 cm long; uppermost pair of axillary buds 1–4(–7.5) mm long; spreading, conspicuous; terminal bud plump, 3–5.5 mm long, with grey-brown, scurfy hairs; underdeveloped internode absent. Petiole 3–5 mm long, soon glabrescent. Lamina narrowly ovate, (4–)8–15 × (0.7–)1.9–3 cm, thinly coriaceous, with few hairs even when young; base rounded to shortly truncate; margin closely undulate and slightly recurved; apex gradually long-pointed; midrib above narrowing gradually from base, raised, 0.2–0.3 mm wide at midpoint, below raised, slightly angled, rather narrow; venation not distinct on both surfaces, slightly less so below, raised, 6–8 veins per 5 mm, angle of divergence 70–80°. Inflorescence unbranched, axis 3–8 mm long, sparsely hairy toward base, lowest internode 3–8 mm long; 3-flowered; bracts not known; pedicels 1.1–1.8 cm long, glabrous. Flowers unknown. Immature fruit ± round, c. 8 × 7 mm, minutely pointed, drying brown, wrinkled; outer layer c. 0.25 mm thick, compact. Stone ? spherical; walls c. 0.15 mm thick, smooth; spongy layer ? thin.

Distribution: Japen Island (Geelvink Bay), Irian Jaya; collected only once.

Notes: *Calophyllum bifurcatum* can be recognised easily. It has a nonfunctional terminal bud and consequently profuse branching, short petioles, and rather narrowly ovate leaf-laminas that are long-pointed at the apex and rounded at the base. The venation is somewhat distant, and the inflorescences are axillary and have a well-developed basal internode. The axillary branches have reduced leaves at the very base.

Calophyllum brassii A. C. Sm. *J. Arnold Arbor.* 22: 352 (1941).

Tree 20–30 m high, d.b.h. to 68 cm. Twigs ± flattened, 2.5–6 mm across, 2-, 4-, or 6-angled, with a slight horizontal line at the node, drying brown

(yellowish); indumentum short, subpersistent; internodes 0.5–6(–8) cm long; uppermost pair of axillary buds 2.5–7 mm long, erect; terminal bud subconical, 0.5–1.4 cm long, with woolly to rather scurfy indumentum, the underdeveloped internode to 1.5 mm long. Petiole 1–6(–8) mm long, sometimes subpersistently tomentose. Lamina elliptic to oblong, (3–)6–17 × (1.9–)4–6 cm, very coriaceous, with persistent hairs on the midrib below; base rounded to heart-shaped; margin slightly undulate and strongly recurved; apex apiculate to shallowly retuse; midrib above narrowing fairly quickly near the base, raised, 0.1–0.6 mm wide at the midpoint, below very prominent, raised, usually angled; venation usually rather obscure above and below, raised, sometimes sunken above, 10–16 veins per 5 mm, angle of divergence 65–80°. Inflorescences with 3-flowered branches to 1.3 cm long, axis 1.2–5 cm long, tomentose, lowest internode 1.5–4 mm long; 15–many-flowered; bracts to 3 mm long, soon falling; pedicels (0.5–)0.7–2 cm long, glabrous. Flower ? hermaphroditic. Tepals 4(or 5); outer two 3.8–4.5 × 1.7–2 mm; inner two 4–4.7 × 2.1–2.7 mm. Stamens 65–105; filaments to 2.3 mm long; anthers 0.4–0.7 mm long. Ovary 0.6–0.9 mm long; style 1.2–1.7 mm long; stigma 0.3–0.5 mm across. Fruit broadly ovoid, *c.* 1.4 × 1.3 cm; apex rounded, drying brown, deeply wrinkled (almost mature); outer layer 0.7–1.5 mm thick, compact. Stone ovoid, 1–1.1 × 0.8–1 cm; apex pointed; walls < 0.2 mm thick, smooth, unmarked; spongy layer at first thick.

Field characters: Buttresses absent. Outer bark yellowish brown to dark brown, with few to many shallow fissures, inner surface brown-orange mottled; underbark dark red and brown-red mottled; inner bark red; latex white, rather curdy, slightly sticky, perhaps also light yellow or brownish.

Distribution: Scattered in western New Guinea: Vogelkop, Fakfak, Digul, with the type specimen from the Idenburg River (Jayapura), extending into eastern New Guinea with a recent collection from Kiunga (Western district).

Ecology: Collected at (20–)400–900 m altitude in primary colline forest, often with *Agathis*. Flowering and fruiting in March; ripe fruit blackish.

Germination and young plant: The seedling breaks the stone to one side of the base; it has two pairs of leaves separated by a poorly developed internode. Subsequent growth is slow at first, with the internodes being less than 1.5 cm long; the plant is erect. Only in plants *c.* 30 cm high are longer internodes developed.

Notes: *Calophyllum brassii* is a very easily recognized species, with its large leaf laminae that have dense venation and often heart-shaped bases, its branched, many-flowered inflorescences, and its small fruits that have a thin-walled stone that is pointed at the apex. This species is closely related to *C. soulattri*, with both having similar seedlings and young plants.

***Calophyllum carrii* P. F. Stevens *Austral. J. Bot.* 22: 360, f. 2 (1974). Fig. 14.**

Tree (for details of trunk and bark see varieties). Twigs slightly flattened, 3.4–7 mm across, ± 4-angled, or with *c.* 8 raised lines, becoming striate when older, drying greyish brown, shortly hairy when young; internodes 1–3 cm long; uppermost pair of axillary buds *c.* 1.5 mm long, suberect; terminal bud plump, 1–3 cm long, with greyish brown, crustaceous indumentum, underdeveloped internode to 3 mm long. Petiole 1–3 cm long, glabrescent. Lamina obovate to suboblong, (5.5–)7–12 × 2.9–6 cm, coriaceous, subpersistently puberulent to scurfy on

midrib below; base acute; margin undulate and recurved, marginal thickening sometimes up to 1 mm wide; apex blunt to shallowly retuse; midrib above narrowing gradually from base, depressed at first, 0.2–1.5 mm wide at midpoint, becoming raised in top half of leaf, below raised, rounded to striate; venation rather obscure above, \pm distinct below, raised, 7–13(–15) veins per 5 mm, angle of divergence 65–75°. Inflorescences unbranched, sometimes with 3-flowered branches to 1.2 cm long, axis 3.3–4.5 cm long, shortly hairy; 5–18-flowered; lowest internode 2–4 mm long; bracts unknown; pedicels 0.5–1.9 mm long, mealy-hairy to puberulent. Flower known only in bud. Tepals (6 or) 8; outer pair *c.* 6.5 \times 5.5 mm, sparsely hairy on back at very base. Stamens 90–120; anthers 0.5–1 mm long. Ovary *c.* 1.8 mm long; stigma *c.* 1.5 mm across. Immature fruit (from var. *longigemmatum*) \pm round, *c.* 1.8 cm long, drying smooth.



Fig. 14 *Calophyllum carrii* P. F. Stevens flowering branchlet (Carr 15599)

KEY TO SPECIES

1. Twigs 3.5–4.5(–5.5) mm across; terminal bud 1–2.2 cm long; lamina lacking an obviously thickened margin var. **carrii**
 1. Twigs 4.5–7 mm across; terminal bud 2–3 cm long; lamina with thickened margin c. 1 mm wide var. **longigemmatum**

var. **carrii**

Tree c. 35 m high, d.b.h. to 100 cm. Twigs 3.5–4.5(–5.5) mm across, \pm 4-angled or with c. 8 raised lines; terminal bud 1.3–2.2 cm long. Lamina with slightly recurved margin, marginal thickening not obvious.

Field characters: Trunk with buttresses to 0.9 m high, outer bark dark brown, fissured; underbark light brown; latex golden, clear.

Distribution: Central and Northern districts of Papua.

Ecology: Lower montane rain forest, at 1050–1525 m altitude. Flowering in February (late bud).

var. **longigemmatum** P. F. Stevens *Austral. J. Bot.* **22**: 361 (1974).

Tree c. 30 m high. Twigs 4.5–7 mm across, usually with 8 raised lines; terminal bud 2–3 cm long. Lamina with strongly recurved margin, marginal thickening c. 1 mm wide.

Field characters: Trunk without obvious buttresses; outer bark dark grey, flaking off in irregular, rectangular scales; underbark reddish and cream, mottled; inner bark creamy-red; latex yellow.

Distribution: Known only from near Jayapura and the West Sepik district of northeastern New Guinea.

Ecology: Lowland rain forest, at 15–300 m altitude.

Notes: *Calophyllum carrii* can be recognized by its long, plump terminal bud, obovate to suboblong leaf-lamina with the midrib on the upper surface depressed for at least half its length, and flower with (usually) eight tepals. Its indumentum is not well developed, and the older twigs at least are striate.

Although the two varieties are readily distinguished by the characters given above, neither is well known.

Calophyllum caudatum Kan. & Hat. *Bot. Mag. Tokyo* **56**: 561, f. 2 (1942).

Tree c. 5 m high. Twigs slightly flattened, 0.7–1 mm across, slightly 4-angled at first, soon becoming rounded, drying brown, sparsely hairy when young; internodes 0.7–1.7 cm long; uppermost pair of axillary buds c. 0.7 mm long, spreading; terminal bud plump, 2–3 mm long, with subspreading, red-brown hairs, underdeveloped internode absent. Petiole 3–4 mm long, hairy. Lamina narrowly ovate, 3.7–5.5 \times 1–1.7 cm, coriaceous, sparsely hairy when young, some hairs persisting on midrib below; base cuneate; margin slightly undulate but not recurved; apex very long-pointed; midrib above narrowing gradually from base, raised, 0.2 mm wide at midpoint, below not very obvious, slightly raised, striate; venation \pm obscure above and below, slightly raised below, 11–14 veins per

5 mm, angle of divergence 55–70°. Inflorescences unbranched, axis 4–9 mm long, slender, sparsely hairy, lowest internode 4–9 mm long; c. 3-flowered; bracts c. 5 mm long, persisting; pedicels 0.4–0.9(–1.2) cm long, \pm glabrous, slender. Flower known only in late bud, ? hermaphroditic. Tepals 4 or 6; outer pair c. 2.2 mm long. Stamens 25–35; anthers c. 1 mm long. Ovary c. 0.8 mm long. Fruit unknown.

Distribution: Western New Guinea, known only from one collection made in Geelvink Bay.

Ecology: Edge of *Agathis* forest; at 400 m altitude. Late bud in early May.

Notes: *Calophyllum caudatum* can be recognized by its slender twigs, its narrowly ovate lamina with a long-pointed apex and midrib and venation both inconspicuous, and its slender, 3-flowered inflorescence.

Calophyllum collinum P. F. Stevens *J. Arnold Arbor.* 61: 571, f. 36b–e (1980).

Calophyllum sp. D, P. F. Stevens (1974).

Tree 22–36 m high, d.b.h. to 85 cm. Twigs slightly flattened, 1.2–3.5 mm across, strongly 4-angled, often with 4 additional lines, drying dark brown, transiently mealy-hairy to subpersistently tomentose; internodes 0.4–2 cm long; uppermost pair of axillary buds c. 1 mm long, subspreading; terminal bud plump, 6–9 mm long, with brown subtomentose to subcrustaceous indumentum, underdeveloped internode to 1 mm long. Petiole (0.4–)0.6–1.2 cm long, glabrescent to subpersistently tomentose. Lamina obovate to elliptic (rarely suboblong), (1.8–)2.3 \times (1–)1.3–4.5 cm, coriaceous, transiently mealy-hairy to subpersistently puberulo-tomentose on midrib below; base acute to cuneate; margin slightly undulate and not or slightly recurved; apex rounded to subretuse or subcuneate; midrib above gradually narrowed from base, strongly sunken but at least margin raised, 0.2–0.4 mm wide at midpoint, becoming raised toward apex, below raised, striate; venation not distinct to \pm distinct on both surfaces, raised to \pm flat, 11–20 veins per 5 mm, angle of divergence 65–80°. Inflorescence unbranched, axis 0.7–2.8 cm long, mealy to subtomentose, lowest internode 1–10 mm long; 7–21-flowered (based on number of fruits per infructescence); bracts not known; pedicels 4–9 mm long, glabrous. Flowers not known. Fruit subspherical, rarely ovoid, 1.2–1.8 \times 1.1–1.7 cm; apex rounded, rarely acute, drying brown, smooth; outer layer 1.5–3 mm thick, compact apart from air spaces developing under skin. Stone \pm round, 0.9–1.4 \times 0.8–1 cm; apex rounded, rarely obtuse; wall 0.3–0.5 mm thick, to 0.7 mm thick at base, smooth, unmarked; spongy layer thin.

Field characters: Trunk without buttresses; outer bark brown, sometimes grey, fissures at first short and distinct, becoming confluent, inner surface brown, sometimes orange-brown; underbark red; inner bark red or reddish; latex yellow, clear, viscous, sometimes becoming green.

Distribution: Endemic to New Guinea where it is known from the Snow Mountains, Western and Morobe districts.

Ecology: Colline forest or lowland forest with colline aspect, at 25–520 m altitude. Fruiting in March, July, and August; fruit blue to blackish.

Notes: *Calophyllum collinum* can be recognized by its short internodes, its strongly 4-angled twigs that usually have an additional four raised lines, and its small, oblong-obovate leaf laminae with a strongly sunken midrib and rather dense venation (11–20 veins per 5 mm). Its fruits have a thick outer layer that is compact except for air spaces that sometimes develop under the skin. This species has attributes more typical of plants found in higher altitude forests.

Calophyllum collinum is a fairly common tree around Kiunga, especially conspicuous because of its clean, brown-coloured bole that becomes deeply fissured only in very large specimens. Its relationships are not clear. This species is similar to *C. sil*, with both may have a similar midrib; the latter species has larger leaves with less dense venation and twigs with longer internodes.

Calophyllum confusum P. F. Stevens *Austral. J. Bot.* **22**: 363, f. 3 (1974).

Tree 9–27 m high, d.b.h. to 25 cm. Twigs flattened, 1–1.5 mm across, 4-angled, drying blackish, sparsely brown or greyish-brown short-hairy; internodes 1–4.5(–6) cm long; uppermost pair of axillary buds to 2.8 mm long, erect; terminal bud \pm conical, 3–6.5 mm long, with brown, subadpressed hairs, underdeveloped internode absent. Petiole 0.6–1 cm long, glabrous. Lamina ovate to elliptic, (3.5–)4.5–8.5 \times 1.2–2.6 cm, thinly coriaceous, subpersistently puberulent, or soon becoming glabrous on midrib below; base acute; margin distantly and shallowly undulate but not recurved; apex acute to subacuminate; midrib above gradually narrowed from base, \pm flat at first, becoming slightly raised, 0.1–0.15 mm wide at midpoint, below slightly raised, substriate; venation \pm obscure above, below \pm distinct, raised (latex canals clearly depressed below), 8–12 veins per 5 mm, angle of divergence 65–75°. Inflorescence ? unbranched, axis 0.2–1.5 cm long, sparsely and subpersistently short-hairy towards base, lowest internode 2–15 mm long; 3(–5)-flowered (based on number of fruits per infructescence); bracts unknown; pedicels 7–11 mm long, glabrous. Flowers unknown. Fruit ovoid, 2.3–2.8 \times 1.9–2.2 cm; apex \pm rounded, drying purplish, smooth; outer layer 2.6–4 mm thick, compact. Stone subellipsoid, 1.7–2 \times 1.3–1.6 cm; apex rounded; walls 0.2–0.3 mm thick, smooth; spongy layer thin.

Field characters: Outer bark greenish yellow to dark brown, becoming scaly; latex white or yellow, sticky.

Distribution: Only known from the New Georgia group of the Solomon Islands.

Ecology: Well-drained, primary rain forest, at 80–305 m altitude. Fruiting in March.

Notes: *Calophyllum confusum* can be recognized by its slender, much-branched twigs that dry blackish, its uppermost axillary buds that are tightly adpressed to the terminal bud, its rather narrowly ovate to elliptic leaf-lamina that dries dark on the upper surface, and its relatively large (2.3–2.8 cm long) fruit that dries smooth and has a thick, compact, outer layer and a thin-walled stone lacking a basal plug. The petioles are relatively slender and dry blackish.

The relationships of *Calophyllum confusum* are not clear; it may be related to *C. leucocarpum* A. C. Sm., from Fiji, and to the *C. novoguineense* complex, although all the other species in that group have much smaller fruits (< 1.7 cm long) with an outer layer < 1 mm thick.

Calophyllum euryphyllum Laut. *Bot. Jb.* 58: 14 (1922). **Fig. 15.**

C. peekelii sensu T. C. Whitm. (1967) p.p., non Laut. (1922).

Tree 12–30 m high, d.b.h. to 100 cm. Twigs strongly flattened, 2.5–6.5 mm across, 4-angled and with two additional raised lines, drying dark brown, rather persistently mealy-hairy to shortly tomentose; internodes (1–)3–10(–16) cm long; uppermost pair of axillary buds (1–)3–10(–14) mm long, spreading; terminal bud subconical, 0.7–1.6 cm long, with brown, puberulo-tomentose indumentum, underdeveloped internode (2–)4–11 mm long. Petiole 1.6–3.5(–4.2) cm long, usually persistently puberulent. Lamina ovate to subelliptic, (6.5–)8.5–19 × (1.5–)5.4–12 cm, coriaceous, becoming glabrous or subsersistently short-hairy on midrib on both surfaces; base broadly rounded to cuneate or acute, margin at most slightly and distantly undulate and slightly recurved; apex subretuse to quite long-pointed; midrib above abruptly narrowed near base, becoming ± raised, angled; venation ± obscure on both surfaces, or ± distinct below, 9–13 veins per 5 mm, angle of divergence 60–80°. Inflorescences sometimes 2 per axil and unbranched, or sometimes with 3-flowered branches to 1.2 cm long, axis 1.2–5 cm long, deciduous, lowest internode 0.5–1.3 cm long; 5–15-flowered; bracts 3–5.5 mm long, deciduous; pedicels 0.7–1.2 cm long, densely short-hairy. Flower ? hermaphroditic. Tepals 4; the outer pair 8–9.5 × 6–7.5 mm, densely hairy on back; inner pair 8–10 × 7–8 mm, sometimes hairy in band down back. Stamens 70–180; filaments to 6 mm long; anthers 2–3 mm long. Ovary to 3 mm long, densely hairy; style *c.* 3.5 mm long; stigma *c.* 3 mm across. Fruit round, 2.8–6 × 2.8–6 cm; apex rounded, drying brown, rather closely and shallowly wrinkled; outer layer 2–5 mm thick, compact. Stone globular, 2.5–5.5 cm diameter; apex rounded; walls 0.5–1.4 mm thick, smooth, unmarked; spongy layer thin.

Field characters: Trunk without or with only very short buttresses; outer bark brown, becoming fissured, ± scaling, the inner surface dark red; underbark buff, reddish buff, or red-brown; inner bark red; latex clear yellow, rarely yellowish white, sticky.

Distribution: Scattered: islands in Geelvink Bay, the Vogelkop, near Jayapura, Central and Milne Bay districts, the Bismarck Archipelago (not yet found in New Ireland), and the Aru Islands; perhaps the Celebes also.

Ecology: Usually primary rain forest, sometimes over coral; to 610 m altitude. Flowering August and September. Fruiting May, June and November; fruit greenish.

Germination and young plant: The radicle breaks the stone wall to one side of the base. The seedling has two pairs of leaves separated by an internode 0.5–2 cm long. Subsequently produced internodes are much longer and the plant is erect.

Notes: *Calophyllum euryphyllum* is a very distinctive species with its strongly flattened, usually shortly hairy twigs; well developed and spreading uppermost pair of axillary buds; rather large, ovate leaf laminas with inconspicuous venation; flowers with four tepals and a shortly hairy ovary; and spherical fruits that have a compact outer layer and a thick-walled stone lacking a basal plug.

A specimen from the Kiriwina Islands looks like *C. euryphyllum*, but the midrib on the upper surface of the lamina narrows gradually from the base, and

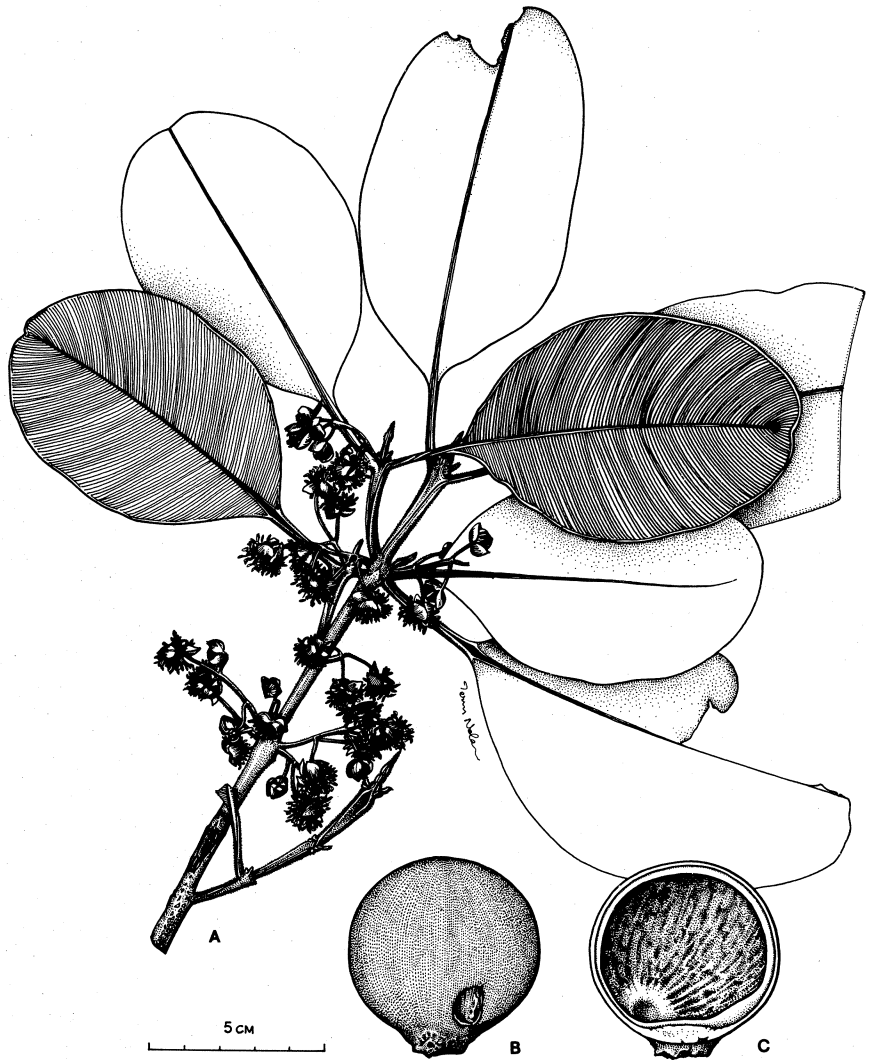


Fig. 15 *Calophyllum euryphyllum* Laut (A) flowering branchlet (Hoogland 4662) (B) fruit (C) fruit with part of wall removed to show seed (B & C: LAE 53644)

the flowers have nine tepals. The specimen is rather poor, and further collections are needed to establish the identity of this plant.

The relationships of *C. euryphyllum* are unclear. It is possibly close to *C. papuanum* and its relatives, which have very different terminal buds, fruits, and germination; to *C. obscurum*, which has much smaller leaves and fruits; and to *C. costatum* J. F. Bailey, which also has small leaves and fruits that probably have a basal plug. *Calophyllum carrii* may also be a member of this group; its fruits are unknown, but its leaf has a depressed midrib. Hairs of all of these taxa are much branched and are generally similar.

Calophyllum goniocarpum P. F. Stevens *Austral. J. Bot.* 22: 369, f. 6 (1974).

(Shrub or) tree, to 36 m high, d.b.h. to 60 cm. Twigs slightly flattened, 2–4.5 mm across, usually rather strongly 4-angled, drying brown, sometimes yellowish when older, with brown, \pm transient to subpersistent, puberulent to shortly tomentose indumentum; internodes 0.5–5(–7.5) cm long; uppermost pair of axillary buds 1–4 mm long, suberect to erect; terminal bud plump, 0.5–1.4 cm long, with grey to brown, scurfy to shortly tomentose indumentum, underdeveloped internode absent or rarely to 2.5 mm long. Petiole 0.4–3 cm long, becoming glabrous. Lamina obovate to oblong or elliptic, (4.2–)6–23 \times (2–)2.5–9.5 cm, coriaceous, soon becoming glabrous or subpersistently puberulent to subtomentose on midrib below; base acute to heart-shaped, margin distantly undulate and slightly recurved; apex rather long-pointed to retuse; midrib above \pm abruptly narrowing at base, becoming \pm raised, 0.2–0.5 mm wide at midpoint, sometimes disappearing up to 5 mm below apex, below raised, striate, sometimes weakly angled; venation usually not distinct on both surfaces, slightly raised (latex canals sometimes also raised), 9–17 veins per 5 mm, angle of divergence 60–80°. Inflorescences unbranched, or sometimes with 3-flowered branches to 1 cm long, axis 1–6 cm long, puberulent to subtomentose at base (also elsewhere), lowest internode 0.3–3.6 cm long; 5–17-flowered; bracts to 5 mm long, soon falling off; pedicels (0.3–)0.5–0.9 cm long, to 1.8 cm long in fruit, glabrous. Flower ? hermaphroditic. Tepals 4(or 5); outer pair 4.5–5 \times 3.5–4 mm; inner pair to 6 \times 4 mm. Stamens 50–180; filaments to 3 mm long; anthers 0.5–2 mm long. Ovary 1.2–1.5 mm long; style *c.* 2.5 mm long; stigma *c.* 0.7 mm across. Fruit ellipsoid to globular, 1.7–2.8 \times 1.2–2.6 cm; apex rounded, drying often purplish brown, smooth; outer layer 1.5–5 mm thick, air spaces often developing especially under skin. Stone ellipsoid to \pm globular, 1.4–2 \times 0.8–2.6 cm; apex acute to obtuse; walls (2 or) 3 or 4(or 5)-angled, 0.5–1.4 mm thick (to 2 mm thick in angles, *c.* 0.3 mm thick just one side of base), rough or pock-marked; spongy layer thin.

Field characters: Buttresses and spurs absent; outer bark brown, grey-brown, pale yellowish brown, olive, or yellow-green, with long, shallow fissures or small lenticels, the inner surface yellowish straw-coloured; underbark brownish, yellow, or red with yellow on back; inner bark reddish; latex opaque yellow, not very sticky, or watery, resinous.

Distribution: New Guinea and the Moluccas, scattered.

Ecology: Well-drained, often colline forest; at 10–800 m altitude. Flowering in August. Fruiting March, April, July, August, and October; fruit bluish to blackish, sometimes apparently dull green.

Notes: *Calophyllum goniocarpum* can be recognized by its plump terminal buds, its usually only moderately well-developed indumentum, its medium-sized to large leaf-laminas with fine, often rather dense venation, its inflorescence axis at least 1 cm long, and its fruits with angled stones.

There is considerable variation in the specimens assigned to *C. goniocarpum*. Variation in floral characters is poorly known; however, it may be noted that specimens from the Moluccas and the Vogelkop Peninsula (clearly more similar to one another than to any other specimens with angled stones) have flowers with 140–180 stamens, whereas those from the Papuan Islands have 50–80. Specimens from around Kiunga have stones that are almost round in transverse section, the angles being poorly marked; elsewhere in the range of the species, the stones are almost triangular or square in cross-section. A specimen from the Milne Bay area has rounded twigs about 1.3 mm across that dry yellowish, the terminal bud is as short as 3.5 mm long, and lamina is as little as 4.3 cm long; it has not been included in the description.

Calophyllum heterophyllum P. F. Stevens *Austral. J. Bot.* **22**: 371, f. 7 (1974).
Fig. 16.

More or less prostrate shrub 1 m high to canopy tree 29 m high, d.b.h. to 35 cm. Twigs flattened, 2–3.5 mm across, usually slightly 4-angled, drying yellowish brown, brown-puberulent when young; internodes 1–3(–5) cm long; uppermost pair of axillary buds to 1.5 mm long, suberect; terminal bud plump, 0.5–1(–1.2) cm long, with brown, crustaceous to puberulo-tomentose indumentum, underdeveloped internode to 1(–3.5) mm long. Petiole 0.35–1.1 cm long, subsersistently puberulent. Lamina oblong, elliptic, ovate, or obovate, 0.5–9.5 × 2–4 cm, coriaceous, subsersistently puberulent on midrib above, margin, and especially midrib below; base rounded to cuneate; margin obscurely undulate and flat to recurved; apex broadly truncate to subacute; midrib above narrowing gradually to rather quickly near base, flat or ± sunken at first with margin raised, becoming raised, 0.25–0.3 mm wide at midpoint, below raised, striate; venation ± obscure above and a little clearer below, raised to depressed, 6–11(–14) veins per 5 mm, angle of divergence 75–85°. Inflorescences unbranched, rarely with 3-flowered branches to 0.6 cm long, axis 1–3.2 cm long, puberulent (? glabrous toward apex), lowest internode 0.2–1.3(–17) cm long, uppermost internode often very much shorter than others, terminal five flowers appearing umbellate; (3–)5–11-flowered; bracts not known; pedicels 0.4–1.6 cm long, ± glabrous. Flowers ? hermaphroditic. Tepals 4 (or 5); outer pair *c.* 5.5 × 3.5–4 mm; inner pair 6–7.5 × *c.* 3.5 mm. Stamens 100–110; filaments to 3 mm long; anthers *c.* 1 mm long. Ovary *c.* 1.1 mm long; style *c.* 2.5 mm long; stigma 0.7–1 mm across. Immature fruit ± globular, *c.* 1.2 × 1.2 cm, drying purplish, smooth; outer layer soon disorganised by air spaces. Stone ? angled.

Field characters: Trunk not buttressed; outer bark brown, smooth; latex yellowish, copious.

Distribution: Western New Guinea: Vogelkop, Snow Mountains; Papua: Western district.

Ecology: Variable: shrubs or treelets, in heathy vegetation developed over poor, white, badly drained loam, at 1200–1300 m altitude (Star Mts); large trees in

primary forest, at 810 m altitude (Keban Valley); canopy trees common on lower ridges, at 100 m altitude (Palmer River). Flowering in May.

Notes: *Calophyllum heterophyllum* can be recognized by its plump terminal bud and its medium-sized lamina with obscure venation, at least on the upper surface, and usually only 7–11 veins per 5 mm. The terminal internode of the inflorescences is often notably shorter than the others, or even absent, so there often

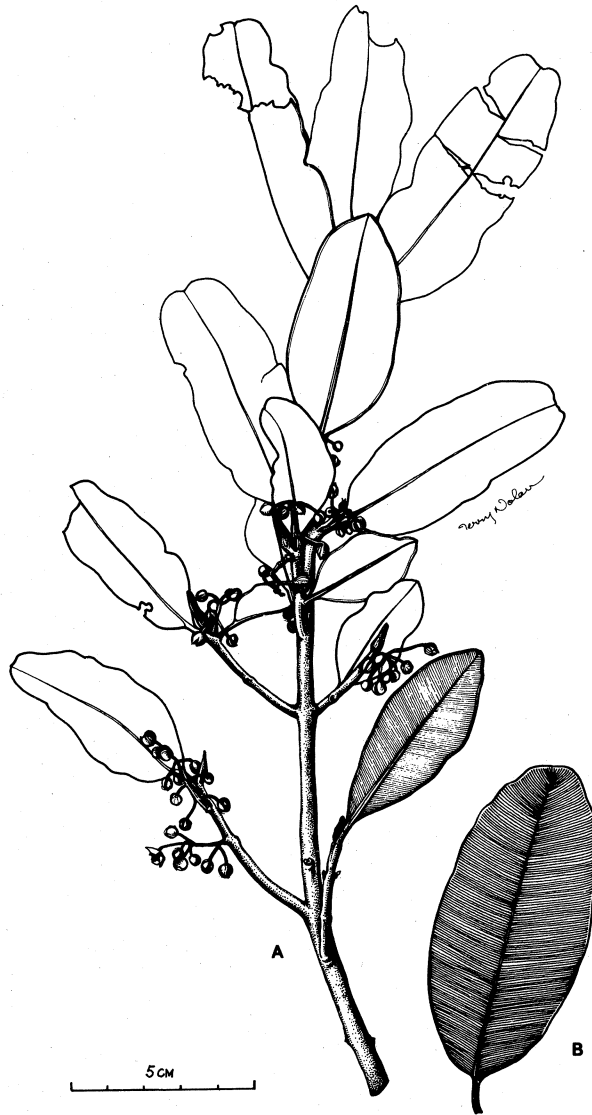


Fig. 16 *Calophyllum heterophyllum* P. F. Stevens (A) flowering branchlet (*Kalkman 4151*) (B) detail of leaf venation (*Kalkman 4554*)

appears to be a terminal umbel of five flowers. The flowers have four tepals, with the outer pair rather thick. The stone is possibly angled.

The delimitation and relationships of *C. heterophyllum* are unclear. It probably belong to the *C. trachycaule* complex, and can be most readily distinguished by its more distant venation and inflorescence with a terminal group of five flowers. The leaves of *C. heterophyllum* are very variable in size, shape, and margin, and field study of this taxon is much needed.

Calophyllum hirasimum P. F. Stevens *J. Arnold Arbor.* 61: 603, f. 36j–l (1980).

C. congestiflorum sensu Kan. & Hat. (1942), non A. C. Sm. (1941) [= *C. pauciflorum* A. C. Sm.].

Tree 4–18 m high, d.b.h. to 30 cm. Twigs flattened, 1–2 mm across, 4-angled when young, becoming \pm rounded, drying dark brown, subpersistently mealy-hairy; internodes 1–6 cm long; uppermost pair of axillary buds (1–)1.5–2 mm long, erect; terminal bud plump, 0.5–1(–1.2) cm long, with brown, crustaceous to puberulo-tomentose indumentum, underdeveloped internode to 1 mm long. Petiole 5–10 cm long, mealy-hairy when young. Lamina elliptic to oblong-elliptic or obovate, 2.8–6.7 \times 1.4–3.2 cm, coriaceous, midrib subpuberulent on both surfaces, \pm persistently so below; base acute; margin slightly undulate and recurved; apex rounded; midrib above narrowed near base, raised, 0.05–0.15 mm wide at midpoint, below raised, angled to striate; venation \pm distinct above and distinct below, raised, 9–12(–15) veins per 5 mm, angle of divergence 65–70°. Inflorescences unbranched, axis 0.8–2.8 cm long, \pm puberulent toward base, lowest internode 0.4–1.4 cm long; 3–7-flowered,; bracts often leaf-like, to 2.8 \times 1.5 cm, subpersistent; pedicels 0.5–1 cm long, glabrous. Flowers ? hermaphroditic. Tepals 4 (or 6); outer pair 3.5–4 \times 3.5–4 mm (rarely 2.4 \times 1.5 mm); inner ones to 6.5 \times 4 mm. Stamens 50–85; filaments to 2.5 mm long; anthers c. 1 mm long. Ovary c. 1.7 mm long; style c. 1.5 mm long; stigma c. 1 mm across. Fruit ellipsoid, c. 1.4 \times 1 cm; apex pointed, drying brown, slightly pruinose, smooth; outer layer thin, disorganized by large air spaces. Stone ellipsoid, c. 1.1 \times 0.9 cm; apex rounded; walls to 2 mm thick, somewhat thinner at base, smooth, unmarked; spongy layer thin.

Distribution: Western Snow Mountains and Vogelkop, Irian Jaya.

Ecology: Locally abundant small tree of primary *Nothofagus*-conifer forest, remnant Ericaceae-Myrtaceae-*Nothofagus* scrub, or secondary forest, at 1750–2150 m altitude. Flowering January, July, and November (floral axis reportedly red). Fruiting January and April; fruit purple.

Notes: *Calophyllum hirasimum* can be recognized by its small, elliptic to oblong-elliptic or obovate lamina with rather distinct venation; its inflorescences, which have subpersistent leaf-like bracts; and its ellipsoid fruits, which have a thin outer layer that is disorganized by air spaces, and a smooth thick-walled stone.

Calophyllum inophyllum L. *Sp. Pl.* 1: 513 (1753). **Fig. 17.**

Tree up to 35 m high, d.b.h. to 150 cm. Twigs 3.5–5.5 mm across, strongly 4-angled, sometimes with 2 additional raised lines, drying brown, usually glabrous; internodes 1–4.5 cm long; uppermost pair of axillary buds c. 1 mm long, spreading; terminal bud plump, 5–9 mm long, with short, greyish brown hairs, under-

developed internode to 3 mm long. Petiole 1.4–2.5 cm long, glabrous. Lamina ovate to elliptic, (8.5–)11–20 × 5.5–10 cm, coriaceous, glabrous; base ± rounded; margin rather distantly undulate and slightly recurved; apex rounded to retuse; midrib above narrowing quickly at base or not, 0.2–0.8 mm wide at the midpoint, becoming raised, below raised, angled towards the base; venation



Fig. 17 *Calophyllum inophyllum* L. (A) flowering branchlet (BSIP 15490) (B) fruit (from live material, Lae Botanic Gardens)

distinct on both surfaces, raised, 5–9 veins per 5 mm, angle of divergence 70–80°. Inflorescences usually unbranched, axis 2.5–15 cm long, glabrous, whitish, lowest internode (0.2–)2.5(–3.5) cm long; 5–11(–30)-flowered; bracts to 4 mm long, soon falling; pedicels 1.5–4.5 cm long, glabrous. Flower ? hermaphroditic. Tepals 8; outer pair 6.5–8 × 4.5–6.5 mm; inner ones to 14 × 8 mm. Stamens 210–340; filaments (3–)4–6.5 mm long; anthers 0.9–2 mm long. Ovary c. 3.5 mm long; style 4–8 mm long; stigma 1.5 mm across. Fruit ± pear-shaped, 3.5–4.5 × c. 3.5 cm; apex rounded or slightly pointed, drying greyish and wrinkled; outer layer 1–2.5 mm thick, compact. Stone ± globular, 2.3–3.6 × 2–3.2 cm; apex rounded; walls 0.8–1.5 mm thick, smooth, unmarked, basal plug 4–10 mm across; spongy layer thick.

Field characters: Outer bark often brown to grey, rarely blackish, scaly and with boat-shaped fissures at first, becoming strongly fissured, inner surface brick-orange; underbark reddish; latex clear yellow. Bole often twisted, sometimes horizontal and with erect branches.

Distribution: Throughout Papuasia in suitable habitats; elsewhere from Australia (Northern Territory and Queensland) to Madagascar and E. Africa.

Ecology: A common and characteristic tree of the beach-side forest on sandy and coral shores; sometimes growing a little inland on sandy soils; usually at sea level, rarely to 165 m altitude. Flowers and fruits almost throughout the year, with flowers fragrant and fruits green and probably dispersed by bats. The seed, enclosed by the stone, floats.

Germination and young plant: The radicle pushes out the basal plug. The seedling has three or four pairs of leaves separated by well-developed internodes, but the lowest pair(s) of leaves may drop off early. Subsequently produced internodes are also well developed and the plant is erect.

Vernacular name and uses: 'Dalo' (Kwara'ae, Solomon Islands). Much used for canoe manufacture since the shape of its curved trunks can be followed in construction.

Notes: *Calophyllum inophyllum* is easily recognized by its bent and twisted trunk, broad leaves with relatively few veins and prominent inflorescences with large flowers on long pedicels. The greyish wrinkled fruits are also distinctive.

Calophyllum insularum P. F. Stevens *J. Arnold Arbor.* 61: 669, f. 40d (1980).

Calophyllum sp. A, aff. *C. caudatum* Kan. & Hat., P. F. Stevens (1974).

Tree to 33 m high, d.b.h. 40 cm. Twigs slightly flattened or not, 0.9–1.3 mm across, not or slightly 4-angled, with obscure horizontal lines at nodes, drying blackish, subpersistently tomentose; internodes 1–3.5(–7) cm long; uppermost pair of axillary buds c. 1.5 mm long, erect; terminal bud narrowly conical, 5–8(–9.5) mm long, shape obscured by long, dense, reddish brown hairs, underdeveloped internode to 1 mm long. Petiole 0.7–1.3 cm long, subpersistently tomentose. Lamina narrowly ovate to elliptic, 4.9–10 × 1.1–2.5 cm, coriaceous, persistently tomentose on midrib below (and margin); base cuneate; margin undulate and slightly recurved; apex long-pointed; midrib above abruptly nar-

rowed at base, flat to slightly raised, 0.1–0.4 mm wide at midpoint, below raised, slightly angled or rounded; venation distinct on both surfaces, raised, (13–)16–19(–22) veins per 5 mm, angle of divergence 70–80°. Inflorescences unbranched, axis 3–5 mm long, tomentose, lowest internode 3–5 mm long; 1-flowered; bracts not known; pedicels 5.5–8 mm long, tomentose. Flower known in late bud, ? hermaphroditic. Tepals 8; outer pair 7.5–8.5 × 4–5 mm, tomentose outside and silky hairy inside; next pair to 7.5 × 4 mm. Stamens 80–100; anthers 1.3–2.3 mm long. Ovary 1.5–2 mm long; style 1.5–3.5 mm long; stigma *c.* 1.3 mm across. Fruit not known.

Field characters: Trunk without buttresses; outer bark dark brown, with numerous shallow fissures; inner bark brown; latex yellow, clear.

Distribution: Known only from islands in Geelvink Bay.

Ecology: Colline rain forest, *c.* 200 m altitude. Late bud in October.

Notes: *Calophyllum insularum* can be recognized by its tomentose indumentum, its narrowly ovate to elliptic leaf lamina with dense venation, its single-flowered, axillary inflorescences, and its flowers. The flower buds seem to have two lips, since each apex of the outer tepals separate early (this may be due to the way that the specimens are dried). The outer pair of tepals has hairs on both surfaces.

Calophyllum laticostatum P. F. Stevens *Austral. J. Bot.* 22: 375, f. 18 (1974). **Fig. 18.**

Tree 15–43 m high, d.b.h. to 91 cm. Twigs slightly flattened, 2–5.5 mm across, 4-angled, drying deep brown, with subsistent brown hairs; internodes (0.4–)1–3 cm long; uppermost pair of axillary buds to 2 mm long, spreading; terminal bud plump, (0.8–)1.3–2.7 cm long, with ± crustaceous, grey-brown indumentum, underdeveloped internode to 4 mm long. Petiole (0.4–)0.7–1.4 cm long, becoming glabrous. Lamina elliptic to narrowly obovate, (3–)6.5–16 × (0.8–)1.4–4.5 cm, coriaceous, transiently short-hairy on midrib below, or glabrous; base narrowly cuneate, at very base often shortly rounded; margin not undulate to rather distantly so and narrowly to broadly recurved; apex acute (or long-pointed); midrib above narrowed gradually from base, broadly depressed, 0.2–1.6 mm wide at midpoint, below raised, striate; venation above ± obscure, below ± distinct, raised (sometimes with latex canals ascending over veins on lower surface), (9–)11–20 veins per 5 mm, angle of divergence (40–)60–70(–80)°. Inflorescences unbranched, rarely with 3-flowered branches to 3 mm long, axis 1.2–5.5 cm long, ± puberulent, especially toward base, lowest internode 3–11 mm long; 5–21-flowered; bracts *c.* 4 mm long, soon falling; pedicels 2–11 mm long, sparsely puberulent to glabrous. Flower known only from buds, ? hermaphroditic. Tepals 4 or 6; outer pair *c.* 5 × 4 mm long. Stamens *c.* 170; anthers *c.* 1 mm long. Ovary *c.* 1 mm long; style *c.* 1.2 mm long; stigma *c.* 0.8 mm across. Fruit almost globular, 1.3–1.9 × 1.2–1.6 cm; apex rounded, drying mid-brown, broadly and obscurely wrinkled; outer layer 1–3 mm thick, compact or with air spaces developing under skin. Stone ± round, 0.6–1.1 × 0.6–1 cm; apex rounded; walls 0.2–0.8 mm thick, smooth, unmarked; spongy layer thin.

Field characters: Trunk without buttresses or spurs, ? rarely with aerial roots; outer bark yellowish in young tree, becoming grey to brown, shallowly to rather deeply fissured, scaling or not, the inner surface dark red, or orange-brown and orange or red and brown mottled; underbark red; inner bark red; latex yellow, rarely greenish yellow, clear, sticky.

Distribution: Papua New Guinea, scattered (Western, Morobe, Milne Bay and New Britain districts), possibly also in the Philippines (Luzon).

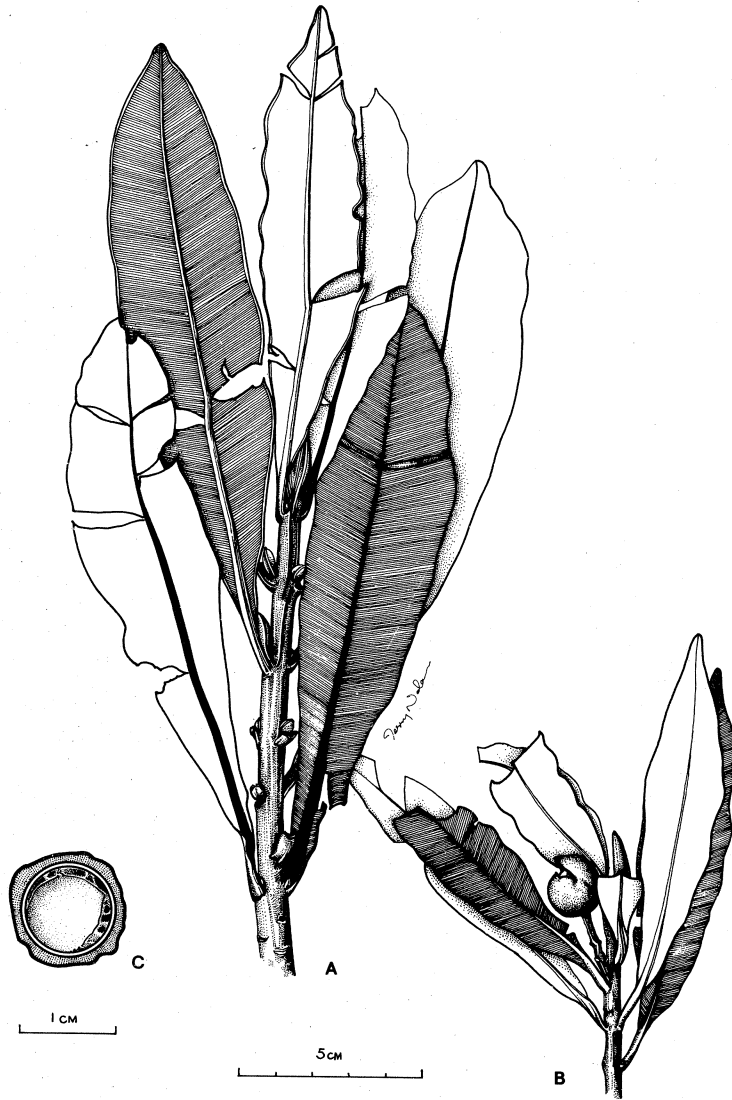


Fig. 18 *Calophyllum laticostatum* P. F. Stevens (A) branchlet (*Coode & Katik s.n.*) (B) branchlet with fruit (C) fruit—transverse section showing seed (B & C: NGF 26854)

Ecology: Well-drained lowland or colline rain forest, at 20–1370 m altitude. Flowering in January. Fruiting October, January, March, submature fruit in May; fruit bluish.

Young plant: The young plant is erect.

Notes: *Calophyllum laticostatum* can be recognized by its fairly long plump terminal buds (usually greater than 1 cm long), and by its rather narrowly elliptic, coriaceous leaves that have a broadly sunken midrib narrowing gradually from the base. The fruits are small (less than 2 cm long) and have a well-developed outer layer.

Relatively little material of *C. laticostatum* in flower and fruit is known, and there is a considerable amount of vegetative variation (see also Stevens, 1974). It is closely related to species to the immediate west of New Guinea.

One of the specimens from Kiunga, Western district, has leaf-laminas that are long-pointed at the apex. Field notes of this specimen mention 'much branched aerial roots'. I have not seen such roots on plants of *C. laticostatum* either at Kiunga or on New Britain.

Calophyllum leleanii P. F. Stevens *J. Arnold Arbor.* 61: 587, f. 40e–g (1980).

C. solomonense A. C. Sm. (1941); T. C. Whitmore (1966), (1967); P. F. Stevens (1974), all p.p.

Tree 8–25 m high, d.b.h. to 54 cm. Twigs flattened, (3–)4–6 mm across, slightly 2-, 4-, or 6-angled, with slight horizontal lines at nodes, drying brown, mealy-puberulent when young; internodes (0.7–)1.5–10 cm long; uppermost pair of axillary buds 1–6 mm long, spreading to suberect; terminal bud often narrowly conical, 0.8–2 cm long, with brown, crustaceous to adpressed hairs, underdeveloped internode to 4.5 mm long. Petiole 1.1–2.5 cm long, puberulent when young. Lamina elliptic or ovate to suboblong, (5.5–)10–28 × (2.5–10) cm, coriaceous, sparsely puberulent on midrib below when young; base acute to cuneate; margin narrowly recurved and undulate; apex obtuse to fairly long-pointed; midrib above abruptly narrowed at to gradually narrowed from base, ± raised, angled; venation obvious on both surfaces, especially so above (latex canals sometimes raised), 5–10 veins per 5 mm, angle of divergence 50–80°. Inflorescences unbranched, sometimes with 3-flowered branches to 3 mm long, axis 0.3–2.5 cm long, subglabrous, lowest internode 1–10 mm long; 5–11-flowered; bracts not known; pedicels 0.8–1.7 cm long, glabrous. Flower staminate or hermaphroditic. Tepals 4, 7, or 8; outer pair 6–7.5 × 5.5–8 mm, fleshy, strongly concave; next pair c. 7 × 6 mm; inner ones 8.5–11 × 3–4.2 mm. Stamens 330–420; filaments to 7 mm long; anthers 0.8–1.5 mm long. Ovary in hermaphroditic flower c. 2 mm long, absent in staminate flower; style c. 2.7 mm long; stigma c. 0.9 mm across. Fruit almost spherical, 1.8–3.5 × 1.6–3.1 cm; apex slightly pointed, drying greyish brown, wrinkled; outer layer 0.6–2 mm thick, to 4 mm thick when fresh, compact. Stone globular to ellipsoid, 1.6–2.5 × 1.4–1.9 cm; apex rounded to obscurely pointed; walls 1.3–2 mm thick, to 3 mm thick at base, smooth, unmarked, basal plug c. 10 mm across; spongy layer thin.

Field characters: Trunk without buttresses; outer bark orange to yellowish when young, becoming brown to grey, scaly, the inner surface yellow to orange; under-bark red; inner bark red; latex yellow, clear or opaque.

Distribution: Scattered: Sulawesi (probably), New Britain, and the Solomon Islands.

Ecology: Locally common in primary slope and ridge forest; on Santa Isabel in soil derived from ultramafic rock; at 45–915 m altitude. Flowering in December. Fruiting December and April; fruit greenish.

Local uses: The wood is used for making spears, and latex from the fruit is used as paint in sing-sings (West Nakanai, Hoskins); it is a good timber tree.

Notes: *Calophyllum leleanii* can be recognized by its fairly long terminal bud and suberect to spreading uppermost axillary buds; its rather large lamina with the midrib on the upper surface often relatively inconspicuous; its large flowers, which have numerous stamens (more material is needed to confirm this); and its sharply and shallowly wrinkly fruits. The fruits have a fairly thick outer layer and stone wall; the stone has a basal plug. *Calophyllum leleanii* is most similar to *C. waliense*; this is discussed further under *C. waliense*.

Calophyllum macrophyllum Scheffer, *Nat. Tijd. N.I.* VII, 2: 405 (1873).

? Tree; twigs slightly flattened, 5–7 mm across, strongly 4-angled to winged, drying brown, glabrous at maturity; terminal bud \pm conical, c. 5 mm long, with brownish hairs; other details of twigs and buds unknown. Petiole 1.3–1.7 cm long, glabrous at maturity. Lamina elliptic to suboblong, 32–45 \times 9–11 cm, coriaceous, glabrous at maturity; base cuneate; margin barely undulate and slightly recurved; apex acute; midrib above rather quickly narrowed at base, raised, 0.3–0.4 mm wide at midpoint, below strongly raised, angled; venation not distinct above, distinct below, raised, with 3–5 veins per 5 mm, angle of divergence about 80°. Inflorescence, flower, and fruit not known.

Distribution: Gebeh Island (Moluccas), known only from the type collection.

Notes: The very large leaf-lamina with distant venation and the relatively small terminal bud allow *C. macrophyllum* to be recognized readily, but it is still known only from the poor sterile collection on which the original description was based.

Although it seems unlikely that the type specimen was taken from a sapling (Stevens 1974), the leaves would be large even for a young plant of *Calophyllum*.

Calophyllum morobense P. F. Stevens *Austral. J. Bot.* 22: 378, f. 9 (1974).

Tree to 21 m high, d.b.h. to 30 cm. Twigs flattened, about 1.5 mm across, 4-angled, drying dark brown, sparsely puberulent when young; internodes 1–3.5(–7.5) cm long; uppermost pair of axillary buds about 0.5 mm long, spreading; terminal bud plump to narrowly conical, 2.5–5 mm long, with short brown hairs, underdeveloped internode absent. Petiole 0.6–1 cm long, glabrous at maturity. Lamina elliptic to ovate or suboblong, 4.5–9 \times 2–4.5 cm, coriaceous, glabrous at maturity; base acute to cuneate; margin slightly undulate and not or slightly recurved; apex long-pointed; midrib above gradually narrowed from base, \pm sunken at first, eventually becoming slightly raised, 0.1–0.2(–0.3) mm wide at midpoint, below slightly raised, striate; venation \pm obscure to distinct on both surfaces, slightly raised or not (latex canals sometimes sunken), 13–16 veins per 5 mm, angle of divergence 75–80(–85)°. Inflorescence unbranched, axis

1–1.5 cm long, glabrous, lowest internode *c.* 3 mm long; *c.* 7-flowered; bracts unknown; pedicels 5–7 mm long, glabrous. Flower unknown. Fruit ovoid to \pm globular, *c.* 2.8 \times 2.2–2.8 cm; apex pointed, drying brown, sharply and closely wrinkled; outer layer 2–3.5 mm thick, compact. Stone ovoid to ellipsoid, 2.2–2.7 \times 1.8–1.9 cm; apex \pm bluntly pointed; walls 1.3–1.5 mm thick, smooth apart from shallow, elongated pock marks, probably with basal plug *c.* 6 mm across; spongy layer thin.

Distribution: Endemic to the Morobe district of northeastern New Guinea.

Ecology: Alluvium in lowland rain forest; 5–35 m altitude. Fruiting in April; fruit bluish to almost black.

Notes: *Calophyllum morobense* can be recognized by its medium-sized, strongly pointed leaf-laminas with a relatively inconspicuous midrib on both surfaces and fairly dense venation (13–16 veins per 5 mm). The fruits are relatively large, more or less pointed at the apex, and strongly wrinkled when dry; the stone walls are 1.2–1.5 mm thick.

Calophyllum neo-ebudicum Guillaumin *J. Arnold Arbor.* 12: 227 (1931).

Calophyllum pseudovitiense P. F. Stevens (1974); *C. vitiense* sensu A. C. Sm. (1941), T. C. Whitm. (1966)¹, (1967), (1974)², Foreman (1972)³, non Turr. (1915).

Tree 6–58 m high, d.b.h. to 184 cm. Twigs slightly flattened, 1.5–4 mm across, slightly 4-angled, drying brown to blackish, puberulent to shortly tomentose when young; internodes 0.7–4 cm long; uppermost pair of axillary buds to 2 mm long, \pm erect; terminal bud plump, rarely conical, 0.4–1.5 cm long, with greyish to reddish hairs, underdeveloped internode to 4 mm long. Petiole 0.6–3.7 cm long, glabrous when mature. Lamina rather narrowly ovate to elliptic (or suboblong), (4–)5–19.5 \times 1.5–7.3 cm, coriaceous, glabrous to subsersistently puberulent on midrib below; base cuneate to narrowly acute or attenuate; margin undulate but slightly or not recurved; apex long-pointed; midrib above gradually narrowed from base, sunken, margins usually raised, becoming raised toward or above midpoint, (0.1–)0.2–0.5(–0.8) mm across at midpoint, below raised, angled toward apex, striate toward base; venation \pm distinct above and below, raised (latex canals raised or not), 7–14 veins per 5 mm long, angle of divergence 60–80°. Inflorescences usually unbranched, axis 1.5–9.2(–13) cm long, puberulent or shortly tomentose, especially toward base, lowest internode 0.4–3.3(–4.5) cm long; 7–17-flowered; bracts to 5 mm long, not persistent, pedicels 0.7–2 cm long, glabrous to puberulent. Flower ? hermaphroditic. Tepals 8 (to 12); outer pair 2.5–5.5 \times 2.7–4 mm long; inner ones 7–10 \times 3.5–6 mm long. Stamens 150–275; filaments to 5.5 mm long; anthers 0.4–0.8 mm long. Ovary 1.5–2.5(–3) mm long; style 2.5–3 mm long; stigma 0.5–1 mm across. Fruit ovoid to ellipsoid, 2.1–3.7(–4.3) \times 1.5–2.8(–3.3) cm; apex \pm rounded, drying purplish brown to blackish, broadly and \pm deeply wrinkled to smooth; outer layer (0.5–)1–3 mm thick, compact, usually with air spaces developing near skin and stone. Stone \pm ovoid, (1.5–)1.8–3.2(–4) \times (1–)1.3–2.5 cm; apex rounded to obtusely pointed;

¹ T. C. Whitmore (1966), Guide Forests British Solomon Is., p. 78.

² —(1974), Commonwealth Forestry Inst. paper 46: 1–77.

³ D. B. Foreman (1972), Check List Vascular Pl. Bougainville, pp. 42, 86 & 87, fig.

walls (0.7–)1.3–2.1(–3) mm thick, smooth, unmarked, with basal plug 6–10 mm across; spongy layer thin.

Field characters: Trunk rarely with buttresses to 1.3 m high; outer bark grey to yellowish mottled at first, with brown and pinkish patches intermingled, later brown, deeply fissured, not hoop marked, the inner surface blackish; underbark reddish, fibrous; latex yellow, rarely cream-coloured, clear, but tending to become cloudy, sticky. Crown pyramidal when young, becoming cauliflower-shaped with age.

Distribution: ? Celebes, New Britain and Bougainville, to the New Hebrides, Fiji, Samoa and Tonga; abundant in the Solomon Islands.

Ecology: Usually primary lowland to colline rain forest, to 825 m altitude, favouring ridges and other well-drained habitats. Flowering February, April, May, July to December (flower scented). Fruiting more or less throughout year; fruit pale green at first, turning bluish to purple-black when ripe.

Details of the establishment of *C. neo-ebudicum* on Kolombangara (the Solomon Islands) are given by Whitmore (1974, as *C. vitiense*). The fruits are well dispersed, and the seedlings grow to adult size in closed forest as well as in gaps.

Germination and young plants: The roots pushes out a basal plug during germination. The seedling has 2–4 pairs of leaves, when there are four pairs, some leaves are always very much reduced (1–4 mm long) and soon fall off; the internodes are 1–2.2 cm long. Subsequent growth is erect, and internodes gradually become longer.

Vernacular name: 'Gwarangwaro' (Kwara'ae, Solomon Islands).

Uses: Through much of the range of the species, the timber is used for building canoes; more locally it is used for building houses or in making spears or bowls. Hair oil is made from the flowers (Fauro Islands). In Malaita small saplings, with the outer layer of the bark removed to give bright, saffron-coloured sticks, are reported to have been used in bride purchase.

Notes: *Calophyllum neo-ebudicum* can be recognized by its frequently dark-drying twigs and petioles, and by its ovate-elliptic lamina, the upper surface of which often dries somewhat shiny greenish and has a depressed midrib. The predominantly eight-tepaled flowers have small anthers and a short (less than 3 mm long) style. The spherical to ovoid-ellipsoid fruits dry more or less smooth and have a rather thick outer layer and a moderately thick stone; the stone has a basal plug. Indumentum elsewhere than on the terminal bud is usually inconspicuous.

***Calophyllum novoguineense* Kan. & Hat. *Bot. Mag. Tokyo* 56: 562, f. 3 (1942).**

C. warenense Kan. & Hat. (1942).

Tree 15–20 m high, d.b.h. to 20 cm. Twigs slightly flattened, 0.4–1.2 mm across, 4-angled, drying brown, sometimes yellowish when old, with sparse, \pm adpressed hairs when young; internodes (0.2–)0.5–2 cm long; uppermost pair of axillary buds 0.7–1.2 mm long, suberect; terminal bud subconical, 1–2 mm long, with brown, adpressed to spreading hairs, underdeveloped internode to 1 mm long. Petiole 1–4 mm long, \pm glabrescent. Lamina elliptic to subcuneiform or

subobovate, 0.6–5 × 0.35–3 cm, coriaceous, subadpressed to erect hairs on midrib below, sometimes on entire lower surface; base cuneate; margin somewhat undulate and recurved, entire lamina often ± boat-shaped; apex subacute to rounded; midrib above narrowing gradually from base, ± raised, (0.07–)0.15–0.3 mm wide at midpoint, sometimes disappearing up to 5 mm below apex, below only slightly raised, striate; venation above not distinct, below distinct, raised 5–9(–11) veins per 5 mm, angle of divergence 50–70°. Inflorescences unbranched, axis 0.2–2.5 cm long, pubescent, especially toward base, lowest internode (2–)4–7 mm long; 3–7-flowered; bracts c. 1.5 mm long, falling early; pedicels 3–15 mm long, glabrous or sparsely pubescent. Flower ? hermaphroditic. Tepals 4; outer pair 2.5–3.2 × 2–2.5 mm; inner pair 2–3.5 × 1.5–2.5 mm. Stamens 20–35; filaments to 2 mm long; anthers 0.4–1.5 mm long. Ovary 0.4–1 mm long; style c. 1 mm long; stigma 0.3–0.5 mm across. Fruit ± globular, 5–7 × 4.5–6 mm; apex pointed, drying brown, ± wrinkled; outer layer 0.3–0.5 mm thick, becoming disorganized by air spaces. Stone globular to ellipsoid, 3.5–6.5 × 3–5.5 mm; apex rounded; walls < 0.1 mm thick, smooth, ? unmarked; spongy layer thin.

Field characters: Outer bark yellow-brown, smooth except for fine vertical cracks, the inner surface dull straw-brown; underbark red to deep red; inner bark red; latex cloudy, not sticky, white or becoming white when rubbed (details from specimens from the Western district).

Distribution: Endemic to New Guinea, scattered, occurring in the Fakfak, Jayapura and Western districts.

Ecology: Varied habitats: edge of lowland freshwater swamp, well-drained lowland forest; dry thicket by seashore; colline, *Agathis*-dominated forest; and chalk; at 2–750 m altitude. Flowering March, April and August. Fruiting April, August (submature) and September.

Young plants: Young plants c. 30 cm high have short (less than 1 cm long) internodes and narrowly elliptic leaves.

Notes: *Calophyllum novoguineense* is characterized by its strongly 4-angled twigs, its small terminal bud, and its lamina less than 5 cm long that is at most subacute at the apex, which dries notably darker brown above than below. The flowers have four tepals and few anthers; the fruits are small.

Calophyllum novoguineense is a member of a species complex occurring from the Moluccas to Fiji. All members have similar hairs characterized by having at most a single rounded, basal branch and a notably rough surface; the leaves and fruits are generally small. The flowers, where known, have few stamens and usually only four tepals. Species limits in the taxa centered on New Guinea (*C. novoguineense*, *C. bicolor*, *C. parvifolium*, and *C. caudatum*) are not very clear.

Calophyllum novoguineense is closest to *C. bicolor*, which also frequently has hairs on the lower surface of the lamina.

Calophyllum obscurum P. F. Stevens *Austral. J. Bot.* **22**: 380, f. 10 (1974).

Tree to 30 m high, d.b.h. to 90 cm. Twigs slightly flattened, 2–2.5 mm across, 4-angled, drying greyish brown, with short, subpersistent, greyish hairs; internodes 0.5–1.75(–3) cm long; uppermost pair of axillary buds to 1.5 mm long, ± spreading; terminal bud plump, 0.7–1(–1.7) cm long, with subcrustaceous, greyish

indumentum, underdeveloped internode 1–4 mm long. Petiole 0.9–2.5 cm long, persistently mealy-hairy. Lamina elliptic, ovate, or obovate, 7–11.5 × 3.3–6 cm, coriaceous, subpersistently mealy-hairy on midrib below; base acute; margin undulate but slightly recurved; apex obtuse to subacuminate; midrib above narrowing gradually from base, rather indistinct, margin slightly raised near base, 0.25–0.35 mm wide at midpoint, becoming raised, below raised, subangled; venation ± obscure above and below, raised, 9–16 veins per 5 mm, angle of divergence 60–75°. Inflorescences unbranched, rarely with 3-flowered branches to 0.7 cm long, axis 0.7–2.8 cm long, puberulent, lowest internode (0.3–)1–1.7 cm long; 5–11-flowered; bract unknown; pedicels 0.8–1.2 cm long, puberulent. Flower known only in late bud, ? hermaphroditic. Tepals 8; outer 4 c. 5.5 × 5.5 mm, shortly hairy on back. Stamens 200–250; anthers 1.5–2.3 mm long. Ovary c. 1 mm long; style c. 1.5 mm long; stigma 1.6–2.4 mm across. Fruit ± globular, 2.4–3.1 × 2.2–2.7 cm; apex sharply pointed, drying greyish brown, wrinkled; outer layer 0.5–1.3 mm thick, compact. Stone ± globular, 2.2–2.9 × 2–2.6 cm; apex rounded; walls 1.5–2 mm thick, 3–4 mm thick at base, smooth or slightly wrinkled, unmarked; spongy layer thin.

Distribution: Endemic to the Solomon Islands, occurring in the Choiseul, Santa Isabel and Malaita districts.

Ecology: Ridges in primary rain forest, or raised, sometimes flooded coral platforms, at 60 m altitude. Flowering February and March (flower scented). Fruiting August and December; fruit green to greyish.

Notes: *Calophyllum obscurum* can be recognized by its plump terminal bud and its medium-sized leaf-laminas that dry dull in colour and have obscure fairly close venation and a rather indistinct midrib on the upper surface. The inflorescence is covered by short, greyish hairs, and the wrinkled fruits have a thin outer layer and a thick-walled stone that appears to lack a basal plug. In two collections, the flower is reported to be yellow; this colour may be caused by the presumably brownish indumentum covering the white tepals.

The thick-walled stone that lacks a basal plug and the indumentum covering the entire inflorescence immediately distinguish *C. obscurum* from the other species of *Calophyllum* in the Solomon Islands. It is perhaps related to *C. carrii*, from mainland New Guinea, although that species has more robust twigs, leaf-laminas with a depressed midrib on the upper surface, clearer venation, and longer pedicels. Ripe fruits of *C. carrii* are unknown. *C. obscurum* is also similar to *C. costatum* J. F. Bailey, from Australia.

***Calophyllum papuanum* Laut. Bot. Jb. 58: 9, f. 2 (1922).**

Tree (5–)16–40 m high, d.b.h. to 92 cm. Twigs strongly flattened, 2–5(–8) mm across, (rarely 2–)4- or 6-angled, often with inconspicuous transverse raised line at nodes, drying brown, usually subpersistently tomentose; internodes 1–6 cm long; uppermost pair of axillary buds 2.5–4.5 mm long, erect; terminal bud strongly flattened, 7–15 mm long, with brown tomentose indumentum, underdeveloped internode to 3 mm long. Petiole 0.6–2.5 cm long, usually subpersistently tomentose. Lamina ovate to subobovate, subcuneiform or suboblong, (2.4–)6.5–17(–22) × (1.4–)3.5–8(–11) cm, coriaceous, when young with hairs on both surfaces, often persistently subtomentose on lower surface; base cuneate to

rounded; margin slightly undulate and not to slightly recurved; apex subacute to rounded; midrib above usually narrowing gradually from base, sunken at first, soon becoming \pm raised, (0.2–)0.4–0.8 mm wide at midpoint, below raised, angled; venation above \pm obscure, below \pm distinct, raised, 5–12 veins per 5 mm, angle of divergence 60–80°. Inflorescences usually unbranched, axis (0.3–)0.7–1.5 cm long, shortly tomentose to sparsely puberulent, lowest internode 0.3–1.2 cm long; (1–)3–7(–11)-flowers; bracts to 5.5 mm long, soon falling off; pedicels 0.5–1.3 cm long, puberulent to subtomentose. Plant ? dioecious. Tepals usually 8; outer pair 4.5–9.2 \times 4.5–9 mm, shortly tomentose on back; inner tepals 6–14 \times 4–12 mm, at least outer pair puberulo-tomentose on back. Stamens (70–)150–300: staminate flower with filaments 3.5–10 mm long; anthers 2.3–5 mm long; pistillate flower with filaments c. 3 mm long; anthers 0.5–1 mm long. Ovary 2.3–5.5 mm long in pistillate flower (smaller in staminate flower), tomentose; style 1.5–2.5 mm long; stigma 3–5.5 mm across (absent in staminate flower). Fruit \pm globular, 2–4 \times 2–4 cm; apex rounded, drying brown, smooth; outer layer 1.5–5 mm thick, \pm compact, but air spaces developing near stone. Stone \pm globular, 1.4–3 \times 1.4–3 cm, sometimes weakly 2–4-angled; apex rounded; walls 1–2.5 mm thick, barely developed just to one side of base, irregularly pock-marked; spongy layer thin.

Field characters: Trunk sometimes with spurs or buttresses to 3 m long; outer bark dark grey to brown, becoming strongly fissured and flaking when mature, the inner surface purplish to red-black; underbark clear red to pink; inner bark dark to pale red; latex clear yellow, very sticky, sometimes light yellow, milky. Crown conical at first, becoming irregular and spreading.

Distribution: Moluccas, mainland New Guinea, and Fergusson and Goodenough islands (Papuan Islands district).

Ecology: Usually a canopy tree of colline or montane forest often dominated by Fagaceae, rarely in more or less swampy forest or depleted *Agathis* forest over limestone with thick clay cover, also scattered throughout the Western and Digul districts at low elevations; (2–)120–1830 m altitude. Flowering January to March, May, July, September, November, and December; with flowers scented. Fruiting January, April, and September; fruit greenish.

Germination and young plant: The radicle pushes through the area of very thin stone just to one side of the base. The seedling has three, or rarely two pairs of leaves separated by well-developed internodes; the lowest pair of leaves may drop off well before the others. Subsequent internodes are also well developed, and growth is erect. Germination is similar in fruits with angled and with rounded stones.

Uses: The wood is used in building.

Notes: *Calophyllum papuanum* is a very distinctive species with a flattened terminal bud and medium-sized leaf-laminas that usually have subpersistent, puberulo-tomentose indumentum over the lower surface. The flower has a tomentose ovary, and the rather large, spherical fruits are 2–4 cm long and have a pock-marked stone.

Plants of *C. papuanum* growing at higher altitudes have angled stones; those growing at lower altitudes have rounded ones. Other interesting variation is shown by specimens from the hills south of the Sepik River, that have rather small, narrow, subovate leaf laminas that are minutely rounded at the base; fruits are not known from plants with leaves of this type. The single collection from Morotai and a fragmentary collection from the Andai Mountains, Vogelkop, both have small leaf laminas.

Calophyllum parvifolium Choisy *Mém. Soc. Hist. Nat. Paris* 1: 229 (1823).

C. microphyllum Planch. & Triana (1862); *C. microphyllum*, auct. non Planch. & Triana (1862), non Scheffer; *C. schefferi* Vesque (1893).

? Tree or ? shrub. Twigs somewhat flattened, 0.7–1.2 mm across, slightly 4-angled, drying brown, glabrous or with subadpressed hairs when young; internodes 0.5–2.8 cm long; uppermost pair of axillary buds 0.4–1 mm long, spreading; terminal bud plump, 1.8–3 mm long, with short, brown, subadpressed hairs, underdeveloped internode to 1.5 mm long. Petiole 1.5–2 mm long, sparsely puberulent at first. Lamina ovate to broadly ovate, 2.5–4 × 1.5–3 cm, coriaceous, drying boat-shaped, with subpersistent, short hairs on midrib below; base cordate; margin slightly undulate and not recurved; apex acute (or rounded); midrib above narrowed gradually from base, level (not raised), *c.* 0.1–0.2 mm wide at midpoint, below slightly raised, edges ± impressed, inconspicuous; venation rather obscure above and below, raised, 4–7 veins per 5 mm, angle of divergence 40–60°. Inflorescences unbranched, axis 1.5–4.7 cm long, slender, sparsely hairy toward base, lowest internode 1–2.5 cm long; 3–7-flowered; bracts unknown; pedicels 2.2–3.5 cm long, glabrous, slender. Flower ? hermaphroditic. Tepals reported to be 8, probably 4 in flower examined; outer tepals *c.* 4.5 × 3 mm; inner tepals *c.* 5.5 × 3.5 mm. Stamens *c.* 28; filaments to 2.2 mm long; anthers 1.1–1.4 mm long. Ovary *c.* 0.8 mm long; style *c.* 1.3 mm long; stigma not known. Fruit (not seen) reported to be round, barely 4 mm long; apex pointed.

Distribution: Gebeh Island (Moluccas) and nearby Waigeo Island; known only from two specimens.

Ecology: Montane forest.

Notes: *Calophyllum parvifolium* is a poorly known species characterized by its leaves with small, sometimes almost heart-shaped laminas and distant venation, and by its long, very slender, glabrous pedicels.

The nomenclature of *C. parvifolium* and its synonym, *C. microphyllum* Scheffer, was discussed by Stevens (1974).

Calophyllum parvifolium is probably most closely related to *C. novoguineense*, which occurs in the western half of New Guinea. *Calophyllum novoguineense* has well-developed, subpersistent indumentum on its twigs, a lamina that is at most rounded at the base, and pedicels up to 15 mm long. The two species dry in much the same way and apparently have similar flowers, although *C. parvifolium* may have flowers with eight tepals (see description; this would be another difference between the two species).

Calophyllum pauciflorum A. C. Sm. *J. Arnold Arbor.* 22: 341 (1941). **Fig. 19.**

C. congestiflorum A. C. Sm. (1941).

Tree 8–36 m high, d.b.h. to 48 cm. Twigs strongly flattened, 1.25–3 mm across, 4- or 6-angled, sometimes 2-angled when older, with inconspicuous transverse raised line at nodes, drying brown, glabrous or sparsely mealy-hairy; internodes 0.3–5 cm long, to 10 cm on leader shoots; uppermost pair of axillary buds 1–4.5 mm long, at first inconspicuous; terminal bud strongly flattened, 5–11 mm long, with short brown hairs, underdeveloped internode absent (or to 2 mm long). Petiole 2–8 mm long, \pm glabrous when mature. Lamina cuneiform, elliptic, or obovate, 2.5–5.5(–9.5) \times 0.9–2.5(–4) cm, coriaceous, young leaf sparsely puberulent on both surfaces, sometimes with mealy hairs persisting near midrib below when older; base cuneate; margin slightly undulate or recurved; apex obtusely pointed to rounded; midrib above narrowed gradually from base, \pm sunken at first with margins raised, becoming \pm raised, centre sunken, (0.3–)0.4–0.6 mm wide at midpoint, below raised, angled; venation on both surfaces \pm obscure, slightly raised, 7–12 veins per 5 mm, angle of divergence 50–70°. Inflorescences unbranched, axis 0.3–1.2(–1.5) cm long, shortly hairy at least towards base, lowest internode 2–4 mm long; 3–5-flowered; bracts 2.5–4.5 mm long, soon falling; pedicels 2–6 mm long, glabrous or with sparse \pm mealy indumentum. Plant ? dioecious. Tepals (7 or)8; outer pair *c.* 3.75 \times 3.5 mm, sometimes with hairs on back toward base; inner tepals to 5.5 \times 6.5 mm. Stamens 70–125; filaments to 4.5 mm long; anthers 0.7–1.7 mm long. Ovary 1–2 mm long; style *c.* 1 mm long; stigma 1.5–2.5 mm across. Fruit globular, 1.5–1.9 \times *c.* 1.7 cm, drying brownish, smooth or finely lined; outer layer 3–4.8 mm thick, \pm compact. Stone globular, 1–1.3 \times 1–1.3 cm, usually rather obscurely 2- or 3-angled; apex rounded; walls 0.7–1.5 mm thick, thinner just to one side of base, pitted; spongy layer thin.

Field characters: Trunk not buttressed, sometimes fluted at base; outer bark brown to dark brown, rarely light grey, fissured and scaling, the inner surface brown to dark brown; underbark dark red; inner bark reddish brown; latex clear yellow, sticky, sometimes grey and cloudy.

Distribution: New Guinea mainland, excluding the Vogelkop Peninsula.

Ecology: Lower or sometimes upper montane forest, often dominated by *Castanopsis* or *Nothofagus*; at 1550–2900 m altitude. Flowering January and April. Fruiting January, February, and September; fruit greenish.

Germination and young plant: The radicle probably breaks through the stone wall just to one side of the base. The seedling has three pairs of leaves separated by well-developed internodes. Subsequently produced internodes are longer, and the terminal bud is functional.

Uses: The green wood is good as fuel.

Notes: *Calophyllum pauciflorum* is a distinctive species recognizable by its flattened terminal buds and its small, often cuneiform leaf-laminae that appear glabrous when mature. The midrib on the upper surface of the lamina narrows gradually from the base, and the venation is more or less obscure. The inflorescences have only three to five flowers, and the fruits are less than 2 cm long.

Calophyllum pauciflorum is related to *C. vexans* and especially to *C. papuanum*. The differences between the three species are mostly in the size of

parts and the prominence of the indumentum, but there is never any trouble in identifying specimens. Although specimens of *C. papuanum* from higher altitudes have smaller leaves and fruits with angled stones (and in these characters approach *C. pauciflorum*), in indumentum development, venation prominence, and midrib type, they are like specimens of *C. papuanum* from lower altitudes.



Fig. 19 *Calophyllum pauciflorum* A. C. Sm. flowering branchlet (Carr 14088)

The anthers of high altitude specimens of *C. papuanum* are 2.3–2.5 mm long, considerably longer than those of *C. pauciflorum*.

The similarities between the three taxa (flattened terminal bud, twig type, branched to almost stellate hairs, more or less well-developed dioecy, mushroom-like stigma, and pocked, often angled, stone) are considerable, and it is of interest to see that the three taxa replace one another geographically and/or ecologically. Although *C. papuanum* and an imperfectly known form of *C. vexans* grow within a few hundred metres of each other, in apparently similar habitats near Kiunga in the Western district of Papua, the identity of the form of *C. vexans* is in doubt (see the discussion after that species).

More collections of *C. pauciflorum* are needed to evaluate the variation in stamens and pistil size and to ascertain whether or not the species is dioecious (Stevens 1974, 1980).

Calophyllum peekelii Laut. *Bot. Jb.* 58: 11 (1922). **Fig. 20.**

C. kajewskii A. C. Sm. (1941).

Tree 20–40(–?63) m high, d.b.h. to 180 cm. Twigs not to somewhat flattened, 3.8–6.5 mm across, strongly 4-angled to winged, rarely slightly angled, drying dark brown, glabrous or almost so; internodes (0.5–)1–7 cm long; uppermost pair of axillary buds < 1 mm long, spreading, inconspicuous; terminal bud plump, 0.9–1.5 cm long, with crustaceous, greyish brown indumentum; internode underdeveloped, 2–5 mm long. Petiole 1.1–2 cm long, glabrous when mature. Lamina obovate, to oblong or subelliptic, 8.5–17.5(–21.5) × 3.5–10 cm, rather thickly coriaceous, sparsely mealy on midrib when young, soon becoming glabrous; base acute; margin distantly undulate and not or slightly recurved; apex rounded to shallowly retuse; midrib above narrowing rather gradually from base, slightly raised, centre ± sunken, 0.3–0.9 mm wide at the midpoint, below raised, angled to striate; venation distinct above and below, raised, 6–9(–12) veins per 5 mm, angle of divergence 65–75°. Inflorescences unbranched, sometimes with 5-flowered branches to 1.7 cm long, axis 1.5–8 cm long, usually glabrous, basal internode (0.1–)0.4–1.1(–2) cm long; 7–12(–31)-flowered; bracts to 4 mm long, soon falling; pedicels 0.7–1.5(–2) cm long, glabrous. Plants ? dioecious. Tepals 8; outer pair broadly ovate, 4–5 × 3.5–5.5 mm; inner tepals 4.5–7.3 × 6–6.3 cm. Stamens 210–290: staminate flowers with filaments to 6 mm long; anthers 1.7–2.5 mm long; pistillate flowers with filaments to 2 mm long; anthers 1–1.5 mm long. Ovary c. 2.5 mm long; style 2.7–3.5 mm long; pistillate flowers with stigma c. 4 mm across: staminate flower with stigma c. 2 mm across. Fruit globular to ovoid, 4.5–7 × 4.2–6 cm; apex rounded to obtusely pointed, drying brownish, with broad, shallow, longitudinal wrinkles; outer layer 2–4 mm across, compact. Stone spherical to ± ovoid-ellipsoid, 3.8–6 × 3.7–5.2 cm; apex rounded to obtusely pointed; walls 3–5 mm thick, smooth, unmarked, basal plug to 7 mm across; spongy layer thin.

Field characters: Trunk sometimes with small, thick buttresses or spurs to 1.6 m high; outer bark dark brown, deeply fissured, scaling, thick, the inner surface blackish, or brownish black and yellow mottled; underbark pink-brown to deep red; inner bark pink-brown to deep red; latex clear (opaque) yellow, very sticky. Crown broad, branches spreading, leaves suberect.

Distribution: Japen Island (Geelvink Bay district), scattered on mainland New Guinea (West Sepik, Western and Central districts), also New Britain and New Ireland to the Solomon Islands, where it is common.

Ecology: Usually in well-drained primary lowland rain forest, also in seasonally inundated rain forest, swamps or forest growing over limestone; to 311 m altitude. Flowering February, April, August, September, and December; flowers scented. Fruiting January, February, June, September, and November; fruit dull green or blue-green, perhaps eaten by flying foxes.

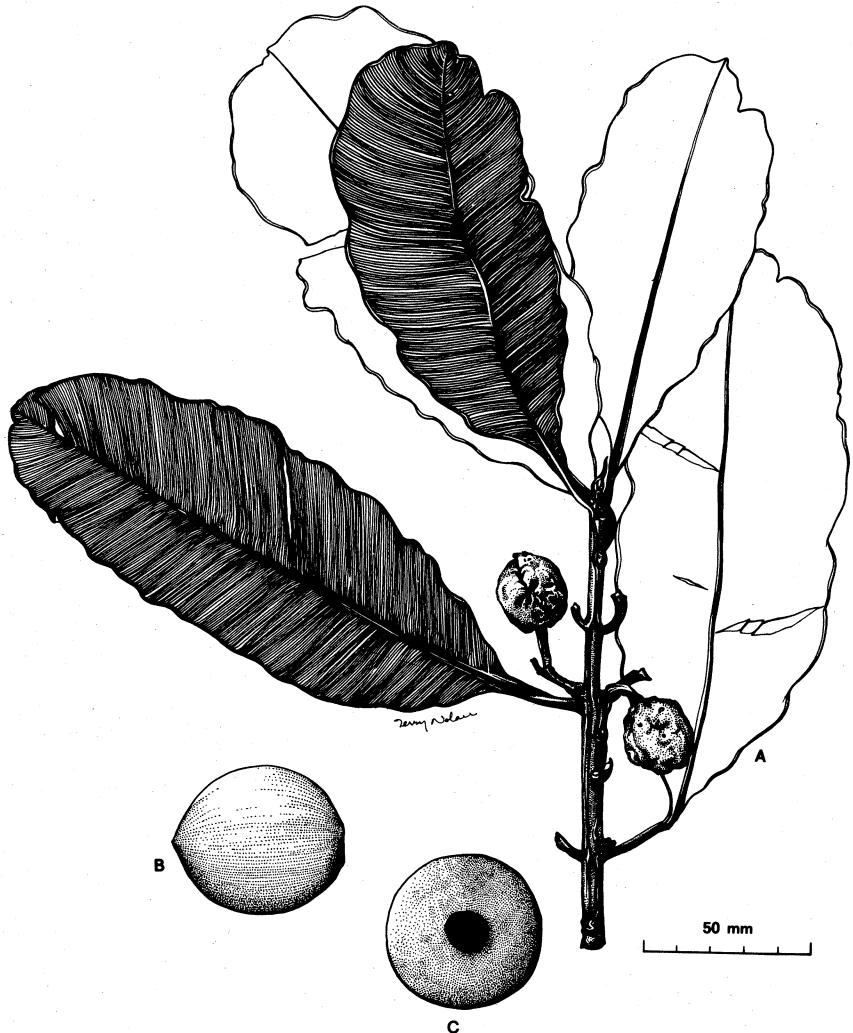


Fig. 20 *Calophyllum peekelii* Laut. (A) fruiting branchlet (BSIP 8920) (B) fruit—side view (C) fruit—basal view (B & C: BSIP 3846)

Germination and young plant: The radicle pushes out the basal plug from the stone during germination. The seedling has three pairs of leaves separated by well-developed internodes; the lowest pair is only *c.* 1 cm long and soon drops off. Subsequently produced internodes are also well developed and growth is erect.

Vernacular names: 'Baula', 'bau'ula' (Kwara'ae, Solomon Islands).

Uses: The wood is strong and is excellent for building canoes or houses. The bark can be removed from the log, dried, and used as a fuel; the flammable latex in the bark ensures a good blaze.

Notes: *Calophyllum peekelii* is a very distinctive species with its stout, strongly 4-angled twigs, its obovate to oblong, coriaceous leaf laminae that are rounded to retuse at the apex, and its large fruits the size of a small orange. The fruits have a thick-walled stone with a basal plug that is pushed out during germination.

There is little variation within *C. peekelii*, but as with the other possibly dioecious taxa, more material and field observations are needed to determine whether or not the species is dioecious or has some other breeding system. Saplings have leaves with lamina up to 42 × 14 cm that are rather abruptly pointed at the apex.

Calophyllum persimile P. F. Stevens *J. Arnold Arbor.* **61**: 620, f. 40k (1980).

C. suberosum sensu P. F. Stevens (1974) p.p.; *Calophyllum* sp. *C.*, P. F. Stevens (1974).

Tree 20–25 m high, d.b.h. to 40 cm. Twigs slightly flattened, (1.5–)3–6.5 mm across, strongly 4-angled to ± winged, or 6-angled, with obscure transverse lines at nodes, drying brown and shiny when young, later yellowish, transiently and sparsely brown mealy-hairy; internodes 1–7.5(–9) cm long; uppermost pair of axillary buds (1–)2.5–3.4 mm long, erect; terminal bud plump to conical, (4–)7–9 mm long, with brown, crustaceous to scurfy indumentum, underdeveloped internode to 2 mm long. Petiole (1–)1.6–3.7 cm long, glabrous. Lamina elliptic to oblong (or subovate), (5–)10–30 × *c.* (2.5–)3.5–9(–11.3) cm, very coriaceous, sparsely mealy-hairy on midrib below; base acute to decurrent, rarely broadly rounded and ultimately acute; margin slightly and distantly undulate and not to slightly recurved; apex retuse to rounded (or obtuse); midrib above gradually narrowed from base, raised, surrounding lamina raised, 0.3–0.8 mm across at midpoint, below raised, rounded to angled; venation ± distinct on both surfaces, raised, 4–10 veins per 5 mm, angle of divergence (50–)65–80°. Inflorescences unbranched, axis 1–2.1 cm long, mealy-hairy toward base, lowest internode 0.4–1.3 cm long; *c.* 5-flowered; bracts 5–6.5 mm long, subpersistent; pedicels 3–8 mm long, glabrous. Flower ? hermaphroditic. Tepals 4; outer pair *c.* 5 × 6 mm; inner pair *c.* 9 × 8 mm. Stamens *c.* 90; filaments to 3 mm long; anthers 2–2.4 mm long. Ovary *c.* 2.5 mm long; style *c.* 2.5 mm long; stigma 3.5–5 mm across. Immature fruit ovoid, *c.* 3 × 2.2 cm, smooth; outer layer *c.* 3 mm thick. Stone not known.

Field characters: Trunk sometimes with small buttresses; outer bark yellow, or grey, red-brown, and yellowish mottled, or pale brown, rarely brownish black, fissured, sometimes scaly, the inner surfaces bright yellow, brownish under

fissures; underbark red-brown or red and pale red mottled; inner bark red to cream-coloured; latex yellow, opaque, slightly viscous or not.

Distribution: Western Papuaia, from Western and West Sepik districts westwards.

Ecology: Well-drained rain forest (eastern New Guinea); moist valleys, or rain forest inundated in wet season (western New Guinea); at 20–560 m altitude. Flowering in September.

Germination and young plant: The seedling has two or (usually) three pairs of leaves separated by internodes 1–2.5 cm long. Subsequently produced internodes are less than 4 cm long, the young plant is arched, and the leaves are held in one plane; the stem straightens later. In older plants the internodes are considerably greater than 4 cm long.

Notes: *Calophyllum persimile* can be recognized by its usually strongly 4-angled twigs; its large, very coriaceous, usually elliptic to oblong leaf-laminas with the midrib on the upper surface surrounded by raised lamina; and its 4-tepaled flowers. The young plant does not grow very fast, and the stem is initially arched. The epithet *persimile* ('very similar') was chosen because of the considerable similarity of dried specimens of this species to these of *C. suberosum*.

When I described *C. suberosum*, I included in it specimens of the species later described as *C. persimile*. I found plants of these two species with large, coriaceous leaves at Kiunga, and they differed very obviously in bark, seedling, and ecological preferences. Although it is not as easy to separate sterile material in the herbarium, *C. persimile* has elliptic to oblong leaf laminas with a length to width ratio of (2–)2.5–3, whereas the leaf laminas of *C. suberosum* are ovate to elliptic and with a length to width ratio of 2–2.5. However, flowers of *C. suberosum*, ripe fruits of *C. persimile*, and observations on the ecology of both species from throughout their ranges are needed to clarify the relationship between them.

The difference in the seedling and young plant of the two species are independent of the environment. The first young plant of *C. persimile* that I saw was growing in a swamp with numerous seedlings and young plants of *C. suberosum*; it had the same characteristic arching and slow growth of the numerous young plants later seen in better-drained ridge forest.

There is some variation within *C. persimile*. The specimens from Japen Island that have been previously called *Calophyllum* sp. *C.*, aff. *C. savannarum* (Stevens 1974) are smaller in most of their parts (measurements in brackets in the description above) and are only tentatively included in *C. persimile*. Leaves of *C. persimile* from the Western district of Papua differ slightly in anatomy from leaves of specimens from elsewhere.

Calophyllum piluliferum P. F. Stevens *Austral. J. Bot.* **22**: 387, f. 11 (1974).

Tree c. 18 m high, d.b.h. c. 23 cm. Twigs flattened, 1–1.5 mm across, slightly 4-angled, drying brown when young, yellowish or whitish brown when older, transiently short-hairy; internodes 0.5–3 cm long; uppermost pair of axillary buds to 1.5 mm long, \pm erect; terminal bud plump, 4–6 mm long, with brown, \pm subcrustaceous indumentum; underdeveloped internode to 1 mm long. Petiole 0.6–1.2 cm long, glabrescent, drying blackish. Lamina elliptic to suboblong,

4.3–8.8 × 1.4–3.2 cm, coriaceous, ± transiently short-hairy on midrib below; base attenuate; margin barely undulate but slightly recurved; apex acute to bluntly long-pointed; midrib above gradually narrowed from base, raised, 0.1–0.2 mm wide at midpoint (disappearing just below apex), below raised, striate; venation not distinct to distinct, the latter especially below, raised, 12–22 veins per 5 mm, angle of divergence 65–75°. Inflorescence usually unbranched, axis 0.2–1.6 cm long, glabrous, lowest internode 2–4 mm long; 3–11-flowered; bracts unknown; pedicels 0.6–1.2 cm long, glabrous. Flower unknown; few stamens persisting at base of fruit; filaments to 2 mm long; anthers c. 0.5 mm long. Fruit globular, c. 1.1 × 1.1 cm; apex rounded, dryish whitish purple-brown, smooth; outer layer c. 0.5 mm thick, with large air spaces developing. Stone ellipsoid, c. 9.5 × 7.5 mm; apex 3- or 4-angled, bluntly pointed; walls c. 0.4 mm thick, to 1 mm thick in angles, ± smooth; spongy layer thin.

Field characters: Trunk without buttresses, but pneumatophores perhaps present; outer bark light grey, slightly vertically cracked, with few pustules; underbark reddish; inner bark paler red; latex yellow.

Distribution: Southern New Guinea; Digul and Western districts (two collections only).

Ecology: Forest in or near swamps, to 40 m altitude. Fruiting in August; fruit blackish red.

Notes: *Calophyllum piluliferum* can be recognized by its rather small leaves that are acute to bluntly long-pointed at the apex and attenuate at the base, and by its fairly small, globular fruits with angled stones. Older twigs dry pale brown.

Calophyllum robustum P. F. Stevens *Austral. J. Bot.* **22**: 392, f. 13 (1974).

Tree 18–30 m high, d.b.h. to 65 cm. Twigs flattened, 3.5–5.5 mm thick, 4-angled and with a prominent raised line running down from the middle of each petiole, sometimes with indistinct horizontal lines at the nodes, drying dark brown to blackish, indumentum mealy or shortly pubescent, subpersistent; internodes 1.5–6 cm long; uppermost pair of axillary buds 1–4(–12) mm long, spreading; terminal bud narrowly conical, 2–4 cm long, with dense short brown hairs, underdeveloped internode 4–7 mm long. Petiole 1.3–2.3 cm long, glabrous to persistently puberulent. Lamina oblong to elliptic, 13–31 × 5–8.5 cm, coriaceous, with ± persistent hairs on midrib below; base acute to rounded; margin rather closely undulate and narrowly recurved; apex abruptly acuminate, acumen c. 1 cm long; midrib above narrowing gradually from base, raised (centre sunken), 0.4–0.6 mm wide at midpoint, below prominently raised, angled; venation above ± obscure, below distinct, raised, 13–16 veins per 5 mm, angle of divergence 70–80°. Inflorescence unbranched, axis 0.4–1.1 cm long, often becoming glabrous, lowest internode 4–8 mm long; 5–7-flowered (based on infructescence); bracts unknown; pedicel in fruit 1.2–1.5 cm long, 2.5–3 mm thick, glabrous. Flowers not known. Fruit ovoid to globular, 2.5–3 × 1.8–2.3 cm; apex sharply pointed, drying brown, closely wrinkled; outer layer 1.6–2.6 mm thick, compact, strong. Stone c. 2.5 × 1.7 cm; apex bluntly pointed; walls < 0.1 mm thick, smooth, ? marked; spongy layer thin.

Field characters: Outer bark yellowish at first, becoming grey to brown, fissured; underbark pink; inner bark brown; latex milky or clear yellow; sapwood yellowish red, extremely hard, merging to red heartwood. Crown spreading; leaves and smaller branches pendulous.

Distribution: In Papuaia, Morobe district and near Ioma, Northern district. Not common.

Ecology: In lowland rain forest from 30 m to 180 m altitude. Fruiting in March and November.

Seedlings and young plant: The seedlings have two pairs of leaves almost forming a whorl; subsequently produced pairs of leaves are separated by long internodes. The stem is arched at first, becoming erect only some 30 cm or more behind the apex.

Notes: *Calophyllum robustum* is somewhat similar to *C. soulattri*, but may be separated by its long terminal buds, large, more or less oblong leaves with dense venation, robust pedicels and floral axes, and large fruits (the field notes on the type of this species mentions fruits up to 4×2.5 cm). The fruits of *C. soulattri* are under 2.2×1.4 cm. More collections of *C. robustum* are needed to understand the relationships of the species.

***Calophyllum rufinerve* Kan. & Hat. Bot. Mag. Tokyo 56: 563, f. 4 (1942).**

Tree 20 m high. Twigs somewhat flattened, 1.5–2 mm across, strongly 4-angled, drying brown when young, yellowish when older, subsersistently brown-tomentose; internodes 0.5–3 cm long; uppermost pair of axillary buds to 2 mm long, erect; terminal bud plump, 5–11 mm long, with brown, tomentose indumentum, underdeveloped internode absent. Petiole 0.8–1.3 cm long, tomentose. Lamina subovate to elliptic, 6.8–12.5 \times 1.9–3.4 cm, coriaceous, subsersistently tomentose on midrib below; base cuneate to subrounded; margin slightly undulate and slightly recurved; apex acute; midrib above gradually narrowed from base, raised, 0.2–0.35 mm wide at midpoint, below raised, striate; venation not distinct above, \pm distinct below, slightly raised (latex canals \pm impressed), 12–16 veins per 5 mm, angle of divergence 75–80°. Inflorescences \pm fasciculate, axis absent; 1–3-flowered; bracts unknown; pedicels *c.* 1 cm long, pilose. Flowers inadequately known. Tepals 4, *c.* 2.5 mm long. Stamens *c.* 25; anthers *c.* 1.2 mm long. Ovary *c.* 1 mm long; style *c.* 0.8 mm long. Fruit globular, *c.* 5 mm across.

Distribution: Western New Guinea; known only from Geelvink Bay.

Ecology: *Agathis* forest, at 400 m altitude. Flowering and fruiting in May; fruit black.

Notes: *Calophyllum rufinerve* is a very poorly known taxon that can be characterized by the tomentose indumentum on the terminal bud, twig, and midrib, the pilose pedicels, the fasciculate inflorescence, and the small, globular fruits only *c.* 5 mm across. Details of flower and fruit are taken from the original description.

Calophyllum savannarum A. C. Sm. *J. Arnold Arbor.* **22**: 352 (1941). **Fig. 21.**

Tree 10–12 m high, d.b.h. to 19 cm. Twigs strongly flattened, 1–2.5 mm across, 2-angled or rounded, drying (pale) brown, glabrous when mature; internodes 1.5–5 cm long; uppermost pair of axillary buds < 1 mm long, spreading; terminal bud apparently and soon falling off; internode underdeveloped, 3–7(–13) mm long. Petiole 0.7–1.5(–2) cm long, glabrous. Lamina ovate to elliptic, (5.5–)7–12.5 × (2–)2.3–4.5 cm, coriaceous, glabrous; base acute to decurrent; margin moderately and distantly undulate and slightly recurved; apex cuneate to bluntly acuminate; midrib above narrowed gradually from base, raised, continuous with surrounding lamina, 0.3–0.6 mm wide at midpoint, below slightly raised, angled; venation distinct on both surfaces, raised, 5–7 veins per 5 mm, angle of divergence 45–60°. Inflorescences unbranched, axis 3–4 cm long, glabrous, lowest internode (0.3–)0.5–1.5 cm long; 5–9-flowered; bracts unknown; pedicels 1.1–1.7 cm long, glabrous. Flower ? hermaphroditic. Tepals 4; outer pair *c.* 5.5 × 5 mm; inner pair *c.* 7 × 4 mm. Stamens 50–70; filaments to 3 mm long; anthers 2–2.7 mm long. Ovary 1.2 mm long; style *c.* 3 mm long; stigma *c.* 1.5 mm across. Fruit ovoid, *c.* 1.4 × 1.1 cm; apex rounded, drying greyish olive, smooth; outer layer *c.* 0.8 mm thick, compact except for air spaces developing under skin. Stone ovoid-ellipsoid, 1–1.1 × 0.6–0.7 cm; apex ± rounded; walls *c.* 0.15 mm thick, smooth, unmarked; spongy layer thin.

Field characters: Crown with hanging branches.

Distribution: Western New Guinea: Japen Island (Geelvink Bay district) and near Jayapura (Jayapura district).

Ecology: Secondary forests on steep slopes; principal component of forest clumps in secondary savannah; at 20–500 m altitude. Flowering in August. Fruiting June and August; fruit blue.

Notes: *Calophyllum savannarum* is an easily recognized species, even when sterile, because of its nonfunctional terminal bud and consequent profuse branching, and its axillary shoots that are noticeably swollen at the base. The axillary buds, that are almost glabrous, are inconspicuous because they are enclosed in little hollows in the leaf base. The leaf-laminas are coriaceous, dry dark brown, but with lighter coloured midrib, margins and veins, and have rather distant, steeply ascending veins.

Calophyllum savannarum is most closely related to *C. articulatum* P. F. Stevens, that occurs in the Moluccas.

Calophyllum sil Laut. *Bot. Jb.* **58**: 14 (1922).

C. procerum A. C. Sm. (1941): *C. warburgii* sensu A. C. Sm. (1941), non Engl. (1893).

Tree 4–30 m high, d.b.h. to 140 cm. Twigs slightly flattened, 2.6–4 mm across, strongly 4-angled, sometimes rounded or with 6 raised lines, drying brown, sparsely mealy-hairy; internodes 0.3–3.5 cm long; uppermost pair of axillary buds *c.* 1 mm long, spreading; terminal bud plump, 5–10(–13) mm long, brown puberulent, underdeveloped internode to 2.5(–3.5) mm long. Petiole 0.6–1.5(–2) cm long, glabrous when mature. Lamina obovate to elliptic, (2.8–)5–12.5 × (1–)

2.5–5.5 cm, coriaceous, glabrous or sparsely puberulent on midrib below; base cuneate, acute, or broadly rounded and ultimately shortly acute; margin broadly undulate but slightly recurved; apex acute to cuneate or rounded; midrib above gradually narrowed from base, sunken, 0.2–0.6 mm wide at midpoint, becoming raised in upper $1/6$ – $1/4$ –($2/3$) of lamina, below raised, striate to obscurely angled;

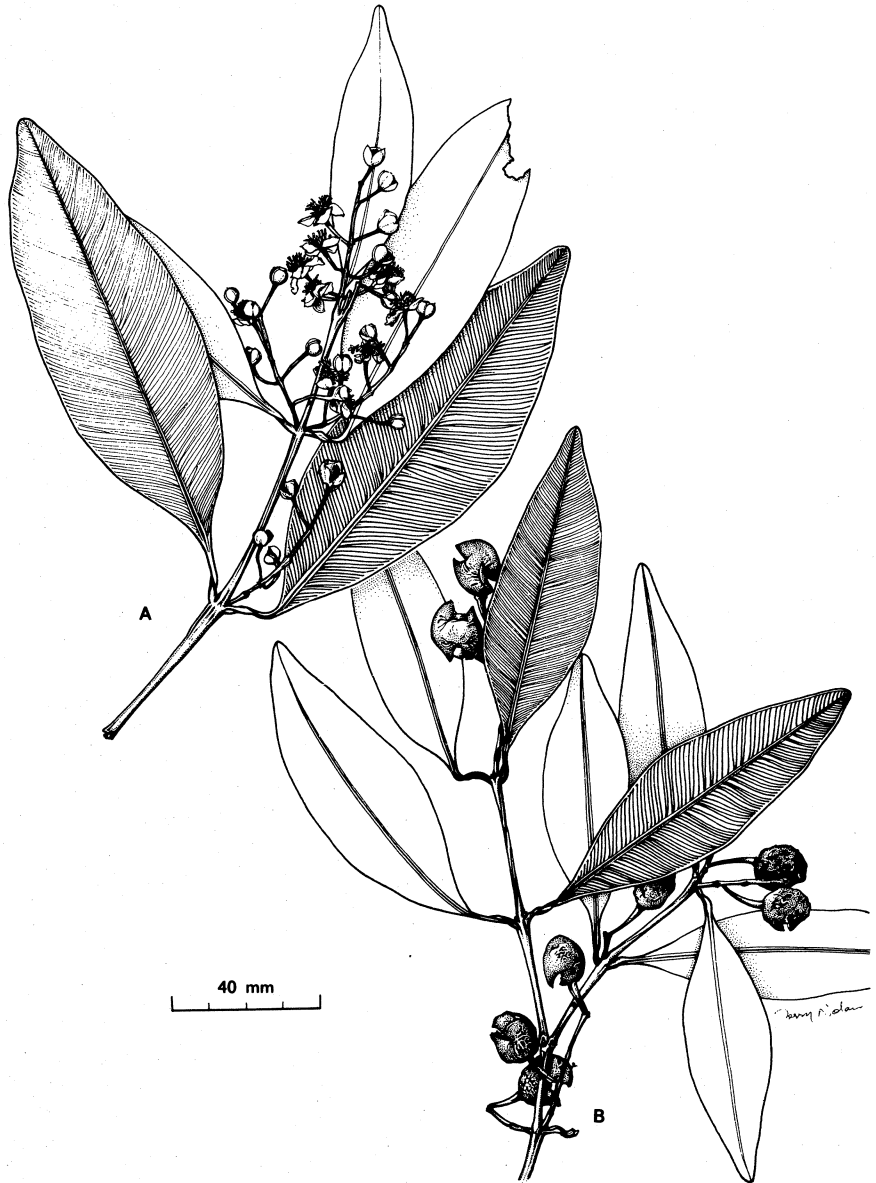


Fig. 21 *Calophyllum savannarum* P. F. Stevens (A) flowering branchlet (B) fruiting branchlet (both BW 6221).

venation above and below distinct, raised (on lower surface with latex canals ascending obliquely over veins), (5–)7–13 veins per 5 mm, angle of divergence (60–)70–80°. Inflorescences usually unbranched, very rarely with 3-flowered branches to 5 mm long, axis 0.3–4.5 cm long, short-hairy, lowest internode (0.1–)0.2–0.7(–1.2) cm long; 3–13-flowered; bracts to 3.5 mm long, soon falling; pedicels 3–7 mm long, short-hairy. Flower ? hermaphroditic. Tepals 4(–6); outer two 3.5–4 × 2.5–3 mm; inner tepals 4.5–6 × 2.5–4 mm. Stamens 45–80; filaments to 2.5 mm long; anthers 0.5–1.3 mm long. Ovary 1.3–1.5 mm long; style 1.5–1.7 mm long; stigma 0.5–0.7 mm across. Fruit globular to ovoid, 1.3–1.9 × 1–1.6 mm; apex ± pointed, drying purplish brown, sharply wrinkled; outer layer 0.4–1.2 mm thick, to 2 mm thick toward apex, compact. Stone ± globular, 0.8–1.3 × 0.8–1.2 cm; apex rounded; walls 0.1–0.4 mm across, smooth, ? unmarked; spongy layer thin.

Field characters: Trunk without buttresses (with spurs); bark grey to grey-brown, fissured, hard; inner bark red-brown; latex sticky, honey-coloured (one report).

Distribution: Southern mainland New Guinea and northern Australia; forms of uncertain status from the Moluccas, northern mainland New Guinea, and New Britain.

Ecology: Savannah woodland or riverine gallery forest, rarely secondary forest; at 7–215 m altitude. Flowering April, and June to August (flower scented). Fruiting May, and September to November; fruit bluish to purple-black.

The northern mainland New Guinea/New Britain variant occurs in rain forest, at 10–630 m altitude.

Vernacular name: The specific epithet, 'sil', is a local name given to this species in the southern part of western New Guinea.

Uses: The wood is used for larger dugout canoes on the Fly River (Western district).

Notes: *Calophyllum sil* can be recognized by its plump terminal bud; its moderate-sized and more or less elliptic leaf lamina that has a sunken midrib on the upper surface; its 4-tepaled flowers; and its fruits, which dry sharply wrinkled and purplish brown, with the outer layer moderately developed, compact, and not detaching from the thin-walled stone.

Variation within *C. sil* is discussed in Stevens (1974). The variant from New Guinea usually grows at a moderate elevation (but *BW 6259* was collected at 10 m altitude) in rain forest; the status of this variant is unclear, since all except one of the specimens (*NGF 36754*) are sterile. The specimens from the Moluccas region are also all sterile.

Calophyllum sil is probably related to *C. laticostatum* and perhaps also to *C. collinum*. All have basically similar hairs, blue fruits, and flowers often with four tepals (flowers of *C. collinum* are not known). In addition, both *C. sil* and *C. laticostatum* sometimes have latex canals on the lower surface of the leaf obliquely ascending over the normal latex canal/vein system.

***Calophyllum soulattri* Burm. *Fl. Ind.* 2: 121 (1768).**

Calophyllum lanceolatum Warb. (1891); *C. warburgii* Engl. (1892); *C. kiong* Laut. & K. Sch. (1901); *C. versteegii* Laut. (1922); *C. solomonense* A. C. Sm.

(1941) p.p.; *C. paludosum* C. T. White (1941); *C. spectabilis* sensu Baker (1923), non Willd. (1811).

Tree to 26 m high, d.b.h. to 70 cm, or rarely a shrub. Twigs flattened, 2–4.5 mm across, \pm 4-angled, often with a raised line running down from the petiole, with an indistinct horizontal line at the node, drying brown or sometimes yellowish, glabrous or woolly hairy; internodes 1–8 cm long; uppermost pair of axillary buds 1–4 mm long, erect; terminal bud conical, 9–20 mm long, hairs short and scurfy to long and brown (to 1 mm long), undeveloped internode (absent or) to 2 mm long. Petiole 1.3–2.7 cm long, glabrous to woolly hairy. Lamina oblong or ovate to narrowly elliptic, (4.5–)7–29 \times (15–)2–10 cm, coriaceous, sometimes persistently woolly hairy near the midrib; base acute; margin closely undulate and slightly recurved; apex acute to subacuminate; midrib above narrowing rather quickly from the base, sunken at the very base, becoming sharply raised, 0.2–0.55 mm wide at the midpoint, below prominent, angled or not; venation above and below rather obscure to distinct, raised, (8–)10–19 veins per 5 mm, angle of divergence (60–)70–85°. Inflorescences often with 5-flowered branches up to 2.7 cm long, axis 0.3–2 cm long, rarely absent, white, persistently hairy at base, lowest internode to 8 mm long; 5–19-flowered; bracts to 5 mm long, soon falling; pedicels 0.6–2 cm long, slender, usually glabrous. Flower ? hermaphroditic. Tepals 4; outer pair 5–6.5 \times 3–5 mm, sometimes hairy on the back; inner pair 5–9 \times 3.2–5 mm. Stamens 70–130; filaments 1.5–3 mm long; anthers 0.7–1.5 mm long. Ovary to 2 mm long; style to 2.5 mm long; stigma c. 1 mm across. Fruit globular to ovoid, to 2.2 \times 1.8 cm; apex often with small point, drying blackish, smooth; outer layer to 3 mm thick, compact. Stone almost globular, to 1.5 \times 1.3 cm; apex rounded; walls to 0.3 mm thick, smooth, unmarked, sometimes with a basal plug; spongy layer thin.

Field characters: Trunk sometimes spurred. Outer bark often yellowish at first and smooth, becoming brown, scaly and with vertical boat-shaped fissures, inner surface yellow; underbark red; inner bark pink; latex fluid, white, but sometimes yellowish brown to yellow, especially in the Solomon Islands. Crown often deep and dense, branches spreading, leaves held \pm hanging or at an acute angle to the twig.

Distribution: Throughout Papuasia at suitable altitudes, although probably not in the Snow Mountains, Eastern Highlands or Southern Highlands districts, recently collected in the Papuan Islands; not yet found on New Ireland although it probably occurs there. Elsewhere it is known from Vietnam to the Northern Territory of Australia.

Ecology: From sea level to 1220 m altitude, usually a rather small tree in the canopy or subcanopy of lowland rain forests; it prefers well-drained places, especially ridges, but it quite often in other habitats. Flowering and fruiting throughout the year; the fruit is dark blue to blackish.

Germination and young plant: In the typical form, the radicle breaks the stone just to one side of the base. The seedlings have two pairs of leaves which appear to form a single whorl; the plants produce leaves separated by very short internodes for some months, but after that, these new internodes become longer. The plant is erect. On Manus Island, and probably Bougainville and the Solomon Islands, the radicle pushes out the basal plug; the young plant does not seem to go through a stage during which the internodes are short.

Vernacular names: 'Kiong' and variants (Huon Peninsula, Morobe district).

Notes: *Calophyllum soulattri* is a variable species, but it may be recognized by its usually subumbellate inflorescences with small flowers and fruits borne on rather slender pedicels, and its leaves with close and fine venation, wavy margin, and midrib above narrowly but abruptly raised above the surface of the leaf.

The variation of *C. soulattri* in Papuaasia is very great. In Manus, and in nearly all of specimens from the Solomon Islands that have ripe fruits, the stone has a basal plug. This plug is pushed out during germination; although the leaves of the seedling are \pm whorled, the internodes produced immediately afterwards are much longer and growth is fast. Such specimens often have yellow, sticky latex. *Calophyllum paludosum* was described from a specimen of this type, and although in other respects such specimens are indistinguishable from the typical form, they may need their own name. The name *C. versteegii* is based on a specimen whose inflorescence has no main axis. Another conspicuous variant has long, woolly hairs on nearly all parts of the plant when young, these persist on the stem, near the midrib of the lower side of the leaf, and on the inflorescences. Specimens of this variant have been found scattered through the New Guinea mainland.

Calophyllum streimannii P. F. Stevens *Austral. J. Bot.* **22**: 401, f. 14 (1974).

Tree 15–35 m high, d.b.h. *c.* 30 cm. Twigs slightly flattened, 2–4 mm across, \pm strongly 4-angled, drying dark brown, \pm shortly hairy when young; internodes 0.5–5 cm long; uppermost pair of axillary buds to 2 mm long, suberect; terminal bud plump, 5.5–10 mm long, crustaceous to puberulo-tomentose indumentum, underdeveloped internode to 1 mm long. Petiole (0.4–)1.5–2.5 cm long, glabrous or subsersistently puberulent. Lamina suboblong to elliptic or subobovate, 5.2–14 \times 2.2–6 cm, coriaceous, glabrous (or with subsistent hairs on midrib below); base acute to attenuate; margin rather distantly undulate and sharply recurved; apex acuminate to subacute; midrib above narrowing gradually from base, becoming \pm raised, surrounding lamina raised or not, 0.3–0.5 mm wide at midpoint, below raised, \pm angled, the venation above \pm distinct, below distinct, raised, 6–10 veins per 5 mm, angle of divergence 65–80°. Inflorescence unbranched, axis *c.* 2 cm long, persistently puberulent to subtomentose, at least towards base, lowest internode 0.7–1 cm long; *c.* 7-flowered; bracts unknown; pedicels *c.* 6 mm long, ? glabrous. Flower known only in bud, ? hermaphroditic. Tepals 8. Stamens *c.* 80; anthers *c.* 1.3 mm long. Fruit ovoid to ellipsoid, 3.6–5 \times 2.8–3.8 cm, pointed at apex, drying dark brown, smooth; outer layer 4–5 mm thick, compact. Stone ovoid, *c.* 2.5 \times 1.9 cm; apex bluntly pointed; walls 1–1.8 mm thick, 3 mm thick at base, smooth, unmarked, with basal plug *c.* 8 mm across; spongy layer thin.

Field characters: Trunk without buttresses; outer bark yellowish to dark reddish; inner bark cream-coloured; latex yellow.

Distribution: Morobe district, little collected.

Ecology: Ridges or hillsides, often with dipterocarps, at 30–300 m altitude. Fruiting in January; fruit blue.

Germination and young plant: The radicle pushes out a plug from the base of the stone. The seedling has two pairs of leaves separated by an internode of c. 1 cm long. Subsequently produced internodes are longer, and the plant is erect.

Notes: *Calophyllum streimannii* can be recognized by its suboblong to elliptic, medium-sized to rather large leaf-laminas that are acuminate at the apex, somewhat sharply recurved at the margin, and have only 6–10 veins per 5 mm. The fruit is large (3.6–5 cm long) and is pointed at the apex; the outer layer is thick (4–5 mm across), and the stone has a basal plug. The limits and distribution of *C. streimannii* are unclear; it may occur near Kiunga, in the Western district. *Calophyllum streimannii* and *C. morobense* may be related.

Calophyllum suberosum P. F. Stevens *Austral. J. Bot.* 22: 403, f. 15 (1974).

C. peekelii sensu T. C. Whitm. (1967) p.p., non Laut. (1922).

Tree 13–35 m high, d.b.h. to 60 cm. Twigs flattened, 5–7(–9) mm across, 4- or slightly 6-angled, with inconspicuous transverse lines at nodes, drying yellowish, sparsely mealy brown hairy when young; internodes 1–7.5 cm long; uppermost pair of axillary buds 2–5 mm long, \pm erect; terminal bud narrowly conical, 0.8–1.3 cm long, with brown crustaceous to \pm scurfy indumentum, underdeveloped internode to 2 mm long. Petiole 2–3.3 cm long, glabrous when mature. Lamina ovate to elliptic, 16–35 \times 7.5–14.2 cm, coriaceous, transiently brown mealy-hairy on midrib below; base broadly rounded and finally acute; margin wavy and slightly recurved; apex acute to rounded; midrib above gradually narrowed from base, raised, surrounding lamina raised, 0.4–0.7 mm wide at mid-point, below strongly raised, \pm angled; venation distinct above and especially below, raised (latex canals sometimes also raised), 5–8(–9) veins per 5 mm, angle of divergence 70–80°. Inflorescence unbranched, axis 1.5–2.8 cm long, mealy-hairy at least toward base, lowest internode 1–1.5 cm long; 3–5-flowered; bracts unknown; pedicels in fruit 1.5–3 cm long, up to 0.6 cm diameter, glabrous. Flower unknown. Fruit \pm globular (in spirit), 8–9.5 \times 7–8 cm; apex rounded to very bluntly pointed, with broad, longitudinal ridges; outer layer 4–7 mm thick, compact. Stone spherical, 6–7 \times 6–7 cm; apex rounded; walls c. 0.7 mm thick, smooth, ? unmarked; spongy layer c. 2 cm thick.

Field characters: Trunk with stilt roots to 2 m high; outer bark (yellowish) grey-brown, deeply fissured, with flakes or scales, the inner surface straw-brown; underbark pale reddish brown; inner bark pale reddish brown; latex clear yellow, very sticky.

Distribution: Southern New Guinea from Mimika to Gulf districts; scattered.

Ecology: Swamp forest and river banks sometimes subject to tidal influence, below 45 m altitude. Fruiting January, March, and November; fruit green, floats in water and may be dispersed by rivers; embryo bright purple.

Germination and young plant: The radicle breaks the stone just to one side of the base. The seedling has three, or sometimes two, pairs of leaves separated by internodes 4–17 cm long; the lowest pair may fall off before the others. Subsequently produced internodes are also long, and the plant is erect.

Notes: *Calophyllum suberosum* is a distinctive species that can be recognized by its large, ovate, coriaceous leaf-laminas in which the midrib on the upper surface is surrounded by raised lamina. The very large fruits with a well-developed spongy layer and bright purple embryo, and the yellow-drying twigs are also characteristic.

Calophyllum suberosum is superficially similar to *C. persimile*; the differences between the two are discussed under *C. persimile*.

Calophyllum trachycaule Laut. *Bot. Jb.* 58: 13, f. 3 (1922).

Tree 10–20 m high, d.b.h. to 52 cm. Twigs somewhat flattened, 1.8–3.5 mm across, 4-angled or rounded, drying brown when young, often yellowish when older, (sub)persistently brown-tomentose; internodes (0.5–)1–6 cm long; uppermost pair of axillary buds 1.5–3(–5) mm long, erect; terminal bud plump, 6–11 mm long, with long brown hairs, underdeveloped internode to 1.5 mm long. Petiole 0.6–1.5 cm long, persistently tomentose. Lamina elliptic or oblong to subovate, (5–)7–14 × 1.5–4.5 cm, coriaceous, ± persistently tomentose on midrib below (also above); base rounded to cuneate or acute; margin obscurely undulate and slightly recurved; apex rather long-pointed to rounded; midrib above gradually narrowed from base, raised, 0.2–0.35 mm wide at midpoint, below raised, slightly striate, angled towards base; venation usually not distinct on both surfaces, sunken to slightly raised (latex canals often sunken), 12–20 veins per 5 mm, angle of divergence 70–80°. Inflorescences unbranched, sometimes with 3-flowered branches to 6 mm long, axis 0.8–3.7 cm long, tomentose, lowest internode 3–6 mm long; 7–19-flowered; bracts unknown; pedicels 2.5–6 mm long, tomentose. Flower ? hermaphroditic. Tepals 4; outer pair 5–6 × 4–5 mm; inner pair 6–8 × 4.5–6 mm. Stamens c. 180; filaments to 3.7–3.8 mm long; anthers 0.5–0.7 mm long. Ovary 1.5–2 mm long; style c. 2.5 mm long; stigma c. 1 mm across. Fruit ellipsoid, c. 2.4 × 2 cm; apex rounded, drying dark purplish, smooth; outer layer 2.2–3 mm thick, compact apart from air spaces developing under skin. Stone ellipsoid, c. 1.8 × 1.2 cm; apex 3- or 4-angled, pointed; walls 1.3–1.7 mm thick (2.3–2.8 mm thick at angles and c. 0.15 mm thick just to one side of base), rather rough; spongy layer thin.

Field characters: Spurs and buttresses absent; outer bark light or straw-brown, with many shallow fissures, not peeling, the inner surface orange and greenish straw mottled, underbark deep red; inner bark red, with darker spots and lines in outer part; latex white, not sticky, or copious, yellowish, milky.

Distribution: Occasional in New Guinea; Vogelkop, Western and Central districts.

Ecology: Lowland or colline forest, at 18–850 m altitude. Flowering in October. Fruiting in November; fruit blue.

Notes: *Calophyllum trachycaule* can be recognized by the well-developed, tomentose indumentum that covers the inflorescence axis and pedicels (but not the tepals), stem, leaf midrib, and terminal bud; by its leaves, which have dense but obscure venation and sunken latex canals; by its short pedicels; and by its medium-sized fruits with angled stones.

This species is a member of a poorly understood group of taxa, all members of which are known, or suspected, to have fruits with angled stones. All taxa are broadly similar in anatomy, hair type, and leaf type, and the eventual number and limits of taxa in this group are quite unclear. Field studies in areas where two or more members of the complex are believed to grow fairly near one another, such as Kiunga, Western district, and near Buso, Morobe district, are needed, as are more flowering and fruiting collections of the whole complex. The *C. trachycaule* complex is restricted to Papuaia, and includes *C. goniocarpum*, *C. trachycaule*, *C. piluliferum*, probably *C. heterophyllum* and *C. rufinerve*, and the taxon described below as *Calophyllum* sp. 1.

Calophyllum vexans P. F. Stevens *Austral. J. Bot.* **22**: 407, f. 16 (1974). **Fig. 22.**
C. gaimanum P. F. Stevens (1974).

Tree 12–35 m high, d.b.h. to 60 cm. Twigs flattened, 1.5–2.5 mm across, 4-angled to \pm winged, with inconspicuous transverse raised line at nodes, drying brown, \pm puberulent at least when young, or subglabrous; internodes 0.5–8 cm long; uppermost pair of axillary buds 1–4 mm long, erect; terminal bud strongly flattened to conical, (3.5–)6–12 mm long, with puberulent or sometimes crustaceous indumentum, underdeveloped internode 0.5–3.5 mm long. Petiole 0.4–1.4 cm long, glabrous when mature. Lamina elliptic to trapeziform, subovate, subobovate, or oblong, 3.4–12.5 \times 1.2–4.7 cm, coriaceous, glabrescent or subsersistently mealy-hairy on and near midrib; base acute to cuneate, or rounded toward and attenuate at very base; margin not to moderately undulate, recurved; apex acute to bluntly pointed; midrib above narrowed gradually from base, at least margins soon becoming raised, centre usually clearly sunken, (0.1–)0.3–0.6(–0.7) mm wide at midpoint, sometimes disappearing up to 5 mm below apex, below raised, finely lined to angled; venation distinct, rarely \pm obscure, raised, (6–)8–11(–16) veins per 5 mm, angle of divergence (40–)55–75°. Inflorescences sometimes 2 per axil, unbranched, axis 0.1–1.3 cm long, subglabrous or short hairy, lowest internode 1–6 mm long; 3–5(–7)-flowered; bracts *c.* 3.5 mm long, soon falling; pedicels 2–8.5 mm long, \pm glabrous. Plant ? dioecious. Tepals 4–8; outer pair 2.7–5 \times 2.8–4 mm; inner tepals 5–6 \times 2.5–4.5 mm. Stamens 30–105; filaments 3–4 mm long; anthers 1.8–2.6 mm long. Ovary 1–2 mm long; style 1.2–1.7 mm long, sometimes sparsely hairy (at least in staminate flowers); stigma 1.8–2.5 mm across, sometimes absent in staminate flowers. Fruit globular to ovoid-ellipsoid, 1.8–2.7 \times 1.4–2.2 cm; apex rounded, drying dark purplish brown, smooth to sharply and shallowly wrinkled; outer layer 1.5–2.75 mm thick, compact. Stone ellipsoid to subovoid, (1–)1.4–1.7 \times (0.75–)0.9–1.4 cm, sometimes subangled; apex rounded; walls 0.7–2.2 mm thick, pocked; spongy layer thin.

Field characters: Trunk sometimes with buttresses or stilt-roots to 1.7 m high; outer bark brown, smooth at first, becoming fissured and \pm scaly, the inner surface blackish; underbark red to red-brown; inner bark reddish, fibrous; latex yellow (or white or greenish), clear, sometimes turning cloudy, sticky.

Distribution: Throughout Papuaia at suitable elevations.

Ecology: Usually well-drained lowland or colline rain forest, but swampy forest in Western district; to 900(–1450) m altitude. Flowering November to July; flowers scented. Fruiting January, April, June and October; fruit greenish.



Fig. 22 *Calophyllum vexans* P. F. Stevens (A) fruiting branchlet (*BSIP* 8970) (B) flowering branchlet with female flowers (*BSIP* 5399) (C) flowering branchlet with male flowers (*BSIP* 13206) (D) fruit—longitudinal section showing seed (*NGF* 10944)

Germination and young plant: The radicle emerges through the area of thin wall just to one side of the base of the stone. The young plant is erect.

Vernacular name: 'Kaumanu' (Kwara'ae, Solomon Islands).

Notes: *Calophyllum vexans* can be recognized by its often flattened terminal bud, its angled twigs, and its leaf-laminas, which are widest near the middle and which have rather distinct venation. The midrib is prominent on the upper surface and it narrows gradually from the base. The inflorescence is small, and the plants appear to be dioecious; the fruits have a pock-marked stone. Circumscribing the limits of this taxon has been difficult, hence the epithet *vexans* ('vexing', 'annoying').

Although *C. gaimanum* is reduced to synonymy under *C. vexans*, it could represent a taxon that may have to be recognized when the variation within this rather variable species is better understood (see also Stevens, 1974). The type of *C. gaimanum* and NGF 17736 (from the Western district), and specimens from Umboi Island, New Britain, and New Ireland (but not from Mussau Island) all have strongly flattened terminal bud and rather narrowly elliptic leaves. In what are presumably staminate flowers, the pistil is relatively well developed; there may be hairs on the style or not. I have not seen hairs on the styles of pistillate plants.

Specimens from the Solomon Islands have a broader lamina and lack an obviously flattened terminal bud; specimens from Irian Jaya have a similar terminal bud, but are distinguishable by other characters such as the darker colour of the dried plant and the greater venation density of the lamina.

All specimens of *C. vexans* collected in Papua (except the type of *C. gaimanum* and NGF 17736: both Western district), the southern part of western New Guinea, and Ceram (the Moluccas) form another distinct group that has almost winged twigs and leaves with rather short petioles. The midrib on the upper surface of the living leaf is dark green, and the lamina is rather soft and fleshy and has an undulate margin, at least around Kiunga. The midrib on the upper surface of the living leaf of the typical form on New Britain is only slightly raised and is yellowish white; the lamina is more coriaceous, and the margin is not undulate. Flowers of this group are not known.

There is discussion of further variation within *C. vexans* in Stevens (1974), as well as details of size variation of stamens and pistils in staminate and pistillate flowers.

Calophyllum waliense P. F. Stevens *J. Arnold Arbor.* **61**: 589, f. 38e-g (1980).

Tree 20–25 m high. Twigs flattened, 2.5–5.5 mm across, 6-angled, soon becoming rounded, with obscure horizontal lines at nodes, drying brown, with brown mealy-hairs when young; internodes 1.5–3.5(–7) cm long; uppermost pair of axillary buds to 2.5 mm long, erect to spreading; terminal bud plump to narrowly conical, 0.8–1.3 cm long, with grey-brown scurfy indumentum, underdeveloped internode absent (< 2 mm long). Petiole 3–5 mm long, glabrous. Lamina elliptic to suboblong, (9–)14.5–27 × (3.8–)6–10.3 cm, coriaceous, mealy-hairy on midrib below when young; base heart-shaped; margin undulate and narrowly recurved; apex rounded to acute; midrib above gradually narrowed from base, sunken, 0.5–1.3 mm wide at midpoint, becoming raised toward apex, below

raised, angled, sometimes angles reduced to lines toward base; venation distinct on both surfaces, raised (latex canals sometimes raised), 4–7 veins per 5 mm, angle of divergence 75–80°. Inflorescences unbranched, axis 1.9–3.2 cm long, flattened and strongly 4-angled, glabrous, lowest internode 3–9 mm long; 5–7-flowered; bracts not known; pedicels 1.3–1.5 cm long, glabrous. Old flower only known, ? hermaphroditic. Outer tepals *c.* 6 × 5 mm; inner tepals to 12.5 × 4.5 mm. Stamens ? numerous; anthers *c.* 1.3 mm long. Ovary *c.* 2.5 mm long; style *c.* 2.5 mm long; stigma *c.* 2 mm across. Fruit broadly ovoid, *c.* 3.8 × 3.3 cm (when preserved in spirit); apex bluntly pointed, drying dark brown, broadly wrinkled; outer layer *c.* 1.5 mm thick, compact. Stone globular, *c.* 3 × 2.8 cm; apex very bluntly pointed; walls *c.* 2 mm thick, smooth, with 4 or 5 longitudinal markings, outer layer persisting over them, basal plug *c.* 10 mm across; spongy layer absent.

Field characters: Trunk without buttresses; outer bark cream-brown to dark brown, slightly fissured; latex yellow, clear sticky.

Distribution: Known only from Manus Island, Papua New Guinea.

Ecology: Lowland forest on ridges *c.* 100(– ?550) m altitude. Young fruit July and October; fruit greenish.

Germination and young plant: The radicle pushes out the basal plug. The seedling has two pairs of leaves separated by an internode *c.* 1.3 mm long. Subsequent internodes are well developed, and the plant is erect.

Notes: *Calophyllum waliense* is a distinctive species. Its stout twigs are 6-angled, and its terminal buds have a scurfy indumentum. The leaf-lamina is large, heart-shaped at the base, and has a sunken midrib on the upper surface. The fruits are large, and the thick-walled stone has four or five longitudinal stripes and a basal plug.

The closest relative of *C. waliense* is probably *C. leleanii*: their twigs and terminal buds are similar, and their leaf-laminas dry a similar colour with the very margin often brighter than the rest. The stones of both species have thick walls and a basal plug. *Calophyllum waliense* differs from *C. leleanii* most obviously in its lamina, which has a heart-shaped base and a sunken midrib on the upper surface, and in its longitudinally marked stone.

Calophyllum sp. 1

Calophyllum sp. P. F. Stevens *J. Arnold Arbor.* **61**: 612, f. 38c & d (1980).

Tree 6–10 m high, d.b.h. to 10 cm. Twigs flattened, 0.7–1.3(–2) mm across, ± 4-angled, drying dark brown when young, yellowish brown when old; shortly hairy when young; internodes 0.5–1.5(–3) cm long; uppermost pair of axillary buds to 1 mm long, erect; terminal bud plump, 2–4 mm long, with brown, adpressed, subcrustaceous indumentum, underdeveloped internode absent. Petiole 4–9 mm long, glabrous. Lamina elliptic, 2.2–5.2 × 0.5–1.5 cm, coriaceous, with transient, adpressed hairs on midrib below, sometimes also above; base cuneate; margin not undulate but slightly recurved; apex acute to subcuneate; midrib above gradually narrowed from base, raised, 0.1–0.15 mm wide at midpoint, below raised, striate or subangled; venation ± obscure above, ± distinct below, raised, 10–14 veins per 5 mm, angle of divergence *c.* 65°. Old

inflorescences unbranched, axis 0.5–1.8 cm long, puberulent toward base, lowest internode 2–4 mm long; 3–7-flowered (based on fruits per infructescence); bracts not known; pedicels 5–10 mm long, glabrous. Flower not known. Fruit globular, c. 8 × 8 mm, drying purplish brown, smooth; outer layer thin, air spaces developing. Stone ± globular, c. 6 × 6 mm, (2- or)3-angled; apex ± rounded; walls 0.2–0.3 mm thick, to 0.5 mm thick in angles, ± smooth; spongy layer thin.

Field characters: Trunk without buttresses; outer bark greyish brown, fissured, the inner surface orange-yellow; underbark orange-reddish; inner bark reddish; latex yellow.

Distribution: Known only from Morobe district, northeastern New Guinea.

Ecology: Rather stunted forest on soil derived from ultramafic rock, at 600–800 m altitude. Fruiting in April; fruit blackish.

Notes: *Calophyllum* sp. 1 can be distinguished from the other taxa known to have angled stones by its short terminal buds, small elliptic leaf-laminas, and very small fruits.

Calophyllum sp. 2.

Calophyllum rhizophorum sensu P. F. Stevens (1974), non Boerl. & Koord. (1911).

Tree to 25 m high. Twigs c. 3.5 mm thick, slightly 4-angled, drying brown, when young with short brown hairs; internodes 0.5–2 cm long; uppermost pair of axillary buds c. 1 mm long, spreading; terminal bud rather plump, c. 8 mm long, with scurfy brown hairs, underdeveloped internode to 1 mm long. Petiole 1.5–2 cm long, becoming glabrous, minutely warty. Lamina obovate to oblong, 8.5–15 × 3.5–5.5 cm, below with small, black dots, coriaceous, glabrescent; base acute to cuneate; margin slightly recurved and slightly wavy; apex subacute to rounded; midrib above raised, narrowed gradually from the base, centre sunken in the bottom half, 0.3–0.5 mm wide at the midpoint, below prominent, raised, angled; venation above and below moderately distinct, raised, 6 or 7 veins per 5 mm, angle of divergence 65–75°. Inflorescences unbranched, axis 0.5–1.5 cm long, with very small hairs; 3–7-flowered; bracts unknown; pedicel c. 1 cm long. Flower ? hermaphroditic. Tepals ? 8; outer pair tepals to 6.5 × 4 mm; inner tepals to 6.5 × 4 mm, variable in size. Stamens c. 90; filaments c. 3 mm long; anthers 1.2 mm long. Ovary 2.6 mm long; style 2 mm long; stigma not known. Fruit not known.

Distribution: A single specimen is known from Sorong in the Vogelkop (western New Guinea); it may also occur on Sulawesi.

Ecology: Swamp forest.

Notes: The identity of the single specimen known is not certain; however, it may be immediately distinguished from all other species of *Calophyllum* in New Guinea by the small, black, raised dots on the lower surface of the leaf. However, these may represent fungal infections.

KAYEA Wall.

Tree. Terminal bud with scales, functional, axillary buds conspicuous. Twigs often with surface papillate. Leaves with reticulate venation, latex glands present. Plant glabrous. Inflorescences terminal and axillary near the ends of the twigs; bracteoles present. Flowers hermaphroditic. Sepals 4. Petals 4. Stamens numerous; anthers often with obvious gland. Ovary unilocular, with 4–8 ovules; style terminating in (usually) 4 short arms; stigmas minute. Fruit often enclosed by the sepals, somewhat fleshy or not, usually dehiscent. Seeds 1 or 2 (in Papuaia).

Distribution. About 65 species, Sri Lanka (one species) and eastern India to Australia. In Papuaia, 2 species.

Literature: A. J. G. H. Kostermans (1969), *Kayea* Wall. and *Mesua* L. (Guttiferae), *Reinwardtia* 7: 425–431.

KEY TO SPECIES

1. Leaves < 15 cm long; flowering axis 3.5–9 cm long **K. coriacea**
 1. Leaves > 30 cm long; flowering axis to 26 cm long **K. macrophylla**

Kayea coriacea (P. F. Stevens) P. F. Stevens *Telopea* 5: 360 (1993). **Fig. 23.**

Mesua coriacea P. F. Stevens (1974).

Tree 10–18 m high, d.b.h. to 20 cm. Twigs slightly flattened, 1.5–2.5(–3) mm across, minutely papillate or almost smooth when young, drying rich brown, epidermis soon coming off; internodes 1.5–8 cm long. Petiole 0.4–1.2 cm long, with epidermis soon coming off. Lamina elliptic to ovate, 7.2–12 × 2.2–4.8 cm, coriaceous; base acute to rounded; apex long-pointed; midrib above raised, with fine raised lines, angled, or broadly sunken; main lateral veins slightly raised above, raised below, 3–8 mm apart, 9–18 per side, arching at margin and forming an irregular continuous vein *c.* 3 mm from the margin, fine venation not distinct above and slightly depressed to slightly raised below, blackish latex glands visible on both surfaces. Inflorescences terminal and axillary, 3–7 together, axis 3.5–9 cm long, sometimes with 3-flowered branches to 1 cm long; 5–11-flowered; bracts 1.5 mm long; pedicels 6–10 mm long; bracteoles 1 mm long, borne midway up pedicel to near top. Outer sepals round, *c.* 3.7 × 4.2 mm; inner sepals transversely elliptic, 3 × 4.2 mm. Petals obovate, *c.* 5.5 × 3.3 mm. Stamens with filaments to 3 mm long; anthers *c.* 0.4 mm long. Ovary *c.* 1.5 mm long; ovules 4, or 6–8; style *c.* 6 mm long. Fruit surrounded by enlarged persistent, scurfy calyx, outer calyx round, *c.* 1.6 × 1.6 cm, inner calyx obovate, 1.5 × 1.1 cm; fruit proper dehiscent, 2-valved, almost globular, *c.* 1.2 × 1.7 cm; wall *c.* 0.5 mm thick. Seed one.

Field characters: Buttresses absent. Outer bark light brown and fawn in patches, smooth in places, or rough and cracking; inner bark pinkish fawn. Latex slight, sticky, likely varnish.

Distribution: New Guinea: Western district, and very recently collected on Sudest Island (Papuan Islands district).

Ecology: Occurs in seasonally flooded or ridged forest, at 8–60 m altitude.

Notes: It is not clear how many species of *Kayea* there are in the Western district. Although the collections look rather similar, on close examination we find considerable variation in venation, epidermis, bracteole position, and ovule number. *Kayea coriacea* is, however, not similar to the Australian species, and it is more likely to be related to Philippine species.

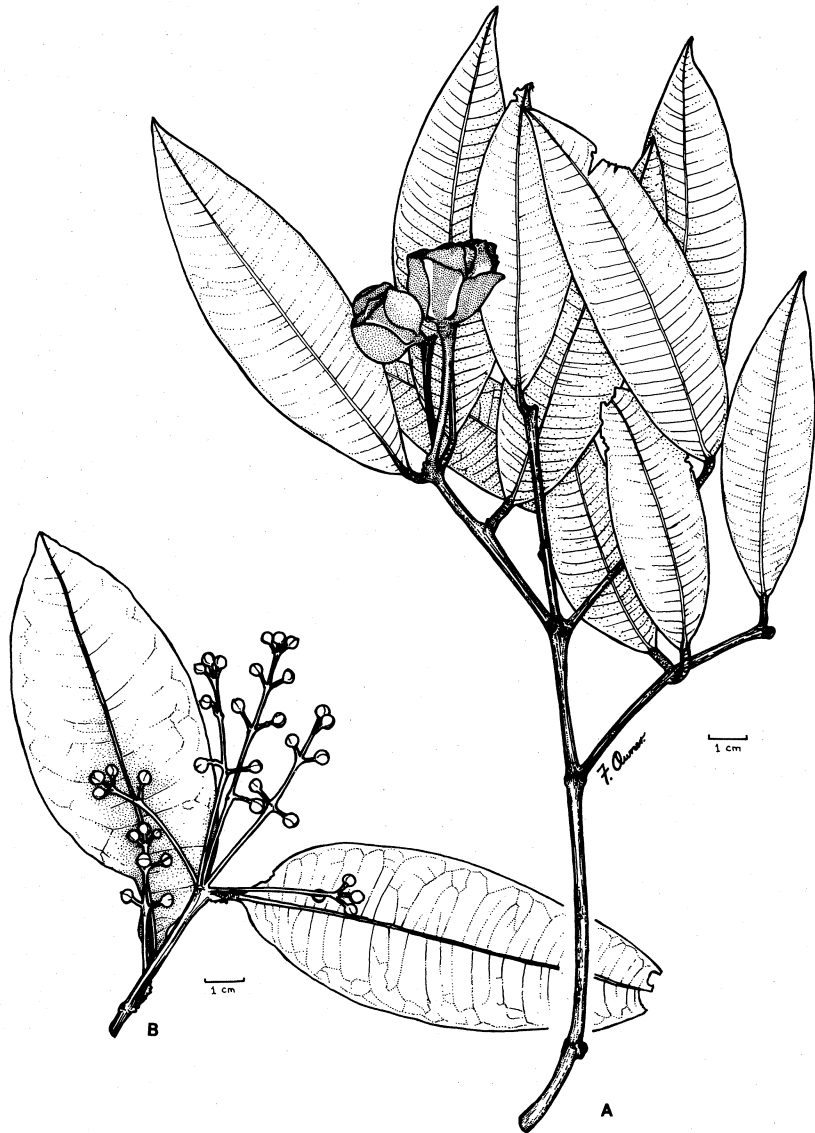


Fig. 23. *Kayea coriacea* (P. F. Stevens) P. F. Stevens (A) fruiting branchlet (NGF 35364) (B) flowering branchlet (Pullen 7426)

Kayea macrophylla Kan. & Hat. *Bot. Mag. Tokyo* **56**: 571, f. 11 (1942).

Mesua macrophylla (Kan. & Hat.) Kosterm. (1969).

Trees 7.6–20 m high, d.b.h. to 30 cm. Twigs slightly flattened, 2–7 mm across, drying with fine raised lines, yellowish to greyish; internodes *c.* 7 cm long. Petiole 1.9–2.7 cm long, epidermis soon coming off. Lamina oblong to subelliptic or subovate, 26–55 × 6.3–15.3 cm, coriaceous; base acute to rounded-cuneate; apex rather long-pointed; midrib above raised, centre sunken or not, *c.* 0.7 mm wide at the midpoint, below strongly raised, with fine raised lines; main lateral veins depressed to slightly raised above, strongly raised below, 0.8–4 cm apart, 13–22 per side, curved towards the margin, fine venation flat to slightly raised above, slightly raised below. Inflorescences axillary and terminal, up to 10 together, axis 5.5–26 cm long, sometimes with branches to 2 cm long; 5–9-flowered (first pair of flowers often to 12 cm from the base); bracts unknown; pedicels 0.7–1.8 cm long, up to 0.2 cm diameter; bracteoles borne *c.* 2/3 up the pedicel. Flowers unknown, but ovaries 6–8 in very young fruits. Fruit closely surrounded by enlarged, scurfy calyx; outer calyx *c.* 4.5 × 5.4 cm, inner calyx *c.* 4.3 × 4 cm; fruit proper almost globular, *c.* 3.8 × 4.6 cm; walls to 2.5 mm thick. Seeds 1 or 2.

Field characters: Bark brown; inner bark pink; wood cream-coloured. Branching sparse.

Distribution: Two collections, one from Geelvink Bay (western New Guinea), the other from near Angoram in the East Sepik district.

Ecology: Low altitude rain forest. Fruiting in May.

Notes: The collection from western New Guinea is in fruit, it has axillary inflorescences; the collection from northeastern New Guinea is just past flowering and has terminal inflorescences.

MAMMEA L.

Usually small trees. Terminal buds surrounded by bud scales, branches usually from axils of scales that fall off and leave prominent scars on the twigs. Lamina with main lateral veins joining a submarginal vein well in from the leaf margin; venation reticulate; latex glands often enclosed by finest reticulations (areolae). Plant glabrous. Inflorescences fasciculate, usually from axils from which the leaves have fallen; bracteoles usually present. Male and apparently hermaphroditic flowers on different plants. Sepals 2, fused in bud. Petals 4–6. Stamens numerous, free, or slightly fused at the base; anthers sometimes with apical glands. Ovary absent in male flowers, in female flowers 2–4(–8)-locular; ovules 4 (or 8), near basal; style terminating in a peltate stigma. Fruit drupaceous, although sometimes woody layer absent, 1- or 2(–4)-seeded; cotyledons fused or separate.

Distribution: About 50 species; mostly in Asia, Malesia and Madagascar, two in tropical America and the West Indies and two in Africa.

Notes: Plants have male and apparently hermaphroditic flowers; it is probable however, that these latter flowers are really pistillate. Most species of *Mammea*

are little collected and are apparently rare, even the widely distributed seaside *M. odorata* is not often found. Many more collections are needed to establish the pattern of the variation of the genus here, and the status of some of the species recognized below will have to be revised. Recent collections suggest that a number of taxa still have to be described. The key to the species is more an indication of the extent of the variation than a key to known, well-understood taxa.

Literature: A. J. G. H. Kostermans (1956), The genera *Mammea* L. and *Ochrocarpus* Thou. *Djawa. Kehut. Indon. Bag. Plan. Kehut.* 9–15; (1961), A monograph of the Asiatic and Pacific Species of *Mammea* L. (Guttiferae), *Pengum Lemb. Pusat Penjel. Kehut.* 72: 1–63. P. F. Stevens (1974), *Mammea* L. and *Mesua* L. (Guttiferae) in Papuaia, *Austral. J. Bot.* 22: 413–23.

KEY TO SPECIES

1. Lamina over 14 cm broad; areolae large, > 1 mm across **M. grandifolia**
1. Lamina narrower; areolae usually smaller
 2. Petiole > 1.2 cm long, top part narrower and drying smoother than the bottom part; base of lamina decurrent to barely rounded **M. novoguineensis**
 2. Petiole usually < 1.5 cm long, drying the same throughout its length; base of lamina usually much rounded to heart-shaped
 3. Lamina usually broadly obovate; fine venation distinct above
 4. Twigs 4.5–8.5 mm thick, hardly flattened; internodes 0.5–4 cm long **M. odorata**
 4. Twigs c. 4 mm thick, flattened; internodes longer **M. papuana**
 3. Lamina at most occasionally broadly obovate; fine venation distinct or obscure above
 5. Fine venation distinct above, with areolae usually at least 0.7 mm across (smaller only in *Mammea* sp. 4)
 6. Latex glands elongated **Mammea sp. 1**
 6. Latex glands round
 7. Lamina subcuneate to narrowly rounded at the base; petiole at least 1.3 mm long **Mammea sp. 2**
 7. Lamina rounded to cordate at the base; petiole usually < 14 mm long, usually at least 5 mm long
 8. Lamina thickly coriaceous; perulae numerous and persistent **Mammea sp. 3**
 8. Lamina rather thinly coriaceous; perulae often fewer, not persisting
 9. Areolae 0.7–1.9 mm across; fruit banana-shaped **M. cordata**
 9. Areolae 0.4–0.7 mm across; fruit \pm spherical **Mammea sp. 4**
 5. Fine venation obscure above, with areolae usually < 0.8 mm across
 10. Flowers sessile **M. veimauiensis**
 10. Flowers pedicellate
 11. Petiole up to 3 mm across; woody layer of fruit < 1 mm thick **M. papyracea**
 11. Petiole at least 3 mm across; woody layer of fruit > 2 mm thick **Mammea sp. 5**

Mammea cordata P. F. Stevens *Austral. J. Bot.* 22: 414, f. 1 (1974). **Fig. 24.**

Shrub or small tree, 1.5–6 m high. Twigs 3–4.5 mm across, flattened, smooth; terminal buds 5–12 mm long, slender, acutely pointed, bud scale scars usually few, often with one pair borne up to 1 cm above the others; elongated internodes (1–)2.5–10 cm long. Petiole 0.7–1(–1.4) cm long. Lamina elliptic to tongue-shaped, (11.2–)16–41 \times (3–)5.7–14 cm, coriaceous; base rounded to heart-shaped; margin recurved; apex long-pointed; midrib above slightly rounded and raised, below raised, with fine raised lines except in the basal 5 mm (rounded part); lateral veins consisting of (17–)21–27 pairs, submarginal vein 2.5–8(–11) mm in from the margin, fine venation raised, latex glands visible above and below, areolae 0.7–1.9 mm across. Inflorescences usually from axils on leafy twigs, sometimes from small mounds up to 5 mm long and 2 mm high; bracts

ovate, c. 1 mm long; apex acute; pedicel 1.1 cm long and pink (in flower), to 1.6 cm long (in fruit). Sepals 2, white, 4×4 mm. Petals 4, cream-coloured or white, 4 mm long. Stamens free, c. 40 (pistillate flowers) or c. 75 (male flowers); anthers \pm oblong, to 1 mm long. Ovary c. 1.5 mm long; style c. 0.5 mm; stigma c. 1.5 mm across. Fruit banana-shaped, c. 7.3×2.3 cm, rather coarsely lined, outer layer to 1 mm thick, compact, woody layer absent. Seeds 3, with cotyledons visible.

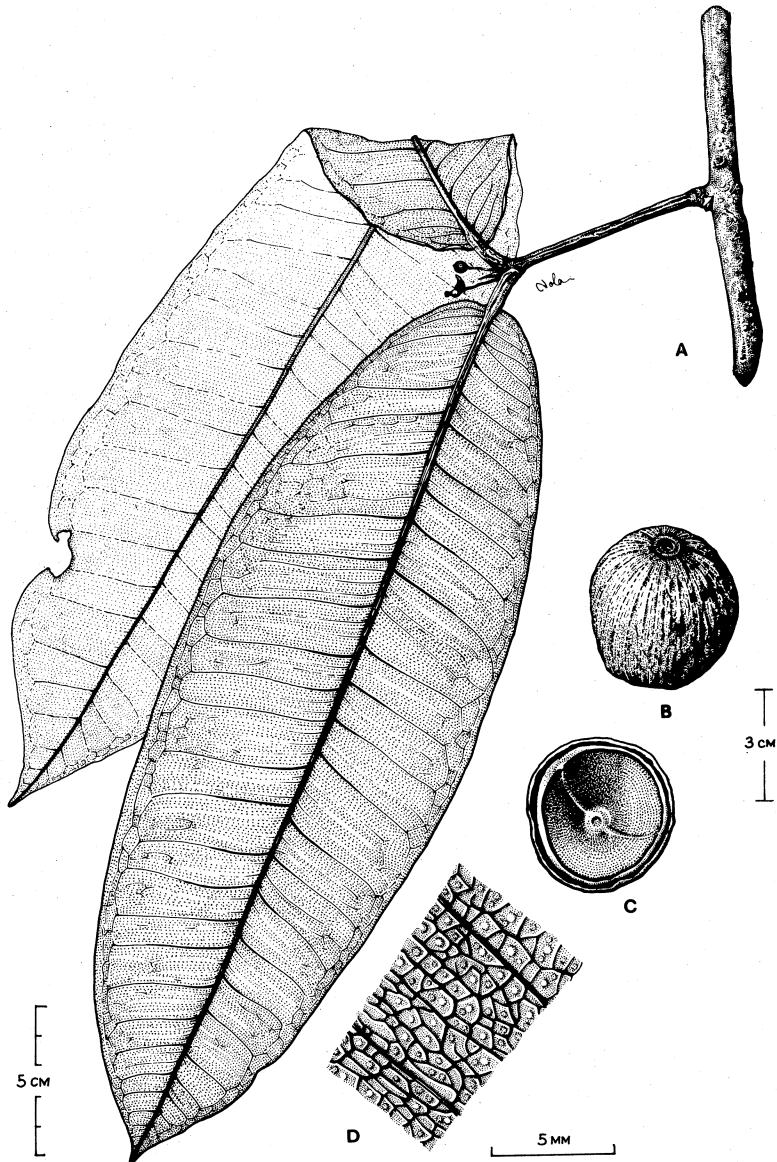


Fig. 24 *Mammea cordata* P. F. Stevens (A) branchlet (B) fruit (C) fruit with part of wall removed to show seed (D) detail of leaf venation (all NGF 5760)

Field characters: Outer bark yellowish brown, smooth; inner bark reddish; latex yellow or creamy-yellow. The leaves tend to have prominent venation and/or are slightly bullate.

Distribution: Fertile specimens known only from Morobe, Northern and Milne Bay districts. Sterile specimens probably of this species have been collected from West Sepik, Western and Papuan Islands districts.

Ecology: From sea level to 300 m altitude, usually in undisturbed lowland or lower montane (*Castanopsis*) rain forest in well-drained habitats. Flowering in May to July. Fruiting in June (type) and October (*Hartley 12274*).

Notes: The number of taxa with rather fine and distinct variation and heart-shaped lamina bases in our area is very unclear. It is probable that there are two taxa represented in the type collection of *M. cordata*, based on fruit type; both grow near Lae. The spherical-fruited type (see Stevens 1974—here excluded from this species).

Mammea grandifolia P. F. Stevens *Austral. J. Bot.* **22:** 416, f. 2d–f (1974).

Tree to 6 m high, d.b.h. to 7.5 cm. Twigs 6–8 mm across, slightly flattened, with fine lines; terminal bud 13 mm long, bud scales lanceolate, *c.* 2.7 × 0.7 cm, scars very numerous and close together; elongated internodes *c.* 10 cm long. Petiole 0.8–1.7 cm long. Lamina obovate, sometimes elliptic, 39–51 × 15.5–22.5 cm, coriaceous; base rounded to almost heart-shaped; apex very shortly and bluntly pointed; midrib above sunken at the very base, becoming raised, centre sunken, below raised, with fine raised lines; lateral veins consisting of *c.* 19 pairs, submarginal vein 6.7–2.7 cm from the margin, fine venation slightly raised above (finest veinlets visible as discoloration), prominently raised, latex glands visible below, areolae (1–)1.5–3(–4.5) mm across. Inflorescences on the branches; pedicels 0.7–1.4 cm long. Single sepal seen 5 × 6 mm, suborbicular, concave; apex acute; stigma *c.* 3.3 mm across. Fruits globular, *c.* 1 × 1 cm (immature), becoming scurfy.

Field characters: Outer bark slightly orange-brown; inner bark pink-red; latex opaque, yellow.

Distribution: Known only from the type collection made at Pinini Creek, Gulf district.

Ecology: Occurs in rain forest at low altitudes.

Notes: The large, broad leaves with coarse areolae immediately distinguish this species. The fruits are reported to be in clusters.

Mammea novoguineensis (Kan. & Hat.) Kosterm. *Djawa. Kehut. Indon. Bag. Plan. Kehut.* **12** (1956). **Fig. 25.**

Ochrocarpus novoguineensis Kan. & Hat. (1942); *Mammea lancelimba* Kosterm. (1956).

Tree *c.* 13 m high. Twigs 3–6 mm across, slightly flattened; terminal bud 1.5–5 mm long, bud scale scars numerous, the uppermost pair up to 7 mm above the

rest; elongated internodes 2.5–7.5 cm long. Petiole 1.2–2.5 cm long. Lamina elliptic to oblong, 24– c. 37 × 4–9 cm, coriaceous; base acute to decurrent; margin recurved; apex long-pointed; midrib above channelled at the bottom, becoming raised, rounded, raised below, ± rounded, lateral veins consisting of 18–22

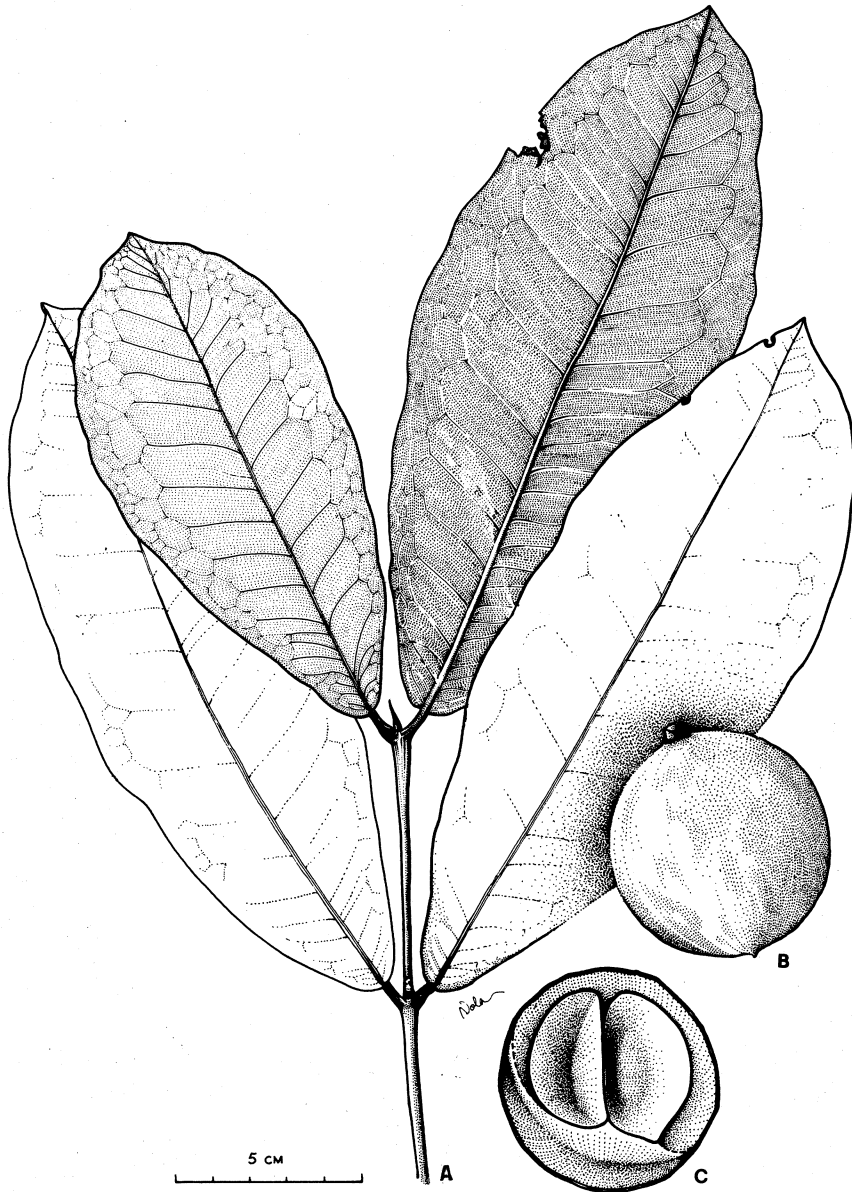


Fig. 25 *Mammea novoguineensis* (Kan. & Hat.) Kosterm (A) branchlet (B) fruit (C) fruit with part of wall removed to show seeds (all NGF 39414)

pairs, submarginal vein 0.4–1.1 cm in from the margin, surface sometimes pitted above, venation rather obscure below, reticulation slightly raised, latex glands usually not visible, scattered, areolae 0.2–0.5 mm across. Inflorescences on old wood, from small mounds, fasciculate; pedicels c. 1.5 cm long. Only male flowers known. Sepals 5×4 mm, hardly apiculate. Stamens c. 80; filaments fused at the base; anthers 1.7–2 cm long, \pm oblong. Ovary absent. Fruit unknown.

Distribution: Known only from Geelvink Bay—Japan Island and Nabire; two collections.

Ecology: At 90–350 m altitude in primary well-drained rain forest. Flowering in March.

Notes: *Mammea novoguineensis* has been interpreted narrowly here. It may be distinguished by its long-elliptic lamina and relatively long petioles. The top of the petiole dries like the midrib, the rest of the petiole dries differently. In other New Guinea species the bottom of the midrib and the whole of the petiole dry the same.

Mammea papuana could be confused with *M. novoguineensis*, but may be easily separated by its obovate leaves which are usually shorter than those of *M. novoguineensis* and which have much larger areolae which can be seen on the upper surface of the lamina as well.

Mammea odorata (Raf.) Kosterm. *Djawa. Kehut. Indon. Bag. Plan. Kehut.* 13 (1956). **Fig. 26.**

Lolanara odorata Raf. (1837); *Ochrocarpus ovalifolius* T. Anderson ex Hemsl. (1885); *O. pachyphyllus* K. Sch. (1889); *O. excelsus* (Planch. & Triana) Vesque (1893); *O. odoratus* (Raf.) Merr. (1945).

Tree to 5–18 m high, d.b.h. to 25 cm. Twigs 4.5–8.5 mm across, only slightly flattened; terminal bud 2.5–7 mm long, bud scales triangular, up to 6 pairs, often rather distant; elongated internodes 0.5–4 cm long. Petiole 0.7–1.6 cm long. Lamina obovate, 9.2–24 \times 5.5–13 cm, coriaceous; base acute to abruptly narrowed and shortly truncate or subcordate; margin recurved; apex rounded to retuse, shortly pointed or not; midrib above slightly raised to shallowly sunken, below strongly raised, with fine raised lines or subangled, lateral veins consisting of 10–16 pairs, marginal vein (0.2–)0.5–1.3 cm in from the margin, surface almost pitted above, fine venation raised above and especially below, latex glands visible, especially below, areolae 0.4–1.0 mm across. Inflorescence from defoliate axils, flowers arising from small mounds to 1.5 mm high; bracts 2 mm long, ovate; pedicels 1.3–1.7 mm long. Flower bud globose, apiculate (point to 1.5 mm long). Sepals 2, 6 \times 5.5 mm, apiculate. Petals 5 or 6, 8.5 \times 5 mm (rarely 8.5 \times 3 mm). Male flowers: Stamens c. 140 (in male flowers); anthers 1–1.5 cm long, oblong; apex acute to retuse. Ovary absent. Pistillate flowers: Stamens as above, perhaps slightly fewer (110 counted). Ovary 1.7–1.8 \times 3 mm; style 3 mm long; stigma 1.7 mm across. Fruit banana-shaped, with a narrow prolongation c. 1.5 cm long, 7.5–12 \times 3.2–3.7 cm, with irregular longitudinal lines; outer layer < 1 mm across; woody layer 3.5–4 mm across. Seed single, with cotyledons not apparent.

Field characters: Crown dense, irregular; bole usually crooked. Outer bark grey to dark brown, smooth at first, becoming vertically fissured and with lines of

circular or vertically elongated pustular lenticels, scaly; underbark brown and corky, or reddish brown; latex white or yellow.

Distribution: In Papuasias, scattered and always uncommon; Vogelkop, Madang, Papuan Islands, Bismarck Archipelago (New Britain and Manus) and the Solomon Islands (Bougainville, New Georgia Group, Guadalcanal, Malaita and San Cristobel).

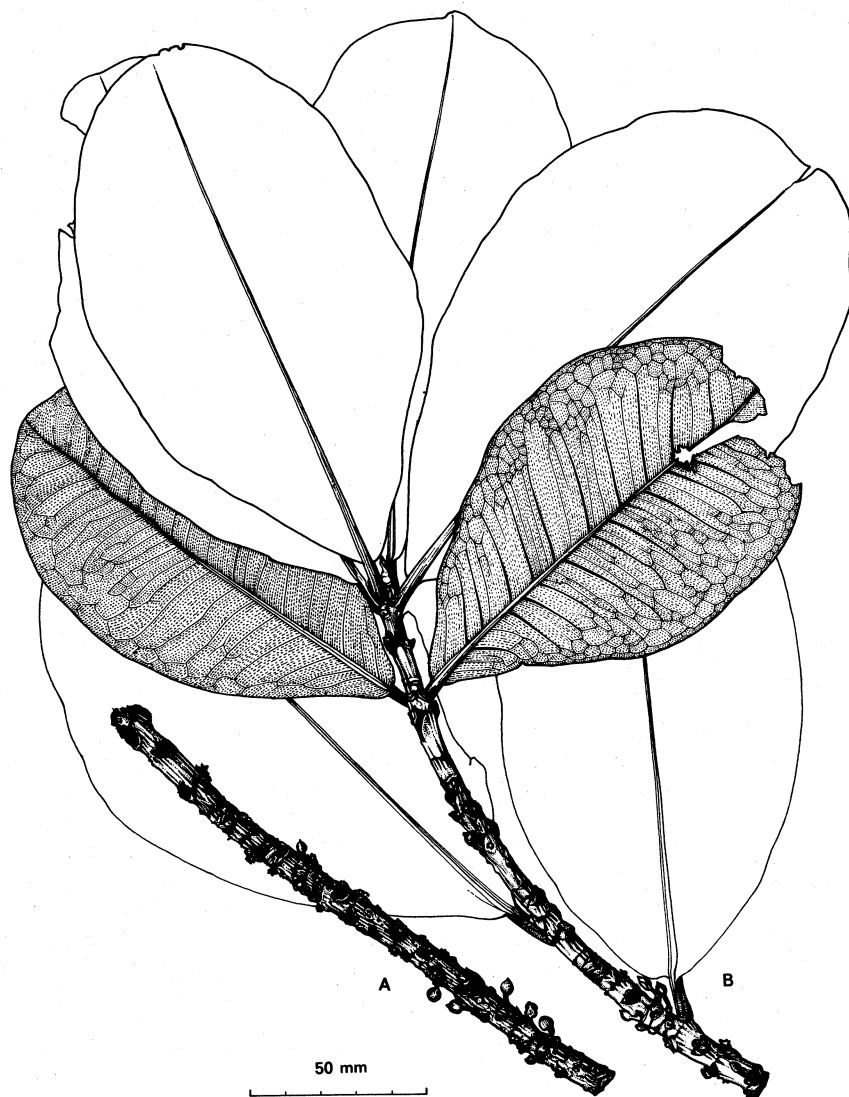


Fig. 26 *Mammea odorata* (Rafin.) Kosterm (A) details of flowering branch (B) branchlet (both BSIP 15474)

Ecology: A plant of seashores, either on sand or on rock. The young seedling has about three pairs of scales leaves (separated by internodes) and two pairs of leaves. Flowering and fruiting probably at any month of the year, the flowers are very sweetly scented.

Mammea papuana (Laut.) Kosterm. *Djawa. Kehut. Indon. Bag. Plan. Kehut.* 14 (1956).

Ochrocarpus papuana Laut. (1922).

Tree to 2 m high. Twigs *c.* 4 mm across, somewhat flattened; terminal bud *c.* 10 mm long, bud scale scars few. Petiole 1–1.5 cm long. Lamina narrowly obovate to obovate, 14–24 × 4–12 cm, shiny above, coriaceous; base acute; margin recurved; apex bluntly long-pointed; midrib raised above, prominently raised below and with fine raised lines; lateral veins consisting of 12–15 pairs, submarginal vein 0.8–1.5 cm from the margin, fine venation raised above and below, latex glands almost invisible, areolae 0.5–1 mm across. Inflorescence axillary, from defoliate axils, male flowers on mounds to 1 cm long; pedicels *c.* 1.2 cm long, 1.7–2 cm long in fruit. Male flowers only known: buds *c.* 5 mm long, apiculate. Sepals *c.* 2.5 × 4 mm. Petals 6, white, *c.* 9 × 3 mm, with 3 petals slightly smaller than other petals. Stamens numerous; anthers *c.* 2 mm long, narrowly obovate, apex retuse. Ovary absent; style on immature fruit *c.* 1 mm; stigma on immature fruit 2.7–2.8 mm across. Fruit (immature) 2.4 × 2.3 cm, ± spherical, much distorted by drying; 1- or 2-seeded.

Field characters: Outer bark dark grey; latex pale yellow to creamy-white.

Distribution: Known only from two collections made in the East Sepik district, northeastern New Guinea.

Ecology: Occurs in rain forest, at 120–850 m altitude.

Mammea papyracea P. F. Stevens *Telopea* 5: 359 (1993).

Tree *c.* 9 m high, d.b.h. *c.* 7.5 cm. Twigs 2–3.5 mm across, slightly flattened, lined when young, otherwise smooth; terminal buds 6–7.5 mm long, slender, pointed, bud scales few, with one pair to 2 cm above the others; elongated internodes 4.5–8 cm long. Petiole (3–)5–10 mm long. Lamina elliptic-oblong, 14–23 × 4.2–9 cm, thinly coriaceous; base broadly rounded to almost heart-shaped; margin recurved; apex sharply pointed to almost rounded; midrib above slightly sunken at the base, becoming raised, below raised, with fine raised lines; lateral veins consisting of 12–15 pairs, submarginal vein 0.4–1.6 cm from the margin, fine venation slightly raised, finest venation not visible, latex glands visible above, areolae *c.* 1 × 1 mm. Inflorescences and flowers unknown. Pedicel in fruit > 1.4 cm long. Fruit spherical, *c.* 5 × 5 cm, finely lined, outer layer to 3 mm thick, compact, woody layer *c.* 0.5 mm thick. Seed single, with cotyledons visible.

Field characters: Outer bark light brown, pustular; middle bark creamy-brown; inner bark brown; latex white, turning yellow.

Distribution: Known only from the type collection from the Morobe district (Buso, south of Lae).

Ecology: Creek bank in lowland rain forest at c. 9 m. altitude. Submature fruits in May.

Notes: *Mammea papyracea* may be distinguished by its leaf-laminas, which when dry have a texture like that of parchment (from which comes the specific epithet) that have latex glands about 2 mm apart. Although species of *Mammea* that have cordate leaf bases tend to have very short petioles, those of *M. papyracea* are notably long and slender.

Mammea veimaurensis P. F. Stevens *Austral. J. Bot.* **12:** 420, f. 3 (1974). **Fig 27.**

Tree to 18 m high, d.b.h. to 20 cm. Twigs 2.5–3.5 mm across, angled or with fine raised lines; terminal bud 2.5–3.5 mm long, pointed, bud scale scars 3–7 pairs, close together; elongated internodes (1.5–)3.5–12 cm long. Petiole 0.5–1.7 cm long. Lamina oblong to elliptic, 27–36 × 5–10.5 cm, coriaceous; base rounded; margin recurved; apex long-pointed (point to 2 cm long); midrib raised above, middle slightly sunken, below raised, angled, 22–28 pairs of veins, submarginal vein 2–6 mm in from the margin, surface pitted above and with obscure venation; venation minutely raised below, latex glands just visible, areolae 0.2–0.4 mm across, somewhat glaucous below. Inflorescences from axils that have lost their leaves, on small mounds. Flowers with c. 7 pairs of bracts to 3 × 4.5 mm, sessile. Hermaphroditic flowers only known: Sepals 2, c. 1.5 × 1.3 cm. Petals 6 or 7, white, c. 2 × 0.7 cm, elliptic, fleshy. Stamens brownish, c. 75; anthers 1.3–1.8 mm long. Ovary c. 4 × 5 mm; style 1.5–2.5 mm long; stigma 3 mm across. Fruit not seen.

Field characters: Latex yellow. Branches horizontal, rather few.

Distribution: Known only from two collections from the Veimaure River, Central district; reported to be quite common.

Ecology: Occurs in lowland rain forest, at 60–90 m altitude. Flowering in May.

Notes: The sessile flowers of *M. veimaurensis* immediately separates it from all other species of the genus in Papuaia. It may be close to *M. congregata* (Boerl. & Koord.) Kosterm., from the Aru Islands.

SPECIES IMPERFECTLY KNOWN

***Mammea* sp. 1**

Tree c. 8 m high. Twigs c. 4–6 mm across; bud scales 2–many pairs. Lamina oblong to oblong-elliptic, 28–40.5 cm long, rigidly coriaceous; fine venation sharply raised on both surfaces, latex glands elongated, visible on both surfaces, areolae (1–)1.5–3 × 0.4–1.8 mm. Fruit unknown.

Distribution: Fergusson Island (Milne Bay), once found at 170 m altitude.

***Mammea* sp. 2**

Tree c. 10 m high. Twigs c. 3–5 mm across; bud scales c. 3 pairs. Lamina rather narrowly obovate, c. 32.5 cm long, coriaceous; fine venation sharply raised on

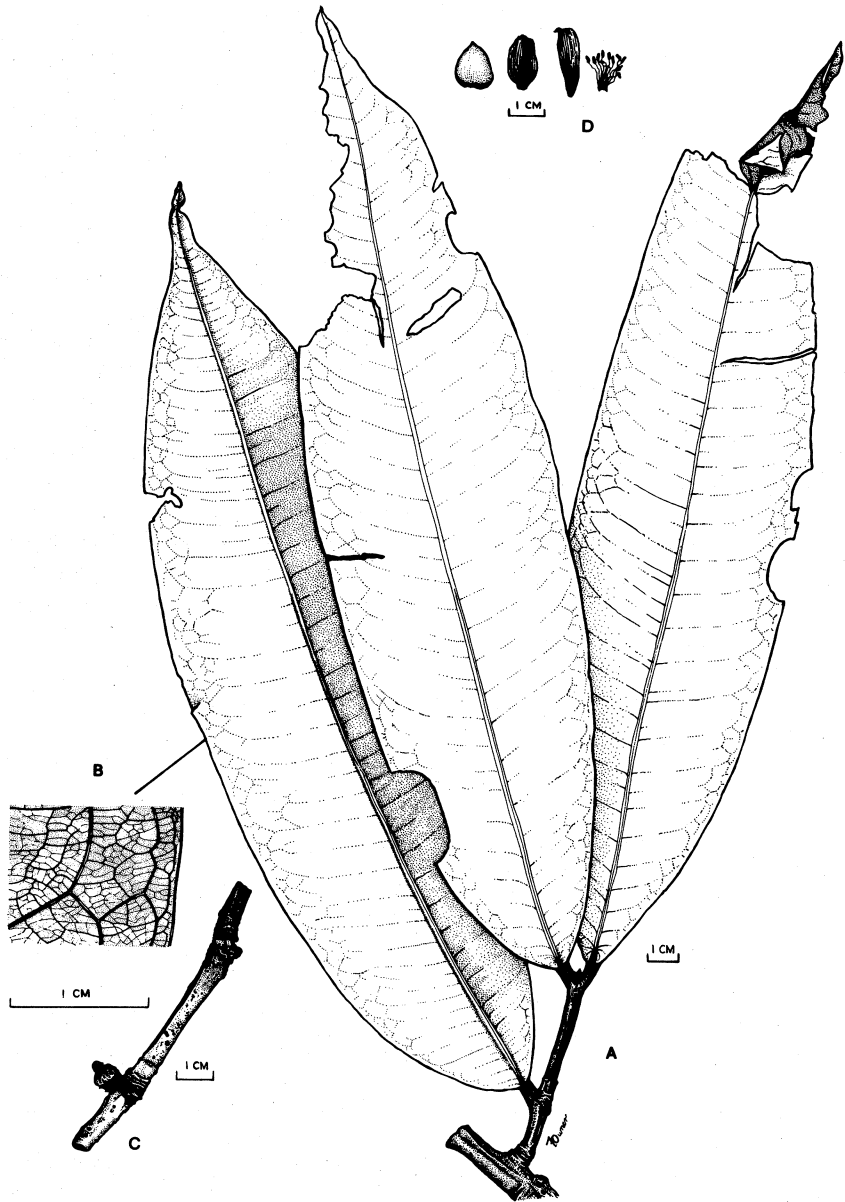


Fig. 27 *Mammea veimaurensis* P. F. Stevens (A) branchlet (B) detail of leaf venation (C) detail of branchlet (D) detail of flowers—ovary, perianth and stamens (all LAE 51535)

both surfaces, latex glands round, visible on the lower surface, areolae 0.7–1.7 mm across. Fruit subspherical, *c.* 4 × 3.3 cm, irregularly wrinkled and with faint, fine lines; outer layer 1–2.8 mm thick; woody layer apparently absent. Seed single.

Distribution: Gulf district, once found near Ihu; at 60 m altitude.

Mammea sp. 3

Shrub *c.* 2 m high. Twigs 4–4.5 mm across, bud scales very numerous, close together, to 14 mm long, persistent. Lamina elliptic-oblong to obovate, 16.5–*c.* 34 cm long, thickly coriaceous; fine venation slightly raised above, raised below, latex glands round, visible below, areolae 0.7–2 mm across. Fruit (submature) ovoid, slightly curved, *c.* 3.8 × 2.5 cm, scaly; outer layer *c.* 1 mm across; woody layer *c.* 1 mm across. Seed single.

Distribution: Southern Highlands district, once collected at Lake Kutubu.

Mammea sp. 4

Tree *c.* 12 m high. Twigs *c.* 3.5 mm across, bud scales 4—many paired. Lamina elliptic-oblong, 28–33 cm long, coriaceous, fine venation slightly raised above, raised below, latex glands round, visible below, areolae 0.4–0.7 mm across. Fruit globular *c.* 3.3 × 3 cm, with fine lines; outer layer *c.* 0.7 mm thick; woody layer *c.* 0.6 mm thick, hard. Seed single.

Distribution: Woodlark Island (Milne Bay); once collected at 15 m altitude.

Mammea sp. 5

Shrub or small tree *c.* 7.5 m high. Twigs 3.5–4 mm across, bud scales few. Lamina elliptic to subovate, 15.5–17.5 cm long, coriaceous; fine venation obscurely raised above, raised below, latex glands circular, visible below, areolae 0.4–1.5 mm across. Fruit somewhat obovoid, *c.* 3.9 × 3.1 cm, broadly wrinkled; outer layer *c.* 1.5 mm thick; woody layer *c.* 2.5 mm thick. Seed single.

Distribution: Gulf district, Aird Hills, once collected at 30 m altitude.

MESUA L.

Tree. Terminal bud aborting, axillary buds immersed in stem. Leaves with very finely reticulate venation, latex glands usually present. Plant pubescent on inflorescence and outer sepals only. Inflorescences axillary, 1–4-flowered, true bracteoles present when more than 1-flowered. Flowers hermaphroditic. Sepals 4 or 5. Petals 4 or 5. Anthers with inconspicuous glands. Ovary bilocular; ovules 4; stigmas 2, large. Fruit dry, dehiscent, with 1–4 seeds, septae persistent and woody.

Distribution: About 5 species, from Sri Lanka to Sumatra, a form, probably long cultivated, in Java and some Lesser Sunda Islands.

Notes: *Kayea* has until recently been considered synonymous with *Mesua*, but morphology, anatomy, and probably also chemistry clearly distinguish between the two (Stevens 1986).

Literature: P. F. Stevens (1986), *Mesua ferrea* became *M. nagassarium* (Burm. f.) Kosterm. but has to be called *M. ferrea* again (Guttiferae), *Taxon* 35: 352–354.

Mesua ferrea L. *Sp. Pl.* 1: 515 (1753).

Tree to 12 m high. Twigs slightly flattened, 0.6–1 mm across, drying smooth, blackish; internodes 1–3.5 cm long. Petiole 3–8 mm long. Lamina ovate-elliptic, 3.2–8.4 × 0.7–2.3 cm, coriaceous; base acute to wedge-shaped; margin flat; apex pointed, surface glaucous below; midrib above flat, below slightly raised, the edges sunken; lateral veins close, hardly distinguishable from other veins, areoles < 0.4 mm across, latex glands not visible. Flowers single, axillary, with several small bracteoles at base; pedicels 2.5–7 mm long, glabrous. Sepals green, 4, to 17 × 13 mm. Petals white, obovate, to 3 × 2.7 cm. Stamens with filaments white, to 13 mm long; anthers yellow, to 2.3 mm long. Ovary c. 4.5 mm long; style to 10.5 mm long; stigma bilobed, to 2 mm across. Fruit ovoid, 2.5–4 × 1.6–2 cm, sharply pointed at the apex, surface lined, walls to 2.5 mm across. Seeds 1(–4).

Field characters. Trunk sometimes fluted; bark brown, becoming scaly; inner bark pinkish; latex sparse, often colourless; heartwood dark red and very hard.

Distribution: Occasional: in Papuaia only occurs in cultivation.

Vernacular name: The hard wood gives the plant one of its vernacular names, namely 'iron wood'.

Notes. The description is that of the Javan form, that appears to be most commonly grown. Other forms have larger leaves and flowers with petals up to 4.7 × 4.5 cm, but there are otherwise few differences. *Mesua ferrea* is a very handsome tree, with a good, conical shape when young, dense foliage, pendulous young leaves that vary from white to dark red, mature leaves that are white on the underside, and showy, scented flowers.

BUDDLEJACEAE

B. J. Conn¹

Trees, shrubs, less often woody climbers or suffrutescent herbs, lacking spines, mostly with indumentum stellate or lepidote and/or glandular hairy. Stipules false, leafy, reduced to a line or absent. Leaves simple, opposite and those of a pair equal or almost so (less often in whorls of 3 or 4, or subopposite to alternate), petiolate (less often sessile) or occasionally connate-perfoliate (some *Buddleja* spp.). Inflorescence terminal and/or axillary, usually variously cymose; lower bracts often leafy, or all bracts scale- or sepal-like. Calyx, corolla and androecium 4- or 5-merous, usually actinomorphic (sepals often unequal), mostly bisexual, usually fragrant. Calyx campanulate or nearly so, persistent; sepals mostly connate, lobes slightly longer to much shorter than tube, usually entire. Corolla variously shaped; lobes imbricate or valvate in bud, orbicular to oblong, acute, obtuse, or rounded, entire or crenate. Stamens included or exerted, inserted on the corolla tube, mostly isomerous; filaments often elongate at anthesis, shorter or longer than the anthers; anthers usually basifixed, dehiscence introrse, locules 2 (or 4), parallel or divergent basally, discrete or fused apically. Ovary superior, 2- or rarely (in some bacciferous *Buddleja* spp.) 4-locular; ovules many; placentation axile; style 1, included or exerted, persistent; stigma variously shaped, unbranched. Fruit a bivalved capsule, rarely berry-like (in some *Buddleja* spp.); seeds many, small, oblique, ellipsoid, fusiform, or polyhedral; embryo cylindrical or nearly so; endosperm fleshy or starchy. Colleters absent.

Distribution: Mainly tropics and subtropics, with a few genera extending to warm temperate regions. Seven genera containing 121 species, of which only one genus (*Buddleja*), consisting of two species occurs in Papuaasia.

Ecology: see under 'Ecology' of *Buddleja* (below).

Notes: This family is frequently included in the Loganiaceae (refer discussion under notes of the latter family).

Literature: B. J. Conn (1992), Buddlejaceae, in G. W. Harden (Ed.) *Fl. New South Wales*, 3: 551 & 552. J. Hutchinson (1959), The families of flowering plants, vol. 1, ed. 2a (Oxford); (1973) *ibid.* ed. 3. P. W. Leenhouts (1962), *Flora Malesianae praecursores XXXIII, Loganiaceae*, *Bull. Jard. Bot. Brux.* 32: 417-458; (1963), *Loganiaceae, Fl. Males.* ser. 1, 6: 293-387; (1972), *Addenda, corrigenda et emendata—Loganiaceae, Fl. Males.* ser. 1, 6: 953-960. A. J. M. Leeuwenberg (Ed.) (1980), *Loganiaceae*, in Engl. & Prantl, *Nat. Pflanzenfam.*

¹ National Herbarium of NSW, Royal Botanic Gardens, Mrs Macquaries Road, Sydney, New South Wales, 2000, Australia.

28b I: 1–255. H. Solereder (1892), Loganiaceae, in Engl. & Prantl (Eds) *Pflanzenfam.* **4**, 2: 19–50.

BUDDLEJA Houst. ex L.

Shrubs, less often small trees, woody climbers or herbs; branches terete; branchlets, leaves (beneath) and inflorescences tomentose, usually with hairs stellate; stipules interpetiolar. Leaves opposite or nearly so, often thick and wrinkled, petiolate; lamina with margin entire, serrate-dentate, or rarely lobed. Inflorescences terminal and/or axillary, thyrsoid, spike-like or globose, bracteate with linear bracts. Calyx, corolla and androecium 4-merous. Calyx \pm campanulate, gamosepalous; lobes slightly longer to much shorter than the tube; outer surface usually hairy; inner surface glabrous. Corolla salverform, sometimes campanulate, variously coloured, from white to orange or to dark violet, or purple, often with an orange throat; lobes imbricate in bud; outer surface with stellate and/or glandular hairs present, less often glabrous. Stamens inserted on the corolla tube, included to just exerted; anthers subsessile; slightly to deeply lobed at base. Ovary mostly laterally compressed, mostly with stellate hairs, 2(or 4)-locular; ovules many; style short or long; stigma usually club-shaped, sometimes conical. Fruit a 2-valved capsule, septicidal (subg. *Buddleja*); valves mostly splitting to the middle. Seeds many, small, often winged; endosperm fleshy.

Distribution: Approximately 100 species in the tropical and subtropical regions of America, Africa and Asia. In Papuasia, 1 native species and 1 possibly becoming naturalized.

Ecology: Forms part of shrubbery of open terrain, often pioneering disturbed vegetation areas, also occurs along forest borders, from sea level to 3000 m. The seeds of the species with capsular fruits are wind dispersed.

Uses: Some species are used as fish poisons, whereas others are used for medicinal purposes because of the presence of saponin. A few species are planted as ornamentals.

Notes: Frequently misspelt as 'Buddleia'. Leeuwenberg (1979) recognizes four sections of which section *Chilianthus* (*B. davidii*) and section *Neemda* (*B. asiatica*) are represented in Papuasia.

Literature: A. J. M. Leeuwenberg (1979), The Loganiaceae of Africa XVIII *Buddleja* L. II. Revision of the African and Asiatic species, *Landb. Hogesch. Wageningen* **79**(6): 1–163. Also refer Literature under Family.

KEY TO SPECIES

1. Stipules indistinct, forming a stipular line between the bases of the leaves; corolla 3–6 mm long, white, sometimes pale violet or greenish **B. asiatica**
1. Stipules distinct, leafy, often divided into 2 auricles; corolla 8–12 mm long, blue-pink to lilac on outer surface, red on inner surface of tube **B. davidii**

Buddleja asiatica Lour. *Fl. Cochin* . 72 (1790). **Fig. 28.**

B. arfakensis Kan. & Hat. (1942).

Evergreen woody shrubs, undershrubs or sometimes small trees, 0.8–7 m high. Branches terete or subterete, densely stellate-pubescent, often densely adpressed-hairy or woolly-hairy; hairs white or grey. Stipules often inconspicuous, forming a stipular line between the bases of opposite leaves. Petiole (0.2–)0.5–1.5 cm long, tomentose; lamina narrowly oblong to narrowly ovate, 5–17 × 0.5–4 cm; base acute to cuneate; margin subentire to serrate; apex long-acuminate; lower surface stellate-pubescent to rather long woolly-hairy; upper surface glabrous or hairy. Inflorescences metabotryoidal to botryoidal (composed of a number of 1–3-flowered cymes), 4–30 cm long. Flowers sessile or subsessile; pedicels 0.2–2 mm long; bracts linear, 1.5–2 mm long. Calyx gamosepalous, at least at the base, campanulate, 2–4.5 mm long; outer surface densely pubescent; inner glabrous; lobes triangular-oblong, 0.5–1 mm long, apex acute. Corolla 3–6 mm long, white, sometimes pale violet or greenish; outer surface with dense stellate hairs, inner surface woolly from distal half of tube to base of lobes; tube 2–4.5 mm long; lobes oblong-ovate to ± orbicular, 1–1.5 mm long, apex rounded to obtuse. Stamens inserted 1.7–2.5 mm above base of corolla; anthers 0.5–0.8 long, base deeply 2-lobed. Pistil 2–3 mm long; ovary ovoid or nearly conical, 1–1.5 mm long, glabrous or lepidote; stigma club-shaped, 0.7–1 mm long. Capsule ovate-oblong to ellipsoid, flattened, 3–5 × 2–3 mm, glabrous or sparsely minutely lepidote, brown, apiculate. Seeds ellipsoid, winged at both ends, 0.8–11 mm long; endosperm 0.6–0.7 × 0.2–0.3 mm, laxly covered by cellular testa, 0.8–1 × 0.6–0.7.

Distribution: Southeastern Asia from Pakistan and the Deccan to South China and Taiwan, the Marianas, and throughout Malesia. In Papuasia it occurs in the Vogelkop, Mimika, Western Highlands, Eastern Highlands, Madang, Morobe and Central districts. Sometimes cultivated.

Ecology: A pioneer species mostly associated with disturbed areas, such as disused food gardens, roadsides and old gold mining sited, or secondary vegetation. In general, it occupies open situations such as grasslands, gravel-beds of rivers, lava streams, and landslips. It has a wide altitudinal tolerance, occurring from 80 to 2900 m altitude.

Buddleja davidii Franch. *Nouv. Arch. Mus. Hist. Nat. Paris* II 10: 65 (1887).

Shrubs, up to 2.5(–3) m high. Branches ± terete to subquadrangular, densely white-grey stellate-tomentose when young, particularly at internodes, glabrescent. Stipules auriculate, auricles 2, free, c. 3 mm long × 2 mm wide at base, densely pubescent. Petiole 2–5 mm long, glabrescent, densely stellate-tomentose to woolly; lamina elliptic-oval, oblong-ovate to narrowly ovate, 5.5–10 × 2–4 cm, lower surface densely pubescent to tomentose, upper surface mostly glabrous with midrib tomentose at least at base; base cuneate to subobtusate; margin crenate to minutely serrate-dentate; apex ± acute to subacuminate. Inflorescences thyrsoid, long and rather narrow, 12–20 cm long (composed of mostly shortly stalked dichasia or metabotryoids). Flowers subsessile, with pedicels 1–2(–3) mm long; bracts linear, 2.5–5 mm long. Calyx slender-campanulate, c. 3 mm long; outer

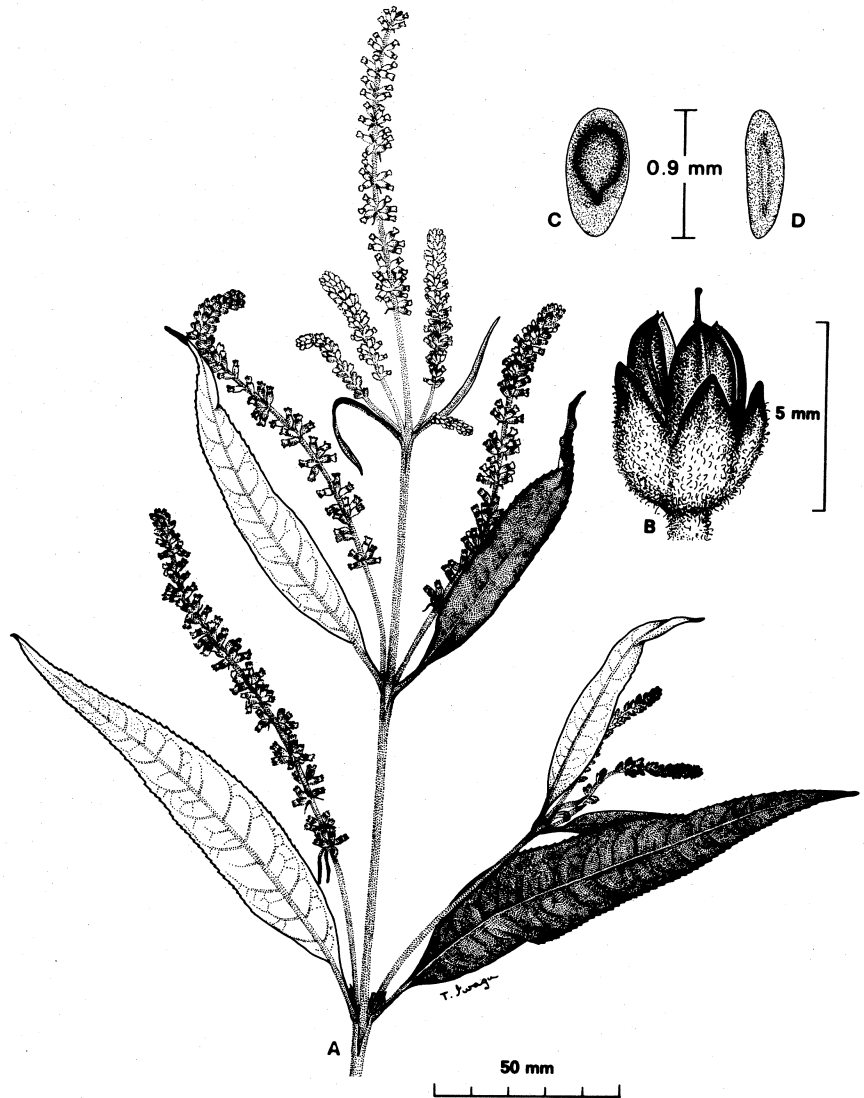


Fig. 28 *Buddleja asiatica* Lour. (A) flowering and fruiting branchlet (B) fruit and calyx (C) seed—view of broadest side, showing embryo (D) seed—view of narrow side (all *D & N 194*)

surface sparsely stellate-pubescent, becoming glabrous distally; inner surface glabrous with occasional minute glandular hairs; tube 4–10 mm long; lobes subequal, mostly narrowly triangular, 0.8–1.2 mm long, apex subacute to acute. Corolla 8–13 mm long, lilac-purple, with mouth orange-yellow; outer surface glabrous to sparsely stellate-pubescent; tube 6–10 mm long, slightly swollen near

middle, inner surface glabrous basally, sparsely hairy distally; lobes semiorbicular, 2–2.5 mm long, spreading, margin entire to crenate, apex rounded. Stamens included, glabrous or sometimes with a few scattered hairs on the anthers; anthers *c.* 1 mm long, base slightly bilobed, apex apiculate to subacute. Pistil 3–4.2 mm long; ovary \pm oblong, 1.2–2 mm long, minutely pubescent, or sometimes with glandular hairs; stigma club-shaped, 0.6–2 mm long. Capsules narrowly ellipsoid or narrowly ovoid, 5–9 \times 1.5–2 mm, sparsely stellate-pubescent or glabrous. Seeds thread-like, long-winged at both ends, 2–4 mm long, minutely reticulate; testa 0.5–0.6 \times 0.3–0.4 mm.

Distribution: Indigenous in China and Japan, but cultivated and often naturalized throughout the world. In Malaysia and Papuaia commonly cultivated as an ornamental. Occasionally found as a 'garden-escape' on roadsides.

LOGANIACEAE

B. J. Conn¹

Trees, shrubs, woody climbers or herbs, sometimes epiphytic or hemi-epiphytic. Colleters often present in axils of leaves, stipules and sepals. Leaves usually decussate; margin \pm entire; usually penninerved, rarely 3–7-plinerved (*Strychnos*) or curvinerved (*Mitrasacme*); stipules interpetiolar, often reduced to stipular line, sometimes intrapetiolar. Inflorescences cymose, monadic to triadic, botryoidal, metabotryoidal to paniculate. Flowers actinomorphic, usually bisexual. Calyx 5-merous (4-merous in *Mitrasacme*), sepals united or free. Corolla 5-merous (4-merous in *Mitrasacme*), gamopetalous. Androecium isomerous, alternating, inserted on corolla tube, included or exserted; anthers basifixed or sometimes subdorsifixed, slightly to deeply bifid basally, dehiscence introrse by lengthwise slits. Ovary superior (some *Mitrasacme* spp. semi-inferior), 2-locular; placentas axile, often peltate; ovules 1-many, amphitropous or anatropous; style usually one (2, \pm connate in *Mitrasacme* and *Mitreola*). Fruit always superior, capsular, berry-like or drupaceous. Seeds 1-many, with copious endosperm; embryo minute, straight; cotyledons small.

Distribution: Tropics, subtropics and a few genera extending to warm-temperate regions. About 22 genera containing approximately 349 species, of which 7 genera with 33 species occur in Papuasia.

Ecology: Mostly confined to the ever-wet tropical lowlands. Some species of *Mitrasacme* occur in areas that are subjected to periodical dry periods, whereas a few species (e.g. *Fagraea racemosa*, *Strychnos axillaris* and *S. minor*) tolerate a broad climatic range. *Fagraea salticola*, *Geniostoma antherotrichum* and *G. randidianum* occur at altitudes up to 3000(–3200) m. Most of the other species occur at altitudes below 2000 m.

Notes: The flowers are usually whitish and frequently fragrant (sometimes slightly unpleasant). Insects are the most common pollinators. Some species are pollinated by nocturnal insects (some *Fagraea* species), whereas others are pollinated at dusk (some *Geniostoma* species).

The seeds of capsular fruits are dispersed by birds in species of *Geniostoma* which have the seeds embedded in orange-red pulp. Likewise, birds, bats and possums eat the fleshy berry-like fruits of certain genera (e.g. *Fagraea*) and so aid the dispersal of these seeds. *Neuburgia* seems to have buoyant fruits which may be water dispersed.

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Loganiaceae are generally regarded as a heterogeneous family. Leenhouts (1963) followed the work of Solereder (1892) and subdivided the family into seven tribes. Hutchinson (1959, 1973) raised nearly all of these tribes to family rank. Leeuwenberg (1980) further modified the infrafamilial classification and recognized ten tribes, five of which occur in Papuasias. For further details refer Leeuwenberg *et al.* (in Leeuwenberg 1980). Note that the tribe Buddlejaceae is here regarded as the distinct family Buddlejaceae (see this volume).

Literature: B. J. Conn (1983), Loganiaceae, in P. van Royen, The alpine flora of New Guinea, **4**: 2647–2657; (1992), Loganiaceae, in G. W. Harden (Ed.) *Fl. New South Wales*, **3**: 477–481. G. Perry (1983), Loganiaceae, in B. D. Morley & H. R. Toelken (Eds) Flowering plants in Australia 247–249 (Rigby). J. Hutchinson (1959), The families of flowering plants, vol. 1, ed. 2a (Oxford); (1973) *ibid.* ed. 3. P. W. Leenhouts (1962), Florae Malesianae precursores XXXI–II, Loganiaceae, *Bull. Jard. Bot. Brux.* **32**: 417–458; (1963), Loganiaceae, *Fl. Males.* ser. 1, **6**: 293–387; (1972), Addenda, corrigenda et emendata—Loganiaceae, *Fl. Males.* ser. 1, **6**: 953–960. A. J. M. Leeuwenberg (Ed.) (1980), Loganiaceae, in Engl. & Prantl, *Nat. Pflanzenfam.* **28b** I: 1–255. H. Solereder (1892), Loganiaceae, in Engl. & Prantl (Eds) *Nat. Pflanzenfam.* **4**, 2: 19–50.

KEY TO GENERA

1. Herbaceous plants, annual (rarely perennial), up to 0.5(–0.7) m high
2. Stem with a pseudowhorl of 4 large leaves at base of inflorescence; capsule 2-lobed, not horned distally, valves caducous except for basal cupular part; style 1 SPIGELIA
2. Stem with rosulate leaves basally and/or leaves in pairs along stem, never pseudowhorled; capsule 2-horned distally, valves \pm persistent; styles 2, \pm connate
3. Calyx, corolla and androecium 4-merous; styles free basally, connate distally, c. 0.8–9 mm long; corolla usually campanulate or salverform, rarely urceolate, tube usually at least 2 mm long, lobes \pm valvate in bud MITRASACME
3. Calyx, corolla and androecium 5-merous; styles free, 0.2–0.5 mm long; corolla urceolate, tube up to 1 mm long, lobes imbricate in bud MITREOLA
1. Woody plants, shrubs or trees, usually at least 2 m high, or climbers, may be epiphytes or hemiepiphytes
4. Calyx, corolla and androecium 4-merous; branches, lower surface of leaves and inflorescences densely tomentose, hairs stellate BUDDLEJA
(see Buddlejaceae)
4. Calyx, corolla and androecium 5-merous; plants \pm glabrous, if tomentose then hairs never stellate
5. Leaves 3–5(–7)-plinerved; tendrils present; woody climber STRYCHNOS
5. Leaves penninerved; tendrils absent; habit various, mostly shrubs or trees
6. Fruit a dehiscent 2-valved capsule; inflorescence axillary and/or ramiflorous or cauliflorous; corolla campanulate to rotate GENIOSTOMA
6. Fruit indehiscent, berry-like or drupaceous; inflorescence usually terminal, sometimes axillary; corolla funnel-shaped to salverform
7. Corolla-lobes valvate in bud; fruit drupaceous, 1 (or 2)-seeded; seeds spindle-shaped, at least 10 mm long, not embedded in pulp NEUBURGIA
7. Corolla-lobes contorted or imbricate; fruits berry-like, many-seeded; seeds angular, c. 1 mm long, embedded in pulp FAGRAEA

FAGRAEA Thunb.

Terrestrial, epiphytic, often scrambling shrubs, woody climbers or small to large trees, glabrous. Stipules connate, forming a collar around the branchlet. Leaves

petiolate or sometimes sessile, coriaceous or \pm fleshy; margin entire. Inflorescences cymose, variously modified, nearly always terminal, (2- or) 3-many-flowered; bracts small, \pm triangular; bracteoles usually smaller than bracts, sometimes enclaspings calyx. Calyx fleshy to coriaceous; lobes imbricate, usually \pm rounded distally, thick with thin margin, colleters at base of inner surface. Corolla fleshy, usually white to cream-coloured, sometimes outer surface greenish or pinkish, second day turning yellow or orange; tube \pm thin-walled basally, thicker distally; lobes contorted, overlapping anticlockwise, shorter than tube, \pm rounded distally. Stamens inserted in throat, sometimes on a thickened ring; filaments broadened at base, geniculate just above base, strap-shaped, sometimes filiform; anthers basifixed, deeply bilobed basally and bluntly ellipsoid, or slightly bilobed and acute-linear, dehiscence introrse by longitudinal slits. Ovary ellipsoid, tapering into a filiform to cylindrical style; style \pm as long as tube or distinctly exserted; stigma capitate, obconical, peltate or bilobed. Fruit berry-like, usually globular to ellipsoid, style-base usually persistent, pale grey-green or whitish, maturing through yellow and orange to bright red or white, with a sticky white latex present under the epidermis; calyx not or slightly enlarged; seeds many, irregularly angular, c. 1 mm long, minutely warty, brown.

Distribution: About 35 species from Sri Lanka, through southeastern continental Asia to southern China, Hainan, and southern Taiwan, throughout Malesia, Papuasia, northern Australia and New Caledonia, and in the Pacific from the Marianas to the Marquesas. In Papuasia there are c. 16 species.

Ecology: Mostly halophilous plants, along forest margin, on river banks and creeks, in open places, also shrubs or trees in open forest and savannah, from sea level to altitudes of up to c. 3000 m.

Notes: As epiphytic shrubs they are often in the crown of the host tree or are found on the trunk of large trees, clasping the trunk with their roots. The roots may reach the ground and so the plant becomes a hemi-epiphyte. Several species are able to exist as epiphytes, hemi-epiphytes or terrestrial plants.

The flowers are visited by insects. These protandrous flowers open after sunset and anthesis apparently lasts for about two days. The seeds are mainly dispersed by birds, sometimes by bats and possums. Some species are myrmecophilous; these have extra-floral nectaries near the leaf-bases, on the leaf-lamina, and on the calyx. In those species that have large stipules or auricles, the ants frequently live in the shelter provided by these structures.

The stipules are connate so that they form a 'collar' around the branchlet. This soon splits (except in *F. racemosa*) into two more or less axillary halves that may be rounded or bilobed distally. The auricles (present in *F. woodiana*) are appendages of the lamina base. They are always inserted distinct from the stipules.

Leenhouts (1962) subdivided the genus into three sections and all three are represented in Papuasia. The following species belong to sect. *Cryptophyllum*: *F. elliptica*, *F. fragrans* and *F. umbelliflora*. *Fagraea racemosa* is the only species of sect. *Racemosae*. The remaining twelve Papuasian species belong to sect. *Fagraea*.

Literature: B. J. Conn (1983), Loganiaceae, in P. van Royen, The alpine flora of New Guinea, 4: 2647–2650 (Cramer). B. J. Conn & E. A. Brown (1993), Review

of *Fagraea gracilipes* complex (Loganiaceae), *Telopea* 5: 363-374; P. W. Leenhouts (1962), *Flora Malesianae* precursores XXXIII, Loganiaceae, *Bull. Jard. Bot. Brux.* 32: 417-458.

KEY TO SPECIES

1. Leaves sessile to shortly petiolate; petiole < 0.5 cm long; lamina with base rounded or subcordate, never attenuate or decurrent
 2. Stipules 0.5-0.8 cm long; lamina c. 9-10 × 4.5-5.5 cm; inflorescences 2 (or 3)-flowered **F. eymae**
 2. Stipules 1.5-1.7 cm long; lamina 17-35 × 5-17 cm; inflorescences c. 15-flowered, glomerulous **F. carstensensis**
1. Leaves petiolate; petiole at least (0.6-)1 cm long; lamina with base various, when attenuate and decurrent leaves may appear sessile
 3. Leaves distinctly auriculate; auricles reflexed, 0.4-1(-1.5) cm wide, clasping base of petiole and branchlet **F. woodiana**
 3. Leaves without auricles or small auricle-like swellings present, but never reflexed
 4. Inflorescence axillary (in distal nodes)
 5. Inflorescence umbelliform; basal non-flowering part of axis absent; peduncle thick, 0.4-0.6(-1.0) cm long; bracts and bracteoles absent; stipules 3-4 mm long . . . **F. umbelliflora**
 5. Inflorescence triadic (rarely monadic), thyrsoidal to metabotryoidal, never umbelliform; basal non-flowering part of axis up to c. 4 cm long, ± slender; peduncles thin, 1.5-2.5 cm long; bracts c. 0.5-1 mm long; bracteoles c. 0.5 mm long, inserted ± halfway up pedicel; stipules 0.5-2.5 mm long **F. fragrans**
 4. Inflorescence terminal (lower node of inflorescence may produce a pair of leaves so that inflorescence may appear terminal and axillary as in *F. elliptica*)
 6. Inflorescence a bracteose or frondobracteose panicle, usually > 100(-c. 150)-flowered; corolla 0.8-1.2 cm long; fruit 5-7 mm long **F. elliptica**
 6. Inflorescence mostly triadic, botryoidal, metabotryoidal or thyrsoidal, never paniculate, up to 25(-45)-flowered; corolla at least 2 cm long; fruit 10-60 mm long
 7. Stipules remaining connate, even when leaves are mature, forming a collar around the branchlet; basal non-flowering part of inflorescence (1-)4-10(-30) cm long. **F. racemosa**
 7. Stipules soon splitting between the petiole bases to form two ± axillary halves; basal non-flowering part of inflorescence reduced or 1-3(-4) cm long.
 8. Stigma bilobed; stamens inserted on a fleshy rim in corolla-tube; anthers linear, narrowly elliptic to narrowly ovate in outline, shortly bilobed basally
 9. Bracteoles inserted at or near base of calyx and ± appressed to it; leaf-base subcordate to rounded, rarely broadly cuneate **F. salticola**
 9. Bracteoles inserted c. halfway up pedicel, not appressed to calyx; leaf-base acute or subacute (rarely subobtusate) to attenuate
 10. Corolla narrowly funnel-shaped, (4-)4.5-10 cm long, cream-coloured, turning via yellow to mid-orange; calyx-lobes spreading to reflexed in fruit; inflorescence 7-16 cm long, widely branched; pedicels 0.5-2.5 cm long; peduncles 2-4 cm long **F. berteriana**
 10. Corolla salverform, 2-2.5(-4.5) cm long, deep green on outer surface, cream-coloured to white on inner surface; calyx lobes ± appressed to surface of fruit; inflorescence 4-8 cm long, ± compact; pedicels 0.4-1.5 cm long; peduncles 1-2 cm long **F. bodenii**
 8. Stigma capitate, obconical or peltate (may be slightly bilobed when peltate); stamens inserted in corolla-tube but not on fleshy rim (except in *F. annulata*); anthers oblong to elliptic in outline, basally divided for about half their length
 11. Stamens inserted on a distinct thickened rim about halfway up the corolla-tube **F. annulata**
 11. Stamens not inserted on a distinct thickened rim in the corolla-tube
 12. Calyx 0.3-0.6 cm long; bracteoles up to 1(-1.5) mm long, inserted about halfway up pedicel; anthers 2-5 mm long **F. gracilipes complex**
 12. Calyx 1-3.3 cm long; bracteoles 2-10(-26) mm long, inserted halfway up pedicel to just below the calyx, sometimes confluent basally and then clasping the calyx; anthers (3.5-)5.5-7 mm long **F. ceilanica**

Fagraea annulata Hiern *Nova Guinea* 8: 202 (1909).

Trees 6–8 m high. Stipules 2.5–5 mm long, split to form two axillary halves that are adnate to petiole, with apex truncate to faintly bilobed. Petiole slender, 0.6–2.5 cm long. Lamina \pm oblong, ovate to obovate, 5–14 \times 2.2–5.5 cm, firmly herbaceous; base acute, often subcontracted and decurrent; margin entire; apex shortly acute-acuminate; veins faint to indistinct, *c.* 10 pairs. Inflorescence terminal, cymose, 2–15-flowered; non-flowering part of axis reduced; peduncles reduced; pedicels 0.5–1.2 cm long, thick; bracteoles inserted on the distal half of pedicel. Calyx campanulate, 0.6–1 cm long; tube up to 0.5 cm long; lobes often recurved. Corolla funnel-shaped, 3.7–4.4 cm long; tube 2.6–3.5 cm long, with a distinct horizontal rim about halfway up inner surface. Stamens inserted on horizontal rim, *c.* 18 mm long, subflexuose; anthers oblong, *c.* 6 mm long, approximately basal half of locules free. Pistil 26–27 mm long, *c.* 10 mm exserted above corolla mouth; ovary *c.* 3 mm long; stigma subpeltate, *c.* 2.5 mm diameter. Fruit ellipsoid-oblong (immature), *c.* 1.2 \times 0.4–0.7 cm.

Distribution: Endemic to Papuaia. Once collected (*Versteeg 1237*) from the Noord River near Zandvoort and Sabangkamp (Digul district, western New Guinea).

Ecology: On river bank at low altitude. Flowering June.

Notes: The status of this taxon is in doubt since it only differs from *F. ceilanica* by the presence of the thickened annulus in the corolla-tube. Leenhouts (1963) suggests that 'it is not impossible that it is of hybrid origin' between *F. ceilanica* and *F. berteriana*.

Fagraea berteriana A. Gray ex Benth. *J. Linn. Soc. (Bot.)* 1: 98 (1856). **Fig. 31C–F.**

F. obovata Wall. var. *papuana* F. M. Bail. (1898); *F. peekelii*, *F. pachypoda*, *F. calophylloides* Gilg & Bened. (1916); *F. salomonensis* Gilg & Bened. (1921); *F. affinis* S. Moore (1923); *F. novae-guineae* Cammerl. (1924); *F. pluvialis* S. Moore (1929).

Usually trees (in mainland New Guinea and D'Entrecasteaux Islands), 3–10(–20) m high, sometimes epiphytic or terrestrial, erect or scrambling shrubs (in New Britain, New Ireland and the Solomon Islands usually woody climbers or epiphytes), 3–10(–26) m high. Stipules connate by thin intrapetiolar rim, 5–9 mm long, soon split into round axillary halves which are partly adnate to petiole, with apex bilobed. Petiole \pm slender, (1.5–)2.5–4(–5) cm long. Lamina elliptic or oblong, sometimes slightly ovate or obovate, (8–)10–16(–19) \times (4.5–)6–10.5(–12) cm, thin- to fleshy-coriaceous; base subacute to attenuate, shortly decurrent; margin entire, sometimes slightly recurved basally; apex rounded, often with short blunt (rarely acute) point, acumens up to 0.5 cm long; veins faint to indistinct, 7–*c.* 45-flowered, widely branched; basal non-flowering part of axis reduced; peduncles 2–4 cm long; pedicels 0.5–2.5 cm long; bracts (0.3–)0.4–1 cm long; bracteoles broadly triangular, 0.2–0.3(–0.5) cm long, inserted about halfway up pedicel. Calyx narrowly campanulate, 1–1.5 cm long; tube 0.6–1 cm long; lobes \pm semicircular, 0.3–0.4 cm long. Corolla narrowly funnel-shaped, (4–)4.5–10 cm long, varying from cream-coloured, yellow through to mid-orange; tube narrow, \pm cylindrical, 3.2–8 cm long; lobes oblong-ovate to oblong-obovate, 1–2.5 cm long. Stamens inserted on a thickened rim *c.* halfway

up the inside of the corolla-tube, 2– c. 3 cm long, included or just exerted at mouth, glabrous; anthers narrowly linear, 1–1.5 cm long, shortly bilobed basally, attenuate distally. Pistil 5–8(–9) cm long, included or just exerted from mouth, glabrous; ovary c. 0.5 cm long; style c. 4–8 cm long; stigma distinctly bilobed (may superficially appear to be capitate since lobes often folded upwards and adpressed), lobes 0.7–1 cm long. Fruit ellipsoid to globular, 3–6 × 2.5–4.5 cm, maturing to orange or red, up to c. 1 mm of base of style persistent; calyx-lobes spreading to reflexed.

Field characters: Outer bark usually dark brown, sometimes light brown to grey, usually hard, fissured and flecked, sometimes flaking off in large irregular patches; inner bark lighter. Outer wood hard, white, straw-coloured to light brown; inner wood pinkish white, reddish when dried. Flowers usually very strongly scented.

Distribution: This species occurs in Micronesia, south through Papuasias to Australia (northeastern Queensland), and east throughout Melanesia and Polynesia (as far as Marquesas). In Papuasias it occurs in the Fakfak, West Sepik, Western, Western Highlands, Southern Highlands, Eastern Highlands, Morobe, Central, Northern, Milne Bay, Papuan Islands, New Britain, New Ireland, Manus, and Bougainville districts, and on Choiseul, New Georgia group, Guadalcanal, Malaita and San Cristobal islands, plus the Santa Cruz group, in the Solomon Islands.

Ecology: Occurring in open to dense, wet to dry, primary forests (e.g. Fagaceae, Myrtaceae, *Annesijoa*, *Calophyllum*, *Pimeleodendron*, *Quercus*, *Syzygium*, *Terminalia* dominated communities) or secondary forests, frequently along ridges, river banks and creeks, or in more open communities amongst or on rocks and boulders, along edge of secondary forests and savannah, in littoral forests, along the beach and in mangrove communities. It sometimes occurs on poorly drained soils (yellow-orange to red-brown clays), but more commonly on well-drained soils. Also associated with karst limestone, conglomerates, volcanic larva and ultra-basic derived soils. In Papuasias it occurs from sea level to 1000(–2286) m. Flowering throughout year, mostly September to November. Fruiting throughout year, mostly March to November.

Vernacular names: 'Argook' (unspecified New Britain lang.); 'bó', 'bula', 'fai bula' (Kwara'ae); 'dondo' (Kulumo); 'kengong' (Pindiu) (note: same name, but in Moraegoe language, used for *F. dolichopoda*); 'semeos' (Arigenang-Finschafen).

Uses: In the Solomon Islands the sticky interior of the fruit is used as a flytrap. The timber is hard and often used for house posts and tools.

Notes: This species should be taxonomically re-evaluated. The current broad circumscription applied to this taxon appears to include taxa that are probably worthy of specific status. The other Papuasian *Fagraea* species that have their closest affinities with this species are *F. bodenii* and *F. salticola*.

The specific epithet has been previously incorrectly spelt as 'berteriana', and should be corrected to 'berteroana'.

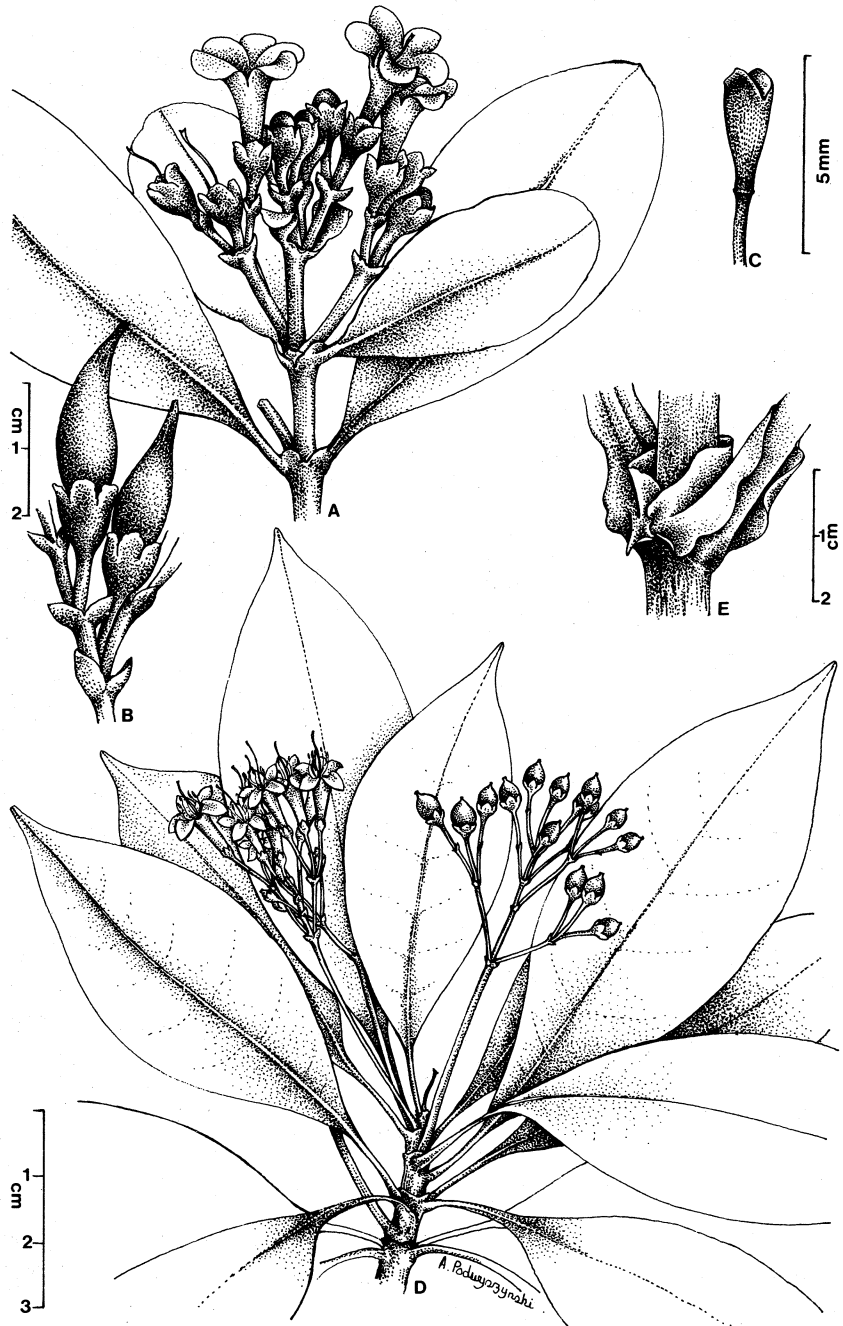


Fig. 29. *Fagraea bodenii* Wernh. (A) flowering branchlet (NGF 10756) (B) fruits (NGF 32152) (C) stigma and distal part of style (NGF 10756) *F. fragrans* Roxb. (D) flowering branchlet, also with immature fruits (Verdcourt 5055) *F. woodiana* F. Muell. (E) stipules and base of petiole (NGF 45222)

Fagraea bodenii Wernh. *Trans. Linn. Soc. (Bot.)* 9: 111 (July 1916). **Fig. 29A–C.**

F. jasminodora Gilg & Bened. (Oct. 1916); *F. ampla* S. Moore (1923); *F. suaveolens* Cammerl. (1924); *F. papuana* Merr. & Perry (1942).

Shrubs or trees, (1.5–)8–30(–45) m high, occasionally epiphytic. Stipules 0.3–1 cm long, soon split into two axillary halves that are adnate to petiole, with apex rounded, obtuse or bilobed. Petiole 0.8–2(–3) cm long, mostly slender, (0.7–)1.5–3 mm diameter. Lamina elliptic, elliptic-obovate to oblong, 5–15.5 × 2.5–8 cm, coriaceous; base acute (rarely subobtuse), slightly decurrent; margin entire; apex obtuse or rounded, often with a blunt point, acumen < 7 mm long; veins faint, occasionally distinct, *c.* 6–10 pairs, midrib raised on lower surface. Inflorescence terminal, cymose, usually metabotryoidal, 4–8 cm long, (2–)5–15(–*c.* 25)-flowered; the basal non-flowering part of axis reduced; peduncles thick, 1–2 cm long; pedicels thick, 0.4–1.5 cm long; bracts at base of pedicel, *c.* 4 mm long; bracteoles inserted about halfway up pedicel, 0.2–0.4 cm long. Calyx narrowly campanulate, 0.7–1(–1.3) cm long; tube *c.* 4.5 mm long; lobes ± depressed-ovate, mostly *c.* 3 mm long. Corolla salverform, 2–2.5(–4.5) cm long, deep green on outer surface, cream-coloured to white on inner surface; tube tubular or narrowly obconical, *c.* 1–1.5(–3) cm long; lobes ± orbicular to oblong, *c.* 1–1.5 cm long. Stamens inserted *c.* 10 mm above base of corolla mouth; filaments *c.* 15 mm long; anthers linear-lanceolate, 6–13 mm long, basally < 1 mm of locules free. Pistil 10–15(–50) mm long; style *c.* 10(–30) mm long; stigma distinctly bilobed, 2–3 mm diameter. Fruit broadly ellipsoid-subglobose, *c.* 4 × 2.5 cm, distally contracted into a long conical robust point, maturing to orange or red, calyx adpressed to surface of fruit, style extending as fruit matures.

Field characters: Bole 8–15 mm high; d.b.h. 10–40 cm. Outer bark cream-coloured to grey; inner bark cream-coloured. Wood brownish pink to straw-coloured.

Distribution: This species is endemic to Papuaia. It has been collected from the Snow Mountains, Jayapura, West Sepik, Southern Highlands, Gulf, Morobe, Central, Milne Bay and Bougainville districts.

Ecology: Occurring on well-drained volcanic soils and clay-rich soils, frequently from disturbed sites, river banks and lake margin communities, primary and secondary submontane to montane moss forests (that are frequently dominated by *Nothofagus*), and from forest ridge communities. It occurs at altitudes of (80–)1250–2840 m. Flowering December to March, May, June, August. Fruiting December to February, May to October.

Vernacular names: 'Mangapom' (Waskuk—note: variant of name used for *F. ceilanica*); 'gwa' (Wagu).

Notes: This species is characterized by its conspicuous stipules and strongly beaked fruits. The fruits are on short, stiff pedicels.

Fagraea carstensensis Wernh. *Trans. Linn. Soc. (Bot.)* 9: 111 (1916).

Small trees, *c.* 3 m high. Stipules split into two axillary halves which are fully adnate to midrib, quadrangular, 1.5–1.7 cm long, 1–1.5 cm wide. Leaves sessile. Lamina broadly obovate to obovate-oblong, 17–35 × 5–17 cm, coriaceous; base subcordate by a broadly rounded wing (wing apparently not auriculate); margin

entire; apex rounded and shortly acute-acuminate; veins conspicuous, 5–12 pairs, raised on lower surface. Inflorescences terminal, sessile, cymose, glomerulus, *c.* 15-flowered, the reduced leaves at base of the inflorescence are connate and much broader basally, \pm perfoliate; peduncles and pedicels reduced; bracts and one pair of bracteoles relatively large (1.5 cm and 1 cm long, respectively), clasping the calyx. Calyx subcampanulate, *c.* 2 cm long; tube slender; lobes *c.* 1.5 cm long. Corolla funnel-shaped, 4.5–5 cm long; tube *c.* 3.3 cm long, diameter *c.* 2 cm at mouth; lobes *c.* 1.5 cm long. Stamens with anthers elliptic (in outline) and *c.* 6.5 mm long, basal 2 mm of locules free. Pistil with stigma obconical-peltate (diameter 3 mm). Fruits unknown.

Distribution: Endemic to Papuasias where it has been twice collected from the Mimika district (from Mt Carstensz and Mt Tamrau).

Ecology: It occurs in forests at altitudes of 200–860 m.

Notes: The above description is based on Leenhouts (1963). This species is very poorly understood.

Fagraea ceilanica Thunb. *Vet. Acad. Handl. Stockh.* 3: 132, t. 4 (1782). **Fig. 30A–F.**

F. obovata Wall. (1824), non Bl. (1826); *F. littoralis* Bl. (1826); *F. rostrata* Bl. (1838); *F. ternatana* Miq. (1866); *F. archboldiana* Merr. & Perry (1942); *F. angiensis* Kan & Hat. (1942).

Shrubs or small trees, 1–10(–20) m high, or epiphytes to 7(–10) m high. Stipules split into two axillary halves that are partly adnate to base of petiole, slender, to *c.* 0.4–1 cm long; apex usually obtuse to truncate, never bilobed. Petiole slender to robust, 1–2(–3) cm long, exauriculate. Lamina obovate to oblong-obovate (rarely ovate), sometimes broadly so, 8–15(–20.5) \times 3–6(–9) cm, fleshly or coriaceous; base attenuate and decurrent, rarely obtuse or rounded; margin entire; apex obtuse, usually with a blunt (sometimes acute) point, acumen 2–10 mm long; veins faint to indistinct, 6–*c.* 14 pairs, midrib slightly raised on, lower surface. Inflorescence terminal, cymose, triadic or botryoidal, sometimes metabotryoidal, (6–)7–13 cm long, compact, 3–5(–9)-flowered; the basal non-flowering part of the axis reduced or 1–3 cm long; peduncles reduced or up to 1(–2) cm long; pedicels usually thick, sometimes slender, 4–15(–40) mm long; bracts at base of pedicel, 4–10 mm long; bracteoles \pm triangular to ovate, 2–10(–26) mm long, inserted halfway up pedicel to just below the calyx, sometimes confluent at the base and together clasping the calyx. Calyx campanulate to slightly urceolate, 1–3.3 cm long; tube 0.3–0.8 cm long; lobes \pm orbicular to ovate, 0.5–1.5 cm long. Corolla narrowly to broadly funnel-shaped, (2.5–)3.5–7.5 cm long, white or cream-coloured, or greenish white; tube 2–4 cm long, rim absent; lobes semicircular, obovate to spatulate, 0.7–3 cm long. Stamens inserted about halfway up corolla-tube, 15–20 mm long, just exerted from mouth; anthers \pm oblong to ovate, (3.5–)5.5–7 mm long, up to 2.6 mm of basal parts of locules free. Pistil 35–40 mm long, up to *c.* 10 mm exerted beyond corolla mouth; ovary 6–8 mm long; stigma usually peltate to slightly cup-shaped, sometimes obconical, 1–3 mm diameter. Fruit ovoid or ellipsoid to subglobular, (2.5–)3–5 cm long slightly to strongly beaked distally (base of style persistent), up to *c.* 4 mm long, maturing to orange or red.



Fig. 30 *Fagraea ceilanica* Thunb. (A) flowering branchlet (NGF 30334) (B) fruit and calyx, with bracteoles inserted near base of calyx ('*F. gardeniaeflora*'/'*F. archboldiana*' form)(UPNG 1644) (C) stigma and distal part of style (*Kanis 1100*) (D & E) stamens, dorsal and ventral views (NGF 30334) (F) flower ('*F. litoralis*'/'*F. ternatana*' form)(UPNG 1663)

Field characters: Outer bark brown; underbark green; inner bark white to straw-coloured. Wood tough, dense, yellow to straw-coloured.

Distribution: This species occurs from Sri Lanka, throughout Southeast Asia to Papuasia, and as far north as Taiwan. In Papuasia it occurs in the Vogelkop, Fakfak, Snow Mountains, Western, West and East Sepik, Western Highlands, Southern Highlands, Eastern Highlands, Madang, Morobe, Northern, Central, Milne Bay, New Britain and Bougainville districts, and in the New Georgia Group of the Solomons Islands.

Ecology: Occurring in open, frequently distributed sites along water courses and road sides, in fire-induced vegetation (often with *Baecckia* and Ericaceae), along forest margin. Also occurs in primary and secondary forests from lowlands to Fagaceae-dominated moss forests, both on dry and on marshy or periodically inundated soils (e.g. bordering *Metroxylon* swamps). In Papuasia it occurs at altitudes of 30–2440 m.

Vernacular names: 'Dong ok' (Telefomin); 'frafoguw' or 'frijvegoe' (Maibrat); 'Iarnof' (Owen Stanley Ra.); 'mangapom' (Waskuk—note: variant of name used for *F. bodenii*); 'nera bara' (Sinasina) 'pungomatomea' or 'punguna-tomia' (Koroba); 'sonawalla' (Saidor); 'to-r' (Kumul); 'tsinkewabo' (Kutubu); 'vomook' (Kiunga); 'vorena' (Ka); 'wagu' (Megai).

Uses: In Papuasia the wood is used for making hair combs (New Britain) and for firewood (Pureni, Southern Highlands).

Notes: Leenhouts (1963) applied a broad species concept to this taxon, such that, he regarded *F. ceilanica* as an extremely variable species. In Papuasia, it is represented by two main forms. The taxonomic significance of these forms is not known, but they may deserve specific status. The two forms are characterized below.

1. **The '*F. gardeniaeflora*'/'*F. archboldiana*' form** has the bracteoles inserted near or at the base of the calyx. These bracteoles are 1–2.5 cm long and are often partly connate basally. The usually campanulate calyx is 2–3.3 cm long. The corolla is broadly funnel-shaped and 4–6 cm long. This form is common in the Wau-Bulolo area (Morobe district) and is made up of shrubs and trees. On each side of the broadened base of the petiole (in '*F. gardeniaefolia*'), there is often a small, but distinct swelling (probably a gland) that may look like a rudimentary auricle.

2. **The '*F. litoralis*'/'*F. ternatana*' form** is the other main type found in Papuasia. This form has bracteoles that are inserted about halfway up the pedicel. These bracteoles are 0.2–0.8 cm long and are sometimes displaced (relative to each other) along the axis so that they appear alternate. The often slightly urceolate calyx is (0.8–)1.5–1.7(–2) cm long. The corolla is mostly narrowly funnel-shaped and (3.5–)4.5–8 cm long. These plants may be epiphytes, shrubs or trees.

Simonett 43 records that the tap root of this species is strongly developed (up to 5 m long) and that it 'frequently appears on landslides within four years' of the landslide occurring.

Fagraea elliptica Roxb. [*Hort. Beng.* 84 (1814), nom. nud.] *Fl. Ind.* ed. Wall. 2: 32 (1824). **Fig. 31A & B.**

F. pseudoelliptica Kan. & Hat. (1942).

Shrubs 2–5 m high to trees up to 30 m high, crown flat and dense, sometimes with buttresses up to 1 m high. Stipules connate, collar-like, (1.5–)3–7(–7.5) mm long, may split into rounded axillary halves which are partly adnate to petiole. Petiole 1–2(–4) cm long, slender, mostly 2 mm diameter. Lamina elliptic-oblong to obovate-oblong, 8–20(–32) × 2–8(–15) cm, thin to thick coriaceous; base acute to slightly attenuate; margin entire; apex mostly short- to long-acuminate, acumens 0.6–1.4 cm long, sometimes obtuse, rarely rounded or subretuse; veins mostly faint to indistinct, 6–20 pairs, midrib slightly raised on both surfaces. Inflorescences terminal, sometimes frondose and so may appear to be axillary in the distal 1–3 nodes, (4–)7–15(–18) cm long, bracteose- or frondobracteose panicles, usually > 100 (–c. 150)-flowered; the basal non-flowering part of the axis up to 6 cm long, ± slender; peduncles up to 1.5 cm long; pedicels 0.1–0.4 cm long, slender; bracts present at base of peduncles and pedicels, narrowly to broadly triangular, 2–5(–20) mm long, margin entire, apex subacute; bracteoles often present on pedicels, broadly triangular, c. 1 mm long (occurring in pairs). Calyx campanulate, (1–)1.5–2.5(–3) mm long; tube up to c. 2 mm long; lobes ± orbicular, c. 1 mm long. Corolla salverform, 8–12 mm long, white; tube narrow and cylindrical, 4–8 mm long, diameter c. 1 mm at mouth; lobes ± oblong, c. 3 mm long, minutely papillose on both surfaces. Stamens initially erect, later reflexed, inserted in mouth, (7–)10–16 mm long, (7–)10–15 mm exerted above corolla mouth; anthers oblong, c. 1.5–2 mm long, c. 0.7 mm wide, basal half of locules free. Pistil 12–15 mm long, 4–6 mm exerted above corolla mouth; ovary c. 3 mm long; style 9–12 mm long; stigma capitate, c. 0.5 mm long. Fruit globose, 5–7 mm long, distally rounded or < 0.1 mm of base of style persistent, maturing to orange or brick-red.

Field characters: Outer bark brown, flaky; underbark brown; inner bark light brown to cream-coloured, rapidly staining to greenish brown and eventually to deep walnut-coloured. Wood hard, dark cream-coloured, bright amber or straw-coloured. The flowers have a sweet scent.

Distribution: Occurring throughout much of Malesia. In Papuasias it occurs in the Vogelkop, Geelvink Bay, Snow Mountains, West and East Sepik, Western, Morobe and Milne Bay districts.

Ecology: Occurs on both swampy and well-drained soils, frequently collected from river bank communities, often associated with secondary forests, grasslands and other clearings. Collected from mostly sandy, clayey or copper-rich soils. In Papuasias it occurs at altitudes of 60–800 m.

Vernacular names: ‘Ilo’ (Orne); ‘niperen’ (New Guinea—Leenhouts 1963); ‘sabago’ (Kutubu); ‘sewa’ (Daga); ‘una’ (Yebora); ‘vio’ (Ambunti).

Uses: In the Milne Bay district the very durable wood is used for house posts.

Fagraea eymae Backer in Leenh. *Bull. Jard. Bot. Brux.* 32: 425 (1962).

Shrubs. Stipules split to form two axillary halves which are almost completely adnate to petiole, quadrangular to slightly bilobed, boat-shaped, 0.5–0.8 cm long,

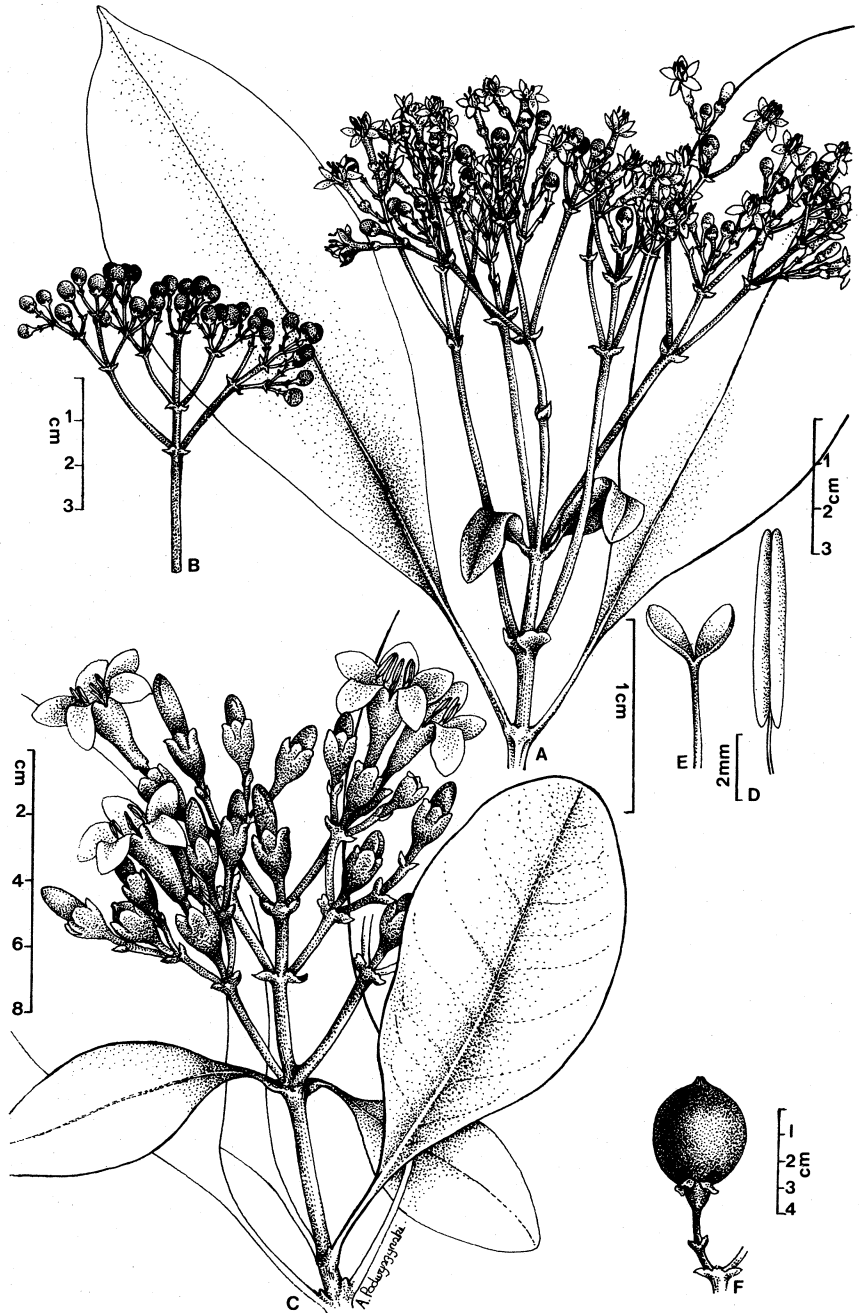


Fig. 31. *Fagraea elliptica* Roxb. (A) flowering branchlet (Hartley 10964) (B) infructescence (van Royen & Sleumer 6852) *F. berteriana* A. Gray ex Benth (C) flowering branchlet (BSIP 12682) (D) stamen (BSIP 2111) (E) stigma and distal part of style (BSIP 15064) (F) fruit and calyx (NGF 26531)

nearly completely hidden by base of leaf. Leaves subsessile to shortly petiolate. Lamina *c.* 9–10 × 4.5–5.5 cm, firmly coriaceous; base rounded or subcordate, slightly auriculate; margin entire, recurved; apex obtuse or minutely pointed; veins faint to inconspicuous, 5 or 6 pairs. Inflorescence terminal, cymose, 2(or 3)-flowered; peduncles reduced; pedicels thick, 1–2 cm long; bracteoles inserted near distal end of pedicel, ovate to oblong, 0.6–1.5 cm long. Calyx campanulate, 2–2.5 cm long; lobes 1.7–2 cm long. Corolla distinctly funnel-shaped, *c.* 5.5 cm long; tube 4.5 cm long, almost hemispherical distally; lobes ± orbicular, *c.* 1 cm long. Stamens inserted at base of hemispherical part of corolla-tube; filaments *c.* 2.7 cm long; anthers oblong, 8–11 mm long, basal 4–5 mm of locules free. Pistil with style *c.* 1.3 cm long; stigma ± cupular-peltate, 2.5 mm diameter. Fruit globular, 2.5–3 cm diameter, calyx adpressed to fruit.

Distribution: This species is endemic to Papuasia where it has been collected from the Wissel Lake area of the Snow Mountains district.

Ecology: It occurs in permanently inundated secondary forest on peat. Altitude *c.* 1740–1750 m. Flowering in January.

Vernacular name: 'Ipu' or 'iepo' (probably only an orthographic variant) (Wissel Lake).

Notes: This species is very poorly known.

Fagraea fragrans Roxb. [*Hort. Beng.* 84 (1814) nom. nud.] *Fl. Ind.* ed. Wall. 2: 32 (1824). **Fig. 29D.**

Trees, 8–25(–55) m high, girth up to 1.3(–2.5) m, sometimes shrubs. Stipules collar-like, soon split into small axillary halves that are partly adnate to petiole, 0.5–2.5 mm long. Petiole 1–2.5 cm long, slender, 1.5–2 mm thick. Lamina oblong-narrowly ovate to elliptic, 4–15 × 1.5–6 cm, mostly thin, rarely coriaceous; base acute to shortly attenuate; margin entire; apex usually shortly acuminate (rarely blunt to acute), acumen blunt and up to 6(–10) mm long; veins faint to distinct, 4–9 pairs, slightly raised on lower surface, midrib slightly sunken on upper surface. Inflorescence axillary in distal nodes, erect, cymose (rarely monadic), triadic, thyrsoidal to metabotryoidal, up to *c.* 10 cm long, (1–)3–*c.* 30-flowered, the basal non-flowering part of the axis is up to *c.* 4 cm long, ± slender; peduncles thin, 1.5–2.5 cm long; pedicels thin, 0.5–1 mm long; bracts at base of peduncles and pedicels, triangular, 0.5–1 mm long, margin irregular, apex obtuse; bracteoles inserted about halfway up pedicels, *c.* 0.5 mm long. Calyx campanulate, 2.3–8 mm long; lobes ± orbicular, *c.* 1 mm long, ± adpressed to corolla, margin slightly erose. Corolla narrowly funnel-shaped, 7–15(–23) mm long, pale cream-coloured to light orange; tube diameter 4–5 mm at mouth; lobes broadly elliptic, 3–5 mm long. Stamens erect, inserted on upper half of tube or usually just below mouth, 10–15 mm long, *c.* 10 mm exerted above corolla mouth, basally < 1 mm adnate to inner surface of corolla-tube; anthers oblong-linear to oblong-elliptic, 1.7–2.3 mm long, basal half of locules free. Pistil 18–30(–60) mm long; ovary *c.* 3–5 mm long; stigma capitate or subconical, 0.2–0.5 mm long, faintly bilobed. Fruit broadly ellipsoid, *c.* 7–10 mm long, base of style persistent, maturing to red or orange, pedicels unchanged since flowering.

Distribution: Occurring in India (Bengal), Southeast Asia, Malesia and Papuaia. In Papuaia it occurs on Japen Island (Geelvink Bay district) and is cultivated at Lae and elsewhere.

Ecology: According to Leenhouts (1963) this species occurs in humid, often seasonally but constantly swampy forests, in poorly aerated, compacted or swampy soils. Outside Papuaia, it occurs from sea level up to altitudes of c. 800 m.

Vernacular names: 'Mana hurudu'; 'manderi' (Japen Is.).

Notes: Sterile specimens of *F. fragrans* can be distinguished from the closely related *F. elliptica* by the former having stipules that form small 'cup-shaped' axillary halves in the leaf-axils, whereas those of *F. elliptica* are connate and form an annular ocrea that is more or less closely adpressed to the axis.

Fagraea gracilipes complex

Notes: Leenhouts (1962) treated the *Fagraea gracilipes* complex as a single variable species occurring in New Guinea, the Bismarck Archipelago, the Solomon Islands (including Santa Cruz), Australia and Fiji. He regarded this species as being represented by several variants that, although often locally distinguishable, were not worthy of formal recognition. However, this broad-species concept has largely hidden the biological reality of the entities within this group. Conn & Brown (1993) recognized four species in this complex for Papuaia (namely *F. amabilis*, *F. dolichopoda*, *F. sp.* (Southern New Guinea) and *F. obtusifolia*). They concluded that *F. gracilipes* sens. str. is endemic to Fiji, and that *F. cambagei* and *F. fagraeacea* are both endemic to Australia. For a full discussion of the complex, refer Conn & Brown (1993).

KEY TO SPECIES IN COMPLEX

1. Corolla narrowly funnel-shaped to almost tubular; mouth less than 5 mm in diameter, sometimes to 5 mm (New Guinea, from sea level to 70 m altitude) **F. sp. (Southern New Guinea)**
1. Corolla distinctly and broadly funnel-shaped in upper half, basally \pm tubular; mouth more than 5 mm in diameter
 2. Peduncle and pedicel slender; inflorescence up to 9-flowered (Papua New Guinea, at 700–2300 m altitude) **F. dolichopoda**
 2. Peduncle and pedicel thickened and hence robust; inflorescence variable, usually at least 10-flowered (except inflorescence of *F. amabilis* is (5–)7–15(–20)-flowered)
 3. Lamina usually broadly elliptic to almost circular, (7–)8.5–11.5 cm wide; inflorescence usually 20–30-flowered, rarely as few as 9-flowered; fruits 1–2(–2.5) cm long; anthers inserted in lower third of corolla tube (Solomon Islands, sea level to 320 m altitude) **F. obtusifolia**
 3. Lamina elliptic, rarely slightly obovate or narrowly elliptic, (3.5–)5–8.3 cm wide; inflorescence usually 7–15-flowered, rarely as few as 5- or as many as 20-flowered; fruits 3–3.5(–5) cm long; anthers inserted \pm at middle of corolla tube (New Guinea, at altitudes of 1170–2300 m) **F. amabilis**

***Fagraea amabilis* S. Moore** *J. Bot.* **61:** suppl. 36 (1923).

F. elata Merr. & Perry (1942).

Tree 10–28 m high. Leaves with petiole (0.7–)1.5–4 cm long; lamina elliptic to slightly obovate, rarely narrowly elliptic, 7.8–15(–18) cm long, (3.5–)5–8.3 cm wide; base cuneate, occasionally somewhat abruptly so; apex bluntly acuminate

to rounded (acumen *c.* 4 mm long), rarely retuse; midrib distinctly raised on lower surface; veins distinct; stipules indistinct, split into 2 small axillary halves that are partly adnate to petiole. Inflorescences terminal, metabotryoidal, crowded, with pedicels short and moderately divergent from peduncles, (5–)7–15(–20)-flowered; peduncles and pedicels moderately robust; bracteoles inserted 1/2 way up pedicel, broadly triangular, with apex \pm acute. Calyx *c.* 5 mm long; lobes oblong. Corolla white, often with a yellowish or greenish tinge, funnel-shaped; tube *c.* 25 mm long, thick and fleshy; mouth *c.* 12 mm wide; lobes oblong, *c.* 12 mm long, *c.* 11 mm wide, with margin entire, membranous, often becoming ragged. Stamens inserted *c.* 1/2 way up tube, not on thickened rim, distinctly exerted; anthers *c.* 3 mm long. Pistil *c.* 30 mm long, distinctly exerted beyond mouth; stigma capitate, entire. Fruit ovoid, 3–3.5(–5) cm long, with prominent beak (beak *c.* 8 mm long); mature fruits orange; pedicel thickened below calyx, not or only slightly lengthened; calyx slightly enlarged.

Field characters: Outer bark grey-brown to cream-brown, smooth; inner bark pale brown to light orange; wood straw-coloured to pinkish, hard to very hard.

Distribution: Endemic to New Guinea, collected from the Jayapura, West Sepik, Western Highlands and Southern Highlands districts.

Ecology: Occurs in montane to lower montane communities, usually in *Nothofagus*-dominated forest, at 1170–2300 m altitude.

Vernacular names: 'Bulu' (Kaporika); 'il'ki' (Untembil); 'kamin' (Mendi); 'oombi' and 'oopuk' (Enga—note: same name used for *F. salticola*); 'puk' (Hattam).

Notes: This species is morphologically similar to *F. dolichopoda*, which also occurs at high altitudes in Papua New Guinea. The floral features of *F. amabilis* and *F. dolichopoda* are similar, with both having relatively large flowers. However, they differ by several features. The leaves of *F. amabilis* are elliptic to slightly obovate, whereas *F. dolichopoda* has narrowly obovate to narrowly elliptic leaves ((3.5–)5–8.3 cm wide and 2.1–4(–5) cm wide, respectively). There is a tendency for *F. amabilis* to have slightly more flowers per inflorescence than *F. dolichopoda* (respectively, (5–)7–15(–20)-flowered and (3–)5–7-flowered). *Fagraea amabilis* has larger fruits (3–3.5 cm long, rarely to 5 cm) compared with those of *F. dolichopoda*, which appear to be only *c.* 1.5 cm long.

Collections from the Southern Highlands district of New Guinea, particularly those from Mt Giluwe were previously regarded as *F. gracilipes* (sens. lat.). These specimens tend to have narrower leaves than those of typical *F. amabilis* and are here regarded as *F. ceilanica* Thunb.

***Fagraea dolichopoda* Gilg & Bened. *Bot. Jb.* 54: 196 (1916). Fig. 32A.**

Small to medium tree, 2.5–10(–25) m high, once recorded as epiphyte (Craven & Schodde 1262). Leaves with petiole 1.3–2.7 cm long; lamina narrowly obovate to narrowly elliptic, (5.5–)8.5–12.5 cm long, 2.1–4(–5) cm wide; base attenuate to cuneate; apex usually distinctly acuminate to attenuate (acumen 5–12 mm long), rarely obtuse; midrib slightly raised on lower surface; veins faint or not visible; stipules often indistinct, split into 2 small axillary halves which are partly adnate to petiole. Inflorescences terminal, metabotryoidal, open with pedicels

strongly diverging from peduncles, (3–)5–7-flowered; peduncles and pedicels slender; bracteoles inserted from just below calyx to 1/4 way up pedicel, broadly triangular to ovate, with apex acute. Calyx 4–5 mm long; lobes suborbicular. Corolla white to cream-coloured or somewhat yellowish, often with green tinge, fragrant, funnel-shaped to almost campanulate on distal half; tube (20–)25–27 mm long; mouth 10–13 mm wide; lobes \pm oblong, (7–)9–10.5 mm long, (5–)7–10 mm wide. Stamens inserted just below midpoint of tube, long-exserted; anthers 2.5–3 mm long. Pistil 32–35 mm long, exserted *c.* 10 mm beyond mouth; stigma capitate, entire. Fruit ovoid, *c.* 1.5 cm long (immature), white; pedicel slender, becoming slightly thicker immediately below fruit, slightly lengthened; calyx slightly enlarged.

Field characters: Outer bark is brown to light grey or cream-coloured, with irregular vertical ridges; inner bark straw-coloured, brittle and fibrous; wood dark straw-coloured to white.

Distribution: Endemic to New Guinea (including Bismarck Archipelago); recorded from the West Sepik, Morobe, Milne Bay, Papuan Islands and New Ireland districts.

Ecology: Occurs in *Nothofagus*-dominated moss and montane forests, at 700–2300 m altitude.

Vernacular names: 'Kengong' (Moraegoe) (note: same name, but in Pindiu language, used for *F. berteriana*); 'arienge' (Aseki).

Notes: This species has close affinities with *F. amabilis* (refer discussion above).

Fagraea obtusifolia Merr. & Perry *J. Arnold Arbor.* **23:** 415 (1942). **Fig. 32B & C.**

Tree 7–27 m high. Leaves with petiole 2.5–5 cm long; lamina broadly elliptic (almost circular) to elliptic or slightly obovate, 10.3–20 cm long, (7–)8.5–11.5 cm wide; base cuneate to rounded and abruptly cuneate; apex mostly rounded, sometimes obtuse to shortly acuminate (acumen 2–5 mm long), rarely retuse; midrib distinctly raised on lower surface; veins distinct; stipules indistinct, split into 2 small axillary halves that are partly adnate to petiole. Inflorescences terminal, metabotryoidal, open but appearing crowded when many-flowered, with pedicels moderately divergent from peduncles, (9–)20–30-flowered; peduncles and pedicels moderately robust; bracteoles inserted 1/3–1/2 way up pedicel, broadly triangular, with apex obtuse. Calyx 3–5 mm long; lobes suborbicular. Corolla white, often with a yellowish or greenish tinge, distinctly funnel-shaped distally; tube 20–26 mm long; mouth 9–11 mm wide; lobes oblong, *c.* 10 mm long, *c.* 10 mm wide. Stamens inserted in lower 1/3 of tube, not on thickened rim, distinctly exserted; anthers *c.* 3 mm long. Pistil 30–40 mm long, distinctly exserted beyond mouth; stigma capitate, entire. Fruit ovoid, 1–2(–2.5) cm long; mature fruits white; pedicel only slightly thickened and lengthened; calyx slightly enlarged.

Field characters: Outer bark dark to light brown, coarsely fissured; inner bark cream-coloured with close orange circular flecks; outer wood light brown to reddish or pink-brown, hard.

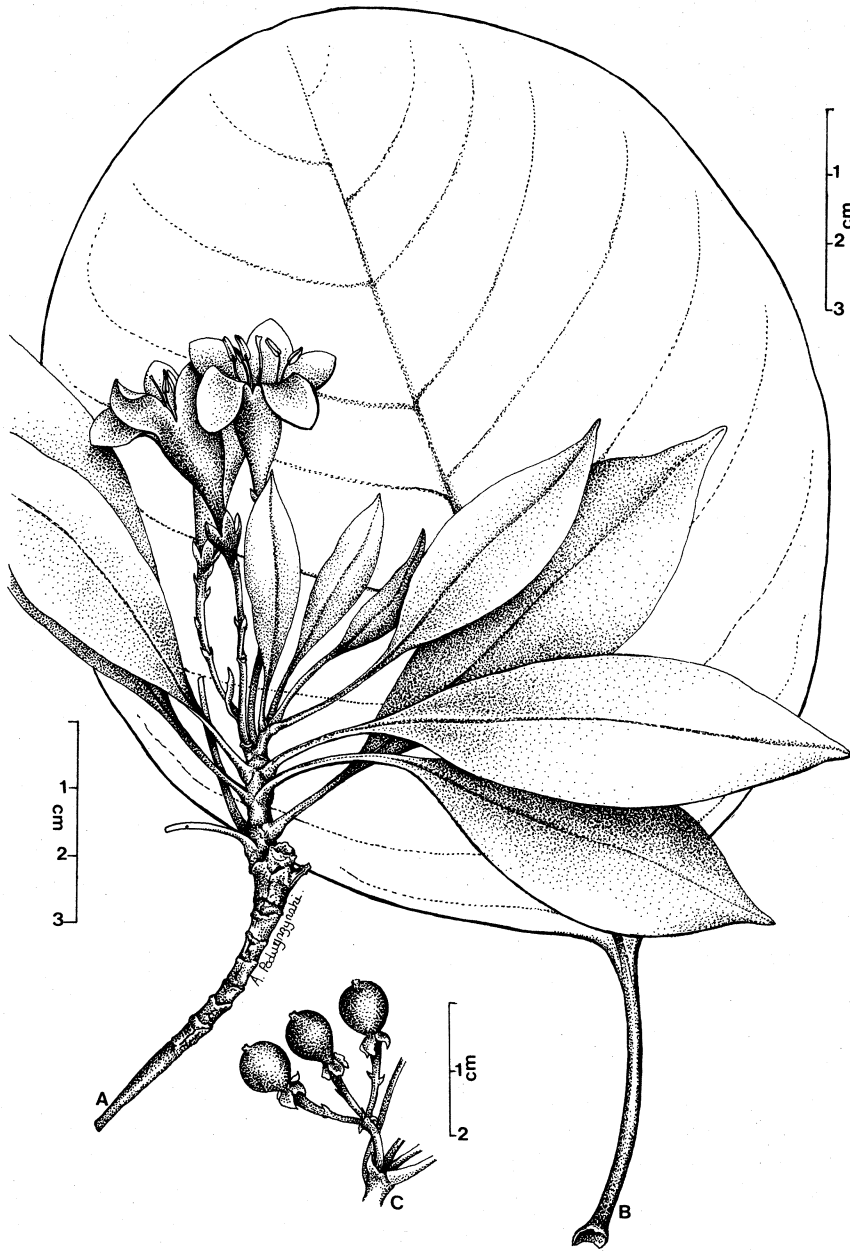


Fig. 32 *Fagraea gracilipes* complex—*F. dolichopoda* Gilg & Bened. (A) flowering branchlet *F. obtusifolia* Merr. & Perry (B) leaf (C) infructescence (B & C: *BSIP 18198*)

Distribution: Endemic to the Solomon Islands (Choiseul, New Georgia, Guadalcanal, Malaita, including Santa Cruz).

Ecology: Occurs on well-drained sites, on slopes and ridges, in primary forests, usually in deep red clay-rich soils. Once recorded from mangrove swamps (Corner 2738). Altitude sea level to c. 320 m.

Vernacular names: 'Bau'u' (Kwara'ae—used on Choiseul, New Georgia, Malaita and Guadalcanal); 'bó' (Kwara'ae—used on Santa Cruz; same name used for *F. berteriana*).

Notes: This species is morphologically very homogeneous. It usually has broadly elliptic to almost orbicular leaves, sometimes slightly obovate. The leaf apex is either very shortly acuminate, rounded, or sometimes retuse. The venation of the leaves is distinct, with raised veins on the lower surface.

Fagraea sp. (Southern New Guinea) sensu Conn & Brown *Telopea* 5: 372 (1993).

'*F. muelleri* race' sensu Leenhouts (1962), non *F. muelleri* Benth. (1869) [= *F. fragraeacea* (F. Muell.) Druce].

Small to medium tree, 5–20 m high. Leaves with petiole (1.6–)2–2.6(–3.5) cm long; lamina elliptic to obovate, sometimes narrowly so, 8.4–16.8 cm long, (3.6–)4.5–7.3 cm wide; base attenuate to cuneate; apex usually shortly acuminate (acumen 3–5 mm long), occasionally obtuse; midrib slightly raised on lower surface; veins faint to indistinct; stipules often indistinct, split into 2 small axillary halves, that are partly adnate to petiole. Inflorescences terminal, metabotryoidal, open, with pedicels strongly diverging from peduncles, 9–15(–20)-flowered; peduncles and pedicels slender; bracteoles usually inserted from just below calyx to half way up pedicel (rarely on lower 1/2), broadly triangular to ovate, with apex acute. Calyx 2.5–3.5 mm long; lobes suborbicular. Corolla white to cream-coloured, turning yellow with age, narrowly funnel-shaped; tube 15–20 mm long; mouth 4–5 mm wide; lobes ± oblong, 4–7 mm long, 3–4 mm wide. Stamens inserted near midpoint of tube, just to distinctly exerted; anthers c. 2 mm long. Pistil 23–25 mm long, exerted 4–5 mm beyond mouth; stigma capitate, entire or faintly bilobed. Fruit globular, 1.2–1.4 cm diameter, or ellipsoid and c. 1.8 cm long; colour of mature fruit white, once recorded as orange (*McVeagh NGF 8281*); pedicel slender, not or only slightly lengthened; calyx not or only slightly enlarged.

Field characters: Outer bark light to dark grey, irregularly vertically fissured or cracked into long rectangular flakes; inner bark cream- to straw-coloured; blaze cream- to straw-coloured, streaked or speckled with amber, aromatic (smelling like over-ripe apples—*Pullen 7194*); wood moderately hard and dense, yellowish to toffee-coloured; heartwood turning pink when cut.

Distribution: Endemic to New Guinea; recorded from the Morehead-Weam and Oriomo areas of the Western district and from near Port Moresby in the Central district.

Ecology: Occurs in gallery woodlands and forests, sometimes in more open forests, frequently inundated during the wet season, at low altitudes (from 25 to 70 m).

Vernacular names: 'Bogong' (Awjoe); 'numae' (Kiunga); 'waragrherh' (Namo).

Uses: The hard, heavy timber is very durable and is used for making combs, house posts, canoes and handles for axes.

Notes: The lack of good herbarium collections and adequate field observations make it impossible to fully evaluate the taxonomic status of this taxon. Based on herbarium material, *Fagraea fagraeacea* sens. str. (of Australia) is morphologically similar to what is here referred to as *F.* sp. (Southern New Guinea). Although the differences, as summarised in Conn & Brown (1993), appear to be trivial, the habitat of each is sufficiently distinct to suggest that they represent separate species. This taxon occurs in lowland gallery woodlands and forests that are frequently inundated, whereas *F. fagraeacea* (of Australia) occurs in rocky mountainous rain forest communities (at 700–1350 m altitude). Additional collections and ecological observations are required so that the status of this taxon can be evaluated.

Fagraea racemosa Jack ex Wall. in Roxb. *Fl. Ind.* 2: 35 (1824). **Fig. 33A & B.**

F. rodatzii K. Sch. & Laut. (1901).

Shrubs to small trees 2–10(–16) m high. Stipules \pm collar-like, even when leaves are mature, 2–3(–4) mm long. Petiole 1–2 cm long, diameter 2–4 mm (mostly thick). Lamina broadly ovate, obovate-oblong, oblong or oblong-lanceolate, 15–30 \times 8–15 cm, thin to thick coriaceous or subfleshy; base \pm rounded, often cordate; margin entire; apex mostly obtuse to rounded or shortly acuminate, when present, acumen 2–10 mm long; veins distinct, (4–)6–12 pairs, distinctly raised on lower surface, sunken to very slightly raised on upper surface, midrib of lower surface strongly raised and forming a narrow ridge. Inflorescences terminal, erect, nodding or pendulous, usually thyrsoid (with many decussate, \pm sessile cymes of up to 7–10 flowers), often variously modified to either spiciform (if internodes and pedicels are short and cymes sessile), corymbose (if cymes have long peduncles, then laxly branched and many-flowered), racemiform or glomerulate, (2–)10–35(–60) cm long, 5–7 to up to 100-flowered; the basal non-flowering part of the axis (1–)4–10(–30) cm long, slender to robust; peduncles up to c. 1 cm long, mostly robust; pedicels absent or 0.4–1(–3) cm long, \pm robust; bracts present at base of peduncles and pedicels, broadly triangular, 1–1.5 mm long, margin sparsely minute-fimbriate, apex \pm obtuse. Calyx \pm campanulate, 3–6 mm long; lobes \pm orbicular, sometimes reniform, 2–4 mm long. Corolla funnel-shaped, 2–4 cm long, white, base of tube sometimes pink; tube c. 15 mm long, diameter at mouth 8–10 mm; lobes \pm orbicular, 5–12 mm long. Stamens erect, 5–18 mm long; anthers broadly oblong, c. 2.5 mm long, c. 1.5 mm wide, basal half of locules free. Pistil 15–20 mm long, inserted to just exerted; ovary c. 3 mm long; style 11–16 mm long; stigma broadly obovoid, c. 1 mm long, distally subtruncate, often slightly bilobed. Fruit globose to ellipsoid, 1–2.5 cm long, c. 2 mm of base of style persistent, reported as maturing to sky-blue (or ?red).

Field characters: Outer bark fawn-grey, slightly fissured; underbark green; inner bark straw-coloured; wood cream-coloured to cream-brown.

Distribution: Occurring in Southeast Asia, throughout much of Malesia, Papuaia and northern Australia (Northern Territory and Queensland). In Papuaia it occurs in the Sepik, Western, Gulf, Morobe, Northern, Milne Bay, and Bougainville districts of Papua New Guinea, as well as in Malaita of the Solomon Islands.



Fig. 33 *Fagraea racemosa* Jack ex Wall. (A) flowering branch (UPNG 4837) (B) inflorescence (NGF 22885) *F. salticola* Leenh. (C) flowering branchlet (D) infructescence (C & D: NGF 18074)

Ecology: Occurring in both primary and secondary forests, on both swampy and well-drained soils, on muddy river banks and sometimes extending into savannahs. It is a lowland species that mostly occurs at altitudes less than 100(–520) m.

Vernacular names: 'Aisauwatrei' (Wandammen); 'angia' (Kukukuku); 'bakabuk-abi' (Zimakani); 'batteriengien' (Tehid); 'berean' (Onjob); 'berimberi' (Marovo); 'bisip' (Dumpu); 'bogabogoia' (Minufia); 'dabe' (Faita); 'gwambi' or 'togwambi' (Wagu); 'fohkipeh' (Wapi); 'galud' (Bilia); 'he'yawi' (Gofabi); 'ketawale' (Buin); 'kubugup' (Amele); 'baroea' or 'mahobastie' (Mamberamo); 'mambungua' (Waskuk); 'misal' (Marind); 'mugwagmu' (Yafai); 'ngara' or 'gara' (Kwara'ae); 'sibèh' (Orokaiva); 'zambe' (Yekora).

Uses: In the West Sepik the wood is used for making a plant stick and is 'probably a male symbol' (Juillierat 47), in the Western region it is used for building purposes.

***Fagraea salticola* Leenh. Bull. Jard. Bot. Brux. 32: 429 & 430 (1962). Fig. 33C & D.**

Trees (rarely large shrubs), sometimes hemi-epiphytes, up to 25 m high. Stipules 3–12 mm long, soon rupturing into 2 axillary halves that are obovate in outline, adnate to petiole, with apex bilobed. Petiole 0.5–1.5 cm long, diameter 2–4 mm. Lamina broadly elliptic to slightly obovate, (4–)5–11.5(–14) × (3–)5–7(–10.5) cm, slightly convex, fleshy to thick coriaceous (drying stiff), upper surface often waxy; base slightly cordate to rounded, sometimes broadly cuneate; margin entire, slightly recurved; apex ± rounded (rarely obtuse); veins faint to indistinct, *c.* 5 pairs, midrib of lower surface raised. Inflorescence terminal, erect, cymose, varying from triadic to metabotryoidal, 4–11 cm long, 3–15-flowered; the basal non-flowering part of axis reduced; peduncles reduced or 1–1.5 cm long, ± robust; pedicels absent or up to *c.* 0.7 cm long; bracts present at base of peduncles and pedicels; bracteoles ± appressed to base of calyx, broadly triangular, 0.3–0.5 cm long; margin entire; apex ± obtuse. Calyx ellipsoid-campanulate, *c.* 15 mm long; lobes ± orbicular, 0.5–0.6 mm long. Corolla funnel-shaped, 2.5–4 cm long; outer surface pale green to yellow-green; inner surface white to cream-coloured, strongly scented; tube 15–25 mm long, diameter at mouth 6–7 mm; lobes ± orbicular to slightly oblong, *c.* 10 mm long. Stamens erect, *c.* 15 mm long, inserted on a thickened rim inside the corolla; anthers attached just above base, narrowly elliptic to narrowly ovate in outline, *c.* 7 mm long, *c.* 1.5 mm wide. Pistil 20–30 mm long; ovary *c.* 10 mm long; stigma bilobed, *c.* 1.5 mm long, diameter 3–4 mm. Fruit ellipsoid, 3.5–4 × 1.5–2 cm, base of style persistent and so apex acute, maturing to red-brown or orange.

Field characters: Bole often fluted, 7–13 m long, d.b.h. 25–30 cm. Outer bark longitudinally fissured, rough, light grey-brown to dark brown; underbark orange to brown; inner (and occasionally outer) bark cream-coloured. Outer wood very pale orange; inner wood white, light orange to yellow-brown.

Distribution: Endemic to Papua New Guinea. It occurs in the Western Highlands, Southern Highlands, Eastern Highlands and Morobe districts.

Ecology: Occurring in submontane to montane forests that are dominated by *Nothofagus*, *Podocarpus* and *Libocedrus*. Soils mostly well drained, but also

occurring on latosols and peat soils. This species occurs at altitudes of (1829-)2500-2850(-3200) m. Flowering mostly April to September. Fruiting mostly April to September (to November).

Vernacular names: 'Banda' (Waimambuno); 'bundo' (Kombugomambuno); 'mama' or 'memin' (Togoba); 'panguma' (Ibiwara); 'tominam', 'ombi' or 'oopuk' (Enga—note: same name used for *F. amabilis*).

Uses: Once recorded as being previously used for making spears (Hoogland & Pullen 5623).

Fagraea umbelliflora Gilg & Bened. *Bot. Jb.* 54: 195, f. 12 (1916).

Treelets or shrubs, 2-5 m high. Stipules collar-like, 3-4 mm long, often split into two axillary halves that are adnate to petiole, with apex rounded. Petiole 2.5-3.5 cm long, slender, diameter *c.* 2 mm. Lamina elliptic to narrowly obovate, 8-13(-18) × 2.5-5(-9) cm, coriaceous; base cuneate, attenuate; margin entire; apex ± acute or broadly rounded and subacuminate, acumen *c.* 5 mm long; veins faint to indistinct, 5-10 pairs, midrib of lower surface raised, slightly raised and/or grooved on upper surface. Inflorescence axillary in distal nodes, ± erect, umbelliform, relatively small, *c.* 4 cm long, 4-10-flowered; basal non-flowering part of axis absent; peduncles thick, 0.4-0.6(-1.0) cm long; pedicels 1-1.5 cm long; bracts and bracteoles absent. Calyx campanulate, 3-6 mm long; lobes *c.* 1.5 mm long, ± appressed to the corolla. Corolla almost tubular, distally slightly funnel-shaped, 20-25 mm long, white; tube 17-23 mm long, diameter *c.* 2 mm basally, diameter at mouth 5-6 mm; lobes ± oval, *c.* 3 mm long. Stamens erect, inserted in distal part of tube, 7-10 mm long, just exerted above corolla mouth; anthers oblong-sagittate, 1.8-3 mm long, *c.* 1 mm wide, the basal *c.* 1 mm of locules free. Pistil 20-27 mm long, *c.* 5 mm exerted above corolla mouth; ovary *c.* 3 mm long; stigma narrowly cuneate, *c.* 0.5 mm long, truncate. Fruit subglobular, diameter *c.* 1 cm, colour of mature fruits unknown; pedicels hardly thickened, slightly longer; calyx appressed to fruit.

Distribution: This species is endemic to Papuaia, where it occurs in the Vogelkop, Geelvink Bay and Sepik districts.

Ecology: A species with a scattered distribution in dense primary forest on clay soils. It occurs from an altitude of 60 to 1200 m. Flowering July, November. Fruiting November.

Vernacular name: 'Niejap' (Kebur).

Fagraea woodiana F. Muell. *Austral. J. Pharm.* 1(9): 323 (1886). **Fig. 29E.**

F. anthocleistifolia Gilg & Bened. (1916).

Epiphytic trees or shrubs, 4-6(-15) m high, more rarely terrestrial trees, shrubs or lianas. Stipules split into two axillary halves that are ± adnate to base of petiole, 1-1.5 cm long, broadly bilobed to truncate. Petiole 4-4.5 cm long, subtransverse-rhombic in section, *c.* 5 mm wide. Lamina obovate to oblong-obovate, 21-50 × 10-20 cm, thin coriaceous; base attenuate and decurrent, ending in a pair of auricles, auricles 4-10(-15) mm wide, reflexed, clasping base of petiole and

branchlet; margin entire; apex broadly rounded and emarginate to slightly acuminate, acumen up to 8 mm long; veins distinct on both surfaces, 7–8 pairs, midrib raised on both surfaces, forming a narrow ridge basally on lower surface. Inflorescences terminal, cymose, paniculate to metabotryoidal, 9–c. 14(–20) cm long, 5–c. 40-flowered; the basal non-flowering part of the axis reduced; peduncles 0.5–5 cm long; pedicels 0.5–1 cm long; bracts broadly triangular, inserted at base of pedicels, up to 10 mm long; bracteoles broadly triangular, 4–7 mm long (occurring in pairs). Calyx campanulate, 8–10 mm long; tube 4–5 mm long; lobes \pm orbicular. Corolla funnel-shaped, 45–75 mm long, green, cream-coloured or yellow; tube 25–40 mm long, diameter c. 10 mm at mouth; lobes oblong-obovate to suborbicular above a basal constriction, 20–36 mm long. Stamens initially erect, later reflexed, inserted c. 5 mm below the mouth, 20–32 mm long; filaments 15–25 mm long, c. 20 mm exerted beyond mouth; anthers sagittate, 6–7.5 mm long, basal 2–3 mm of locules free. Pistil 40–50 mm long, 10–15 mm exerted beyond mouth; ovary 2–3 mm long; style 37–46 mm long; stigma peltate to subcupular-peltate, faintly bilobed, maturing to yellow or orange-yellow; pedicels warty-lenticellate; calyx usually spreading to reflexed.

Field characters: Outer bark grey and smooth, or pale to dark brown and fissured; underbark green with a fairly strong odour; inner bark straw-coloured. Wood hard, dense, straw-coloured.

Distribution: This species is endemic to Papuaia. It occurs in the Geelvink Bay, Western Highlands, Madang, Morobe, Central, New Britain and New Ireland districts.

Ecology: It is associated with primary and secondary forests, in clayey, rocky, rich brown loams or limestone-derived soils. It occurs from sea level to altitudes of 1070(–1600) m. Flowering June, September, October. Fruiting March, June, July.

Vernacular names: ‘Amioendam’ (Biak); ‘subekwa’, ‘wuribeding’ (unspecified language, Leenhouts 1963).

Notes: The flowers have a very sweet fragrance like jasmine. Ants have been observed living amongst the stipules (NGF 48653).

DUBIOUS SPECIES

Fagraea dasyantha Gilg & Bened. *Bot. Jb.* **54**: 195 (1916).

Possibly related to *F. gracilipes* sens. lat. Syntypes apparently destroyed in Berlin.

Fagraea ledermannii Gilg & Bened. *Bot. Jb.* **54**: 191 (1916).

Similar to *F. salticola*, *F. bodenii* or *F. gracilipes* sens. lat. Type apparently destroyed in Berlin.

Fagraea melanochlora Gilg & Bened. *Bot. Jb.* **54**: 192 (1916).

Similar to *F. salticola* or *F. bodenii*. Type apparently destroyed in Berlin.

Fagraea monticola Gilg & Bened. *Bot. Jb.* **54**: 189 (1916).

Similar to *F. salticola* or *F. bodenii*. Type apparently destroyed in Berlin.

EXCLUDED SPECIES

Fagraea pachyclados K. Sch. in K. Sch. & Laut. *Nachtr.* 349 (1905) = basionym of *Mastixiodendron pachyclados* (K. Sch.) Melch. *Bot. Jb.* 60: 167 (1925)(Rubiaceae).

GENIOSTOMA J. R. & G. Forst.

Small shrubs to small trees, rarely scrambling to semi-climbing. Branches terete, quadrangular or 4-winged, variously hairy or glabrous. Stipules mostly intrapetio- lar. Leaves simple, opposite, \pm petiolate or sessile. Inflorescences terminal or axillary, ramiflorous or cauliflorous, uniflorous, dichasial or pleiochasial, often umbelliform or glomerulate. Calyx, corolla and androecium 5-merous. Sepals united at base; inner surface of calyx often with colleters at base; lobes imbricate in bud, margin mostly fimbriate. Corolla campanulate to rotate, white; outer surface glabrous to shortly hairy; inner surface glabrous to densely pilose; lobes imbricate or contorted in bud. Stamens alternipetalous, attached to mouth of corolla tube, exserted, usually recurved after anthesis, glabrous or hairy; fila- ments mostly short; anthers 2-locular, introrse, connective often extended to form an apical appendage. Pistil variously hairy or glabrous; ovary 2-locular; placen- tas axile with many amphitropous ovules; style mostly short; stigma clavate, ellipsoid to globular, sometimes \pm oblong (in outline), c. as large as ovary. Capsule ellipsoid to globular, sometimes \pm oblong (in outline), rarely flattened- ellipsoid, 2-valved, septicidal to subseptifragal, maturing to green, with or with- out a black-purple tinge, usually becoming brown-black when over-mature. Seeds embedded in juicy orange or red pulp, numerous, ellipsoid to subglobular, intruded on the hilar side; surface mostly minutely papillose to areolate, brown to black, endosperm thick, fleshy; embryo small, straight.

Distribution: About 50 species, from the Mascarene Islands, Malesia (excepting the Malay Peninsula) in southern Japan (Kyushu), the Bonin Islands, Micronesia, Melanesia, Australasia (eastern Queensland, Lord Howe Island and northern New Zealand), western Polynesia (Tonga, Samoa, etc.), southeastern Polynesia (Marquesas, as far as Henderson I.) and the Hawaiian Islands. In Papuasia, 7 species, one of them with 5 and another with 2 varieties.

Literature: B. J. Conn (1980), A taxonomic revision of *Geniostoma* subg. *Geniostoma* (Loganiaceae), *Blumea* 26: 245–364; (1983) in P. van Royen, The alpine flora of New Guinea, 4: 2651–2657 (Cramer).

Notes: Conn (1980) recognized 2 subgenera, subg. *Geniostoma* with axillary, ramiflorous or cauliflorous inflorescences, and subg. *Labordia* (endemic to the Hawaiian Islands) with terminal inflorescences. However, *Labordia* is usually recognised as a separate genus.

Subg. GENIOSTOMA

Notes: Conn (1980) divided *Geniostoma* subg. *Geniostoma* into two sections.

KEY TO SECTIONS

1. Stipules large, 4–25 mm long (one species in Papuaia, *G. umbellatum*) . . . sect. **Macrostipulare**
1. Stipules up to 4 mm long sect. **Geniostoma**

KEY TO SPECIES

1. Corolla glabrous on inner surface (rarely glabrous in *G. randianum*)
2. Corolla 5–8 mm long
 3. Leaves usually inserted on distinct leaf-cushions; inflorescences 1(–5)-flowered; capsules flattened ellipsoid, 10–20(–45) × 5–12 mm, septum twisted at the base so capsules appearing loculicidal **G. randianum**
 3. Leaves not inserted on leaf-cushion; inflorescences 3–9-flowered; capsules ± globular, 8–12 × 7–9(–11) mm, septum not twisted so capsules clearly ± septicidal **G. weinlandii**
2. Corolla 1.5–3(–4) mm long
 4. Pistil hairy **G. antherotrichum**
 4. Pistil glabrous **G. leenhoutsii**
1. Corolla hairy on inner surface (very rarely papillose in *G. antherotrichum*)
 5. Pistil hairy
 6. Ovary glabrous
 7. Style 1.5–4 mm long, glabrous basally, hairy distally **G. trichostylum**
 7. Style up to c. 0.5 mm long, ± hairy throughout
 8. Inner surface of corolla pilose **G. rupestre** var. **rouffaeranum**
 8. Inner surface of corolla papillose **G. antherotrichum**
 6. Ovary hairy, at least at the base of style
 9. Inner surface of corolla papillose, never pilose **G. antherotrichum**
 9. Inner surface of corolla pilose, at least in part **G. rupestre**
5. Pistil glabrous
 10. Stipules 4–5 mm long **G. umbellatum**
 10. Stipules up to 2 mm long
 11. Capsules flattened ellipsoid, 10–20(–45) × 5–12 mm; leaves inserted on distinct nodal swellings **G. randianum**
 11. Capsules globular to ellipsoid, 5–10(–22) × 3–7 mm; leaves not inserted on nodal swellings **G. rupestre**

Geniostoma antherotrichum Gilg. & Bened. *Bot. Jb.* 54: 158, f. 2 (1916).
Fig. 34.

G. arfakense Kan. & Hat. (1942); *G. archboldianum* Merr. & Perry (1942).

Shrubs or small trees, mostly erect, sometimes climbing, (1–)2–10(–13) m high, adventitious shoots may be present. Upper branchlets often with four wings, or ± terete, glabrous or tomentose, hairs ± erect, up to 0.2 mm long, mostly one-celled. Stipules inter- and intrapetiolar, broadly triangular to collar-like, 0.8–1.5 mm long, glabrous; apex rounded. Leaves glabrous; petiole (1–)2–7(–12) mm long. Lamina narrowly to broadly ovate to elliptic, rarely obovate, (1–)2–7(–14) × (0.3–)1–3(–6) cm, membranous, chartaceous or subcoriaceous; base narrowly cuneate to rounded; margin entire, often sparsely, minutely setose-tomentose towards apex; apex rounded to acute, or acuminate to long-acuminate, sometimes aristulate; midrib mostly raised on both surfaces; veins usually indistinct, 4–8 pairs. Inflorescences axillary, rarely ramiflorous, mostly triadic, botryoidal, or metabotryoidal, glomerulate to laxly umbelliform, (3–)5–10(–20) mm long, up to 30-flowered; peduncles 0.5–0.8(–10) mm long, shortly tomentose or glabrous; pedicels slender, (1–)2–5(–8) mm long; bracts narrowly ovate, 0.5–0.6 mm long, abaxial surface tomentose or glabrous. Calyx 0.5–1.5 mm long; outer surface glabrous or tomentose; inner surface appearing glabrous, actually minutely papillose distally; lobes triangular or triangular-orbicular, up to 1 mm long, margin

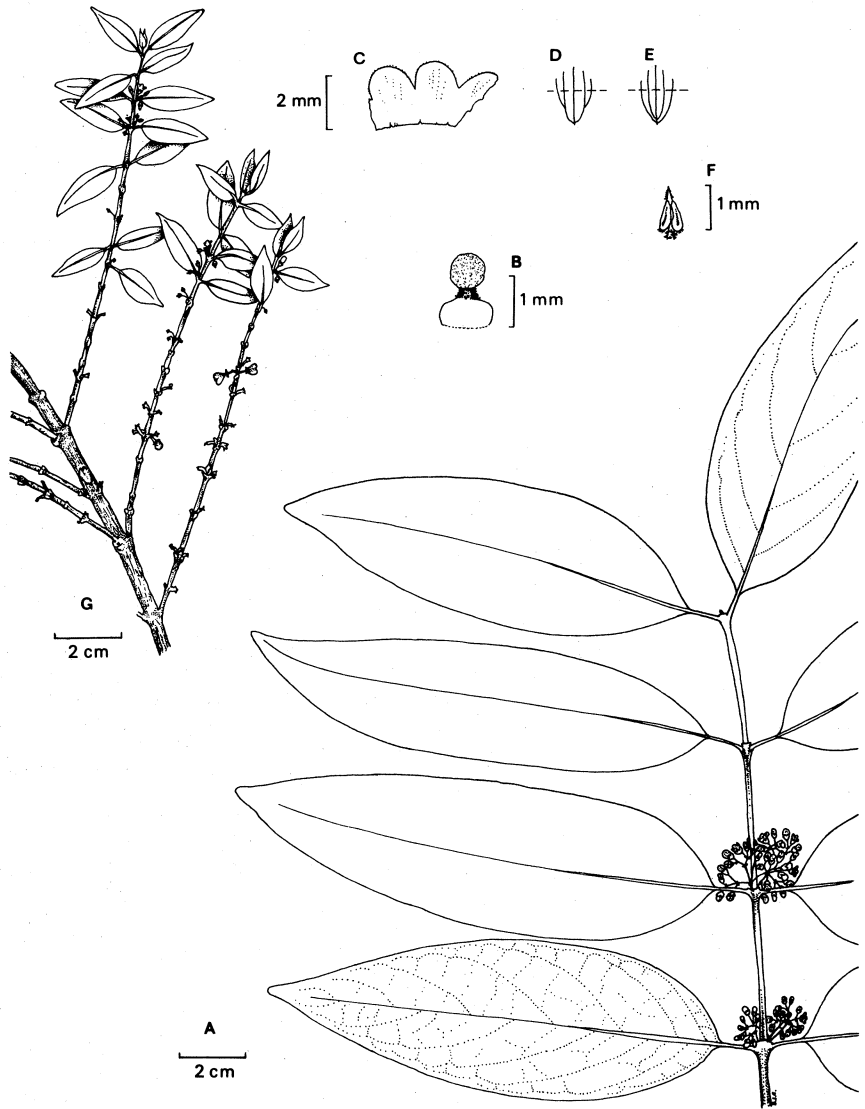


Fig. 34 *Geniostoma antherotrichum* Gilg & Bened. var. *antherotrichum* (A) flowering branchlet (*Kanis 1123*) (B) pistil (*Kanis 1123*) (C) open corolla (D) corolla venation (C & D: *Kanis 1250*) (E) corolla venation (*Hoogland 5166*) (F) stamen (*Kanis 1250*) *G. antherotrichum* var. *archboldianum* (Merr. & Perry) Conn (G) branchlet with flowers and fruits (*Hoogland & Schodde 7355*)

fimbriate, apex subacute. Corolla campanulate, 1.5–3(–4) mm long, whitish green; outer surface glabrous, papillose; inner surface glabrous or very sparsely papillose; lobes 0.8–1.5(–2) mm long, margin sparsely fimbriate, apex obtuse to subacute. Stamens with filaments ligulate, 0.2–0.8 mm long, shortly patent-hairy, hairs 0.1–0.2 mm long; anthers broadly sagittate or cordate, 0.5–0.8 mm long, may be subdorsifixed, surface often shortly patent-hairy, base patent-hairy, connective extended to form a tapering, patent-hairy apical appendage up to 0.5 mm long. Pistil 1–1.5 mm long; ovary subglobose, distally flattened, up to 1 mm long, 1–2 mm wide, glabrous, often tomentose at base of style; style 0.1–0.2(–0.5) mm long. Capsules ellipsoid to obovoid-globular, 3–6(–7) mm long, septicidal; apex apiculate.

Distribution: Endemic to New Guinea.

Ecology: Associated with primary and secondary forests. Frequently located along river banks, amongst low regrowth and deforested areas, such as fire-induced grasslands, landslide or avalanche areas. It occurs on limestone, stony, sandy-clay to humic clay and peaty soils.

KEY TO VARIETIES

1. Outer surface of calyx and corolla papillose; leaf-lamina 7–12 × 2–4 cm; inflorescences botryoidal or metabotryoidal, 5–12(–30)-flowered var. **antherotrichum**
1. Outer surface of calyx and corolla glabrous; leaf-lamina 2–6 × 1–2 cm; inflorescences 1–3-flowered var. **archboldiana**

var. **antherotrichum**. Fig. 34A–F.

G. arfakense Kan. & Hat. (1942).

Petiole 5–12 mm long. Lamina 7–11(–14) × 2–4(–6) cm, membranous, chartaceous or subcoriaceous. Inflorescences botryoidal to metabotryoidal, densely to laxly branched, 10–20 mm long, 5–12(–30)-flowered; peduncle and pedicels shortly tomentose. Outer and distal part of inner surface of calyx and corolla papillose.

Distribution: Collected from the Vogelkop, Eastern Highlands, Madang, Morobe and Milne Bay districts of New Guinea. Altitude (27–)500–2300 m.

var. **archboldianum** (Merr. & Perry) Conn *Blumea* 26: 320, f. 15g (1980). Fig. 34G.

G. archboldianum Merr. & Perry (1942).

Petiole (1–)2–4(–7) mm long. Lamina (1–)2–6 × (0.3–)1–2 cm, subcoriaceous. Inflorescences mostly 1- or 3-flowered; 3–5(–8) mm long; peduncles and pedicels glabrous or shortly tomentose. Calyx and corolla glabrous.

Distribution: Collected in the Vogelkoop, Snow Mountains, West Sepik, Southern Highlands, Western Highlands, Eastern Highlands and Morobe districts of New Guinea.

Geniostoma leenhoutsii Conn *Blumea* 26: 323, f. 17 (1980). Fig. 35.

Small trees, c. 8 m high. Branches ± terete, upper branchlets often laterally compressed, 4 ridges present, glabrous. Stipules inter- and weakly intrapetiolar,

broadly triangular to collar-like, 1–1.5 mm long, glabrous, distally truncate. Leaves glabrous; petiole 10–20 mm long. Lamina oval, 10 × 5 cm, thin chartaceous-membranous; base acute, shortly decurrent; margin entire; apex subacuminate to subacute; midrib raised on lower surface, sunken above; veins distinct, 6 pairs. Inflorescences axillary and ramiflorous, umbelliform, 6–10 mm long, (3–)5- c. 15-flowered; peduncles reduced, > 1 mm long; pedicels 5–7(–10) mm long, minutely tomentose; bracts ± ovate, 6–8 mm long, outer surface sparsely minute-tomentose. Calyx 1–1.5 mm long; outer surface sparsely minute-tomentose, papillose distally; inner surface glabrous; lobes ovate-triangular, up to 1 mm long, margin shortly fimbriate, apex acute to subacute. Corolla campanulate, 2.5–3 mm long, outer surface glabrous; tube 1–1.5 mm long, glabrous; lobes glabrous basally, papillose distally. Staminal filaments ligulate, up to 0.5 mm long, glabrous; anthers subdorsifixed, oblong-ovate to cordate, 0.8–1 mm long, basal lobes obtuse, ± patent-hairy; connective slightly extended to form a short, rounded or broadly triangular apical appendage. Pistil 1.5–2 mm long, glabrous; ovary ovoid, distally flattened, up to 0.5 mm long; style 0.2–0.4 mm long; stigma ± globular. Capsules unknown.

Distribution: It has been collected from the Central and Bougainville districts of Papuaia.

Ecology: Unknown.

Notes: The glabrous corolla and pistil, plus the umbelliform inflorescences are the distinctive features of this species.

Geniostoma randianum Merr. & Perry *J. Arnold Arbor.* 23: 409 (1942); *Conn Blumea* 26: 316, f. 14 (1980).

G. obtusum Merr. & Perry (1942).

Shrubs or small trees, (2–)3–6 m high. Branches slender, glabrous. Stipules inter- and weakly intrapetiolar, most broadly triangular or truncate, 1–1.5 mm long; apex apiculate, obtuse or rounded. Leaves usually inserted on distinct nodal swellings, glabrous; petiole 3–8(–10) mm long. Lamina broadly elliptic-ovate to broadly obovate, 3–6(–7) × 2–3 cm, stiff coriaceous; base obtuse to subcuneate, midrib raised on both surfaces; veins generally indistinct, 4–6 pairs. Inflorescences axillary, 10–15(–20) mm long, 1(–5)-flowered; peduncles up to 2 mm long, glabrous, or absent; pedicels slender, 2–5 mm long, glabrous; bracts lanceolate to triangular-lanceolate, 0.6–1.6 mm long. Calyx 1.5–3 mm long, glabrous; lobes ovate-triangular, 0.5–1 mm long, apex obtuse or shortly subacuminate. Corolla campanulate, 5–8 mm long; outer surface glabrous; tube 3–5 mm long; inner surface glabrous at base, distally sparsely hairy, often extending to the basal half of the lobes, or rarely glabrous throughout; lobes ± ovate, 1.5–3 mm long. Staminal filaments ligulate, (0.4–)0.6–1.5 mm long, glabrous or shortly pilose; anthers ovate-sagittate, 0.8–1.5 mm long, laxly hairy, base obtuse, connective extended to form an apiculate apical appendage. Pistil up to 6 mm long, glabrous; style 0.5–2(–3) mm long; stigma globular to obovoid, up to 1.4(–1.8) mm long. Capsules ovoid to oblong-obovoid, laterally flattened, 10–20(–45) × 5–12 mm, 1(or 2) per axil, sub-septifragal; apex apiculate.

Distribution: This species occurs in the Central and Milne Bay districts of Papua.

Ecology: Usually fringing mossy forests and/or forming part of shrubbery. Often associated with disturbed areas. It occurs at altitudes of 1190 to 2900 m.

Notes: This species is usually easily recognized by its large flowers, distinctive fruits and distinct nodal swellings.

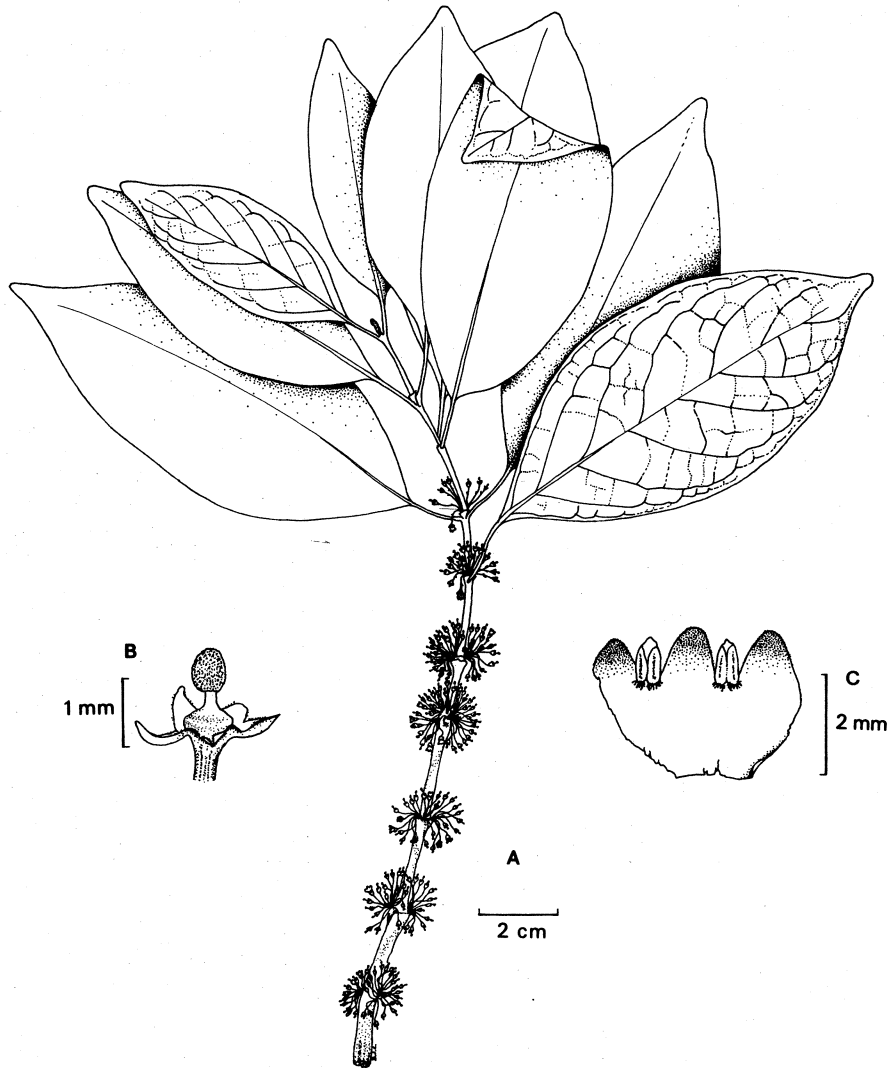


Fig. 35 *Geniostoma leenhoutsii* Conn (A) flowering branch (B) pistil and calyx (C) open corolla with pistil and part of corolla removed (all *Waterhouse 773-B*)

Geniostoma rupestre J. R. & G. Forst. *Char. Gen. Pl.* 24, t. 12 (1776).

G. caulocarpum K. Sch. (1905); *G. acuminatissimum*, *G. psychotrioides*, *G. dasyneurum*, *G. stenophyllum*, *G. schlechteri* Gilg. & Bened. (1916); *G. pullei* Cammerl. (1924); *G. brassii* Merr. & Perry (1942); *G. dallmannense* Kan. & Hat. (1942).

Shrubs or small trees, sometimes straggling, (0.5–)2–5(–12) m high. Branches \pm terete, often compressed, rarely quadrangular, glabrous or hairy. Stipules interpetiolar, may also be intrapetiolar, broadly triangular to collar-like, up to 2.5 mm long, if triangular, then apex rounded to apiculate. Petiole (0.7–)4–15(–25) mm long, glabrous, tomentose to setulose-tomentose. Lamina linear-lanceolate, broadly ovate or broadly oblong, rarely orbicular, (0.5–)3–10(–23) \times (0.2–)2–5(–11) cm, herbaceous to subcoriaceous; base attenuate to rounded, rarely cuneate; margin entire or slightly crenulate; apex rounded, obtuse or long-acuminate, sometimes aristulate, rarely cuspidate; surface glabrous or variously hairy; veins (3–)5–9 pairs. Inflorescences axillary and/or ramiflorous, monadic, triadic, dichasial, botryoidal, and/or thyrsoidal, accessory axes sometimes present, glomerulate, 4–16(–25) mm long, up to 12(–30)-flowered; peduncles sometimes absent, if present then glabrous or tomentose; pedicels slender, 1.6–5 mm long, glabrous or tomentose; bracts \pm triangular, (0.1–)0.5–2(–1.5) mm long, margin minutely fimbriate or entire, apex obtuse to subacute. Calyx (0.8–)1–2.5(–3) mm long, glabrous or sometimes hairy; lobes broadly triangular to triangular, 0.7–2 mm long, margin fimbriate, with hairs up to 0.2 mm long, sometimes entire (hairs absent), apex obtuse to subacute. Corolla campanulate, (1.6–)2–4(–6.5) mm long; outer surface glabrous or sometimes papillose and/or hairy; tube 1–2.5 mm long; inner surface glabrous at the base, sometimes sparsely pilose along the veins, densely or sparsely hairy in throat and/or mouth, sometimes with a second ring near the base, rarely only with ring near base of tube, hairs 0.1–0.8 mm long; lobes ovate to broadly triangular, shortly hairy, becoming papillose towards apex, sometimes glabrous at apex, or glabrous throughout, margin minutely fimbriate or entire, apex obtuse, rarely acute. Staminal filaments 0.2–1 mm long, glabrous or hairy; anthers narrowly oblong-sagittate or elliptic to ovate-sagittate, 0.5–1.5 mm long, base obtuse to cordate, bearded or glabrous, apex minutely apiculate, occasionally connective extended to form a triangular apical appendage, glabrous or shortly patent-hairy. Pistil 1.2–3(–5) mm long, glabrous or hairy; ovary \pm globular; style mostly filiform, sometimes narrowly conical, 0.4–1(–2) mm long; stigma globose or ellipsoid to obovoid-globose to obovoid-ellipsoid, 5–10(–22) \times 3–7 mm, maturing to white, red, black or green with purple-black tinge, septical; apex apiculate.

Distribution: Widely distributed—occurring in the Mascarene Islands and then in Micronesia, throughout Malesia and Papuasia, south to Australia, New Caledonia, New Hebrides and New Zealand, and east to Fiji, Samoa, Tonga, Society Islands and Austral Islands.

Ecology: A variable species associated with both primary and secondary forests, apparently preferring the more open conditions of the latter, from sea level to altitudes of 2800 m.

KEY TO VARIETIES

1. Pistil glabrous
2. Leaves glabrous
 3. Lamina \pm lanceolate; apex acute to acuminate, sometimes obtuse var. **rupestre**
 3. Lamina \pm elliptic to \pm oval; apex \pm obtuse to rounded, rarely shortly subacuminate var. **glaberrimum**
2. Leaves sparsely tomentose, at least on lower surface var. **glaberrimum**
1. Pistil hairy, at least in part
 4. Lamina narrow, 0.4–1.5 cm wide; corolla up to 2 mm long var. **rouffaerianum**
 4. Lamina usually never narrow, 1.5–7 cm wide; corolla usually $>$ 2.5 mm long
 5. Ovary glabrous basally, shortly pilose-tomentose to tomentose-subhoary distally; corolla up to 3 mm long var. **moluccanum**
 5. Ovary pilose, never appearing subhoary distally; corolla 4–5 mm long var. **solomonense**

var. **glaberrimum** (Benth.) Conn *Blumea* **26**: 302 (1980).

G. crassifolium Benth. var. *glaberrimum* Benth (1857).

Vegetatively glabrous. Lamina elliptic, or oblong-elliptic to oblanceolate; base rounded to obtuse; margin entire, often revolute; apex rounded, obtuse or bluntly cuspidate. Inflorescence triadic to botryoidal, accessory axes may also be present, 3–9-flowered, glabrous, rarely with a few scattered hairs basally. Calyx glabrous. Corolla campanulate, 2–4(–5.5) mm long. Pistil 1.5–2 mm long, glabrous.

Distribution: Mariana Islands, Caroline Islands, Solomon Islands, New Caledonia, New Hebrides, Fiji, Tonga, Samoa, Niue, Rapa, Marquesas Islands and Henderson Island. In the Solomon Islands it occurs in the New Georgia, Malaita and Santa Cruz Islands.

Ecology: Occurring in thickets near sea level, often forming part of the beach community. It occurs from sea level to altitudes of 400(–700) m.

var. **moluccanum** (Bl.) Conn *Blumea* **26**: 299, f. 9D–F (1980).

G. lasiostemon Bl. var. *moluccanum* Bl. (1850); *G. dallmannense* Kan. & Hat. (1942).

Branches glabrous or rufous or cinereous setulose-tomentose. Lamina lanceolate, ovate-lanceolate or elliptic-lanceolate, (4–)6–14 \times 2–4 cm, glabrous; base rounded or subacute to attenuate; apex subacuminate to acuminate. Inflorescences axillary, sometimes ramiflorous, mostly botryoidal, often umbelliform, 1– c. 5-flowered; peduncles usually setulose-tomentose. Calyx (0.5–)1–1.5 mm long; outer surface glabrous or shortly tomentose. Corolla (1.5–)2–2.5 mm long; outer surface glabrous; inner surface of tube pilose, mostly restricted to throat and mouth, sometimes with a few scattered hairs only. Ovary glabrous basally, pilose-tomentose to tomentose-subhoary distally, hairs 0.1–0.2 mm long, often semi-adpressed; style 0.5–1 mm long, glabrous, minutely tomentose or sparsely pilose at the base; stigma \pm globular, often truncate and bilobed. Capsules with the basal portion of hairs usually persistent.

Distribution: Caroline Islands and Papuaia. In Papuaia, it occurs in the Vogelkop, Geelvink Bay and Jayapura districts.

Ecology: Collected from primary and secondary forests, also from coastal forests. Usually common and occurring from sea level to altitudes up to 500(–1800) m.

var. **rouffaerianum** Conn *Blumea* 26: 311, f. 9A–C (1980). Fig. 36E–G.

Branches \pm terete to slightly 4-ridged, glabrous. Lamina narrow, elliptic-lanceolate to elliptic-ob lanceolate, 2–5 \times 0.4–1.5 cm, glabrous; base attenuate; margin entire, slightly revolute; apex narrowly acute. Inflorescences axillary, up to 5 mm long, 1–3-flowered; peduncles shortly tomentose. Calyx up to 1 mm long, with a ring of hairs at base of inner surface. Corolla campanulate, not constricted at the middle, up to 2 mm long; inner surface of tube pilose, hairs restricted to throat and mouth, hairs *c.* 0.4 mm long. Ovary glabrous, sometimes with a few hairs at the base of style: style *c.* 0.5 mm long, patent-hairy; stigma \pm globular. Capsules unknown.

Distribution: Only collected from the Rouffaer River in the Jayapura district of Papuaia.

Ecology: Locally common between stones of river bank. Type (*Leeuwen 10345*) collected from an altitude of 200–300 m.

var. **rupestre**

G. rupestre J. R. & G. Forst. (1776); *G. caulocarpum* K. Sch. (1905); *G. acuminatissimum*, *G. psychotrioides*, *G. dasyneuron*, *G. schlechteri* Gilg. & Bened. (1916); *G. pullei* Cammerl. (1924); *G. brassii* Merr. & Perry (1942).

Branches glabrous or hairy. Lamina narrowly to broadly lanceolate, thin chartaceous to subcoriaceous, glabrous or hairy; base attenuate to rounded; margin entire; apex acuminate, or cuspidate, sometimes obtuse. Inflorescences glabrous or hairy. Calyx glabrous on outer surface. Corolla 2–5 mm long; hairs of inner surface lanceolate to oblong-lanceolate, 0.1–0.8 mm long, apex of hairs acute to obtuse; venation variable, mostly complex. Pistil glabrous. Capsules globular to ellipsoid.

Distribution: From Taiwan to Micronesia, then throughout Melanesia; Papuaia, New Caledonia, New Hebrides, Fiji, Cook Islands, Samoa and Tonga.

Ecology: Collected from primary and secondary forests. Often locally common, occurring at altitudes up to 1500 m.

Notes: This variety is composed of a number of intergrading races. Conn (1980) discusses some of the most common groups that are frequently distinct locally.

var. **solomonense** Conn *Blumea* 26: 297, f. 8M–P (1980). Fig. 36A–D.

Branches glabrous. Lamina ovate-lanceolate, elliptic-lanceolate or oblong-elliptic, (8–)11–18 \times (3–)4–6 cm, mostly glabrous, sometimes sparsely tomentose on midrib of lower surface; base attenuate to subobtuse; apex shortly acuminate; veins 8–11 pairs. Inflorescences ramiflorous and/or axillary, umbelliform, 5–10(–14) mm long, 6–12-flowered; peduncles reduced. Calyx 2–2.5 mm long. Corolla campanulate, often slightly constricted at middle, 4–5 mm long; outer surface glabrous; inner surface pilose-tomentose in throat, mouth and base of lobes, distal part of lobes papillose. Ovary often distally flattened, basally glabrous, distal surface pilose, indumentum may extend to halfway down ovary; style 1–1.5 long, pilose at base, distally glabrous or with a few scattered hairs;

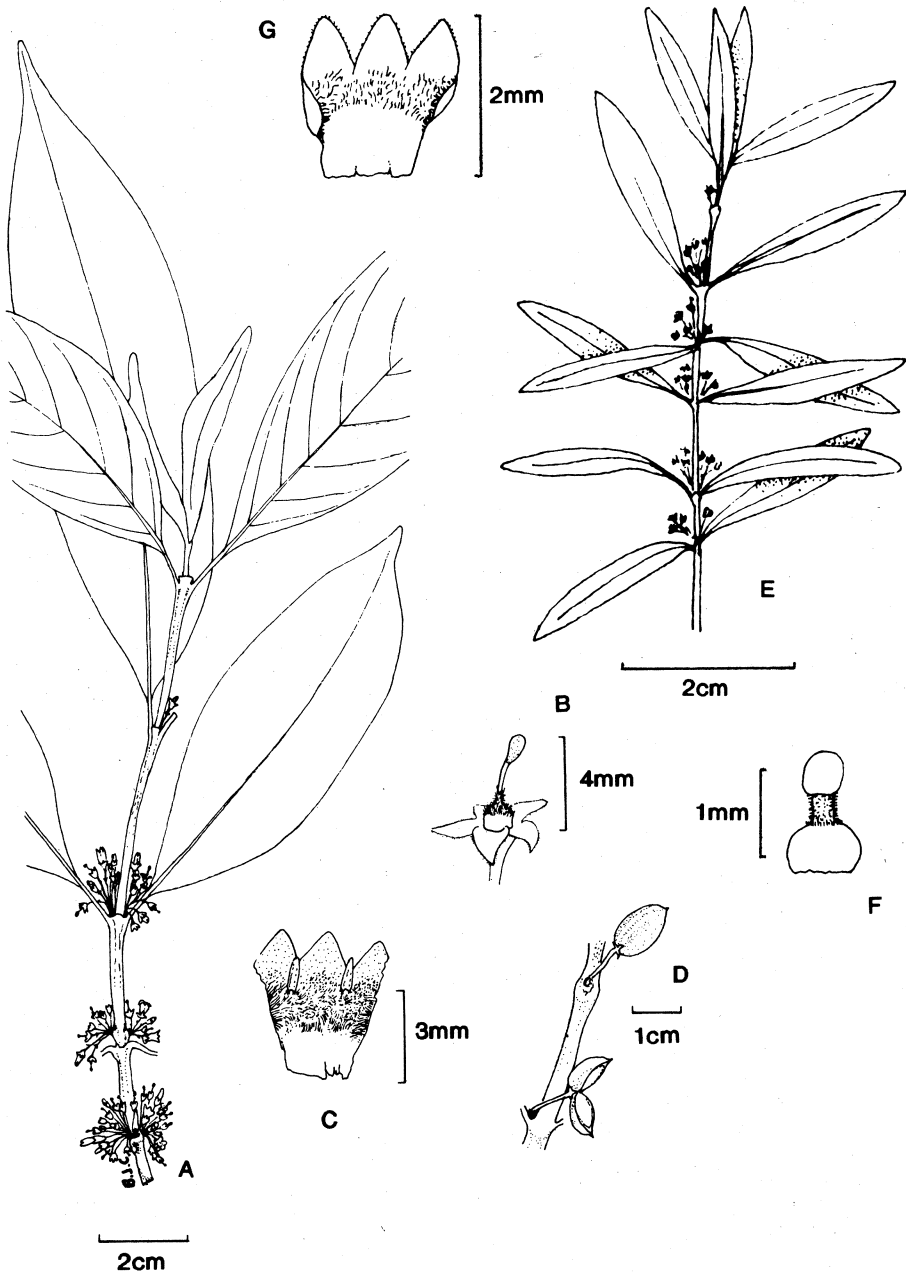


Fig. 36 *Geniostoma rupestre* J. R. & G. Forst. var. *solomonense* Conn (A) flowering branchlet (B) calyx and pistil (C) open corolla with pistil and part of corolla removed (D) infructescence (A–D: *BSIP 12011*) *G. rupestre* var. *rouffaeranum* Conn (E) flowering branchlet (F) pistil (G) open corolla with pistil and part of corolla removed (E–G: *Docters van Leeuwen 10415*)

stigma \pm clavate. Capsules ovoid, globular-ovoid or globular-ellipsoid, 0.7–1.4 cm long, basal portion of hairs usually persistent.

Distribution: In Papuaia, it is endemic to the Solomon Islands, occurring in all districts, except for the Rennell group.

Ecology: Collected from primary and secondary forests. It occurs from sea level to altitudes of 900 m, usually in well-drained soils.

Geniostoma trichostylum Conn *Blumea* 26: 325, f. 18 (1980).

Habit unknown. Branches subterete, laterally compressed distally, glabrous. Stipules interpetiolar, broadly triangular, 1–1.5 mm long; apex obtuse to subacute. Leaves glabrous; petiole 3–10 mm long. Lamina oblanceolate or ovate-elliptic, 6–10 \times 1.5–3 cm, chartaceous; base tapering, cuneate or acute; apex acuminate to abruptly acuminate; veins 6–8 pairs. Inflorescence axillary, umbelliform, 8–13 mm long, 1- c. 6-flowered; peduncles < 1 mm long; pedicels 4–9 mm long, glabrous; bracts lanceolate-ovate, 0.6–1 mm long, glabrous. Calyx 2–3 mm long, glabrous; lobes ovate, c. 1.5 mm long, margin shortly fimbriate, apex subacute to acute. Corolla campanulate, 5–10 mm long; outer surface glabrous; inner surface glabrous at base, papillose to sparsely hairy in throat, hairs broadly ligulate; lobes ovate, 3–6 mm long, margin entire to minutely papillose, apex obtuse to subacute. Staminal filaments c. 1 mm long, glabrous; anthers oblong-cordate, 1.5 mm long, subdorsifixed, glabrous, basal lobes obtuse, connective slightly extended to form a short triangular apical appendage. Pistil 4–7 mm long; ovary globular, 1–1.5 mm long, glabrous; style 1.5–4 mm long, with laterally compressed, lanceolate, oblong or triangular hairs dispersed in a narrow band 0.5–0.8 mm wide; stigma oblong, c. 1.5 mm long, shortly papillose-ligulate. Capsules ellipsoid, c. 15 mm long, glabrous to glabrescent, septicidal.

Distribution: Once collected from the Bougainville district of Papuaia.

Ecology: Not known. Type (NGF 13595) collected from an altitude of 1370 m.

Notes: This species has the hairs of the inner surface of the corolla-tube and, in particular, those of the style dispersed in a narrow band.

Geniostoma umbellatum Conn *Blumea* 26: 353, f. 29 (1980).

Small semi-erect trees, c. 5 m high. Branches subterete basally, up to 6-angled distally, minutely ferruginous-tomentose distally, hairs c. 0.1 mm long, soon becoming glabrous. Stipules forming a foliaceous sheath, 4–5 mm long, laterally continuous with the base of the petiole, distally obtuse. Petiole 1–1.5(–2) cm long, shortly pilose-tomentose to glabrescent. Lamina narrowly obovate to oblong-obovate, 20–21 \times 7–8 cm, membranous-chartaceous; lower surface minutely pilose-tomentose on midrib and veins; upper surface glabrous; base tapering attenuate, decurrent; margin entire; apex shortly acuminate; veins 13–14 pairs. Inflorescences ramiflorous, umbelliform, glomerulate, 6–10 mm long, at least 50-flowered; peduncles < 1 mm long; pedicels slender, 4–8 mm long, sparsely pilose-tomentose or glabrous; bracts inconspicuous, lanceolate-subacute, c. 1 mm long. Calyx 1–1.5 mm long; outer surface sparsely minute-tomentose; inner

surface glabrous; lobes broadly lanceolate or triangular, *c.* 1 mm long, margin sparsely fimbriate, apex subacute. Corolla expanded-campanulate, 2–3 mm long; outer surface glabrous; tube 1–1.5 mm long, inner surface glabrous at base, mostly sparsely short-pilose in throat, pilose-villose at mouth; lobes pilose-villose at base, shortly pilose distally, apex papillose-hairlike, margin fimbriate basally, entire to minutely papillose distally, apex subacute. Staminal filaments ligulate, *c.* 0.5 mm long, pilose-villose or pilose-tomentose; anthers shortly oblong-cordate, *c.* 0.5 mm long, glabrous, basal lobes and apex obtuse. Pistil 1–1.5 mm long, glabrous; ovary \pm globose, up to 1 mm long; style *c.* 0.5 mm long; stigma \pm globular, diameter *c.* 0.5 mm. Capsules reportedly ovoid, septicidal.

Distribution: Once collected from Guadalcanal, Solomon Islands.

Ecology: Associated with hillside secondary forest communities in well-drained soils. The type (*BSIP 11765*) was collected at an altitude of 40 m.

Notes: This species has foliaceous stipules and umbelliform inflorescences with relatively long pedicels.

Geniostoma weinlandii K. Sch. in K. Sch. & Laut. *Nachtr.* 349 (1905). **Fig. 37.**
G. acutifolium Hiern (1909).

Slender shrubs to small trees, erect or spreading to semiclimbing, (1–)2–3(–7) m high. Branches \pm terete, sometimes quadrangular, glabrous. Stipules inter- and intrapetiolar, collar-like; 1–1.5 mm long. Petiole (3–)5–8(–15) mm long, glabrous. Lamina broadly ovate or elliptic-lanceolate, rarely obovate, often irregular, hence appearing \pm oblong on one side of midrib but oval to elliptic on the other side, (5–)10–24 \times (2–)5–9(–11) cm, thin membranous or sometimes chartaceous, mostly glabrous, sometimes sparsely minute-tomentose or papillose on midrib and veins of lower surface; base obtuse, attenuate, rarely subcuneate, often oblique, frequently shortly decurrent; margin entire; apex subobtuse or short- to long-acuminate; veins 6–9 pairs. Inflorescences axillary, partly ramiflorous, umbelliform, 10–24 mm long, 3–9-flowered; peduncles 0.1–1 mm long, glabrous or shortly tomentose; pedicels 4–8 mm long; bracts subulate-lanceolate, 0.2–1.6 mm long, glabrous or sometimes tomentose. Calyx (1–)2–3 mm long; outer surface glabrous or rarely sparsely tomentose; inner surface glabrous; lobes ovate to semi-orbicular, 0.8–1.5 mm long, margin fimbriate, apex subacute to almost rounded. Corolla campanulate to expanded-campanulate, 5–7 mm long, glabrous; lobes broadly ovate to semi-orbicular, 2.5–3(–4) mm long, margin entire, apex obtuse to subacute, sometimes shortly mucronate. Staminal filaments ligulate, 0.4–1(–1.6) mm long; anthers ovate- to oval-sagittate or oblong-cordate, 0.8–2 mm long, usually glabrous, lobes obtuse, rarely sparsely minute-tomentose, apex obtuse or connective extended to form a narrow tapering apical appendage. Pistil 2.5–4 mm long, glabrous; ovary subglobose, distally flattened, *c.* 1 mm long, 1.5–2 mm wide; style slender, 0.9–1.5 mm long; stigma \pm globular, obovoid-truncate or sometimes obovoid and slightly bilobed, 1–2 mm long. Capsules globular, ellipsoid- or obovoid-globular, 8–12 \times 7–9(–11) mm, septicidal; apex apiculate.

Distribution: In Papuaia it occurs in the Snow Mountains, Western, Sepik, Southern Highlands, Eastern Highlands, Madang, Morobe and Northern districts.

Ecology: Commonly associated with lowland river-bank communities. It occurs at altitudes up to 1000(–1900) m.

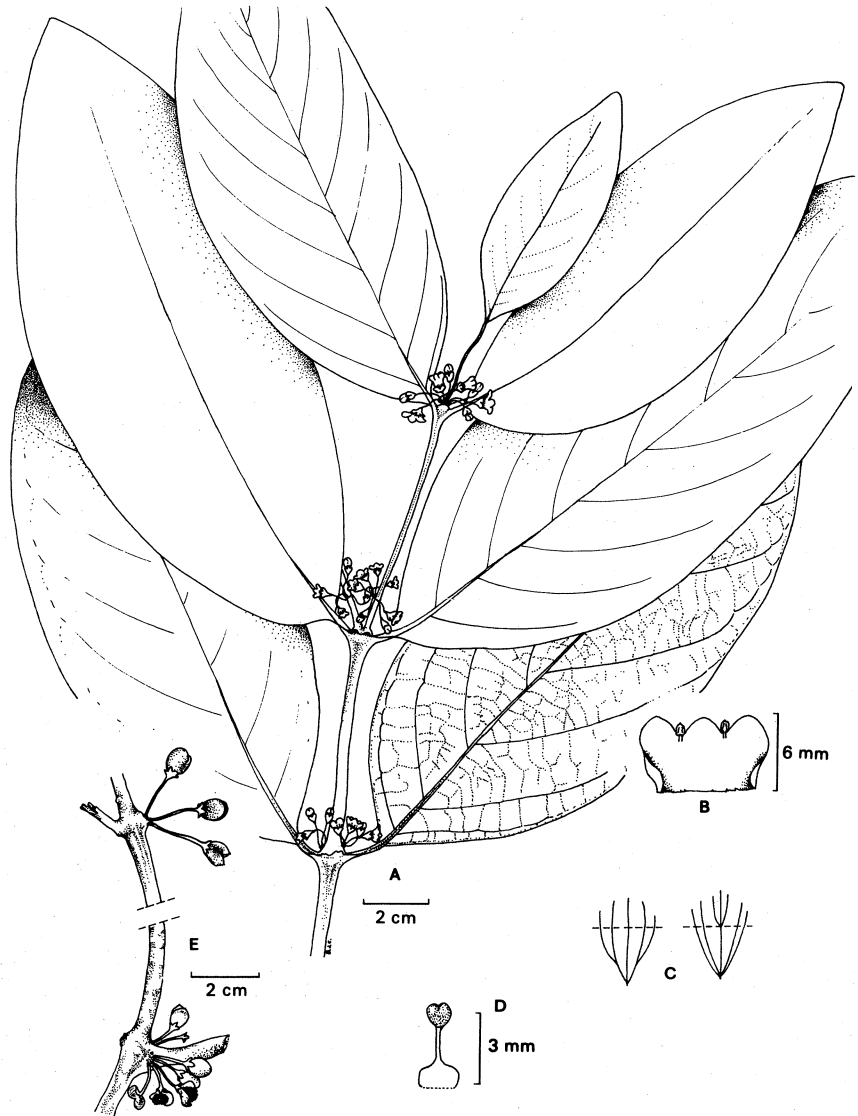


Fig. 37 *Geniostoma weinlandii* K. Schum. (A) flowering branchlet (LAE 52754) (B) open corolla with pistil and part of corolla removed (LAE 52754) (C) corolla venation (Schodde 1409) (D) pistil (NGF 46872) (E) infructescence (NGF 21270)

MITRASACME Labill.

Annual herbs, glabrous or with simple hairs. Stems branched or not. Leaves rosulate or in pairs along stem, (sub-) sessile, connected by interpetiolar stipules. Lamina 1- or 3-5-curvi-nerved. Inflorescences terminal and/or axillary, cymose or solitary in leaf axils. Calyx, corolla and androecium 4-merous. Bracts leafy or sepal-like. Calyx connate basally; lobes about as long as tube, \pm triangular; col-leters few or absent. Corolla membranous to thin fleshy; outer surface glabrous; lobes exduplicate-valvate in bud, triangular to elliptic, apex acute. Stamens inserted on lower half of corolla-tube, mostly included; filaments filiform; anthers 2-locular. Pistil superior or slightly inferior, glabrous; ovary 2-locular, ovules many; styles 2, usually free in their basal portion, connate distally; stigma truncate to 2-lobed, anthers and stigma always at same height. Fruit a capsule, dehiscing by apical loculicidal slits, 2-horned; horns terminated by style-halves which may be torn loose or remain partly connate. Seeds many, ellipsoid or angular, minutely reticulate or verrucose; testa thin; endosperm fleshy.

Distribution: About 40 species, with the greatest development in Australia. Also found in New Zealand, New Caledonia, Malesia, Caroline Island, and in Asia from Deccan and Sri Lanka to Japan and Korea. In Papuaia there are 6 species.

Ecology: Usually found in open habitats, from dry to wet, often locally common. It occurs from sea level to above 3000 m altitude.

Morphology: The inflorescence, except for the modification of solitary flowers, is an irregularly repeating series of umbel-like clusters.

Literature: P. W. Leenhouts (1962), *Florae Malesianae precursores XXXIII*, Loganiaceae, *Bull. Jard. Bot. Brux.* **32**: 417-458.

KEY TO SPECIES

1. Leaves and calyx lobes with a narrow white membranous margin **M. albomarginata**
1. Leaves and calyx lobes without a white membranous margin
 2. Flowers solitary, axillary, sometimes terminal; stigma truncate
 3. Stems distinctly ribbed (usually 4-ribbed), usually glabrous; lamina always lanceolate to narrowly ovate; margin not tuberculate-hairy; seeds with minutely papillose testa **M. indica**
 3. Stems terete to slightly flattened, mostly tuberculate-hairy; lamina of lower leaves elliptic; lamina of upper leaves often lanceolate to narrowly ovate; margin tuberculate-hairy; seeds with minutely papillose testa **M. neglecta**
 2. Flowers in a distinct terminal inflorescence; stigma 2-lobed
 4. Peduncles with a few pairs of appressed bract-like leaves; corolla salverform, 15-24 mm long; capsules 4-7.5 \times 2-3.5 mm **M. elata**
 4. Peduncles without bract-like leaves; corolla urceolate to campanulate, (2.5-)3-5 mm long; capsules 1.2-1.5 mm diameter **M. pygmaea**

Mitrasacme albomarginata Leenh. *Bull. Jard. Bot. Brux.* **32**: 422 (1962).

Up to 10-15 cm high. Stems flattened, minutely appressed-pubescent. Lamina lanceolate, 5-6 \times 1.5 mm, glabrous; base contracted; margin membranous, white; apex aristulate; midrib prominent. Flowers solitary, axillary in upper portion of plant; pedicels 5-10 mm long, minutely pubescent. Calyx conical-campanulate, 3.5 mm long, glabrous, connate basally; lobes triangular, margin membranous, white, apex acute to aristulate. Corolla campanulate, c. 4.5 mm long, white; inner

surface with long bristles in the mouth and some short hairs at apex of lobes; lobes elliptic, 2 mm long, acute. Staminal filaments 1.2 mm long; anthers sagittate, 1 mm long, yellow, basifixed, introrse, apex with a few short bristles. Pistil 2 mm long; ovary globular, 0.7–0.8 mm; styles inserted far apart, upper half connate; stigma truncate. Capsules globular, diameter 1–1.3 mm, light brown, completely enveloped by calyx, styles soon separating from each other. Seeds angular, 0.2 mm long; surface minutely warty.

Distribution: Once collected from the Digul district, at Koerik bivouac near Merauke, Sept. 1954 (*van Royen 4847*—Type)

Ecology: Occurring in grassland vegetation in open areas with mainly low grasses. Locally common. Altitude 8 m.

Mitrasacme elata R. Br. *Prod.* 453 (1810). **Fig. 38.**

M. elata R. Br. var. *brevicalyx* Leenh. (1962).

Erect, delicate herb, (4–)11–55 cm high, glabrous, simple or sparingly branched. Basal leaves rosulate: lamina ovate to obovate, 1.5–3 × 0.5–1 cm, glabrous, sometimes scaly; base tapering; margin entire; apex obtuse, 3–5-curve-nerved; cauline leaves bract-like, deltoid, 2–4.5 mm long; apex acute, connected by interpetiolar stipules. Inflorescences terminal and occasionally axillary, usually irregular, up to 4 lateral branches per node; peduncles terete, glabrous, smooth, or longitudinally finely ribbed; bracts similar to cauline leaves. Calyx campanulate, 1.4–5.8 mm long, glabrous, membranous; lobes semi-orbicular to lanceolate, 0.6–3 mm long, margin fimbriate, hairs sometimes restricted to the acute apex. Corolla salverform, 15–24 mm long; outer surface glabrous, creamy-pink to pale brown; inner surface sparsely pubescent in basal half of tube, yellow-white; tube slender, 11–17 mm long, mouth with thickened fimbriate rim; lobes elliptic, 3–9 mm long, shortly acuminate. Staminal filaments 5–6 mm long, epipetalous for about half its length; anthers ovate-lanceolate or sagittate, 1–2 mm long, basifixed, obtuse, latero-introrse. Ovary 1–2.5 mm, tapering into styles; styles slender, 5–9 mm long, free at base, but connate for most of length; stigma distinctly 2-lobed, c. 1 mm long. Capsules slender, globular-mitre-shaped to oblong-mitre-shaped, 4–7.5 × 2–3.5 mm, enveloped by persistent calyx for greater part, styles usually torn apart or connected by the stigma when mature. Seeds angular, 0.3–0.4 × 0.5–0.6 mm; surface minutely warty.

Distribution: Southeastern Malaysia, Papuaia and Arnhem Land (Australia). Known from the Vogelkop, West Sepik, Western, Morobe, Central and Papuan Islands districts of Papuaia.

Ecology: Dry savannahs and woodlands. It occurs at altitudes up to 550 m.

Mitrasacme indica Wight *Ic.* 4, 4: 15, t. 1601 (1850).

M. alsinoides Clarke (1883), non R. Br.

Herb up to 20 cm high. Stems usually branched, slender, longitudinally furrowed, often becoming distinctly 4-ribbed, slightly compressed, glabrous. Lamina lanceolate to narrowly ovate, 2–4 × 0.3–0.6 mm, glabrous; margin entire; apex acute; only midrib prominent. Flowers solitary, axillary, confined to distal

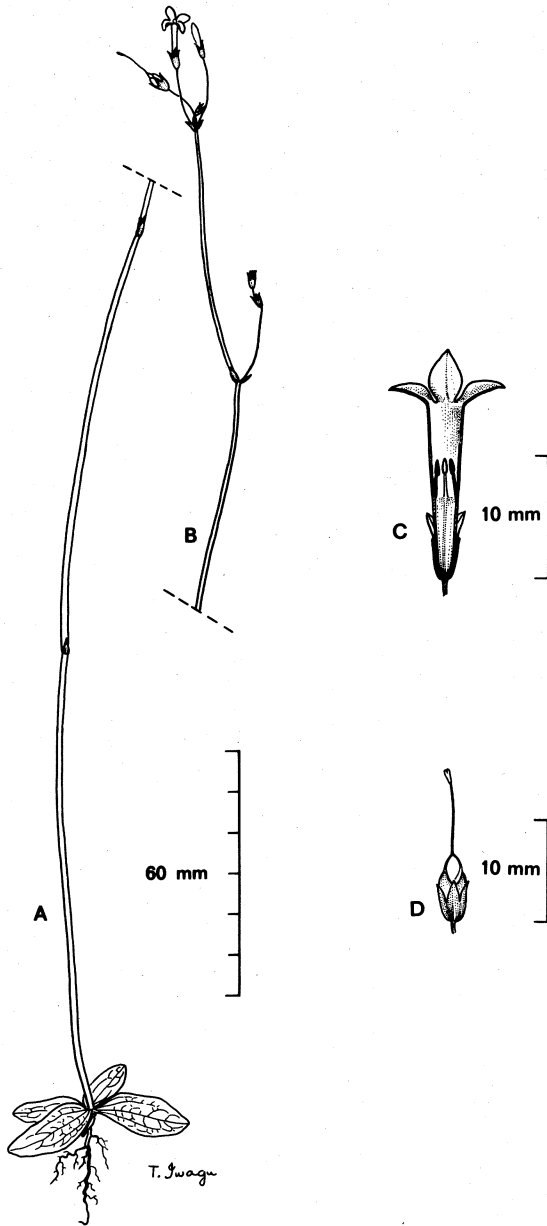


Fig. 38 *Mitrasacme elata* R. Br. (A) habit—lower portion of plant (B) habit—upper portion of plant with inflorescence (C) half flower diagram with pistil removed (D) immature fruit with style attached (source unknown)

portion of plant; pedicels 2.5–7 mm long, glabrous to scabrous. Calyx conical-campanulate. Corolla campanulate, 3–4 mm long; outer surface glabrous, white; inner surface shortly and sparsely pubescent in mouth, yellow-green to white in throat; lobes 1–1.5 mm long, apex obtuse. Staminal filaments 1 mm long; anthers elliptic, rarely sagittate, 0.6–0.8 mm long, basifixed, introrse, sometimes apical appendage present. Pistil 1.2–1.5 mm long; ovary 0.4–0.5 mm long; styles *c.* 0.8 mm long, free at base for *c.* 0.2 mm of their length; stigma broadly truncate, rarely 2-lobed. Capsules subglobular, 1.5–2 mm diameter, style connate only at apex or torn apart. Seeds angular-ovoid, 0.3 × 0.2 mm, brown; surface coarsely reticulate.

Distribution: Southern and eastern Asia from India to Korea, Japan, Taiwan, Malesia, and northern Australia. In Papuasias it occurs in the Central district.

Ecology: Open habitats, often grasslands or savannahs, on poor to heavy soils, dry to swampy. It occurs at sea level and at altitudes up to 500 m.

Mitrasacme neglecta Leenh. *Bull. Jard. Bot. Brux.* 32: 449 (1962).

Herb, up to 15 cm high. Stems simple or branched, if branched, then mostly near base, terete, minutely fluted, shortly tuberculate-hairy to subglabrous. Lamina of upper leaves ovate to often narrowly ovate; lamina of lower leaves ovate or elliptic, 3–6 × 1–3 mm; margin tuberculate-hairy, otherwise glabrous; apex acute; only midrib prominent. Flowers solitary, terminal and axillary, always confined to distal portion of plant; distally the leaves become smaller and narrower, and the internodes become longer, the distal part may appear as a lax raceme; pedicels 6–7 mm long, scabrous. Calyx conical, 2–2.5 mm long; lobes lanceolate, 0.6–0.8 mm long, margin ciliate, especially towards apex, apex acute. Corolla subcampanulate, 3 mm long, white; outer surface glabrous; inner surface with some stiff hairs in the mouth; lobes 1 mm long, apex obtuse. Staminal filaments 0.6–0.7 mm; anthers ovate to elliptic, 0.5 mm long, basifixed, extrorse, apex with minute appendage. Pistil 1.5–2 mm long; ovary broadly cylindrical, 0.5 mm long; style inserted far apart, connate distally; stigma truncate. Capsules globular-mitre-shaped, 1.2–1.5 mm diameter; with styles connected only by stigmas. Seeds slightly flattened-elliptic, 0.3–0.2 mm; surface minutely papillose and warty.

Distribution: Southeastern Malesia, Arnhem Land (Australia) and the Western district of Papuasias.

Ecology: In Papuasias it occurs amongst grasses and low scrub in savannah grassland, at an altitude of 30 m.

Mitrasacme pygmaea R. Br. *Prod.* 453 (1810).

M. polymorpha Clarke (1883), non R. Br.; *M. malaccensis* Wight (1850); *M. nudicaulis* Benth. (1853), p.p., non R. Br.

Erect herb, up to 35 cm high. Stems terete, slightly fluted, densely white hirsute, particularly on lower portion of plant, sparsely hirsute to glabrescent or glabrous distally. Lamina ovate or elliptic, 4–12 × 1–4 mm; base cuneate; margin hirsute; apex obtuse to subacute; lower surface hirsute on midrib and sometimes on veins; upper surface glabrescent to densely hirsute. Inflorescences terminal,

often umbelliform, 0.8–8 mm long, 1–12-flowered; pedicels slender, angular, 0.8–4 mm long; bracts oblong-ovate to oblong-lanceolate, 0.5–1 mm long, margin hirsute and sometimes along midrib of lower surface. Calyx conical-campanulate, 1.5–2.5 mm long, glabrous, except margin or apex of lobes with stiff hairs; lobes triangular, 0.4–0.8 mm long, apex acute. Corolla urceolate to campanulate, (2.5–)3–5 mm long; outer surface white (to pink) with brown or pale orange streaks, glabrous; inner surface very sparsely hairy in mouth; lobes 0.6–1.5 mm long, apex obtuse. Staminal filaments 1.5–3.0 mm long; anthers oblong-ovate to sagittate, 0.5 mm long, basifixed, extrorse, apex acute. Pistil 2–4.5 mm long; ovary 0.7–1 mm long; styles free at basal portion; stigma 2-lobed. Capsules globular-mitre-shaped, diameter 1.2–1.5 mm, the styles remaining connate for greater part. Seeds angular-ellipsoid, 0.5 × 0.3 mm; surface densely and minutely warty.

Distribution: Southeastern Asia to Japan, Malesia to Papuaia, Caroline Islands, tropical Australia and New Caledonia. In Papuaia it occurs in most mainland districts, but as yet not reported from the Bismarck Archipelago.

Ecology: In grasslands, open areas in savannah and woodland communities, and along roadsides. It occurs at altitudes up to 2000 m.

KEY TO VARIETIES

1. Leaves basal, rosulate; lamina with only midrib prominent var. **pygmaea**
1. Leaves basal and cauline, basal leaves not rosulate, upper two pairs of cauline leaves may be rosulate; lamina often 3-nerved var. **malaccensis**

var. **pygmaea**

M. nudicaulis Benth. (1853), non Bl.

Up to 12(–20) cm high. Stems branched usually above base. Leaves basal, rosulate; lamina 4–8 × 2.5–3.5 mm, only midrib prominent.

Distribution: In Papuaia it has been collected from the Western, Morobe, Central and Milne Bay districts.

var. **malaccensis** (Wight) Hara *J. Jap. Bot.* **30**: 23 (1955).

M. polymorpha Clarke (1883), non R. Br.; *M. malaccensis* Wight (1850).

17–35 cm high. Stems usually branched at or near base. Leaves basal and cauline; basal leaves not rosulate, the upper 2 pairs of cauline leaves may be rosulate; lamina (5–)8–12 × 1–4 mm, often 3-nerved.

Distribution: In Papuaia it has been collected from the Western, Western Highlands, East Sepik, Eastern Highlands and Morobe districts.

MITREOLA L.

Annual, erect herbs; glabrous or with simple hairs. Stems branched or not. Leaves petiolate with interpetiolar stipule. Inflorescence terminal and/or axillary, cymose. Bracts sepal-like. Calyx, corolla and androecium 5-merous. Flowers shortly pedicellate to sessile. Sepals connate only at base. Corolla epigynous, urceolate; a dense ring of hairs in mouth; lobes short, imbricate in bud. Stamens

short, included; anthers introrse. Pistil glabrous; ovary semi-inferior, \pm globose, with an indented line deepening at anthesis, 2-locular; ovules many, small; styles 2, short, sometimes absent; stigmas \pm connate to each other, hence appearing subcapitate or bilobed. Fruit a capsule, septicidal, both carpels dehiscent along the central suture; apex 2-horned or bilobed; horns terminated by the styles. Seeds many, small; endosperm fleshy.

Distribution: About 6 species, throughout the tropics and subtropics of America and West Africa, in Madagascar, Southeast Asia, Malesia and northern Australia; in Papuasia, 1 species.

Ecology: Usually found in wet hollows, that may be swampy, under the influence of seasonal conditions, sometimes in shade.

Notes: The inflorescence is fundamentally dichasial, but the branches are arranged as a compound monochasium, in the form of a cincinnus (coiled cyme).

Mitreola petiolata (Gmel.) Torr. & Gray *Fl. N. Amer.* 2: 45 (1841). **Fig. 39.**

M. oldenlandioides G. Don (1837), nom. illeg.; *Cynoctonum mitreola* (L.) Britt. (1894); *C. mitreola* var. *orthocarpa* Hochr. (1910).

Erect herb, (5–)20–60 cm high. Stem simple, or branched from just above the base; quadrangular to narrowly 4-winged, glabrous with wings sparsely tuberculate. Stipules broadly deltoid, 1–1.6 mm long. Petiole 0.5–2 mm long; adaxial surface slightly grooved. Lamina ovate to ovate-oblong, 1.5–4 \times 1–2 cm, very sparsely appressed-pubescent or glabrous: base obtuse-attenuate, mostly decurrent; margin entire, appressed-ciliate; apex obtuse to acute; veins 4–10 pairs, ascending. Inflorescences with hairs deltoid (< 0.1 mm long); pedicles 0.2–0.8 mm long; bracts narrowly deltoid, 1.5–2 mm long. Calyx 1–1.5 mm long, glabrous; lobes ovate, 0.3–1 mm long, margin membranous, apex acute. Corolla 1–2 mm long; papillose, white; lobes oblong-ovate, 0.5–1 mm long. Stamens inserted near base of corolla-tube, glabrous; filaments 0.2–0.5 mm long; anthers 0.8 mm long. Styles free, 0.2–0.5 mm long; stigmas globular. Capsules 2–3.5 mm long, sparsely and shortly hairy on midrib and along margin, also often hairy on distal outer surface; the horns usually curved inwards. Seeds ellipsoid, 0.4–0.8 mm long, concave on one side; surface smooth.

Distribution: See generic distribution. In Papuasia it has been collected from the West Sepik, Central and Milne Bay districts.

Ecology: See generic ecology. It occurs at altitudes up to 400 m.

NEUBURGIA BI.

Shrubs or small to large trees; branches glabrous, lateral branches coalescent with main branch. Stipules interpetiolar, adnate to the petioles, deltoid to obdeltoid, splitting along a distinct suture on older leaves. Leaves sessile to petiolate; venation mostly indistinct. Inflorescences terminal, cymose usually compact, upper flowers forming a cincinnus; bracts semi-amplexicaulous, shortly frimbriate. Flowers \pm sessile. Calyx, corolla and androecium 5-merous, calyx rarely

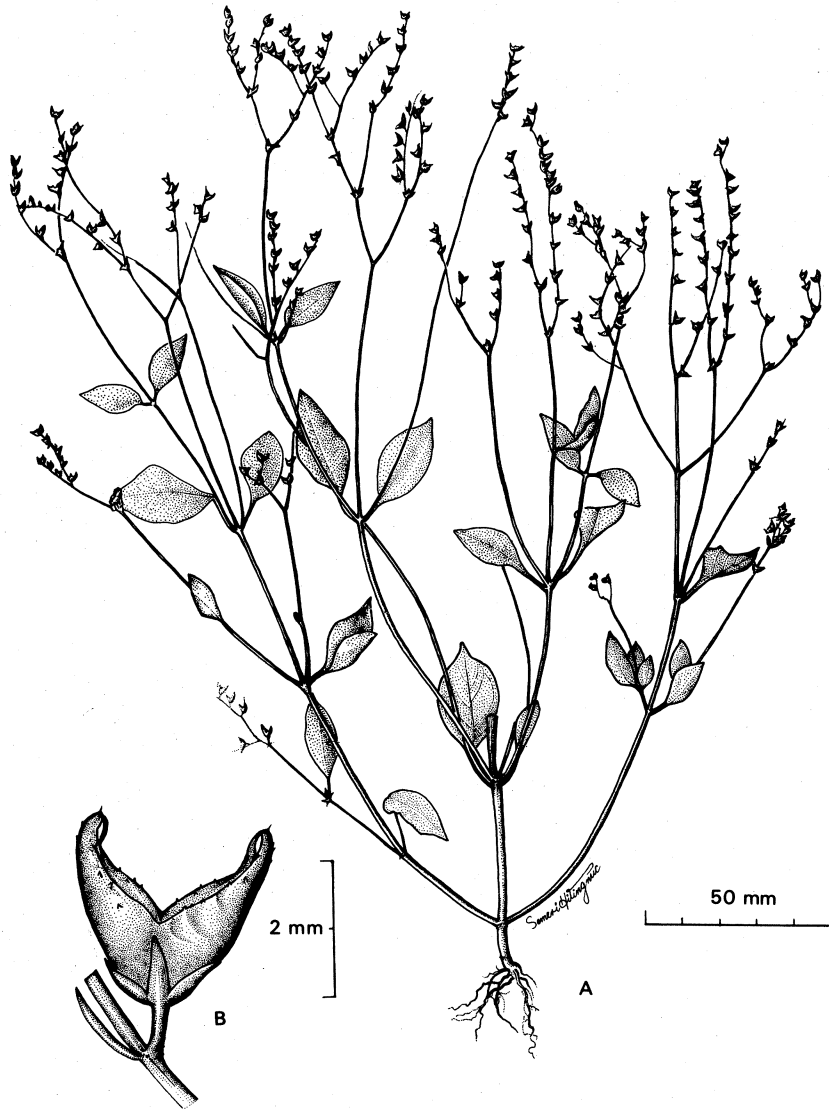


Fig. 39 *Mitreola petiolata* (Gmel.) Torr. & Gray (A) habit (B) fruit and calyx (source unknown)

4-merous. Sepals fused at base; lobes broadly ovate to suborbicular in outline, mostly fimbriate; inner surface usually with hairs and/or colleters at base. Corolla \pm salverform, white; tube thin-fleshy, inner surface of tube glabrous or hairy, mouth of tube with ring or \pm stiff, erect hairs; lobes valvate, fleshy. Stamens included, inserted on distal part of tube; filaments strap-shaped, glabrous; anthers 2-locular, introrse, basal lobes mostly obtuse, often bearded, apex often with connective extended to form a short apical appendage, rarely bearded. Pistil mostly glabrous; ovary 2-locular; ovules many; style often caducous; stigma \pm ellipsoid to club-shaped, sometimes truncate, faintly grooved, hollow. Fruits drupaceous; mesocarp dry, hard and fibrous; locules spindle-shaped, \pm curved. Seeds one per locule, mostly one per fruit, slender spindle-shaped.

Distribution: Approximately 10–12 species, in the Philippines, Celebes, Caroline Islands, Papuasia, New Hebrides, New Caledonia and Fiji. In Papuasia, there are 5 species.

Ecology: Mostly an understorey species of primary, occasionally secondary forests, rarely a canopy forming tree. Often located in ever-wet, marshy areas, from sea level to 2000 m.

Notes: Frequently misspelt as 'Neubergia'.

Literature: B. J. Conn (1979), Notes on *Neuburgia* Blume (Loganiaceae) in Papuasia, *Brunonia* 2: 99–105; (1981), Lectotypification of *Neuburgia corynocarpa* var. *sarcantha* (Loganiaceae), *ibid.* 4: 209–211.

KEY TO SPECIES

1. Corolla-tube c. 1.5 cm long; fruit curved spindle-shaped (when single seeded) *N. tubiflora*
1. Corolla-tube < 1 cm long
 2. Inflorescences usually much > 12 cm long; fruit orange-red *N. celebica*
 2. Inflorescences 2–10(–11) cm long; fruit orange-red or white
 3. Lamina tapering at both ends, elliptic to lanceolate, or oblanceolate, thin; anthers with one or two subulate apical appendages *N. kochii*
 3. Lamina never tapering at both ends, (leaves in *N. corynocarpa* occasionally tapering at both ends, but lamina thicker than in *N. kochii*), base and/or apex obtuse, rounded; anthers with triangular apical appendage or appendage absent
 4. Fruits white, curved or straight clavate; leaves glabrous *N. corynocarpa*
 4. Fruits orange(-brown), flattened; leaves mostly tomentose on lower surface . . *N. rumphiana*

Neuburgia celebica (Koord.) Leenh. *Fl. Males.* ser. 1. 6: 367 (1963).

Couthovia celebica Koord. (1898); *C. calophylla* Gilg. & Bened. (1921); *C. sarcantha* Cammerl. (1924), non Gilg. & Bened. (1916); *C. macrophylla* Merr. & Perry (1942).

Small to medium trees, (4–)7–30(–33) m high. Stem often flanged or fluted. Petiole (3–)5–30(–50) mm long. Lamina elliptic, broadly elliptic, to broadly obovate, sometimes \pm orbicular, (8–)11–23(–30) \times (7–)8–17(–25) cm, herbaceous to thin chartaceous, glabrous; base mostly broadly cuneate, sometimes obliquely subcordate to cordate, decurrent; margin entire or slightly undulate, occasionally sinuate; apex obtuse, occasionally rounded, shortly subacuminate; veins distinct, (5–)6–10(–12) pairs. Inflorescences (9–)11–21(–30) cm long, widely branched; peduncles shortly and densely tomentose or glabrous; many-flowered (usually at

least 150 flowers per inflorescence). Calyx 1-3(-3.5) mm long; outer surface mostly glabrous, sometimes densely tomentose; inner surface mostly glabrous, sometimes with hairs at base, rarely on lobes. Corolla 2-5(-6) mm long; outer surface glabrous to sparsely pubescent; inner surface of tube pubescent, sometimes finely woolly; lobes 1-2.5 mm long, finely papillose, sometimes papillose-pubescent on inner surface. Staminal filaments up to 1 mm long; anthers (0.6-)1-1.7(-2) mm long, lanceolate-oblong in outline, base obtuse, basal lobes free for up to 0.9 mm, glabrous, connective usually extended to form a broadly triangular apical appendage, often bilobed. Pistil glabrous; style 0.5-1(1.8) mm long; stigma globular to club-shaped, 0.5 mm long. Fruits ovate in outline (above a basal constriction), 3-4.5(-5) cm long, curved to straight, orange-red to red; base attenuate; apex obtuse.

Field characters: Bark thin, smooth; outer bark brown, straw-coloured to white; inner bark straw-coloured to white. Wood soft, straw-coloured to white.

Distribution: Occurs in the Caroline Islands, Philippines, Celebes, Moluccas and Papuaia. In Papuaia it has been collected from the Digul, Western, Gulf, New Britain and New Ireland districts, and on Santa Isabel and Malaita in the Solomon Islands.

Ecology: Commonly occurs in freshwater tidal swamp forests, in association with *Calophyllum*, *Myristica*, and *Heritiera*, on river banks, occasionally associated with mangrove community and so periodically flooded with saltwater. Also recorded from *Phragmites* swamp in peaty soils. Collected from well-drained soils in the Solomon Islands. It occurs at altitudes up to 240 m. Flowering in September to January, occasionally extending to April (or May). Fruiting January to April (to July).

Uses: Timber sometimes used for interior constructions.

Notes: This species is readily recognized by the long inflorescences and orange-red fruits.

Neuburgia corynocarpa (A. Gray) Leenh. *Fl. Males.* ser. 1, 6: 363 (1963). **Figs 40 & 41.**

Couthovia corynocarpa A. Gray (1859); *C. densiflora* K. Sch. (1905); *C. rhynochocarpa*, *C. terminaloides*, *C. pachypoda*, *C. brachyura*, *C. nymanii*, *C. sarcantha*, *C. astyla* Gilg & Bened. (1916); *C. brassii* S. Moore (1929); *C. novo-britannica* Kan. & Hat. (1939); *C. leucocarpa* Merr. & Perry (1942); *C. yunzaingensis* Merr. & Perry (1948); *Neuburgia sarcantha* (Gilg & Bened.) Leenh. (1962).

KEY TO VARIETIES

1. Corolla-tube (2-)2.5-4(-4.5) mm long; corolla-lobes (0.5-)0.8-1.5(-2) mm long; staminal filaments < 1 mm long; anthers (0.6-)0.7-1.2(-2) mm long, bearded or glabrous; style (0.3-)0.6-1.2(-2.8) mm long; stigma ovoid-obovoid; fruit 1.5-2.5(-5) mm long var. **corynocarpa**
1. Corolla-tube 4-8 mm long; corolla-lobes 1.5-4 mm long; staminal filaments 1-2 mm long; anthers 1.8-2.2 mm long, glabrous; style (0.9-)2.5-4 mm long; stigma truncate or ovoid to obovoid; fruit 3-6.5 mm long var. **sarcantha**

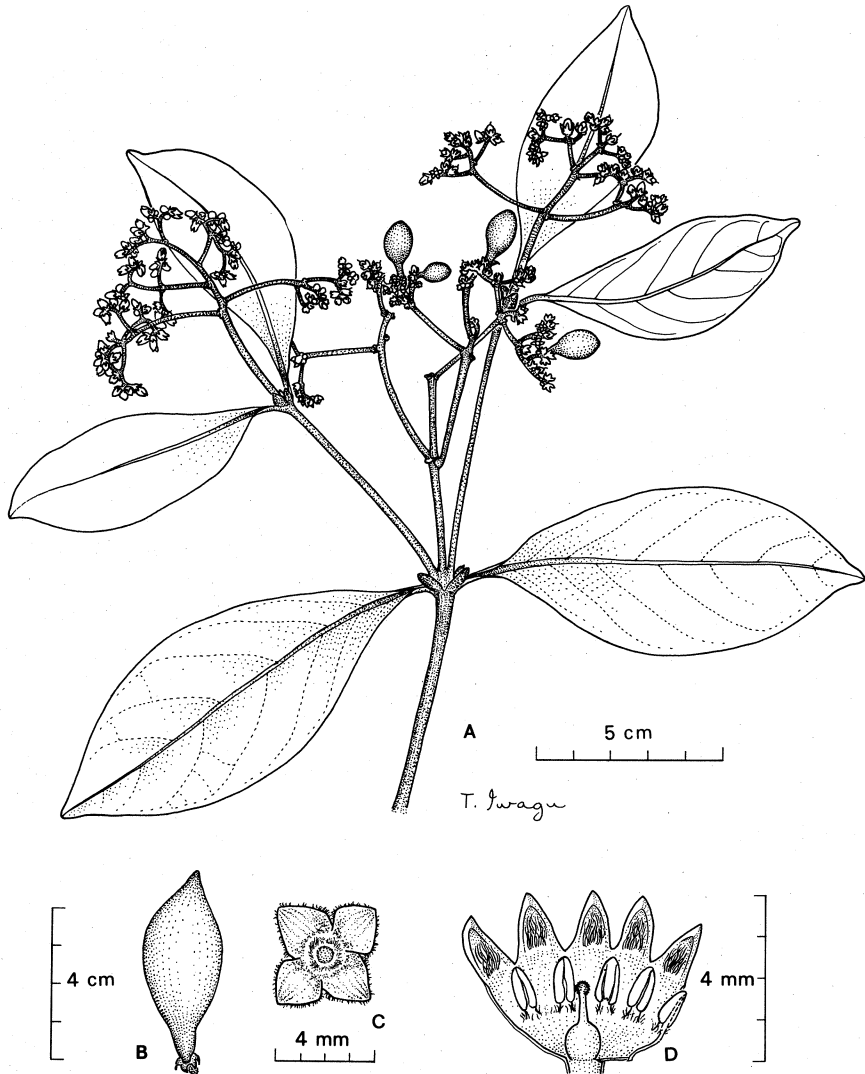


Fig. 40 *Neuburgia corynocarpa* (A. Gray) Leenh. var. *corynocarpa* (A) branchlet with flowers and fruits (*LAE 58658*) (B) fruit and calyx (*BSIP 17032*) (C) calyx with corolla and ovary removed, showing hairs at base of lobes (*Pullen 7448*) (D) open corolla, showing stamens and pistil (*Hoogland 5137*)

var. **corynocarpa**. Fig. 40 & 41.

Erect tree, up to 40 m high, mostly without buttresses. Petiole 3–10(–25) mm long. Lamina elliptic, obovate to broadly obovate, or orbicular, (6–)8–16(–28) × (2.5–)3–12(–20) cm, coriaceous to thick-coriaceous, glabrous; margin entire or undulate; base cuneate to rounded, often subcordate, decurrent; apex obtuse to rounded, subacuminate; veins indistinct, (3–)5–7(–11) pairs. Inflorescences (2–)4–7(–11) cm long, mostly widely branched; peduncles shortly and sparsely tomentose, occasionally densely tomentose, glabrous towards base of inflorescence, many-flowered (usually > 100 flowers per inflorescence). Flowers crowded. Calyx 1–2(–3.5) mm long; outer surface mostly glabrous, occasionally sparsely and shortly pubescent, rarely densely pubescent; inner surface with or without colleters and/or hairs at base; lobes with fimbriate margin, hairs up to 0.2 mm long. Corolla (2–)2.5–4(–4.5) mm long; outer surface mostly glabrous, rarely densely papillose-pubescent; inner surface of tube laxly woolly near the insertion of the stamens, or glabrous; lobes (0.5–)0.8–1.5(–2) mm long, finely papillose on inner surface. Staminal filaments up to 0.8 mm long; anthers sometimes broadly oval, (0.6–)0.7–1.3(–2) mm long, mostly sagittate in outline, base obtuse, subcordate, cordate to sagittate (when sagittate the obtuse basal lobes free for up to 0.6 mm), glabrous or bearded with spreading hairs; connective extended to form a broad to narrow triangular apical appendage, or connective not extended, then apex obtuse or sometimes faintly bilobed. Pistil mostly glabrous, sometimes sparsely hairy on ovary at base of style, particularly in bud; style (0.3–)0.6–1.2(–?2.8) mm long; stigma ovoid-obovoid, longest axis c. 0.5 mm long. Fruits ellipsoid to ovoid (above a basal restriction), 1.5–2.5(–5) × (0.5–)0.6–1.3(–2) cm, straight to curved, white (once recorded as red, LAE 60394); base broadly attenuate to subattenuate; apex mostly obtuse, sometimes acute.

Field characters: Bole usually straight, up to 20 m long; d.b.h. up to 1 m; crown large, deep, spreading and dense. Outer bark smooth to rough, fissured or flakey, white or pale brown to very dark brown; underbark light green; inner bark pale yellow-cream to white. Wood pale yellow-cream to white.

Distribution: Collected from the Kei and Aru Islands, almost all districts of Papuaia, and throughout the Solomon Islands.

Ecology: Often a canopy-forming species of primary forests. Also associated with swamp forests. Generally a low altitude species, occurring from sea level to altitudes of 1500(–2000) m.

Notes: At high altitudes, the leaves are generally smaller, more or less orbicular, and tending to be subfleshy.

var. **sarcantha** (Gilg & Bened.) Conn *Brunonia* 2: 104 (1979).

Couthovia sarcantha Gilg & Bened. (1916); *Neuburgia sarcantha* (Gilg & Bened.) Leenh. (1963).

Tree, (4–)7–25 m high. Petiole (5–)10–20(–25) mm long. Lamina broadly obovate to ± orbiculate, (9–)10–23(–26) × (7–)9–20(–24) cm, coriaceous, glabrous; base shortly cuneate, rounded to subcordate, sometimes obliquely so, decurrent;

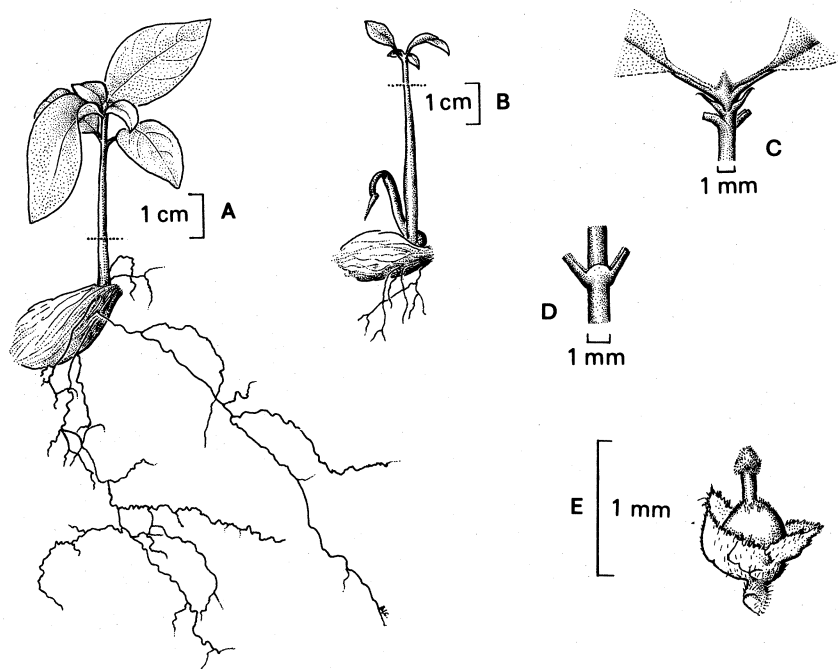


Fig. 41 *Neuburgia corynocarpa* (A. Gray) Leenh. var. *corynocarpa* (A & B) young seedlings (dotted line indicated soil level) (C) detail of growing shoot apex (D) detail of stipules (E) calyx and pistil (all live material, Lae Botanic Gardens, ex LAE 58658)

margin entire, slightly undulate; apex mostly broadly obtuse; veins distinct, (4 or)5 or 6(or 7) pairs. Inflorescences (5–)5.5–9(–12.5) cm long, widely branched, few to sometimes many-flowered (approximately 20- to 150-flowered); peduncles shortly tomentose or glabrous; flowers not crowded. Calyx 2–3.5 mm long; outer surface glabrous; lobes with fimbriate margin, hairs up to 0.1 mm long; inner surface with colleters and hairs at base. Corolla 4–8 mm long; outer surface glabrous; inner surface laxly woolly in tube, mostly at and above the point of insertion of the stamens; lobes 1.5–4 mm long, finely papillose on inner surface. Staminal filaments 1–2 mm long; anthers oblong to ovate in outline, 1.8–2.2 × 1 mm, base broadly obtuse with basal lobes free for up to 0.6 mm, glabrous, connective extended to form a broad triangular apical appendage. Pistil glabrous; style (2–)2.5–4 mm long; stigma broadly truncate, sometimes obovoid to ovoid, 0.3–0.5 mm long, diameter of apex 0.6–1(–1.3) mm (when truncate). Fruits ovoid (above a basal constriction), 3–6.5 × (1–)1.5–2(–2.5) × (0.7–)1.5–2(–2.5) cm; straight, white; base attenuate; apex narrowly to broadly obtuse.

Distribution: In Papuaia it occurs in the Digul, Sepik, Western Highlands, Western, Eastern Highlands and New Britain districts.

Ecology: Often associated with *Castonopsis* forests and *Pandanus* swamps. It occurs at altitudes from 400 to 2000 m.

Neuburgia kochii (Val.) Leenh. *Fl. Males.* ser. 1. 63: 363 (1963). **Fig. 42.**

Couthovia kochii Val. (1907); *C. urophylla* Gilg & Bened. (1916); *C. undulatifolia* Kan. & Hat. (1942).

Shrubs or small trees, (2-)2.5-4(-6) m, or sometimes scandent (NGF 14779). Petiole 2-15 mm long. Lamina ovate, elliptic to oblanceolate, (7-)11-18(-20) × (2-)4-7(-8) cm, thin chartaceous, glabrous; lower surface smooth; upper surface scabrous; base cuneate, decurrent; margin entire, sinuate to subsinuate, sometimes slightly undulate; apex curved, tapering acuminate, blunt to acute; veins indistinct to distinct, 5-9(-14) pairs. Inflorescences 2-4.5 mm long, mostly laxly and widely branched, 11-33(-57)-flowered; peduncles shortly and densely to sparsely tomentose, or glabrous; flowers ± crowded. Calyx 1-2.5(-3) mm long; outer surface glabrous, except sometimes minutely tomentose towards base; margin of lobes mostly fimbriate, hairs up to 0.1 mm long; inner surface with colleters at base. Corolla 3-5(-7) mm long; outer surface glabrous or rarely slightly pubescent; inner surface of tube glabrous or rarely sparsely hairy, mouth with stiff hairs, 0.9-1.5 mm long; lobes 1-2(-3) mm long, shortly papillose on inner surface. Staminal filaments 1.2-2 mm long; anthers lanceolate-sagittate in outline, rarely semi-hastate, (1-)1.3-1.6(-2) mm long; basal lobes obtuse, slightly membranous, slightly bearded with spreading stiff hairs, hairs 0.4 mm long, or glabrous; connective usually greatly extended to form a narrow linear-subulate apical appendage, often bilobed. Pistil glabrous; style 0.2-0.5(-1.5) mm long; stigma cylindrical-ellipsoid to oval-lanceolate in outline, 0.6-1 mm long. Fruits oblique, broadly ellipsoid to obovoid, above a basal constriction (generally flattened in herbarium material), 2.7-5(-6) × (1-)1.5-2 cm, curved, white or red; base attenuate; apex usually obliquely beaked, acute.

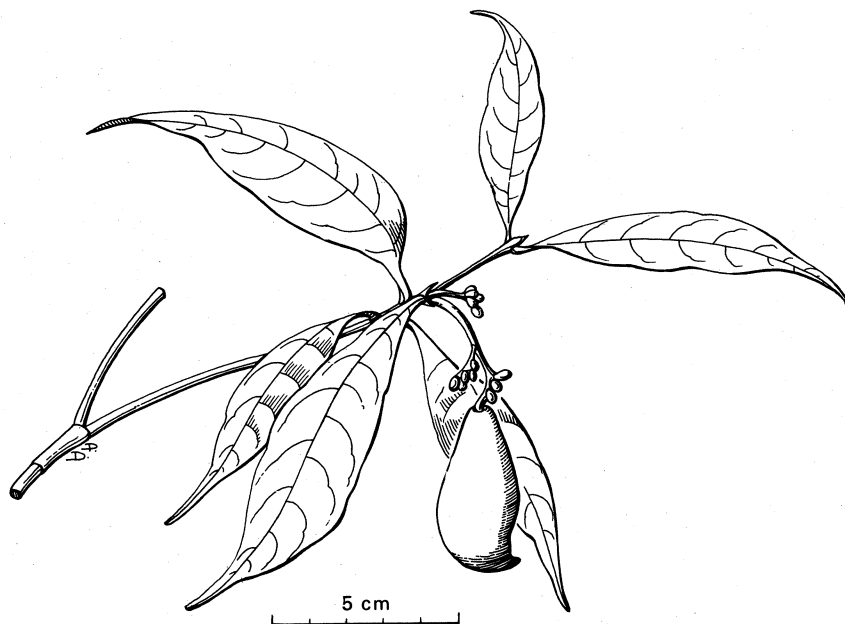


Fig. 42 *Neuburgia kochii* (Val.) Leenh. fruiting branchlet (live material, Lae Botanic Gardens)

Distribution: In Papuaia it occurs in the Vogelkop, Southern Highlands, Eastern Highlands, Gulf, Morobe, Central, Northern, Milne Bay and New Britain districts.

Ecology: An understorey species associated with regrowth areas, secondary and primary forests. Usually on well-drained soils, from sea level to 1100 m.

Neuburgia rumphiana Leenh. *Bull. Jard. Bot. Brux.* 32: 457 (1962).

Shrubs or small trees, 2–6 m high. Petiole 10 mm long, glabrous. Lamina oblong-elliptic to oblanceolate, (10–)17–37 × 5–14 cm, chartaceous to thin coriaceous; lower surface densely to sparsely tomentose, sometimes tomentum restricted to midrib and veins occasionally glabrous; upper surface glabrous; base acute to attenuate, decurrent; margin entire to slightly undulate; apex shortly acuminate, acute or blunt; veins 6–12 pairs. Inflorescences 2–4 cm long, densely ferruginous-tomentose; 20–50-flowered. Calyx 3–5 mm long; outer surface glabrous; inner surface with a few hairs and colleters at base only; lobes with fimbriate margin, hairs 0.2 mm long, ferruginous. Corolla 7–9(–10) mm long; outer surface glabrous; inner surface glabrous, except at the base of the lobes, hairs 1–1.8 mm long; lobes 2–3 mm long. Staminal filaments 1–2 mm long; anthers linear, 1.6–2.5 mm long, base bearded, apex corniculate and occasionally with a few bristles. Styles slender, 4–6 mm long; stigma narrowly club-shaped to ovoid, 0.7 mm long. Fruits flattened obovoid to broadly ellipsoid, 4–6 × 2–3 × 0.7–1 mm, red-orange; base attenuate in outline; apex tapering, sometimes acuminate in outline, tip acute.

Distribution: It occurs in the Geelvink Bay, Jayapura and West Sepik district of Papuaia.

Ecology: Associated with primary and secondary forest, often close to rivers and their associated swamp forests. It occurs from sea level to altitudes of 500 m.

Neuburgia tubiflora Bl. *Mus. Bot.* 1: 156 (1850).

Shrubs or small trees to c. 4 m high. Petiole 10–25(–50) mm long, glabrous. Lamina oval to obovate, 13–20 × 7–10 cm, herbaceous to thin-coriaceous, glabrous; base cuneate, ± decurrent; margin entire; apex obtuse to subacuminate; veins distinct, 3 or 4(–6) pairs. Inflorescences 3–6 cm long, laxly branched; peduncles glabrous, few-flowered. Calyx 3–3.5 mm long; outer surface glabrous; inner surface with colleters at the base. Corolla c. 20 mm long; outer surface glabrous; the ring of hairs in the mouth inserted on a thickened, lobed rim; inner surface of tube with shortly spreading hairs, except glabrous near the base; lobes 5 mm long. Staminal filaments inserted 5–5.5 mm above base; anthers ± lanceolate in outline, 3 mm long, base acute, membranous, basal lobes glabrous, locules free for up to 1 mm, connective extended beyond apex to form a broadly triangular apical appendage. Style 10 mm long; stigma ellipsoid, 0.8–0.5 mm. Fruits curved, spindle-shaped (when two-seeded), 5–5.5 × 1.8 cm; apex acute.

Distribution: Twice collected from Papuaia, both from the Vogelkop district of western New Guinea.

Ecology: Common in young secondary lowland forest. It occurs at altitudes of 50–230 m.

SPIGELIA L.

Annual or perennial herbs or small shrubs, glabrous or hairy. Stems mostly branched. Leaves opposite, often partly in a pseudowhorl at the base of the inflorescence, shortly petiolate or sessile, with interpetiolar stipules connecting petioles. Inflorescences usually cincinnous, terminal and/or axillary in the distal leaf axils. Flowers sessile or very shortly pedicellate. Bracts small, sepal-like. Calyx, corolla and androecium 5-merous. Sepals free or connate at the base; inside at base with some colleters. Corolla salverform; tube cylindrical; lobes valvate in bud, shorter than tube. Stamens included; anthers dorsifixed, lanceolate or ovate in outline, 2-locular, introrse. Ovary superior, 2-locular; ovules many. Fruit a 2-locular capsule, loculicidal and septicidal, 4-valves; valves caducous, except for basal cupular part; apex 2-lobed. Seeds globose to angular; surface verrucose; endosperm fleshy or cartilaginous.

Distribution: Approximately 50 species in tropical and subtropical America, one naturalized in West Africa, Malesia, and Papuaia.

***Spigelia anthelmia* L. *Sp. Pl.* 1: 149 (1753). Fig. 43.**

Annual herb, 2-70 cm high. Stems usually unbranched or sparingly so, erect, terete, glabrous. Leaves herbaceous, opposite; lower cauline leaves few, in pairs (often only one pair); apical leaves 4 in two opposite pairs forming a pseudowhorl; colleters in axils of leaves. Petiole up to 10 mm long. Lamina of lower leaves 2-4 × 0.3-1 cm; lamina of apical leaves 3-6 × 1-2 cm; base cuneate, ± decurrent; apex attenuate; lower surface glabrous; upper surface scabrid; penninerved, veins 3-5 pairs. Stipules triangular, glabrous; apex obtuse. Inflorescences terminal, racemose, usually in axis of the pseudowhorl upper leaves, 2-15 cm long; peduncles 2-15 cm long; bracts linear-lanceolate, 1-2 mm long. Flowers (sub-)sessile; pedicels 0.1-0.5 mm long, glabrous or nearly so. Sepals free, unequal in length, linear-lanceolate, 1.5-3 mm long, acute, glabrous or sparsely puberulous outside, pale green; colleters present at the base of inner surface. Corolla glabrous, white to red or purplish; tube 6-15 mm long; lobes triangular, 2-2.5 mm long, erect, apex acute. Stamens glabrous, inserted below middle of the tube; filament filiform, 1 mm long; anthers attached just above the base, lanceolate in outline, 1-1.75 mm long, apex obtuse. Pistil glabrous; ovary subglobose, 0.5-0.8 mm diameter; style cylindrical, 2-3 mm long; stigma ovate-lanceolate, 0.5 mm long, often pubescent near apex, caducous. Capsules 3-5 × 4-6 mm; surface distally tuberculate-squamulate, becoming smooth towards base; scales c. 0.3 mm long. Seeds obliquely ellipsoid or ovoid, 2-3 × 1.5-2 mm; surface tuberculate, dull brown.

Distribution: Mexico and Florida to Peru and Brazil; naturalized in tropical West Africa, Malesia and Papuaia. In Papuaia it has been collected from Kavieng, New Ireland district.

Ecology: In Malesia it occurs as a weed on sandy coastlines, river banks, gardens roadsides and in waste land areas. It occurs at altitudes up to 600 m. In Papuaia it was collected from sandy coastlines. Apparently rare.

Notes: In Malesia, a decoction of the roots is known to be a very effective vermifuge. It is reported to be very poisonous.

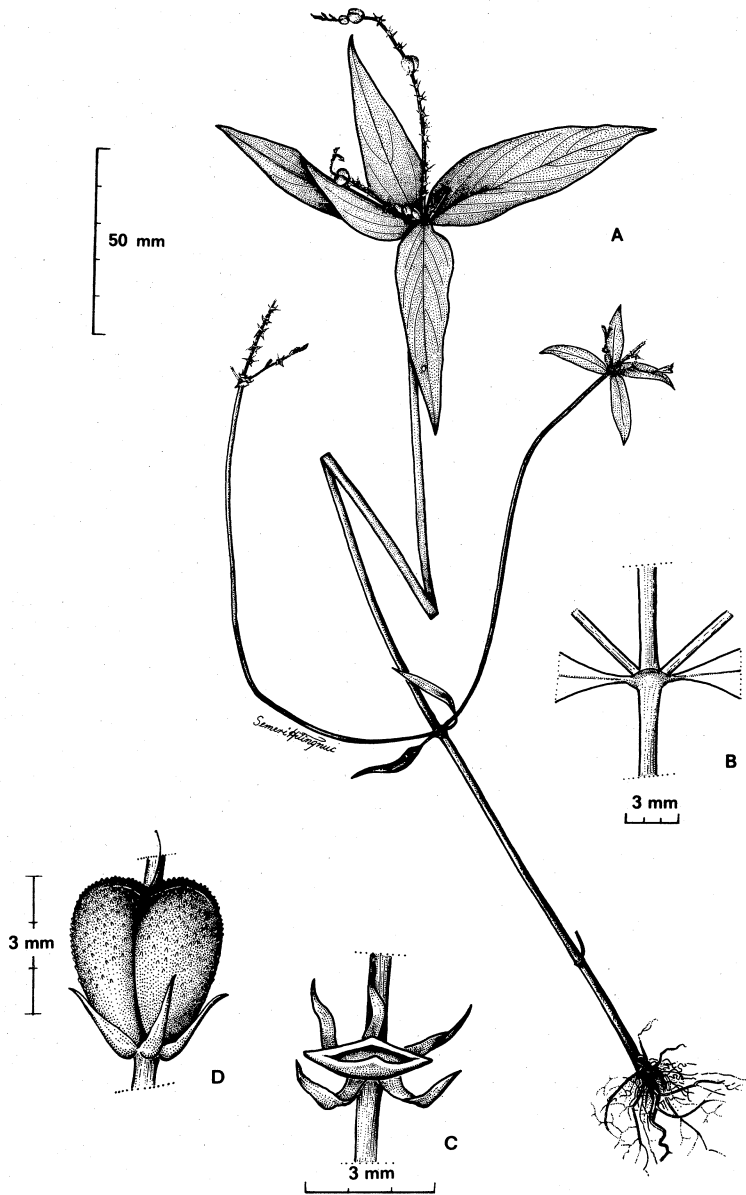


Fig. 43 *Spigelia anthelmia* L. (A) habit, with maturing fruits (B) detail of stipule and leaf-bases (C) calyx with persistent basal part of fruit (D) calyx and fruit, with style attached (source unknown)

STRYCHNOS L.

Woody climbers or trees, glabrous or with simple hairs. Branches often lenticellate, usually with axillary (solitary), or terminal (double) tendrils; the arrangement of tendrils may show aberrations, and so double tendrils may be lateral and/or axillary; sometimes with axillary thorns. Stipules reduced to ciliate and straight interpetiolar rim. Leaves mostly inserted upon nodal swellings, 3–5(–7)-plinerved. Some pairs of scale-like cataphylls are present at the bases of inflorescences and their branches, and bases of new shoots. Inflorescences axillary and/or terminal, thyrsoid. Calyx, corolla and androecium (4 or)5-merous. Sepals shortly connate at base; outer surface usually very sparsely hairy; inner surface glabrous, with colleters at base. Calyx lobes ovate to suborbicular, green, margin fimbriate. Corolla salverform, white to yellow or greenish, thin, to some extent thickened towards apices of lobes, lower part of tube (included by calyx) much thinner; outer surface densely papillose, mostly glabrous; inside hairy except glabrous at base; lobes triangular to oblong, valvate in bud, suberect to recurved when open. Stamens inserted in mouth to just exerted between corolla lobes; anthers 2-locular, slightly bifid at base, introrse. Pistil variously hairy or glabrous; ovary 2-locular, with few to many ovules; style cylindrical, persistent; stigma capitate or slightly 2-lobed. Fruit a berry, globose or ellipsoid, orange to red; pericarp thin, hard; outer surface smooth or minutely warty, glabrous; pulp fleshy. Seeds many, or 2 or 1, lenticular or orbicular to elliptic, usually convex on one side and concave on the other side; testa silky or felty; endosperm bony.

Distribution: Approximately 190 species in the tropics and subtropics. The greatest development of this genus is in Africa, with *c.* 75 species; America *c.* 48 species, Malasia *c.* 23 species; in Papuasias, 2 species.

Ecology: Large woody climbers in forest, sometimes shrub-like in more open vegetation. Many African spp. are trees. The dispersal of seeds is probably by large animals which digest the fruit pulp.

Uses: Curarine is sometimes used in the treatment of tetanus and hydrophobia. Strychnine is believed to act as an aphrodisiac. They are also used in treatment of cholera, asthma, dropsy, rheumatism and haemorrhoids. *Strychnos minor* Dennst. and *S. ligustrina* Bl. (= *S. lucida* R. Br.) are used as remedies for snakebite. The latter is also used as a tonic in fevers and a remedy for dyspepsia. A number of species are used as dart-poisons. The lianes are used as rope.

Notes: The genus is subdivided into 12 sections (Leeuwenberg and Leenhouts, in Leeuwenberg 1980). In Papuasias, two sections are represented. *Strychnos axillaris* belongs to section *Penicillatae* Hill whereas *S. minor* (incl. *S. ledermanii*) belongs to sect. *Lanigeriae* Hill.

Strychnos is known for its poisonousness. Many species are poisonous because they contain high concentrations of alkaloids in their roots, bark, leaves and seeds. The two types of alkaloids are: (1) those of the strychnine group, (most important ones being strychnine and brucine) produced by the old-world species; these cause tetanic convulsions; and (2) those of the curarine group, produced by American species, which cause paralysis.

Literature: N. G. Bisset, P. W. Leenhouts, A. J. M. Leeuwenberg, D. Philcox, C. Tirel-Roudet & J. E. Vidal (1973), The Asian species of *Strychnos*, Part II, Typification, miscellaneous notes, synoptic key, and sectional classification, *Lloydia* 36: 179. B. J. Conn & E. A. Brown (1993), Notes on *Strychnos* L. (Loganiaceae) in Australia, *Austral. Syst. Bot.* 6: 309–319. A. W. Hill (1909), LI.—Decades Kewenses. Plantarum novarum in herbario Horti Regnii conservatorum. Decas LIV. *Kew Bull.* 1909: 357–362; (1911), XXXVIII.—*Strychnos ignatii* and other East Indian and Philippine species of *Strychnos*. *Kew Bull.* 1911: 296–302; (1917), XIX—The genus *Strychnos* in India and the East. *Kew Bull.* 1916: 121–210. A. J. M. Leeuwenberg (1962), The Loganiaceae of Africa IV, *Strychnos* I. *Acta Bot. Neerl.* 11: 47; (1965), The Loganiaceae of Africa VII, *Strychnos* II. *Acta Bot. Neerl.* 14: 218; (1969), The Loganiaceae of Africa, *Strychnos* III. Revision of the African species with notes on the extra-African, *Meded Landbouwhogeschool* 69(1): 1–316.

KEY TO SPECIES

1. Inner surface of corolla with a band of white penicillate hairs in mouth or halfway up lobes; lower surface of lamina hairy on midrib, nerves, and veins, often restricted to base of lamina and petiole; tendrils solitary; pistil glabrous; seeds elliptic or orbicular, 1 or 2 per fruit **S. axillaris**
1. Inner surface of corolla with woolly hairs about mouth, sometimes extending from tube to lobes; lamina glabrous; tendrils double; ovary usually hairy or partly so, sometimes glabrous; style partly hairy, glabrous towards apex; seeds lenticular, many, or 1 or 2 per fruit **S. minor**

Strychnos axillaris Colebr. *Trans. Linn. Soc.* 12: 356 (1819). **Fig. 44E.**

S. oophylla, *S. polytoma* Gilg & Bened. (1916); *S. penicellata* Hill (1917).

Woody climber. Branches often lenticellate, twigs densely to sparsely minute pubescent, glabrescent, or sometimes glabrous; axillary spines sometimes present; tendrils solitary. Petiole 2–8 mm long, hairy to glabrous. Lamina rhomboid to suborbicular and/or elliptic to broadly lanceolate, 3–16.5 × 1.5 cm; base cuneate to subcordate; margin entire; apex cuneate, acuminate or rounded, sometimes subemarginate, acute to blunt; lower surface shortly hairy on midrib, nerves and veins, sometimes sparsely hairy all over surface or hairs restricted to basal portion of midrib and base of nerves, or glabrous; 3(–5)-plinerved. Inflorescences 1–7 cm long, subsessile or distinctly pedunculate, peduncles densely tomentose or glabrous; usually many-flowered. Calyx ovate to suborbicular, 1–2 mm long, green; outer surface glabrous to densely tomentose; inner surface glabrous; lobes with margin entire, fimbriate, hairs c. 0.1 mm long; apex acute to rounded. Corolla 3–4 mm long; yellow-cream coloured, basal half connate; lobes usually distinctly thickened towards apex; outer surface glabrous, papillose, rarely sparsely tomentose; inner surface glabrous, except for a band of white penicillate hairs in the throat or on basal half of lobes, hairs 0.5–0.6 mm long. Stamens included, inserted in corolla-tube, sometimes at the mouth, always below the indumentum; filaments very short, glabrous; anthers broadly ovate, 0.6–0.8 mm long, basally barbate. Pistil 1–1.8 mm long, glabrous; stigma capitiform. Fruits globular, diameter 8–12 mm, yellow to red, few to many; surface smooth, pericarp thin. Seeds 1(or 2) per fruit, either elliptic, 7–15 × 6–10 × 3–5 mm or orbicular, diameter 6–7.5 mm.

Distribution: From Assam through Siam to Cochin-China and Malesia. In Papuasia, it has been collected from the Vogelkop, Jayapura, Western, East Sepik, Gulf, Central and Morobe districts.

Ecology: It is associated with both primary and secondary forests, from dry savannah woodlands to swampy situations. In the Vogelkop district it has been collected from the beach front. It occurs at altitudes up to 1000 m.

Strychnos minor Dennst. *Schluss. Hort. Malab.* 33 (1818). **Fig. 44A-D.**

S. kerstingii Gilg & K. Sch. (1901); *S. pycnoneura*, *S. cinnamophylla*, *S. myriantha*, *S. ledermanii*, *S. leuconeura* Gilg & Bened. (1916); *S. colubrina* Hill (1917), non L.

Woody climber; branches usually lenticellate, twigs glabrous, branchlets greyish and generally smooth; tendrils double. Petiole 3–14 mm long, glabrous. Lamina variable, suborbicular or narrowly ovate to lanceolate, 4–20 × 1.5–11 cm; chartaceous to coriaceous, glabrous, smooth; base sub-cuneate or obtuse to broadly rounded; apex blunt to rounded, shortly blunt-acuminate to acutely acuminate, occasionally caudate, acumen 0.3–2 cm long; 3–5(–7)-plinerved, inner nerves often diverging above the base (usually *c.* 1 cm above base), sometimes at a different height. Inflorescences 4–22 cm long, laxly branched with 10–20 flowers on each, partly to completely sparsely tomentose to very sparsely hairy. Calyx broadly ovate to suborbicular, 1–2 mm long, green; outer surface occasionally glabrous, usually sparsely to densely short-tomentose; inner surface glabrous; lobes with margin fimbriate, apex blunt to rounded. Corolla 2–5 mm long, basal half connate; outer surface pale green to white, glabrous, papillose; inner surface white to yellow, always glabrous at base, long-pilose in distal part of tube to lobes. Stamens inserted in mouth to just exerted; filaments 0.5–1.5 mm long, white, mostly glabrous or sparsely pubescent; anthers ovate-lanceolate or elliptic to oblong in outline, 0.5–1 mm long, dark purple to brown, apex blunt to apiculate, glabrous or slightly barbate. Pistil 2–4 mm long, minutely pubescent to hirto-pilose especially in the middle, rarely glabrous; ovary usually glabrous at the base; style often glabrous, or becoming so towards apex; stigma capitate. Fruit globular, diameter 2–4 cm, orange or orange-yellow, thin-walled, glabrous; surface smooth to minutely warty, many fruits per infructescence. Seeds mostly flattened, irregular, ellipsoid, 12–30 × 10–18 × 2–5 mm, often irregularly curved; 1–8(–many), often 2 per fruit, wall of seed thin.

Distribution: Sri Lanka, India, Southeast Asia, Malesia and Australia. In Papuaia it has been collected from the Vogelkop, Fakfak, Jayapura, Western, Western Highlands, East Sepik, Gulf, Central, Morobe, Milne Bay, New Britain, New Ireland and Bougainville districts, and throughout the Solomon Islands, except, so far, the Rennell Group.

Ecology: Associated with primary and secondary forests. It occurs from sea level to altitudes of 1500 m

Notes: Leenhouts (1962) applied a broad-species concept to this taxon. It is believed that extensive field studies are required so that this taxon can be better understood. The reduction of some species to synonymy, particularly *S. pycnoneura* and *S. cinnamophylla* (both of New Guinea) may not be justified.

DUBIOUS SPECIES

S. melanocarpa Gilg & Bened. *Bot. Jb.* 54: 172 (1916).

As no specimens of this species have been seen and the description is inadequate, the status of this taxon cannot be resolved completely. However, provisionally, it is regarded as being conspecific with *S. minor*.

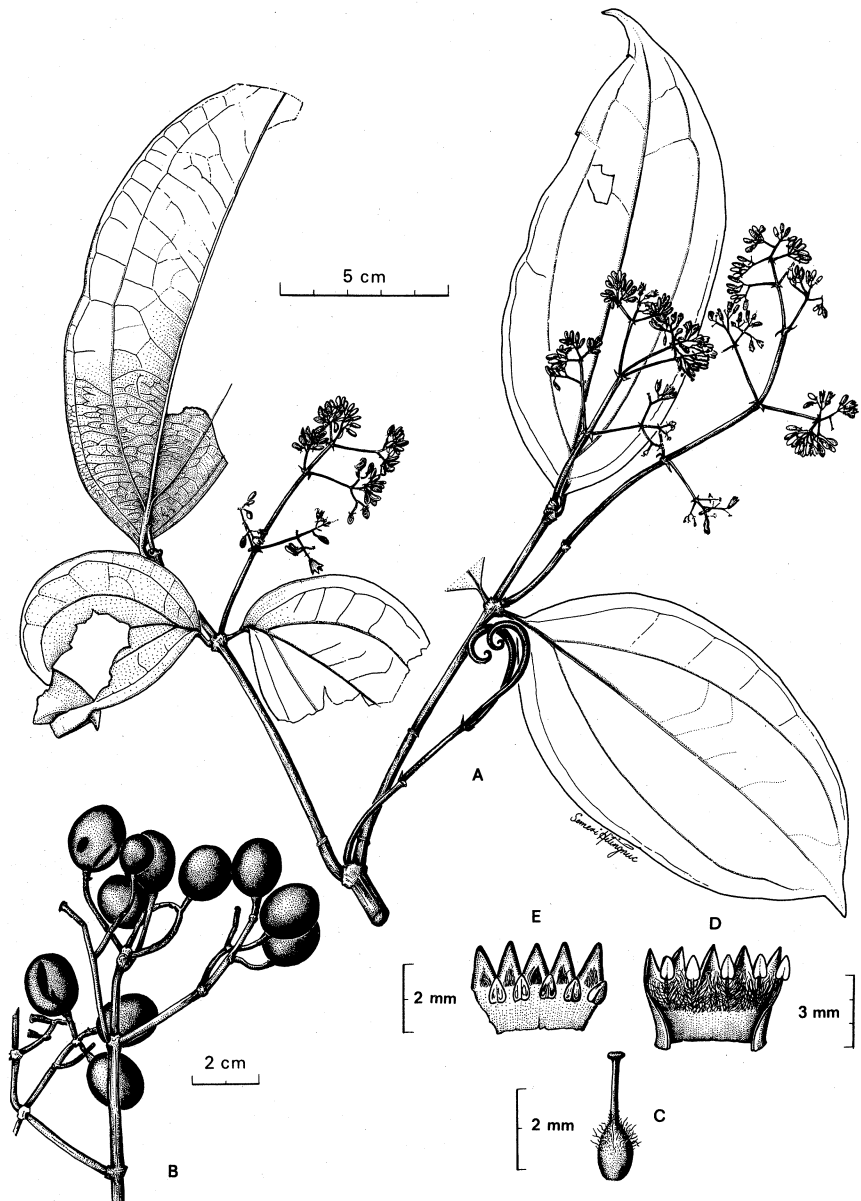


Fig. 44 *Strychnos minor* Dennst. (A) flowering branchlet (*Hoogland 10389*) (B) part of infructescence (*BSIP 4761*) (C) pistil (*NGF 2648*) (D) open corolla showing stamens and indumentum, with pistil removed (*NGF 26483*) *Strychnos axillaris* Collebr. (E) open corolla showing stamens and indumentum, with style removed (*van Royen 3514*)

NELUMBONACEAE

B. J. Conn¹

Robust perennial aquatic, acaulescent, rhizomatous herbs. Latex milky. Stipules axillary, 2-keeled. Leaves simple, arising from upper side of rhizome, usually emergent, sometimes floating and/or submerged. Petiole terete, long, arising directly from rhizome. Lamina large, generally orbicular and centrally peltate: submerged leaves \pm ovate and parallel-veined. Flowers axillary, solitary, emergent, large and showy, actinomorphic, perfect, fragrant (entomophilous); perianth not differentiated into sepals and petals; tepals numerous, at least 20, distinct, free, hypogynous, spirally arranged, gradually increasing in size towards the centre of the flower. Stamens numerous, c. 200–400, hypogynous, spirally arranged; filaments filiform or linear; anthers linear or oblong, tetrasporangiate, pollen grains tricolpate, connective prolonged to form a large apical appendage. Gynoecium composed of numerous (c. 12–40) distinct carpels arranged in 2–4 \pm distinct whorls, individually sunk in the enlarged, obconical spongy receptacle, only stigma visible; ovule solitary, rarely 2, pendulous, anatropous. Fruit (often mistaken for seeds) separate, hard walled, nut-like, loosely contained in cavities of the hardened receptacle; one seed per fruit; embryo without perisperm, endosperm small.

Distribution: The family consists of the single genus *Nelumbo* which has only two species. *Nelumbo pentapetala* (Walt) Fernald (syn. *N. lutea* (Willd.) Pers.) is native to southern and eastern North America. *Nelumbo nucifera* Gaertn. is native to the warmer areas of Asia to Australia. Both species have been introduced into many countries.

Notes: Van Royen (1962) regarded *Nelumbo* a part of the Nymphaeaceae. However, Li (1955) and Takhtajan (1959) regarded it as distinct from the other genera of the Nymphaeaceae and they proposed the new order Nelumbonales to accommodate this genus. Subsequent workers (e.g. Cronquist 1981, Dahlgren 1980, Khanna 1965, Thorne 1983) have supported Li and Takhtajan.

The Nelumbonales differ in many important features from the Nymphaeales, including the tricolpate pollen-grains (monosulcate in the Nymphaeales), the structure of the embryo, seed characteristics, the presence of laticiferous tubes, and the morphology of the chromosomes (Takhtajan 1969). The two orders appear to be unrelated.

Literature: B. J. Conn (1984), Nymphaeaceae, in G. J. Leach & P. L. Osborne (Eds), 'The freshwater plants of Papua New Guinea' (Univ. Papua New Guinea

¹ National Herbarium of NSW, Royal Botanic Gardens, Mrs Macquaries Road, Sydney, New South Wales, 2000, Australia.

Press: Port Moresby). R. Dahlgren (1980), A revised system of classification of the angiosperms, *Bot. J. Linn. Soc.* **80**: 91–124. A. Cronquist (1981), 'An integrated system of classification of flowering plants' (Columbia Univ. Press: New York). P. Khanna (1965), Morphology and embryological studies in Nymphaeaceae 11. *Brasenia schreberei* Gmel. and *Nelumbo nucifera* Gaertn., *Austral. J. Bot.* **13**: 379–387. H. L. Li (1955), Classification and phylogeny of Nymphaeaceae and allied families, *Amer. Midl. Nat.* **54**: 33–41. P. van Royen (1962), Sertulum Papuanum 5: Nymphaeaceae, *Nova Guinea*, *Bot.* **8**: 103–126. A. L. Takhtajan (1959), 'Die Evolution der Angiospermen' (Gustav Fischer Verlag: Jena); (1969), 'Flowering plants—origin and dispersal' (Oliver & Boyd: Edinburgh). R. Thorne (1983), Proposed new realignments in the angiosperms, *Nordic J. Bot.* **3**: 85–117.

NELUMBO Adans.

Description: Refer characteristics of family.

Distribution: Refer family. Only *N. nucifera* occurs in New Guinea.

Nelumbo nucifera Gaertn. *Fruct.* **1**: 73 (1789). **Fig. 45.**

Nelumbium speciosum Willd. (1799).

Petioles 0.5–1.5 cm long, diameter up to 1 cm, rising erect and holding the lamina above the water surface. Lamina generally orbicular, 20–60(–90) cm across; base with a shallow sinus; margin entire when leaf mature, small teeth present only when lamina very young, glabrous; lower surface finely punctate; upper surface glaucous, pale green; major veins radiating from a raised tubercle. Peduncle 1–2.5 m long, diameter 5–10 mm, holding flowers erect above the water surface. Flowers 15–25 cm across, showy, pink, sometimes purple-pink or pink-white, rarely white. Tepals elliptic-ovate; outer series 1.5–5 cm long, 1–4 cm wide, becoming obovate or spatulate towards the centre of the flower, then 6–12 cm long, 3–6 cm wide; apex \pm obtuse. Stamens 2.5–4 cm long, glabrous; filaments 1.5–2.5 cm long; anthers 1–1.5 cm long, yellow, apical appendage 4–8 mm long. Receptacle obconical, 2–6 cm high, distal diameter 2–12 cm, pithy, glabrous distally, \pm flat-topped. Fruiting receptacle 6–11 cm across, initially erect and emergent; as it ages it dries and hardens, becomes slightly woody and turns downwards, releasing fruit; fruit finally floating on the water surface.

Ecology: It is a lowland species that occurs in shallow sheltered waters of lakes, usually growing in mud to a depth of up to 2 m. In favourable conditions it may crowd out other aquatic vegetation.

Distribution: From southern Russia through Asia and Malesia to Australia. In Papuaasia it has been collected from Jayapura, West and East Sepik, Western and Morobe districts.

Uses: The fruits are edible and have been collected and used as food for livestock.

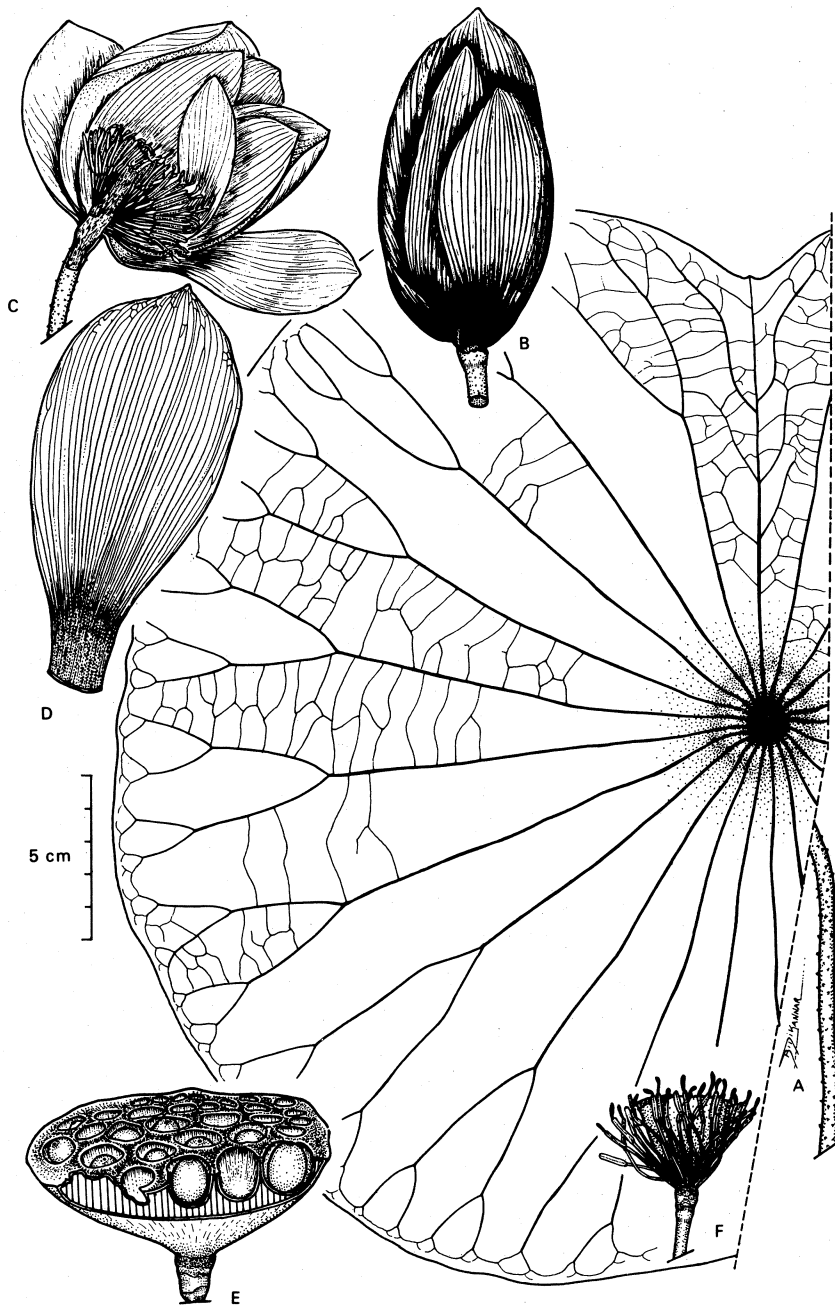


Fig. 45 *Nelumbo nucifera* Gaertn. (A) half of leaf (upper surface) and part of petiole (NGF 16774) (B) flower bud (ANU 21003) (C) half flower (NGF 16774) (D) detail of petal (NGF 16774) (E) spongy receptacle, partly sectioned to show embedded fruits (Brass 7593) (F) old flower with old stamens and developing fruit, after petals have fallen off (NGF 16774)

NYMPHAEACEAE

B. J. Conn¹

Perennial or annual aquatics with rhizomes or tubers. Leaves simple, arising directly from the rhizome, spirally arranged. Petiole \pm terete, long. Lamina emergent, floating or submerged; immature leaves with lamina rolled up and submerged; later (mature) lamina spreading, peltate or subpeltate, or petiole inserted at base of lamina; palmatinerved with lateral veins present between main veins. Flowers solitary, axillary or extra-axillary, long-pedunculate, emergent, usually showy, actinomorphic, bisexual, fragrant (usually entomophilous). Perianth differentiated into sepals and petals. Sepals 4–6(–14), free, hypogynous or epigynous. Petals 8–many, free or connate, equal or unequal in size, sometimes not distinct from petaloid staminodes, hypogynous or epigynous. Stamens many, spirally arranged, free, hypogynous or epigynous, sometimes inserted on corolla-tube; filaments filiform, broadly linear or ovate; anthers mostly linear, tetrasporangiate and bilocular, dehiscence introrse with 2 longitudinal slits, connective often prolonged to form an apical appendage, sometimes some of the inner or outer ones sterile; pollen grains monosulcate. Carpels (3–)5–35, \pm united and sunk into a compound, plurilocular spongy receptacle, or laterally connate; stigmas united into a broad radially grooved and marginally lobed disc; ovules numerous, anatropous. Fruit a caryopsis and nut-like, or a syncarpous berry; seeds small, with or without an arillus; embryo with copious perisperm and little endosperm.

Distribution: The family has its greatest development in the tropics of South America. As defined here, the Nymphaeaceae consists of 6 genera with c. 65 species (Cook et al. 1974). In Papuasia there are 2 genera (*Hydrostemma* and *Nymphaea*) consisting of 7 species. *Nelumbo* is treated in the Nelumbonaceae not in this family (cf. van Royen 1962).

Uses: Many species of *Nymphaea* are commonly cultivated for horticultural purposes.

Notes: To assist in the comparison and identification of *Nelumbo* (Nelumbonaceae) from the two genera of the Nymphaeaceae, the former genus is included in the key to the genera of the Nymphaeaceae (see below).

Frequently, *Hydrostemma* is placed in the separate family Barclayaceae (e.g. Li 1955, Cronquist 1981, Takhtajan 1959).

Literature: B. J. Conn (1984), Nymphaeaceae, in G. J. Leach & P. L. Osborne (Eds), 'The freshwater plants of Papua New Guinea' (Univ. Papua New Guinea

¹ National Herbarium of NSW, Royal Botanic Gardens, Mrs Macquaries Road, Sydney, New South Wales, 2000, Australia.

Press: Port Moresby). C. D. K. Cook et al. (1974), *Water plants of the World* (W. Junk b.v.: The Hague). R. Dahlgren (1980), A revised system of classification of the angiosperms, *Bot. J. Linn. Soc.* **80**: 91–124. A. Cronquist (1981), 'An integrated system of classification of flowering plants' (Columbia Univ. Press: New York). H. L. Li (1955), Classification and phylogeny of Nymphaeaceae and allied families, *Amer. Midl. Nat.* **54**: 33–41. P. van Royen (1962), *Sertulum Papuanum* 5: Nymphaeaceae, *Nova Guinea*, Bot. **8**: 103–126. A. L. Takhtajan (1959), 'Die Evolution der Angiospermen' (Gustav Fischer Verlag: Jena); (1969), 'Flowering plants—origin and dispersal' (Oliver & Boyd: Edinburgh).

KEY TO GENERA

1. Sepals and petals not distinctly different; carpels free, superior, all sunk into a common spongy receptacle; styles present; stigmas distinct; ovule one per carpel; fruit nut-like; lamina distinctly peltate; lamina, flowers and fruits emergent NELUMBO
(see Nelumbonaceae)
1. Sepals and petals distinctly different; carpels connate, to form a many-locular inferior or semi-inferior ovary; style absent; stigmas united to form a depressed stigmatic disc at the upper surface of the ovary; ovules numerous per capel; fruit a spongy, mucilaginous berry; lamina peltate (but appearing to be cordate) or not peltate, generally floating on surface or submerged, flowers on or above the surface; fruit below the surface.
2. Sepals 5; petals connate, forming a corolla-tube; mature lamina submerged HYDROSTEMMA
2. Sepals 4; petals free; mature lamina usually floating on the water surface NYMPHAEA

HYDROSTEMMA Wall.

Barclaya Wall.

Perennial herbs; rhizome tuber-like. Leaf lamina usually submerged and erect; subcoriaceous or membranous when dry; upper surface glabrous; base cordate; margin entire; midrib prominent below. Flowers emergent. Sepals 5, unequal. Petals connate, forming a corolla-tube. Stamens adnate to the corolla-tube, incurved, numerous; outer apical series sterile and morphologically gradually changing into petals. Ovary superior, 6–12-locular, with locules arranged in a whorl; ovules numerous; placenta lamellate; style absent; stigmas radiate, with abaxial appendages that curve over the stigmas. Fruit many-seeded; seeds without arillus, surface usually with soft hairs present.

Distribution: Three species occurring in Asia and Malesia; only one of them in Papuasias.

Ecology: In shallow water at low altitudes.

Notes: Mabberley (1982) proposed that the name *Hydrostemma* should be used instead of *Barclaya*.

Literature: S. -Y. Hu (1968), Studies in the Flora of Thailand; the genus *Barclaya* (Nymphaeaceae), *Dansk. Bot. Arkiv.* **23**: 533–540. D. J. Mabberley (1982), William Roxburgh's 'Botanical description of a new species of Swietenia (Mahogany)' and other overlooked binomials in 36 vascular plant families, *Taxon* **31**: 65–73. Also see under family.

Hydrostemma motleyi (Hook. f.) Mabberley *Taxon* 31: 68 (1982). Fig. 46.

Barclaya motleyi Hook f. (1860); *B. motleyi* forma *membranacea* Royen (1962).

Petiole (3-)7-16(-24) × (1.0-)0.2-0.5 cm, tomentose. Lamina broadly ovate to elliptic, or sometimes oblong-elliptic, 3-17 × 3-14 cm; lower surface grey- or yellowish brown tomentose, mostly restricted to midrib and veins; upper surface finely punctate; base usually cordate, sometimes obliquely cordate (when lamina oblong-elliptic, base only shortly cordate or not at all), with basal lobes obtuse; margin entire, sometimes irregularly sinuate; apex rounded; midrib and main veins prominent below, sometimes less prominent towards apex, inconspicuous above. Pedicels 5-14 cm long, moderately to densely tomentose, rarely glabrous. Sepals linear, 2.5-4.5 × 0.3-0.6 cm, brown; margin membranous; apex subulate, sometime falcate; outer surface shortly pubescent to generally woolly with yellowish brown or grey hairs; inner surface glabrous. Corolla up to 4 cm long, lobes inserted on the tube at different levels, ovate, glabrous. Stamens adnate to corolla-tube; outer apical series sterile; inner basal series 1.5-2 mm long with free parts of filaments usually < 0.2 mm long or absent, but becoming longer in the more apical stamens; anthers oblong, incurved and downward curved, 1.4-2.5 mm long; filaments of staminodes ± ovate, 2.5-4 × 1.5-2.5 mm, curved inward and downward, antheroids becoming smaller and less distinct toward outer series; ovary obconical, 3-4 × 3-4 mm; stigma 2-3 mm long, with an ovoid apical appendage 1.5-2.5 × 1-1.5 mm, cordate. Fruits globose, 1-1.5 cm across, calyx persistent, glabrous. Seeds ellipsoid, 2 × 1 mm, surface with scattered soft hairs at apex and base.

Distribution: Sumatra, Borneo, and Papuaasia; in Papuaasia, collected from the Vogelkop, Fakfak, Digul, Sepik, Morobe, Western Highlands and Western districts.

Ecology: In shallow, often muddy, pools and watercourses, associated with sago swamps and small muddy or gravelly streams in forests, from sea level to altitudes of 1500 m.

NYMPHAEA L.

Perennial herbs with ascending or creeping rhizomes, or with tubers that form long runners. Petiole terete, distally thickened. Lamina usually floating on or sometimes just below the surface, peltate or subpeltate, usually with a deep sinus on one side; upper surface glabrous; margin entire or dentate, crenulate or repandous; midrib prominent, midrib and main veins arising from a tubercle, the lateral veins of the midrib and the main veins anastomosing as they approach the margin (usually for the outer half of their length, gradually decreasing in size towards the margin). Flowers usually floating on or emergent (up to 10 cm) above the water surface, actinomorphic, large, conspicuously coloured, fragrant. Sepals usually 4, hypogynous. Petals numerous, variable, free, hypogynous or epigynous. Stamens adnate to or just below apical margin of the ovary, very numerous, usually the outer series larger than the inner series, often incurved over stigmas; filaments narrower or broader than the anthers; anthers usually oblong or linear,

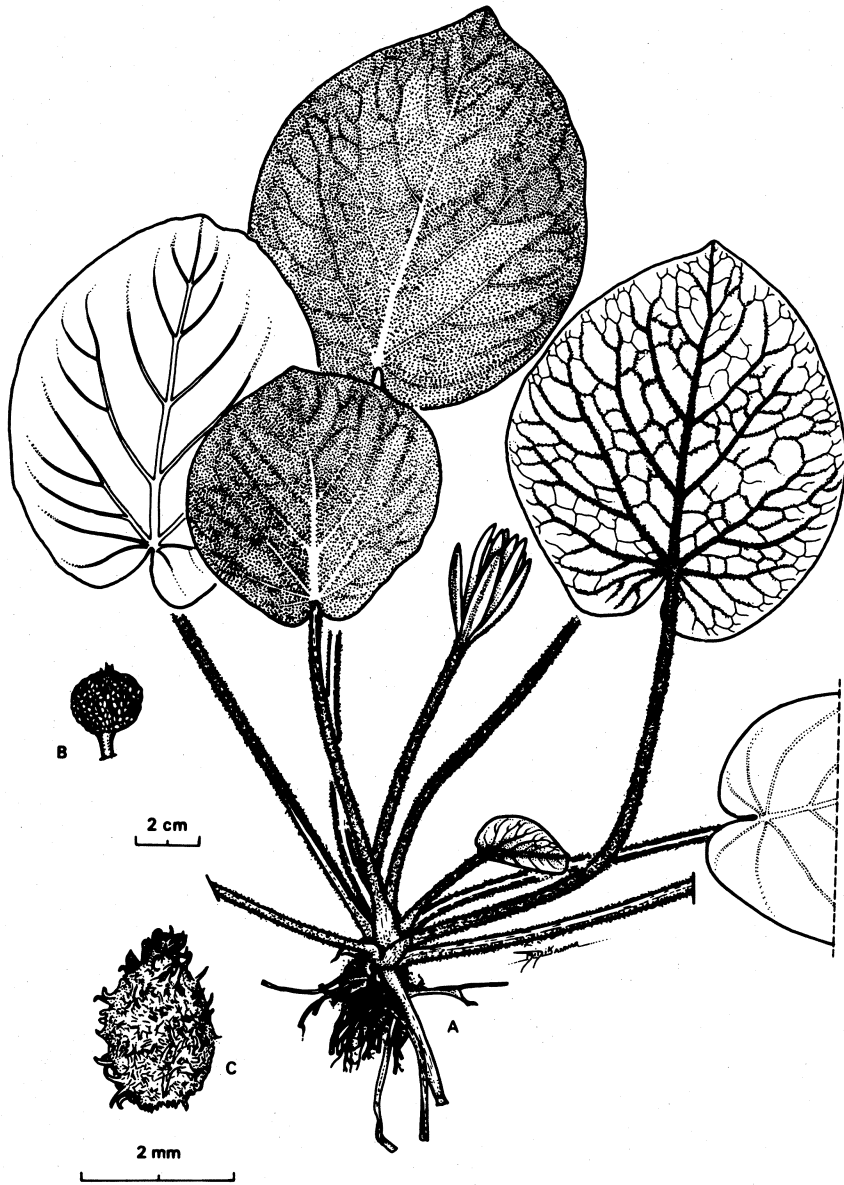


Fig. 46 *Hydrostemma motleyi* (Hook. f) Mabberley (A) habit (NGF 7323) (B) fruit (NGF 36561) (C) seed (NGF 36561)

sometimes the connective prolonged to form an apical appendage. Ovary superior, many-locular, with locules arranged in a whorl, septa double (single in *N. pubescens*); ovules numerous, anatropous; placentas lamellate; style absent; stigmas as many as ovary locules, radiate, outer end usually raised and bilobed, with or without an apical appendage, inner end free or connate. Fruits retracted and ripening under water, often retracted to muddy substrate, spongy, many-seeded, the wall of fruit gradually dissolving. Seeds small, with clear membranous arillus.

Distribution: Approximately 40 species. In Papuasias there are 6 species.

Ecology: Found at low altitudes in lakes, swamps, always in stagnant or very slow-moving waters.

Uses: Used extensively as ornamentals in artificial ponds, in temperate, subtropical and tropical regions at low altitudes.

Notes: The recent work on the genus by S. W. L. Jacobs (National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, Australia) has greatly added to our understanding of this taxonomically difficult genus.

Literature: B. J. Conn (1984), Nymphaeaceae, in G. J. Leach & P. L. Osborne (Eds), 'The freshwater plants of Papua New Guinea' (Univ. Papua New Guinea Press: Port Moresby). S. W. L. Jacobs (1992), Nymphaeaceae, in J. R. Wheeler et al. (Eds), 'Flora of the Kimberley region' (Western Australian Herbarium: Como); (1992), New species, lectotypes and synonyms of Australasian *Nymphaea* (Nymphaeaceae), *Telopea* 4: 635-641; (1994), Further notes on *Nymphaea* (Nymphaeaceae) in Australasia, *Telopea* 5: 703-706; (in press), Nymphaeaceae, 'Flora of Australia', vol. 2 (Austral. Governnt Publishing Service: Canberra); K. C. Landon (1978), Intraspecific classification of *Nymphaea gigantea* (Nymphaeaceae), *Phytologia* 40: 437-455. Also see under family.

KEY TO SPECIES

1. Lamina margin entire or with round or obtuse lobes (sometimes subpinnate in *N. nouchali*)
 2. Stamens inserted immediately above petals, not distinctly separate; filaments broadly ovate; petals white, rarely pink
 3. Staminal filaments 0.6- c. 1 mm wide at base, thin and membranous **N. elleniae**
 3. Staminal filaments 3-4 mm wide at base, slightly thickened, not membranous . . . **N. nouchali**
 2. Stamens distinctly separate from petals; filaments filiform; petals blue or violet, never white **N. violacea**
1. Lamina margin with acute teeth
 4. Lower surface of lamina pubescent, sometimes hairs restricted to veins **N. pubescens**
 4. Lower surface of lamina glabrous
 5. Petals white, with outer whorls often tinged blue, less commonly all white or all blue; sepals 5-10.5 cm long; staminal filaments membranous to cylindrical; anthers 6-15 mm long; sinus of lamina closed and margin of opposite basal lobes overlapping **N. immutabilis**
 5. Petals purple, blue or rarely pink; sepals 2.5-4 cm long; staminal filaments linear; anthers 3-5 mm long; sinus of lamina open **N. macrosperma**

Nymphaea elleniae S. W. L. Jacobs *Telopea* 4: 635 & 636 (1992).

Perennial with vertical elongated rhizome. Juvenile submerged leaf laminas often retained for several years, sagittate, usually red. Mature lamina to 22 cm

long, 18 cm wide; lower surface often red, especially toward the margin; margin entire to slightly sinuate. Flowers held to 20 cm above the water surface. Sepals 4, to 7 cm long, green outside with purple flecks; margin membranous, white; apex acute or occasional obtuse. Petals to 25, narrowly ovate, white; apex acute to obtuse. Stamens to c. 100, grading into the petals, not distinctly separate; filaments narrowly triangular, to 18 mm long, 0.6–c. 1 mm wide at base, thin and membranous; anthers to 8.5 mm long, sometimes slightly apiculate. Carpels 11–22. Ovary lobed. Fruit globose, c. 2.5 cm diameter. Seeds numerous, elliptical, c. 1.7–2.5 mm long, c. 1–1.5 mm diameter, glabrous; cells of the testa with a small lumen, occasionally raised relative to the arms, with arms of unequal length, ends neither expanded nor raised.

Distribution: Occurs in the Western district of Papua New Guinea and Cape York Peninsula (in and north of the Jardine River), Queensland, Australia.

Ecology: It grows in more or less permanent water to a depth of 5 m. Flowering ? April to December; flowers open all day, closing at night.

Notes: This species differs from *N. violacea* in always having white flowers, shorter staminal filaments, usually smaller flowers and leaves. It also often retains its juvenile leaves for a longer period.

Nymphaea immutabilis S. W. L. Jacobs *Telopea* 4: 637 & 638 (1992).

N. giganteae sensu Royen (1962); sensu Conn (1984), non Hook f. (1852).

Annual or perennial herb, with vertical globular rhizome usually < 8 cm long. Mature lamina orbicular, ovate or cordate, 20–c. 70 × 15–40 cm; base peltate, sinus usually closed with adjacent margins overlapping each other; margin dentate; teeth triangular, acute, 2–4.5 mm long, regularly-spaced (5–25 mm apart), with margin between the teeth straight; surface glabrous; midrib flexuose or straight, prominent below, grooved above, main veins and midrib arising from a large raised tubercle. Flowers held up to 50 cm above the water surface, 6–30 cm across. Sepals 4, 5–10.5 cm long, 2.5–5 cm at greatest width, green on the outside with purple flecks; margin membranous and coloured, the same as the outer petals; apex obtuse. Petals 18–34, in two series, narrowly obovate to spatulate, white, with outer whorls often tinged blue, less commonly the petals all white or all blue, usually not fading with age; apex obtuse, although sometimes mucronate. Stamens distinctly separate from petals, 350–c. 400; filaments membranous to cylindrical, to 28 mm long; anthers incurved, 6–15 mm long, connective prolonged to form an ovate apical appendage, acumen to 1.5 mm long. Carpels 9–20. Ovary semi-globose, 1–2.4 × 1.5–3 cm, glabrous, distally lobed. Fruit globose, c. 5 cm diameter. Seeds numerous, ellipsoid, c. 4 mm long, c. 2.5 mm wide, with discontinuous or disorganized rows of short hairs that sometimes almost appear scattered; cells of the testa having an elongated lumen with arms of equal to unequal length, ends sometimes slightly expanded but not raised.

Distribution: Jacobs (1992) records this species as widespread in the monsoonal parts of the Australian tropics from the Kimberley, Western Australia to about the Tropic of Capricorn in coastal Queensland. Material from Merauke in the Digul district are probably referable to this species (see Notes below).

Ecology: In permanent or ephemeral waterholes. Flowering from (March, Jacobs 1992) July to October; flowers open during the day and closed at night. Fruiting from August to December.

Notes: At various times this species has been included in *N. gigantea* (Royen 1962; Conn 1984) or incorrectly known as *N. dictyophlebia* (= *N. macrosperma*). The petals of this species usually do not change colour with maturity, whereas the flowers of *N. gigantea* are initially coloured, but usually fade with age. Although the identity of the plant referred to *N. gigantea* by Royen (1962) is unclear, it seems likely that it is *N. immutabilis*, although his description does include features typical of *N. macrosperma*. Additional collections are required to verify the name of these populations.

Nymphaea macrosperma Merr. & Perry *J. Arnold Arbor.* 23: 389 (1942).

Nymphaea dictyophlebia Merr. & Perry (1942).

Petiole 2–10 mm wide, distally thickened, surface usually finely warty. Lamina suborbicular or elliptic-cordate, 17–35 × 14–40 cm; base peltate or subpeltate, sinus open, with basal lobes acute or acuminate; margin dentate, with teeth up to 3 mm long, the margin between the teeth approximately straight or slightly concave, or convex, the surface finely punctate, glabrous; midrib prominent below, grooved above, main veins and midrib arising from a raised tubercle. Flowers 4–9 cm across. Sepals ovate-elliptic to obovate, 2.5–4 × 1–2 cm, obtuse; outer surface glabrous; inner surface warty. Petals 12–26, ovate, elliptic-ovate, or obovate, 2–4 × 0.7–1.5 cm, purple, blue, or rarely pink; apex obtuse. Stamens 150–500, distinctly separate from sepals and petals, 0.6–2.5 cm long, all curved and tending to cover the stigmas. Anthers and filaments linear; filaments 0.5–2 cm long, glabrous; anthers 3–5 mm long, apical appendage less than 0.5 mm long. Ovary obovoid, 0.6–1.2 × 0.4–1 cm, 6–15-locular, apex sunken in the middle, outer surface glabrous; stigmas obovoid, 2–4 mm long, 1 per locule, apical half free, with apex obtuse, retuse or 3-lobed. Fruits globose or ovoid-globose, 2–3 × 2–3.5 cm, the flat apex usually with remnants of stigmas, anthers and petals. Seeds numerous, 3 × 2 mm, surface with numerous rows of short hairs.

Distribution: Australia and Papuaia. In Papuaia it has been collected from the Jayapura, Sepik, Morobe, Digul, Western and Central districts.

Ecology: A low altitude species, often abundant in the open waters of lakes and swamps in water up to 4 m deep. Flowering and fruiting from August to December.

Notes: Jacobs (1992) concluded that the names *N. macrosperma* and *N. dictyophlebia* refer to the one species. The application of these names has been confused, although *N. macrosperma* has been used correctly more frequently than *N. dictyophlebia*.

Nymphaea nouchali Burm. f. *Fl. Indica* (1768) 120. **Fig. 47.**

Nymphaea minima sensu Bailey (1883), non Reichenbach (1830).

Petiole diameter (1–)2–3(–5) mm. Lamina elliptic-orbicular or round, (5–)12–24(–45) × 5–20(–32) cm, glabrous, but upper surface often finely punctate, lower surface often reddish; base peltate, with basal lobes obtuse, sinus

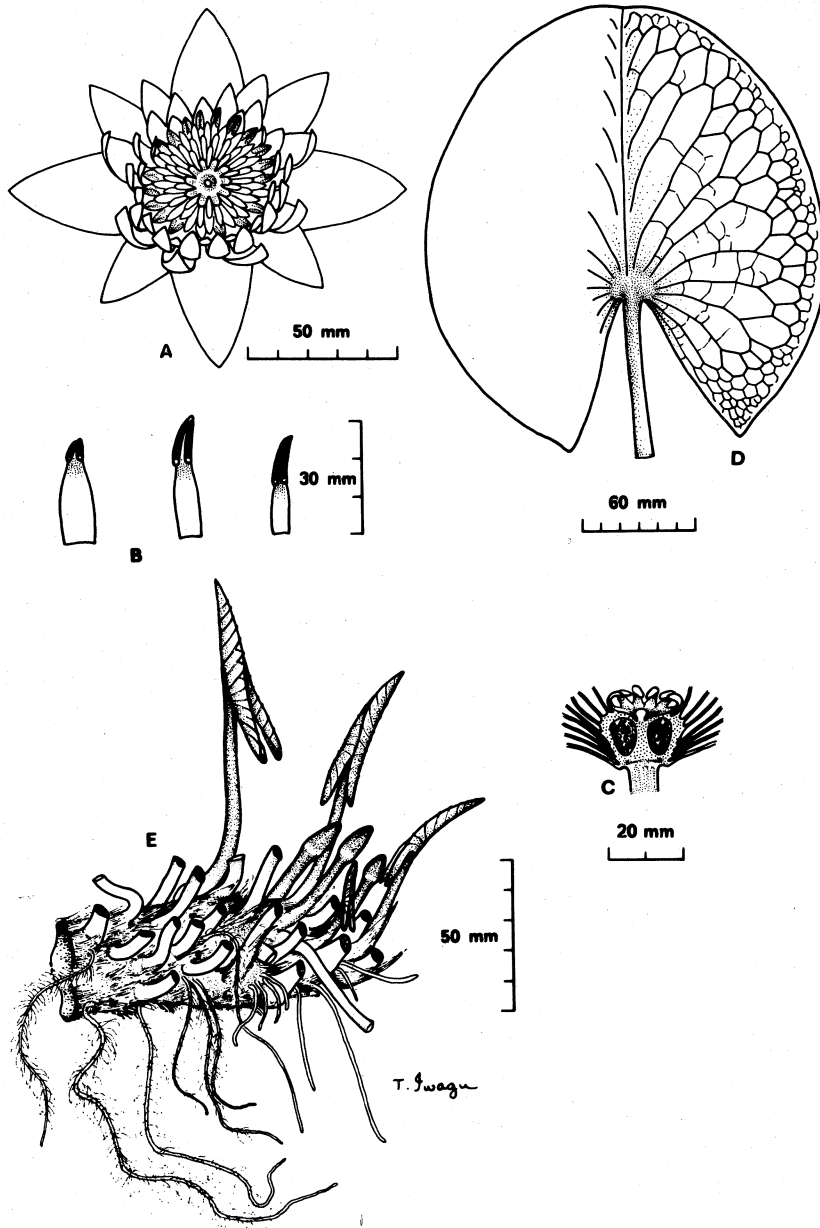


Fig. 47 *Nymphaea nouchali* Burm. f. (A) flower—viewed from above (B) stamens from outer three series of the androecium (C) longitudinal section of gynoecium showing ovary, ovules, stigmas and base of stamens and perianth (D) leaf (E) rhizome with young leaves and buds (all live material, Lae Botanic Gardens)

generally open; margin entire, sometimes irregularly sinuate; apex rounded or sometimes retuse; midrib prominent and angular below, grooved above, midrib and main veins arising from a slightly raised tubercle. Flowers 5–8(–12) cm across. Sepals \pm ovate (2–)3–6(–9) \times (0.7)1–1.5(–3) cm, dark purple; apex obtuse, grooved; surface glabrous; veins 11–16. Petals 6–18, elliptic or \pm ovate 2.5–6 \times 0.5–1.5 cm, white, rarely pinkish; apex obtuse, rarely acute. Stamens 15–65, situated close to corolla, outer series 1.5–2.5 cm long, inner series up to 1.5 cm long; filaments narrowly ovate to narrowly triangular, 7–16 mm long, 3–4 mm wide at base; anthers 5–15 mm long, those of inner series longer than filaments, connective extended to form apical appendage 0.5–1 mm long. Ovary globose to obovoid, 0.7–1.5 \times 0.8–2 cm, 10–20-locular, apex sunken in the middle; stigmas 10–20, oblong, united at base, apex with distinct incurved appendage 1–2.5 mm long. Fruits globose, 1.5–2.5 cm long, apex with remnants of sepals, stamens and stigmas. Seeds ellipsoid-globose, 0.5–1 \times 0.4 mm; surface glabrous with few longitudinal ribs.

Distribution: Occurs in Southeast Asia and Malesia. In Papuaia it is known from the Vogelkop, Digul, Western, Gulf, Central, Northern, Morobe and New Britain districts.

Ecology: It occurs in the open water of swamps and lakes, in 1–2 m of water, and in small slowly-flowing streams, less than 1 m deep, at altitudes up to 50 m. Seems to flower the whole year round, particularly from March to September, with flowers open during the day.

Notes: The flowers of this species are either blue or pink. The pink-flowered form is more common in New Guinea than the blue form, and it often has considerably larger leaves and flowers than the latter.

***Nymphaea pubescens* Willd. *Sp. Pl.* 2, 2: 1154 (1797). Fig. 48.**

Petiole diameter 2–8 mm. Lamina ovate, elliptic or round, 12–50 \times 8–28 cm; lower surface densely yellowish or brown tomentose, sometimes restricted to veins only; upper surface glabrous to finely punctate above base, peltate; basal lobes obtuse or acute, sinus generally closed; margin coarsely dentate, with teeth 3–7 mm long and 7–15 mm apart, teeth sometimes absent in apical part of old leaves; apex obtuse; midrib prominent and flat below, grooved above, midrib and main veins arising from a slightly raised tubercle. Flowers 5–15 cm across. Sepals 4(or 5), obovate, 4.5–8.5 \times 1–2.5 cm; apex obtuse; outer surface pubescent or glabrous; inner surface glabrous; veins 5–9, prominent on outer surface. Petals 12–30, obovate, 2–4 \times 0.8–1.5 cm, white, pink or red, (once recorded as blue); apex variable from obtuse to acute, often mucronate. Stamens 40–90, distinctly separate from the corolla, outer series 3.5–4 cm long, inner series 1.5–1.7 cm long; filaments broadly ovate to linear, 0.3–1.5 \times 0.2–0.4 cm, distally narrow; anthers 0.5–1.2 cm long, apical appendage absent. Ovary semiglobose, 1–2 \times 2–2.5 cm, 14–16-locular, apex sunken in the middle, glabrous; stigmas 14–16, oblong, apex with distinct, incurved appendage 3–5 mm long. Fruits globose, diameter 3–3.5 cm, apex with remnants of stamens and stigmas. Seeds ellipsoid to \pm globose, 0.8–1 \times 4 mm, base and apex \pm obtuse, surface with many longitudinal rows of small, irregular papillae.

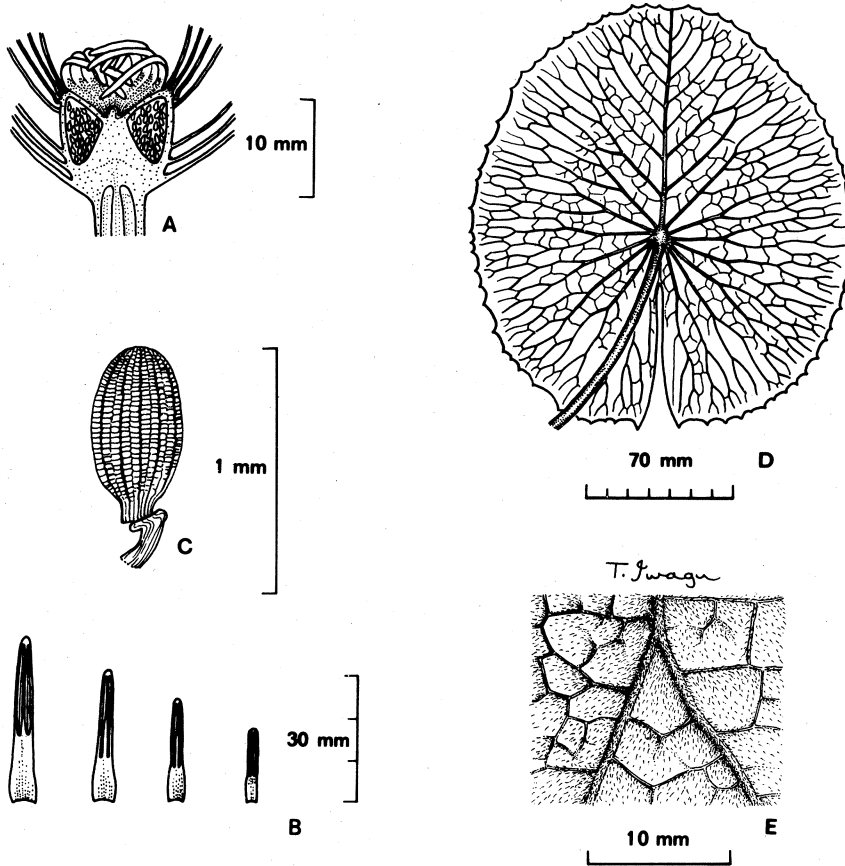


Fig. 48 *Nymphaea pubescens* Willd. (A) longitudinal section of gynoecium showing ovary, ovules, stigmas and base of stamens and perianth (B) stamens from outer four series of androecium (C) partly attached immature seed (D) leaf (E) detail of lower surface of leaf showing hairs (all live material, Lae Botanic Gardens)

Distribution: From India to Malesia. In Papuaia it has been collected from the Digul, West and East Sepik, Morobe and Central districts.

Ecology: Occurs in the shallows of lakes and swamps, the quiet waters of streams and in periodically flooded areas. It occurs at altitudes up to 30 m. Flowering most of the year, at least from February to October.

Nymphaea violacea Lehn. *Hamb. Gartenz.* 9: 208 & 218 (1843).

N. gigantea var. *violacea* (Lehn.) Conard (1905).

Petiole diameter 2–4 mm, glabrous. Lamina ovate, subovate, elliptic or cordate, 9–22 × 10–24 cm, glabrous and finely punctate; base subpeltate, with basal lobes obtuse, sinus open, narrow; margin widely repandous; apex rounded; midrib prominent and shallowly grooved below, grooved above, midrib and main

veins arising from a slightly raised tubercle. Flowers 6–15 cm across. Sepals ovate or oblong-ovate, 3–6, *c.* 1–1.5 cm long; apex obtuse or subacute, glabrous; veins 10–13, slightly grooved. Petals 12–30, obovate, 2.5–7 × (1–)1.5–2.5 cm, pale blue, blue or violet, centre of flower much paler than outer petals; outer series longer than the inner series; apex ± obtuse. Stamens at least 150, distinctly separate from sepals and petals, 0.7–2.5 cm long, inner series shorter than outer series; filaments linear to very narrowly triangular, to 20 mm long, to *c.* 0.6 mm wide at base; anthers linear, 0.4–1.5 cm long, the anthers of the inner series longer than the filaments; if connective extended then apical appendage small, triangular-conoid. Ovary obovoid or subglobose, 1–2.5 × 3–3.5 cm, glabrous, apex sunken in the middle, 9–12-locular; stigmas 6–12, obovate, raised above the apex of the ovary, with a deep longitudinal groove, apical appendage absent. Fruits 3.5 × 4 cm, initially with remnants of sepals, petals, stamens and stigmas, but finally only the sepals and stigmas persist. Seeds ellipsoid, 1.5 × 1 mm, apex and base obtuse or rounded, glabrous.

Distribution: Australia and Papuaia. In Papuaia it has been collected from the Western and Northern districts.

Habitat: It occurs in swamps, lakes and in ponds in savannah. Flowering and fruiting from August to December.

Notes: This species is sometimes regarded as a variety of *N. gigantea* (see Landon 1978).

ONAGRACEAE

*K. Kerenga*¹

Prostrate or erect, annual or perennial herbs, a few shrubs (some trees, extra-Papuasian). Leaves simple, alternate or opposite (whorled, extra-Papuasian); stipules minute or absent. Flowers mostly solitary in the axils, or in spikes, racemes or panicles, hermaphrodite, regular or somewhat zygomorphic, (2-)4(or 5)-merous. Perianth adnate to the ovary. Calyx with tube not or slightly produced above the ovary (in Papuasias); lobes mostly 4-6, valvate. Petals mostly 4 or 5, sessile or clawed, usually valvate. Stamens inserted at the apex of the calyx tube, (1 or 2) 4 or 8-12, usually as many as petals. Ovary inferior (semi-inferior in extra-Papuasia), 2 or 4-6-locular (rarely 1-locular by reduction); placentation axile; ovules many (in Papuasias) or 1-4. Style usually long, with capitate or clavate stigma, often 4-lobed. Fruit a capsule, dehiscent by 4-8 valves, or a berry or nutlet (extra-Papuasian). Seeds many (1-4, extra-Papuasian), with a tuft of long silky hairs or glabrous; endosperm absent.

Distribution: About 17 genera and more than 600 species in both temperate and tropical regions of the world; 2 genera with 8 species in Papuasias.

Literature: P. H. Raven (1977), *Onagraceae, Fl. Males.* ser. 1, 8: 98-113.

KEY TO GENERA

1. Capsule loculicidally dehiscent from the apex downwards with 4 valves; axis persistent; seeds comose; floral tube present; petals 4, white, pink or purple; stamens 8; stem-base without aerenchyma **EPILOBIUM**
1. Capsule irregularly dehiscent; axis not persistent; seeds not comose; floral tube absent; petals 4 and yellow, or 5 and white; stem-base often with aerenchyma **LUDWIGIA**

EPILOBIUM L.

Sprawling or erect, perennial herbs, often flowering in the first year, occasionally somewhat woody near base. Leaves opposite below, upper leaves alternate, entire or dentate-serrate. Flowers borne singly in the upper leaf-axils. Floral tube short. Sepals 4, erect, falling after anthesis. Petals 4, white, pink or purple, emarginate. Stamens 8, alternately long and short, the episepalous ones longer. Stigma clavate. Fruit a long slender, 4-loculate capsule, 4-valved; valves dehiscent from the apex downwards, recurved. Seeds numerous, small, with a terminal tuft of silky hairs (the coma).

¹ Formerly LAE Herbarium, Biology Branch, Papua New Guinea Forest Research Institute, P.O. Box 314, Lae, Papua New Guinea.

Distribution: About 250 species, well represented in the temperate regions at relatively high latitudes and altitudes; in the tropics, it is confined to the higher mountain regions. Four species occur in Papuaasia.

KEY TO SPECIES

1. Leaves narrowly elliptic to elliptic; margin with a few coarse teeth on each side; flowers erect **E. keysseri**
1. Leaves broadly elliptic to ovate; flowers nodding
 2. Stems with elevated pubescent lines running down from the margin of the petioles, and with glabrous ridges running down from the back of the petioles; petals 7–14 mm long **E. detznerianum**
 2. Stems without elevated lines; petals 2.5–8.5 mm long
 3. Petals 6–8.5 mm long; seeds 1–1.4 mm long **E. hooglandii**
 3. Petals 2.5–5 mm long; seeds 0.7–0.9 mm long **E. prostratum**

Epilobium detznerianum Schltr. ex Diels *Bot. Jb.* **62**: 485 (1929); Raven *Blumea* **15**: 277 (1967); *Fl. Males.* ser. 1, **8**: 111–112 (1977).

E. papuanum Ridl. var. *alpestre* Ridl. (1916); *E. papuanum* Hoogl. (1958), non Ridl.

Clumped perennial herb, to c. 15 cm high; plants mostly glabrous with elevated pubescent lines running down the stem from the margin of the petioles and with glabrous ridges running down from the back of petioles. Leaves mostly opposite, alternate in the inflorescence. Petiole 1–1.5 mm long. Lamina broadly elliptic or ovate, 0.2–1 × 0.2–0.7 cm; base and apex obtuse; margin entire. Flowers nodding; pedicel 2.5–8.5 cm long. Floral tube 1.4–3 mm long, 1.5–3.5 mm across. Sepals 4.5–7 × 1–2.5 mm. Petals bright purplish rose, obovate, 7–14 × 3–6 mm, the notch 1.5–2 mm deep. Filaments of episealous stamens 4–5 (–6) mm long, those of epipetalous stamens 3.2–4.5 mm long. Style 5.4–7.5 (–8) mm long. Stigma broadly clavate, 1.3–1.6 mm long, 0.6–1 mm thick, surrounded by anthers at anthesis. Capsule erect, subglabrous, 4–5 cm long. Seeds 0.9–1.5 mm long, 0.5–0.7 mm thick, finely papillose, pale brown; coma 7.5–8 mm long.

Distribution: Endemic to New Guinea. It has been collected from Mt Wilhelmina (Snow Mountains); Star mountains and vicinity (West Sepik); Sirius plateau and Mt Womtakin (Victor Emmanuel Range), West Sepik district; Mt Saruwaged and Mt Bangeta (Morobe); Mt Wilhelm (Eastern Highlands); Kubor Range (Western Highlands); Mt Giluwe (Southern Highlands).

Ecology: Alpine and subalpine grasslands and meadows, open slopes and bogs from 3000 to 4000 m altitude.

Epilobium hooglandii Raven *Blumea* **15**: 278 (1967); *Fl. Males.* ser. 1, **8**: 112 (1977).

E. pendunculare sensu F. Muell. (1889); *E. detznerianum* sensu Hoogl. (1958) non Schltr. ex Diels.

Clumped perennial herbs with decumbent branches, the erect portions 10–35 cm long; plants pubescent along elevated lines running down from the margin of the petioles below, more densely and uniformly so above, and with an admixture of strigulose pubescence in the inflorescence. Leaves mostly opposite, alternate in the inflorescence. Petiole 1–3 mm long. Lamina broadly elliptic to ovate, 0.4–1.3 × 0.3–0.9 cm; nerves ± visible in dried material; base and apex acute or

obtuse; margin entire or with 1–3 very weakly developed teeth. Flowers nodding, becoming erect in fruit, with pedicel 4–12 cm long. Floral tube 1–1.3 mm long, 1.4–2 mm across. Sepals 3–4 × 1–1.6 mm. Petals purplish rose-coloured, 6–8.5 × 2.5–4.5 mm, the notch 1.2–1.5 mm deep. Filaments of episealous stamens 3–6 mm long, those of epipetalous stamens 2–4 mm long. Style 2.5–6 mm long. Stigma clavate, 2–2.5 mm long, 1–1.2 mm thick, surrounded by the anthers at anthesis. Capsule erect, glabrescent, 5–8 cm long. Seeds 1–1.4 mm long, 0.3–0.5 mm thick, finely papillose, brown; coma 5–8 mm long, white.

Distribution: Endemic to New Guinea. It has been collected from Mt Wilhelmina (Snow Mountains); Mt Capella and Star Mountains (West Sepik); Lake Naho (Madang); Mt Saruwaged (Morobe); Eastern and Western Highlands, including Mt Wilhelm; Mt Victoria and Lake Myola (Central); Mt Giluwe and Ibiwara-Tari gap (Southern Highlands).

Ecology: Alpine and subalpine meadow, open edges of streams and often in moist open forested areas from 2000 to 4000 m altitude.

Epilobium keysseri Diels *Bot. Jb.* **62**: 486 (1929); Hoogl. *Blumea*, Suppl. **4**: 223 (1958); Raven *Blumea* **15**: 274 (1967); *Fl. Males* ser. 1, **8**: 111 (1977).

Clumped erect perennial herb, to c. 60 cm high, somewhat woody near the base; plants finely pubescent. Lowermost leaves opposite, the remainder alternate, subsessile. Lamina broadly elliptic to elliptic, 0.4–1.3 × 0.1–0.3 cm; margin revolute or dentate-serrate, with 1–3 coarse teeth on each side. Inflorescence erect. Flowers erect with pedicel 1–2.6 mm long. Floral tube 0.6–1 mm long, 1–2 mm across. Sepals 3–5.5 × 1–2.5 mm. Petals rose-purple, obovate, 4.5–8 × 2.8–4 mm, the notch 1.5–2 mm deep. Filaments of episealous stamens 1.7–2.5 mm long, those of the epipetalous 0.5–1.5 mm long. Style 2.4–4 mm long. Stigma clavate, 1.4–2 mm high, 0.4–0.7 mm thick, surrounded by the anthers at anthesis. Capsule 3–6 mm long, glabrescent. Seeds 0.9–1.2 mm long, 0.3–0.6 mm thick, papillose, brown with pellucid beak; coma 5–7 mm long, white.

Distribution: Endemic to New Guinea. It has been collected from Lake Habbema (Snow Mountains); Star mountains (West Sepik); Nah-Rawa divide (Madang); Mt Saruwaged, Cromwell mountains and Mt Amungwiwa near Wau (Morobe); common on many summits in Papua.

Ecology: Alpine and subalpine grassland and meadows, often in succession after ground-fires or clearing, from 2000 to 3800 m altitude.

Notes: Collections characterized by broadly elliptic leaves and dentate-serrate margins from the Owen Stanley Range in the Central district of Papua vary slightly from those of the other localities within Papuasias. However, study of the species in general shows a great deal of inter-grading of characters, and delimitation of subspecies is uncertain.

Epilobium prostratum Warb. *Bot. Jb.* **16**: 23 (1893); Raven *Blumea* **15**: 280 (1967); *Fl. Males*. ser. 1, **8**: 112 & 113 (1977). **Fig. 49.**

E. papuanum Ridl. (1916).

Sprawling perennial herb, with numerous, well-branched, leafy branches, the erect portions 10–30(–46) cm long, with erect hairs along elevated lines running

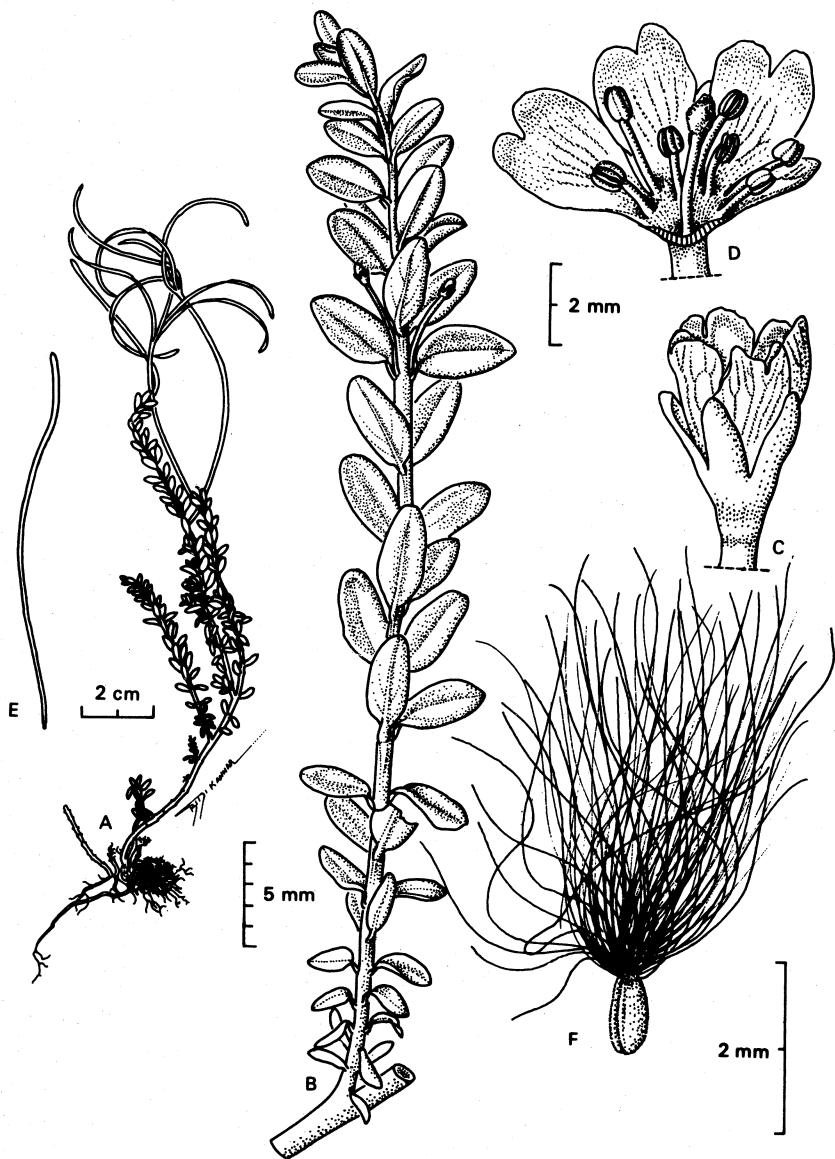


Fig. 49 *Epilobium prostratum* Warb. (A) habit with fruits present (B) detail of branchlet (C) flower (D) flower with part of perianth removed to show pistil and stamens (E) indehiscent capsule (F) seed with coma (all LAE 74371)

down from the margin of the petioles below, more densely and uniformly hairy above, and also with short stiff hairs on the inflorescence. Leaves mostly opposite, alternate in the inflorescence. Petiole 1–3 mm long. Lamina broadly elliptic to ovate, 0.5–0.8 × 0.2–0.4 cm, thick, shining, often reddish; base and apex acute or obtuse; margin entire or with 1–3 very weakly developed teeth on each side. Flowers nodding, becoming erect in fruit; pedicel 5–10 cm long. Floral tube 0.6–0.9 mm long, 0.8–1.1 mm across. Sepals keeled, 3–4 × 0.6–1.4 mm, often with multiple excrescences on the tips. Petals white or purplish rose-coloured, 0.4–0.7 × 0.4–0.5 mm. Filaments white, those of the episealous stamens 3–4 mm long, those of the epipetalous ones 2–3 mm long. Style 1.8–3.5 mm long. Stigma clavate, 0.8–1.5 mm long, 0.5–0.9 mm thick, surrounded by the anthers at anthesis. Capsule 3.5–5 cm long. Seeds 0.7–0.9 mm long, 0.2–0.4 mm wide, finely papillose, brown; coma 5–8 mm long.

Distribution: In Papuasias, it has been collected from the Surerei-Angi Gigi Lake (Vogelkop) and main range in western New Guinea; Mt Saruwaged and Mt Kaindi (Morobe), common in the Highlands districts of eastern New Guinea; and in Papua it is known from Mt Victoria, the Wharton Range and Mt Strong (Central); common in the Southern Highlands, and Guaruridge (Mt Suckling)(Northern).

Ecology: Moist open places, often in succession after landslips and on open edges of streams, from 1200 to 3700 m altitude.

LUDWIGIA L.

Herbs or subshrubs, rooting at the nodes, sometimes in water with white buoyant pneumatophores in addition to normal roots. Leaves alternate, mostly entire. Stipules absent or reduced, deltoid. Flowers borne singly in the axils. Perianth adnate to the ovary; usually 2 bracteoles near the base, or these reduced or lacking. Sepals 4 or 5, persistent after anthesis. Petals as many as the sepals, caducous, yellow or white, contort in bud. Stamens as many as or 2 × the number of sepals; anthers usually versatile. Stigma capitate or clavate, often lobed, number of lobes equal to number of locules. Ovary inferior, 4- or 5-loculate, with numerous ovules in 1 or several rows per locule. Fruit a capsule; dehiscence irregular, by splitting along the sides, or by breaking up rather slowly; the seeds embedded in pithy or woody endocarp from which they detach easily or with difficulty. Seeds rounded or ovoid with a raphe, either inflated and about equal in size to the body of the seed, or narrow.

Distribution: An essentially tropical genus with 23 species found in the Old World, 10 of which are also found in the New World. Four species occur in Papuasias.

Notes: Throughout this account, measurements are taken from dried material, the floral parts shrink considerably on drying.

KEY TO SPECIES

1. Sepals and petals 5; prostrate or ascending plants or floating in water, producing thick white buoyant pneumatophores at the nodes of the floating stems and from the roots *L. adscendens*
1. Sepals and petals 4; erect plants, sometimes growing in shallow water but lacking thick pneumatophores
2. Stamens 4; capsules narrowly conical, truncate at the apex; seeds in several rows in each locule, free *L. perennis*
2. Stamens 8, alternatively longer or shorter; capsule \pm cylindrical; seeds embedded in endocarp or free
3. Capsule evenly cylindrical; seeds free, in several rows in each locule, each seed with an inflated raphe, about equal in size to the body of the seed; robust perennial subshrub, almost glabrous or densely puberulent *L. octovalvis*
3. Capsule narrow below, here seeds arranged in one row per locule and embedded in firm endocarp, capsule expanded above with seeds free and arranged in several rows per locule; raphe slender; slender annual herb *L. hyssopifolia*

Ludwigia adscendens (L.) Hara *J. Jap. Bot.* **28**: 290 (1953); Raven *Reinwardtia* **6**: 387 (1963); Henty & Pritchard *Bot. Bull.* **7**: 130 (1973) f.; Raven *Fl. Males.* ser. 1, **8**: 104–107 (1977). **Fig. 50.**

Jussiaea repens L. (1753), non *L. repens* Forst. (1771); *J. adscendens* L. (1767); *J. fluviatilis* Bl. (1826).

Herb with prostrate or ascending stems or floating in water, producing thick white buoyant pneumatophores at the nodes of the floating stems and from the roots; plants normally glabrous. Petiole 0.5–4 cm long. Lamina broadly oblong-elliptic, 0.5–0.6 \times 0.5–3 cm; base narrowly acute; apex acute or obtuse. Pedicel

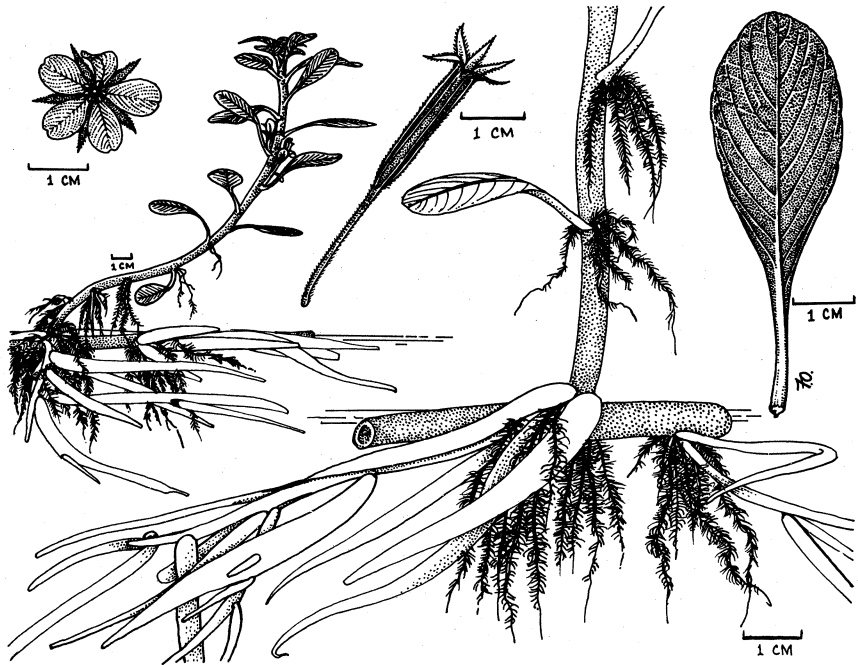


Fig. 50 *Ludwigia adscendens* (L.) Hara. habit, flower and leaf details (all live material, Lae Botanic Gardens)

2–5 cm long. Bracteoles present near base of flower, deltoid, 1–1.2 × 1–1.5 mm. Sepals and petals 5. Sepals deltoid-acuminate, 6–10 × 1–2.5 mm. Petals white, yellow at base, obovate, 8–10 × 5–6 mm; apex rounded. Stamens 10; filaments of episepalous stamens 2–4 mm long, those of epipetalous ones 1–2 mm long. Style 4–6 mm long; stigma globose, shallowly 5-lobed. Fruit a 5-loculate capsule, 1–4 cm long, 10-ribbed, thick-walled. Seeds 1-rowed in each locule, 1–1.5 mm long, firmly embedded in dense corky endocarp, breaking up into corky pieces, each of which encloses a single seed.

Distribution: Southern Asia and Malesia. In Papuaia, sporadic; collected from the Idenburg River in western New Guinea; the Sepik River at Angoram and Ambunti (East Sepik district), and in Papua it is known from Lake Kutubu in the Southern Highlands district, the Kemp Welch River, Waigani swamp and Mountain View Estate near Port Moresby in the Central district.

Ecology: Lowland fresh-water pools and swamps, edge of rivers and lakes and inundated ditches and canoe channels to c. 760 m altitude, mainly aquatic.

Ludwigia hyssopifolia (G. Don) Exell *Garcia de Orto* 5: 471 (1957); Raven *Reinwardtia* 6: 385 (1963); Henty & Pritchard *Bot. Bull.* 7: 131 (1973) f.; Raven *Fl. Males.* ser. 1, 8: 104 (1977). **Fig. 51.**

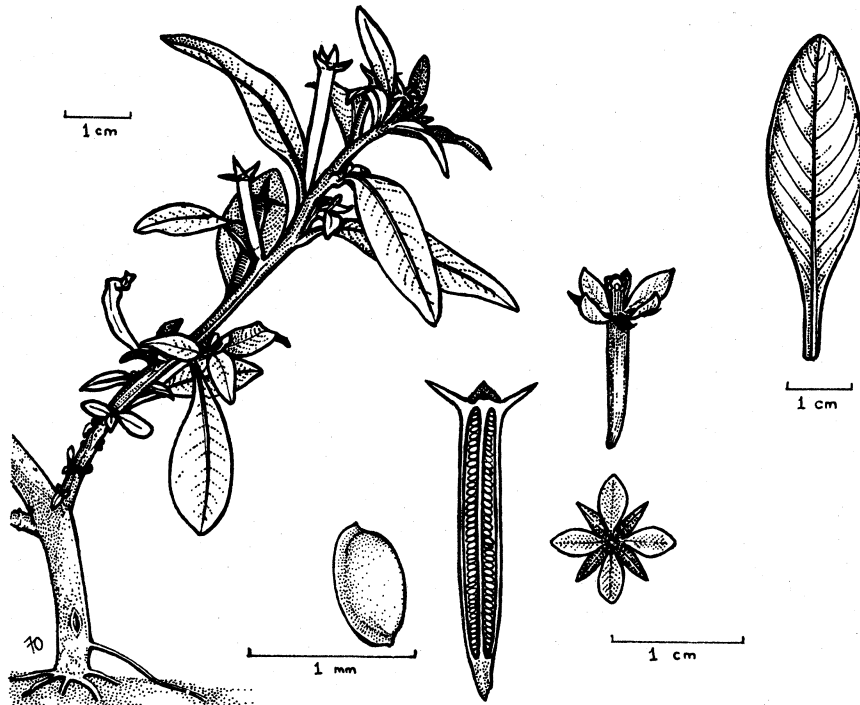


Fig. 51 *Ludwigia hyssopifolia* (G. Don) Exell habit, flower, leaf and seed details (all live material, Lae Botanic Gardens)

Jussiaea linifolia Vahl. (1798), non *L. linifolia* Poir. (1813); *J. hyssopifolia* G. Don. (1832); *J. suffruticosa* Ridl. (1921), non L.; *L. prostrata* C. T. White (1939), non Roxb.

Erect annual herb, to c. 1 m high, much branched, becoming woody at base, with elongate pneumatophores arising from buried submerged stems and roots; young growth and inflorescence minutely puberulent. Petiole 3–8 mm long. Lamina narrowly ovate, 1–10 × 0.2–2 cm; base narrowly cuneate; apex acuminate. Pedicel absent. Sepals and petals 4. Sepals narrowly ovate, 2–4 × 0.6–1 mm. Petals yellow, elliptic, 2–3 × 1–2 mm. Stamens 8, alternately longer and shorter, the epipetalous ones shorter; filaments 0.5–2 mm long. Style 1–2 mm long; stigma globose, 4-lobed. Fruit a 4-loculate capsule, cylindric, 2–3 cm long, expanded above, thin-walled, many-seeded. Seeds oval, pale brown, with a narrow raphe lying horizontally; seeds in several rows and free in the upper expanded portion of the capsule, 0.2–0.3 mm long; below seeds 1-rowed, each embedded in a cube of relatively hard endocarp.

Distribution: Throughout the tropics. In Papuasias, it is widespread in the lowlands and up to c. 3000 m altitude.

Ecology: A plant of wet places; swamps and stream edges, roadsides or shallow water ditches.

Ludwigia octovalvis (Jacq.) Raven *Kew Bull.* **15**: 476 (1926); *Reinwardtia* **6**: 356 (1963); Henty & Pritchard *Bot. Bull.* **7**: 132 (1973); Raven *Fl. Males.* ser. 1, **8**: 101–103 (1977). **Fig. 52.**

Jussiaea suffruticosa L. (1753), non *L. suffruticosa* Walt. (1788); *Oenothera octovalvis* Jacq. (1760); *J. pubescens* L. (1762); *L. perennis* Burm. f. (1768), non L. (1753); *J. angustifolia* Lamk. (1789); *J. octovalvis* (Jacq.) Sw. (1791); *L. pubescens* (L.) Hara (1953).

Robust branching subshrub, to 1.5 m high, subglabrous or densely puberulent. Petiole to 5 mm long. Lamina linear to subovate, 0.5–14 × 0.1–3 cm; base narrowly or broadly cuneate; apex attenuate; submarginal vein well developed. Pedicel to 8 mm long. Bracteoles reduced or to c. 1 mm long. Sepals and petals 4. Sepals ovate to broadly ovate, 3–13 × 1–7 mm. Petals yellow, broadly obovate to cuneate, 3–18 × 2–10 mm, emarginate. Stamens 8, alternatively longer and shorter, the epipetalous ones shorter; filaments 1–3 mm long. Style 1–2 mm long; stigma subglobose, 4-lobed. Fruit a 4-loculate capsule, cylindric, 1.5–5 cm long, 8-ribbed, with seeds in several rows in each locule. Seeds free, 0.5–0.7 mm long; raphe inflated, c. equal in size to the body of the seed.

Distribution: Throughout the tropics. In Papuasias, it is widespread in the lowlands and up to c. 3000 m altitude.

Ecology: In humid cultivated or disturbed land, grassland and near water.

Notes: Raven (1963) described four subspecies, two of which (namely subsp. *sessiliflora* (Mich.) Raven and subsp. *octovalvis*) are, by his determinations, represented at Lae. Study of these and other specimens show a great deal of intergrading of characters, and delimitation of subspecies is uncertain.

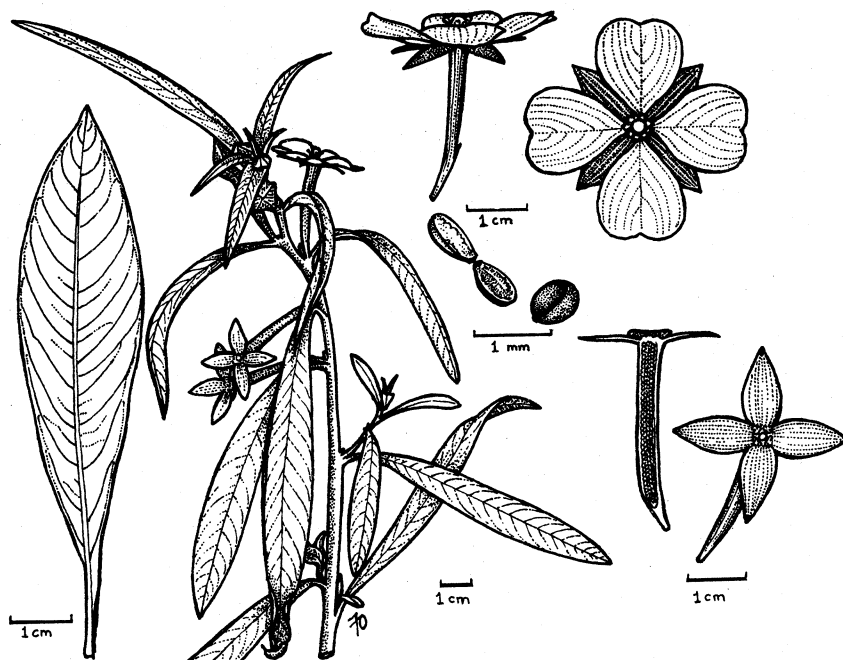


Fig. 52 *Ludwigia octovalis* (Jacq.) Raven. flowering branchlet, flowers, seeds and leaf detail (all live material, Lae Botanic Gardens)

Ludwigia perennis L. *Sp. Pl.* 1: 119 (1753); A. & R. Fernandes *Garcia de Orto* 5: 114 (1957); Raven *Reinwardtia* 6: 367 (1963); *Fl. Males.* ser. 1, 8: 103 (1977).

L. parviflora Roxb. (1820); *L. lythroides* Bl. (1826); *L. gracilis* Miq. (1853).

Erect annual herb, to c. 1 m high, subglabrous or minutely puberulent on younger parts. Petiole 2–10 mm long, winged. Lamina narrowly elliptic, 1–7 × 0.1–0.3 cm; base narrowly cuneate; apex subacute. Pedicel 1–1.5 mm long. Sepals and petals 4 (or 5). Sepals deltoid, 1–2 × 0.5–1 mm. Petals yellow, elliptic, 1–2.5 × 0.5–1.5 mm. Stamens 4; filaments 0.2–0.6 mm long. Style 0.5–1 mm long; stigma globose, shallowly 4-lobed. Fruit a 4-loculate capsule, narrowly conical, 3–7 mm long, thin-walled, truncate at apex, many-seeded. Seeds free, ovoid, c. 0.5–0.6 mm long, with a narrow raphe.

Distribution: Nearly throughout the tropics of the Old World. In Papuaia, it is known from a single collection in the Central district of Papua.

Ecology: Open damp places, flood plains, near and in ditches and river banks.

Notes: This description is based upon a single dried specimen held at LAE.

PORTULACACEAE

*O. Gideon*¹

Herbs or subshrubs. Leaves alternate or opposite, occasionally with axillary hairs. Flowers bisexual, actinomorphic, in axillary and/or terminal capitula or solitary. Sepals usually 2, boat-shaped, free or basally connate. Petals 4 or 5, seldom less or more, mostly obovate and unequal, sometimes connate at the base, often emarginate. Stamens 3–many; filaments basally connate; anthers 2- or 4-locular, dorsifixed, longitudinally dehiscent. Ovary superior or half-inferior, 1-locular with central or basal placentation; ovule 1–many; style simple below, divided above into 2–8 arms. Fruit a circumscissile capsule or dehiscent by valves, rarely indehiscent, occasionally surrounded by the persistent calyx. Seeds 1–many, smooth or rugose, kidney-shaped; embryo curved, surrounded by the abundant mealy endosperm.

Distribution: About 15 genera with *c.* 200 (to perhaps 500) species widely distributed, with high concentrations in the Pacific and South American regions. In Papuaia, 3 genera, of which the genus *Talinum* (of 2 species) is introduced.

Literature: R. Geesink (1969), An account of the genus *Portulaca* in Indo-Australia and the Pacific (Portulacaceae), *Blumea* **17**: 275–301; (1971), Portulacaceae, *Fl. Males.* ser. 1, **7**(1): 121–133; J. McNeill (1974), Synopsis of a revised classification of the Portulacaceae, *Taxon* **23**: 725–728.

KEY TO GENERA

1. Capsule with an operculum, dehiscence circumscissile; ovary half-inferiorPORTULACA
1. Capsule 3-valved; ovary superior
2. Leaves opposite, up to 5 mm longMONTIA
2. Middle cauline leaves spirally arranged, > 10 mm longTALINUM

MONTIA L.

Annual or perennial, succulent herbs or water plants. Stems creeping ascending or floating, copiously branched. Leaves ovate to linear, fleshy, without axillary hairs. Flowers in terminal and/or axillary cymes, or solitary. Sepals 2, free or united below. Petals 5. Stamens 3 or 5. Ovary superior; style arms 3. Fruit a glabrous capsule, dehiscent by 3 valves. Seeds 1–5, black.

Distribution: A cosmopolitan genus with *c.* 50 species, mainly in the temperate regions, both in the northern and southern hemispheres, with one species in Papuaia.

¹ LAE Herbarium, Biology Branch, Forest Research Institute, P.O. Box 314, Lae, Papua New Guinea.

Montia fontana L. *Sp. Pl.* 1: 87 (1753). **Fig. 53.**

M. lamprosperma Cham. (1831).

Aquatic annual herb, glabrous, somewhat succulent; stem decumbent to erect, tending to root at the nodes. Leaves opposite, elliptic, to 5×2 mm. Flowers solitary or in small drooping racemes of 2 or 3 flowers in the axils of the upper leaves. Sepals almost circular, 1 mm in diameter; apex acute to mucronate. Petals 5, pure white, obovate to spatulate, often unequal, to 1.5×1 mm. Filaments to 1 mm long. Style arms 3. Fruit globose, c. 1.5 mm in diameter. Seeds 2 or 3, c. 1 mm in diameter.

Distribution: Temperate Eurasia, America (Andes, Rocky Mts), southeastern Australia (including Tasmania), New Zealand, Central Africa (Mt Kilimanjaro), western New Guinea (Mt Wilhelmina—Snow Mountains), northeastern New Guinea (Mt Wilhelm—Eastern Highlands), Mt Strong (Morobe); Papua (Mt Dickson, Mt Victoria—Central).

Ecology: In high mountain bogs, on stream banks, on mud or on wet open ground, sometimes floating, occurring between 2600 and 3700 m altitude.

Notes: Its presence in the high mountain bogs of Papuasias and central Africa (Mt Kilimanjaro) are the only tropical mountain occurrences in the old world, between its range in the temperate northern hemisphere and the southern counterpart, an almost bipolar type of distribution.

PORTULACA L.

Annual to perennial, erect or creeping herbs, copiously branched, succulent to various degrees. Leaves spirally arranged or opposite, linear to orbicular, mostly with axillary hairs. Flowers in 1–30-flowered, terminal capituli; receptacle infundibular, mostly with hairs or scales in the axils of the bracts (and bracteoles) between the flowers, surrounded by a whorl of involucre leaves. Sepals 2, occasionally keeled or hooded, persistent or caducous together with the petals, stamens and style. Petals 4–6, mostly obovate. Stamens 4–many, in a whorl. Ovary semi-inferior; style arms 4–8. Fruit a globular capsule with a caducous circumscissile operculum. Seeds many, 0.5–1 mm diameter.

Distribution: Less than 40 species, mainly in tropical and subtropical regions, throughout the world, with 3 species in Papuasias.

Notes: This is a very complex genus. The synonymy is extensive and confusion has resulted from frequent misinterpretations of names. Geesink (loc. cit.) has modified and simplified the infrageneric subdivision of the genus. He recognized two subgenera (namely, subg. *Portulaca* and subg. *Portulacella*). The latter subgenus is entirely confined to Australia. *Portulaca* subg. *Portulaca* is represented by two sections (namely, sect. *Neossia* and sect. *Portulaca*). Section *Portulaca* is further subdivided into two subsections (subsect. *Portulaca* and subsect. *Stellulato-tuberculatae*).

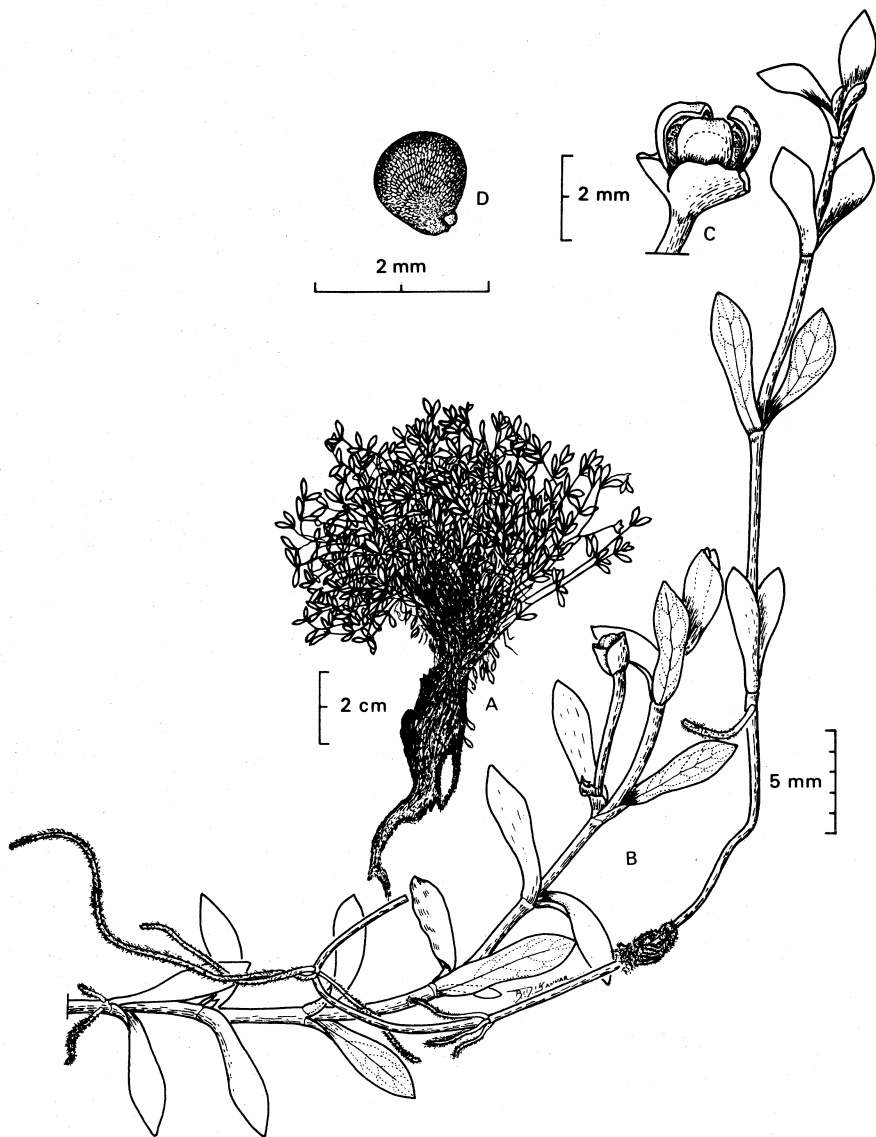


Fig. 53 *Montia fontana* L. (A) habit (B) branchlet (C) fruit (D) seed (all Hartley 13027)

KEY TO SPECIES

1. All leaves opposite; hairs completely surrounding the nodes (sect. *Neossia*) **P. quadrifida**
1. At least the middle cauline leaves spirally arranged; hairs only axillary (sect. *Portulaca*)
 2. Largest leaves obovate to spatulate; axillary hairs inconspicuous; sepals distinctly carinate (subsect. *Portulaca*)
 3. Involutral leaves with an axillary axis; stamens 7–12; fruit c. 4 mm long **P. oleracea**
 3. Involutral leaves mostly without axillary axes; stamens 18–50; fruit c. 7 mm long . . . **P. lutea**
 2. Largest leaves linear to elliptic; axillary hairs usually conspicuous; sepals not carinate (subsect. *Stellulato-tuberculatae*) **P. pilosa**

Portulaca lutea Forst. [*Pl. Esc.* 72 (1786) nom. nud.] ex Seem. *Fl. Vit.* (1865).

Perennial herb, to 60 cm long. Leaves spirally arranged to subopposite, obovate to orbicular, c. 25 × 15 mm, glabrous, with few axillary hairs. Capituli 1–6-flowered. Flowers sessile, surrounded by bracteoles (up to 4 × 2 mm) and hairs. Sepals keeled, suborbicular, up to 9 mm long. Petals 5, obovate-cuneate, c. 10 × 10 mm, bright yellow. Stamens 18–c. 50. Style up to 5 mm long, usually with 5 arms. Capsule many-seeded, c. 7 × 5 mm. Seeds shiny, black, rugose, c. 1 mm diameter.

Distribution: Pacific islands, from New Caledonia and Samoa to the Marquesas; not yet recorded from New Guinea, but likely to be found here.

Ecology: Mostly near the shore.

Portulaca oleracea L. *Sp. Pl.* 1: 445 (1753). **Fig. 54.**

Annual herb, prostrate or semi-erect, up to 30 cm high; stem succulent, branching from near the base. Leaves spirally arranged to subopposite, obovate to spatulate, fleshy, up to 40 × 15 mm, with minute axillary hairs. Capituli 2–30-flowered. Flowers sessile, up to 7 mm wide, surrounded by bracteoles and inconspicuous hairs. Sepals keeled, to 5.7 × 6 mm. Petals 5, obovate-cuneate, to 6 × 6.5 mm, spreading-erect, yellow. Stamens 7–12. Style 3 mm long, bent at the base, with 4 or 5 arms. Capsule many-seeded, 3.5–4 mm across. Seeds shining black, finely rugose, c. 0.8 mm in diameter.

Distribution: Throughout the tropics and warmer parts of the temperate regions. In most districts of Papuaia.

Ecology: Common weed of waste places and cultivation, particularly in sandy and dry open conditions. In New Guinea from sea level to 1800 m (*Hoogland & Pullen* 5407).

Uses: The leaves and tender shoots can be eaten raw or cooked as spinach. It can also be used as a poultice and livestock feed, and as a medicine.

Notes: An aggressive weed, seeding prolifically, re-rooting from cut branches, and also able to withstand dry conditions.

Portulaca pilosa L. *Sp. Pl.* 1: 445 (1753). **Fig. 55.**

Prostrate or erect herb. Leaves spiral, thickened, linear to obovate, 2–30 mm long, with numerous axillary hairs. Capituli 2–12-flowered. Flowers surrounded

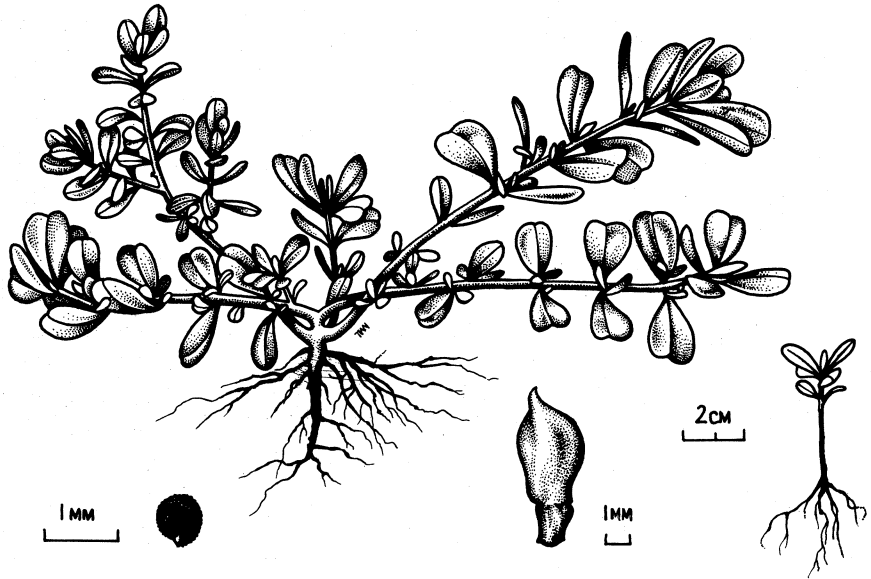


Fig. 54 *Portulaca oleracea* L. habit, seedling, fruit and seed (all live material from Aiyura)

by membranous bracteoles and conspicuous hairs. Petals 4–6. Stamens up to 75. Style arms 4–8. Fruit a many-seeded capsule.

Distribution: Pantropical; represented in Papuaasia by subsp. *pilosa*.

subsp. ***pilosa***

Portulaca tuberosa Roxb. (1814); *P. samoensis* Poelln. (1933).

Succulent herb up to c. 30 cm high. Leaves linear to elliptic, fleshy, up to 25 × 4 mm, with 1–15 mm long axillary hairs. Capituli 2–10-flowered. Flowers surrounded by bracteoles and 3–15 mm long hairs. Sepals up to 6 × 4 mm, often hooded at the apex. Petals (4 or)5(or 6), obovate, 2–11 × 2–12 mm, pink or yellow. Stamens 2–30; filaments c. 3.5 mm long; anthers c. 0.5 mm long. Style up to 8 mm long. Capsule globose, 2–4 mm in diameter, shiny, light green to pale yellow. Seeds 0.4–0.7 mm in diameter, grey-brown to bluish.

Distribution: Throughout Papuaasia: Markham valley, Lae area, Sialum (Morobe); Marshall Lagoon (Central), Gurney (Milne Bay), Misima and surrounding islands (Papuan islands), Mortlock and Tasman islands (Bougainville).

Ecology: Waste places among waysides, near shores, in garden beds.

Uses: Cultivated as an ornamental plant, sometimes used in medicine.

Notes: *Portulaca pilosa* is a complex variable species. For simplicity, Geesink (1969) has combined several names, distinguishing eight subspecies for the Indo-Australian region.

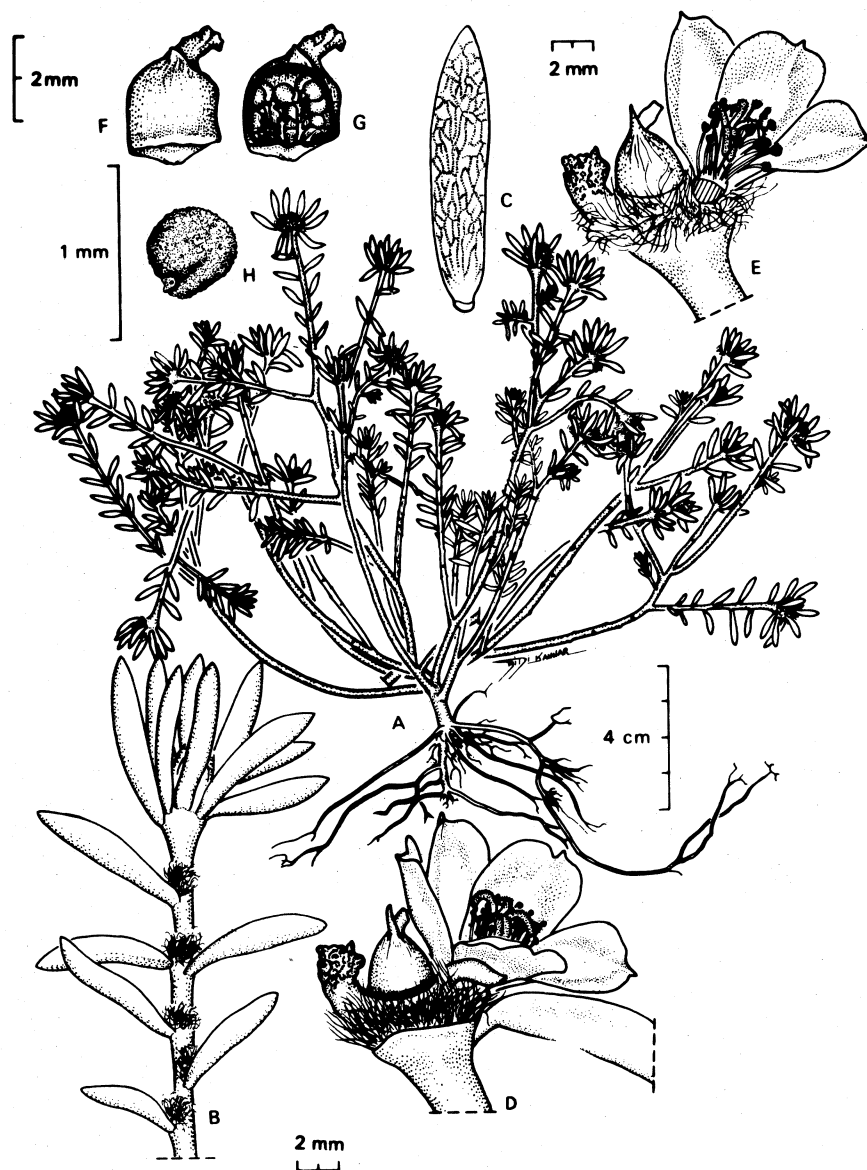


Fig. 55 *Portulaca pilosa* L. (A) habit (NGF 16791) (B) detail of leafy branch (NGF 16791) (C) leaf venation (NGF 16791) (D) flower (from live material, Lae Botanic Gardens) (E) transverse section of flower (from live material, Lae Botanic Gardens) (F) fruit (NGF 16791) (G) transverse section of fruit showing seeds (NGF 16791) (H) seed (NGF 16791)

Since subsp. *pilosa* is the most variable subspecies in the *P. pilosa* complex Geesink has further arranged the Indo-Pacific material into races. These are distinguished by their seeds and floral features.

KEY TO RACES

1. Petals pink; anther 0.5 mm long; seeds blue, 0.4–0.6 mm diameter; testa cells stellate
..... 'pilosa' race
1. Petals yellow; seeds 0.6–0.7 mm diameter
2. Anthers 0.4–0.7 mm long; seeds dark grey 'tuberosa' race
2. Anthers 0.4 mm long; seeds blue (restricted to the Louisiade Archipelago in New Guinea)
..... 'New Caledonia' race

Portulaca quadrifida L. *Mant. Pl. 1: 73* (1767).

Creeping herb, up to c. 8 cm long, rooting at the nodes; nodes encircled by a whorl of hairs. Leaves opposite, elliptic to cordate, 3–15 × 1–5 mm, with axillary hairs c. 5 mm long. Flowers terminal, solitary on an infundibuliform receptacle, surrounded by long silky hairs, with 4 (seldom more) leaves at its edge. Sepals c. 3 mm long. Petals 4, obovate, up to 5 × 4 mm, yellow. Stamens 8 or 12. Style up to 4 mm long, arms usually 4. Capsule many-seeded, ± obovoid, up to 3.5 × 3 mm. Seeds rugose, 0.8–1 mm diameter.

Distribution: Pantropical, throughout Malesia. In Papuasias, it occurs in north-eastern New Guinea, Kairiru Island (East Sepik), Huon Gulf, Tami Island (Morobe), and Ulawa Island in the Solomon islands.

Ecology: Waysides, dry open conditions, often on gravel, occurring at altitudes below 300 m.

TALINUM Juss.

Perennial herbs or subshrubs, much-branched, often with thick roots, glabrous (in Papuasias). Leaves spirally arranged or partly opposite, elliptic to obovate. Flowers terminal, arranged in thyrses or cymes, rarely axillary or solitary. Sepals free, caducous. Petals mostly 5, widely spreading during anthesis. Stamens 5-many. Ovary superior; style arms mostly 3. Fruit a globular capsule, usually 3-valved. Seeds many.

Distribution: The genus consists of c. 50 species, native in south and central America and Africa. *Talinum triangulare* and *T. paniculatum* are now pantropically naturalized, and both occur in New Guinea.

KEY TO SPECIES

1. Flowering axes sharply triangular in cross-section; seeds persistent until fruit matures; stamens 20–35 **T. triangulare**
1. Flowering axes terete; sepals caducous after flowering; stamens 5–15 **T. paniculatum**

Talinum paniculatum (Jacq.) Gaertn. *Fruct. 2: 1791*.

Portulaca paniculatum Jacq. (1760); *T. patens* (L.) Willd. (1799).

Erect herb or subshrub, to 50 cm or more high. Leaves elliptic to obovate, to 10 × 5 cm, fleshy, pinnately nerved; axillary buds with 2 subulate cataphylls.

Inflorescences terminal, thyrsoïdal, up to 15 cm across, each with up to 30 flowers. Sepals 1 mm or more long, caducous, acute. Petals usually 5, obovate, 4 × 2 mm, pink, emarginate. Stamens 5–15; filaments to 3 mm long; anthers *c.* 0.4 mm long. Style below the branches 2 mm long, with 3 arms. Fruit *c.* 3 mm across, opening with 3 valves, yellow or pink. Seeds many, 1 mm in diameter, ribbed, black or brown.

Distribution: Pantropical (still extending its range). In Papuaia, growing near Lae (Morobe district).

Ecology: Waysides, waste places, garden beds, forest edges.

Uses: Cultivated as an ornamental plant; sometimes the leaves are eaten.

Talinum triangulare (Jacq.) Willd. in L. *Sp. Pl.* 2: 862 (1799). **Fig. 56.**

Portulaca triangulare Jacq. (1760); *P. racemosa* L. (1771).

Erect herb or subshrub, to 70 cm or more high. Leaves obovate to narrowly obovate, fleshy, to 15 × 5 cm, pinnately nerved; axillary buds with 2 small cataphylls, each cataphyll having a dormant axillary bud. Thyrses terminal, corymboïd, up to 12 cm across, the axis sharply triangular, with up to 25 flowers. Sepals 4 × 6 mm, green, strongly nerved, acuminate, persistent until fruit matures. Petals 5, obovate, up to 5 × 12 mm, emarginate, pink. Stamens 20–35; filaments 3.5 mm long; anthers 0.5–0.6 mm. Style below the branches 3 mm long, arms 3. Fruit 4 mm in diameter, dehiscent with 3 valves, olive-green to yellow. Seeds many, to 1 mm diameter, finely ribbed, black.

Distribution: Pantropical (still extending its range). In Papuaia it is known from the Sepik, Morobe and Manus districts.

Ecology: Waysides, garden clearings, waste places, shores, forest edges, often an escape from cultivation.

Uses: Pot herb, green feed for poultry.



Fig. 56 *Talinum triangulare* (Jacq.) Willd (A) flowering branchlet (NGF 34321) (B) flower (from live material, Lae Botanic Gardens) (C) fruit (NGF 34321) (D) fruit, cut open to show seeds and placentation (NGF 34321) (E) Seed (NGF 34321)

PROTEACEAE

D. B. Foreman¹

Trees or shrubs. Stipules absent. Leaves spiral, rarely verticillate or opposite, simple or variously divided, often dimorphous; margin entire or toothed, sometimes spiny. Inflorescences axillary or terminal (see Notes below), ramiflorous or cauliflorous, with flowers in pairs, arranged in raceme- or cone-like inflorescences or in dense heads; peduncles present or absent. Bracts present, mostly small, often early caducous, sometimes large and woody. Flowers regular to very irregular, mostly bisexual, rarely unisexual (*Heliciopsis* not known from New Guinea). Tepals valvate, with an expanded limb, often recurved, at first adhering to each other mostly becoming entirely free. Receptacle flat or oblique. Stamens 4, epipetalous; filaments usually relatively short; anthers erect, basifixed, mostly tetrasporangiate, dehiscing by longitudinal slits; connective prolonged or not. Disc mostly present, flat or oblique, annular or \pm horse-shoe shaped or with 4 free or variously fused hypogynous glands. Ovary superior, 1-locular, sessile or stipitate, often oblique. Style \pm expanded in the upper part into a pollen-presenter. Stigma mostly small, terminal or lateral. Ovules 1 or more, pendulous or laterally attached. Fruit dehiscent or indehiscent, a follicle, drupe or small nut. Seeds winged or not; endosperm mostly absent; cotyledons thin or thick and fleshy.

Distribution: Five subfamilies, c. 76 genera and c. 1500 species, mostly in the southern hemisphere. The greatest concentrations of taxa occur in South Africa, the south-west corner of Western Australia, eastern Australia including Tasmania, New Caledonia and South America. The family also extends to Asia, Malesia (including Papuasias), New Hebrides, Fiji, Samoa and New Zealand. In Papuasias the family is represented by c. 58 species in seven genera, of which six also occur in Australia. *Finschia* is the only genus extending into the Solomon Islands.

Notes: All of the New Guinea Proteaceae belong to the subfamily Grevilleoideae which is characterized by having pairs of flowers (the unit inflorescence) arranged in a confluence. The term inflorescence is used here to refer to this compound structure.

Literature: L. A. S. Johnson & B. G. Briggs (1975), On the Proteaceae, *J. Linn. Soc. (Bot.)* **70**: 83–182. H. Sleumer (1955), Proteaceae, *Fl. Males.* ser. 1, **5**: 147–206. C. Venkata Rao (1971), Proteaceae, *Botanical Monograph* **6**, Council of Scientific and Industrial Research, New Delhi, 208 pp.

¹ National Herbarium of Victoria, Royal Botanic Gardens, Birdwood Avenue, South Yarra, Victoria, 3141, Australia.

KEY TO GENERA

1. Fruit a follicle, regularly dehiscent, often persisting
2. Leaves with spiny serrate-dentate margin, arachnoid-tomentose beneath; flowers in dense spike-like confluences; bracts woody and persistent BANKSIA
2. Leaves with variously pinnatifid, lobed, serrate or entire margin, never spiny, variously pubescent beneath, never arachnoid-tomentose; flowers in dense to lax raceme-like confluences or arranged like the spokes of a wheel; bracts never woody, persistent or caducous
3. Flowers arranged like the spokes of a wheel; leaves entire or variously lobed, veins pinnate or 5-plinerved from base of leaf STENOCARPUS
3. Flowers arranged in dense to lax raceme-like confluences; leaves simple, pinnatifid lobed or \pm serrate
4. Leaves entire or pinnatifid, sometimes with silky hairs beneath; flowers in axillary or \pm terminal confluences with pedicels usually < 1.5 cm long; fruits with 1 or 2 flat, winged seeds GREVILLEA
4. Leaves entire, glabrous; flowers in stout \pm terminal confluences with pedicels 2–3.5 cm long; fruit with 2 rows of unilaterally winged seeds ALLOXYLON
1. Fruit a drupe or drupe-like, indehiscent or irregularly so, rarely persisting
5. Leaves densely ferruginous-tomentose, entire or pinnate with a winged rachis contracted near the insertion of the leaflets BLEASDALEA
5. Leaves entire, never pinnate, rarely lobed, winged rachis not present, variously pubescent beneath
6. Leaves entire, often drying a distinctive grey colour, nerves straight and \pm parallel connected by one distinct looped intramarginal vein; fruit indehiscent FINSCHIA
6. Leaves mostly entire, rarely lobed, drying various colours usually not as above, nerves straight in the lower portion only then curved upwards and anastomosing near the margin; fruit indehiscent or irregularly dehiscent HELICIA

ALLOXYLON P. Weston & M. Crisp

Trees or shrubs. Leaves spirally arranged, simple, (lobed or pinnate, not in Papuanian species). Inflorescences short, solitary or fascicled, axillary in the upper leaf axils or terminal. Common bract very small, early caducous. Floral bracts absent. Flowers pink or red, pedicellate. Perianth irregular, separating into four segments; tubular part straight, cylindrical; limb subglobose, slightly recurved. Anthers sessile within the concave limb. Disc glands semiannular. Receptacle oblique. Ovary on a long stalk. Ovules imbricate, in two rows with four or more ovules in each row. Pollen presenter oblique, expanded, \pm turbinate with a small stigmatic surface near the centre. Fruit a follicle, rather woody, canoe-like upon opening, with *c.* 6 superimposed seeds in each half. Seeds subglobose, with an oblong, terminal wing.

Distribution: Four species of which 3 occur in Australia, 2 in Queensland and 1 in north-east New South Wales and south-east Queensland, 1 species occurs in Papuania.

Alloxylon brachycarpum (Sleum.) P. Weston & M. Crisp *Telopea* 4: 505 & 506, f. 3 (1991). **Fig. 57.**

Embothrium brachycarpum Sleum. (1939); *Oreocallis brachycarpa* (Sleum.) Sleum. (1954).

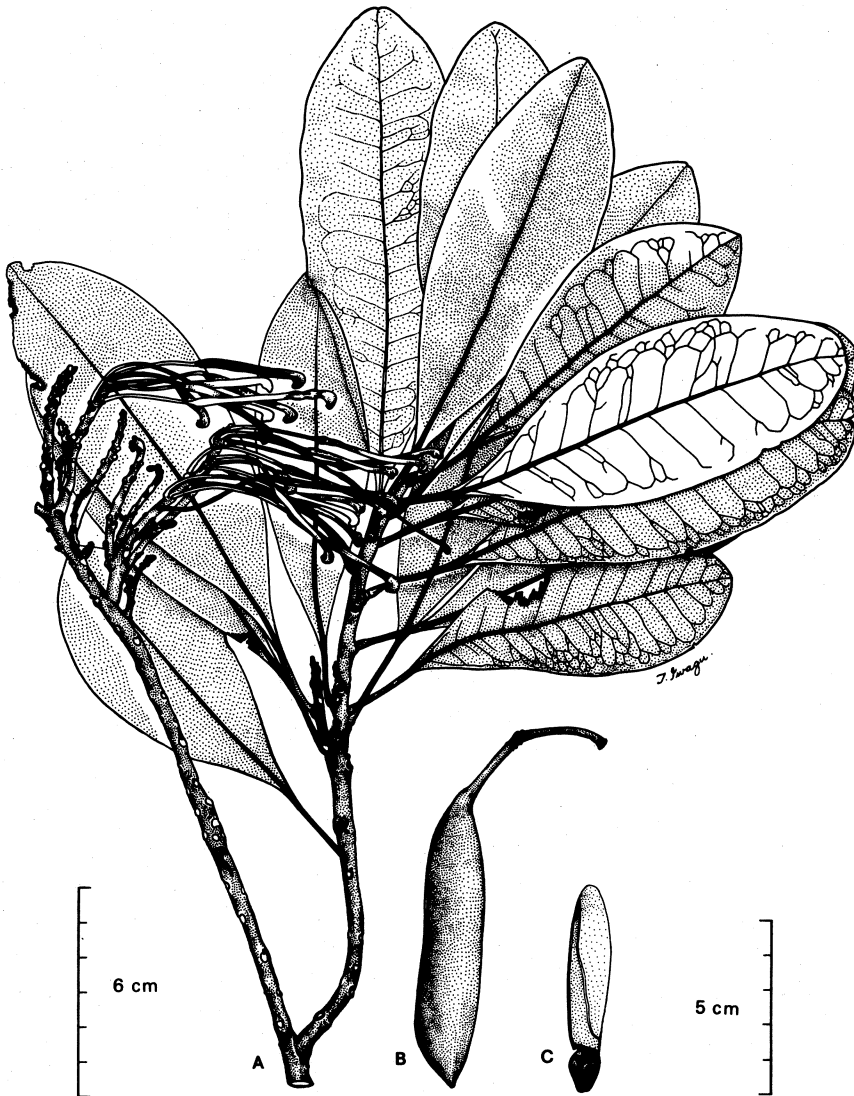


Fig. 57 *Alloxylon brachycarpum* (Sleum.) P. Weston & M. Crisp (A) flowering branchlet (NGF 37175) (B) fruit (NGF 49382) (C) seed (NGF 49382)

Tree 18–40 m high, slender. Twigs sparsely hairy, \pm smooth. Petiole 15–30 mm long, slightly swollen at the base. Lamina narrowly elliptic to narrowly obovate, 5–16 \times 2.5–5 cm, subcoriaceous to coriaceous, glabrous; base cuneate, decurrent on to the petiole; margin entire; apex rounded; midrib slightly prominent above, prominent beneath; nerves *c.* 10 pairs, ascending, straight, interarching towards the margin, slightly sunken above, barely raised beneath; reticulations lax. Inflorescence axillary, solitary, clustered together towards ends of the twigs with 2–50 flowers; rachis rufous to ferruginous-pubescent; flowers in pairs; pedicels 20–35 mm long, ferruginous-pubescent; Perianth pinkish red to bright red, glabrous to minutely ferruginous-pubescent; tube 25–50 mm long, splitting at first along one side to expose the style; limb slightly reflexed, subglobose 2–3 mm diam. Anthers 2 mm long. Ovary glabrous, on a stalk *c.* 20 mm long, slender; style *c.* 20 mm long. Fruit narrowly ellipsoid, 10–14 \times 1.5–2 cm, slightly broader towards the apex, smooth glabrous; pericarp with a coriaceous outer layer 1 mm thick, a rather stiff middle layer *c.* 1 mm thick and a soft inner zone 1–1.5 mm thick. Seeds in two rows of 3–7, impressed into the soft inner zone, 7–8 mm long, *c.* 7 mm wide at the widest part, with an oblong, terminal, membranous wing.

Field characters: Slightly spurred at the base. Bark grey-brown, pustular, peeling in small thick flakes, inner bark reddish brown. Sapwood pale yellow-brown, heartwood reddish brown with prominent broad rays.

Distribution: Digul district (upper Merauke) in western New Guinea and the adjacent Western district of Papua New Guinea; extending to Aru Islands.

Ecology: In lowland rain forest on ridges or besides rivers usually at low altitudes. Flowering June to October. Fruiting July to September, January and February.

Uses: The wood has an attractive grain and is quite suitable for special purposes such as veneer.

BANKSIA L. f.

Shrubs or trees. Twigs pubescent or glabrous. Leaves whorled, scattered or spirally arranged, coriaceous, entire, dentate, lobed or pinnatisect. Inflorescences terminal or axillary, cylindrical or spherical. Flowers bisexual, sessile, in pairs (unit inflorescences) subtended by one common bract and two floral bracts. Perianth linear, regular to slightly irregular; limb and upper portions of the perianth claws separating at anthesis. Anthers all perfect, sessile in the concave like segments; connective shortly prolonged. Hypogynous (disc) glands 4, alternate with tepals, small and membranous. Ovary sessile, very small, 1-locular; ovules 2, attached laterally; style straight, bowed to strongly curved below the pollen presenter, often hard and wiry; pollen presenter erect, small, conical or turbinate; stigma mostly terminal or oblique. Infructescence woody, consisting of few to many woody follicles; bracts persistent, becoming woody. Seeds often 2, compressed, with a terminal membranous wing.

Distribution: About 72 species in Australia, with one extending to the mainland of New Guinea and the Aru Islands.

Banksia dentata L. f. *Suppl.* 127 (1781); Sleum. *Fl. Males.* ser. 1, 5: 203, figs 25–28 (1955); George, *Nuytsia* 3: 275–277, f. 17 (1981). **Fig. 58.**

Tree up to 7 m high, often irregularly shaped. Twigs smooth, brownish to whitish tomentose, becoming glabrous. Leaves scattered on branches. Petiole 2.5–6(–14) mm long. Lamina obovate to oblong, 11–24 × 4–9 cm, glabrous; base gradually tapering; margin irregularly spiny serrate to dentate to subentire, often slightly recurved; apex obtuse or sometimes retuse; lower surface white or very pale brown arachnoid-tomentose; midrib sunken above, raised and prominent beneath; nerves numerous, \pm at right angles to the midrib, only barely visible above, raised and prominent beneath. Inflorescence cylindrical, usually with a whorl of branchlets below, 5–15 cm long. Bracts densely tomentose to densely hirsute. Perianth cream-coloured to pale yellow, 2.5–3.2 cm long, adpressed-pubescent to hirsute; limb 5 mm long. Anthers *c.* 2.5 mm long. Hypogynous scales *c.* 1 mm long. Ovary small with a few sparse hairs; style up to 4.5 cm long, glabrous; pollen presenter *c.* 1 mm long, hardly distinguishable from style; stigma terminal. Infructescence \pm cylindrical but often irregular. Follicles obovate, *c.* 20 mm long, 13–15 mm wide at the widest part, and *c.* 7–8 mm high, hirsute at first becoming \pm glabrous. Seed obovate, *c.* 18 mm long and 8–10 mm wide at the widest part; the terminal wing *c.* 10 mm long.

Field characters: Bark dark grey to black, deeply and irregularly fissured, flaking in large irregular flakes, inner bark dark red. Sapwood reddish brown, heartwood dark brown. Foliage usually rather sparse. No buttresses or stilt roots present.

Distribution: Extends from northern Australia to Papuaia and Aru Islands. In Papuaia it is known from the Digul (Merauke area), Morobe (near Wau and Bulolo), Western, Gulf and Central districts.

Ecology: In savannah forest or grassland, mostly in the lowlands but up to 1200 m altitude. In areas often subjected to regular burning.

Notes: A small flying phalanger is often found in flowering *Banksia* and probably assists in pollination.

BLEASDALEA F. Muell.

Small to medium-sized trees. Twigs and inflorescences covered with a variable indumentum. Leaves alternate, subcoriaceous, simple or imparipinnate; margin \pm serrate. Inflorescences axillary or ramiflorous. Flowers bisexual, in pairs with a common peduncle, subtended by a common, small, ovate bract; floral bracts absent. Receptacle oblique. Perianth tubular, irregular, parts cohesive in bud, separating at anthesis, limb ovoid. Stamens \pm sessile on the concave perianth limbs; connective shortly prolonged. Disc consisting of 2 glands, ventrally unilateral. Ovary shortly stipitate, 1-locular; ovule 2, collateral, pendulous, subapical,

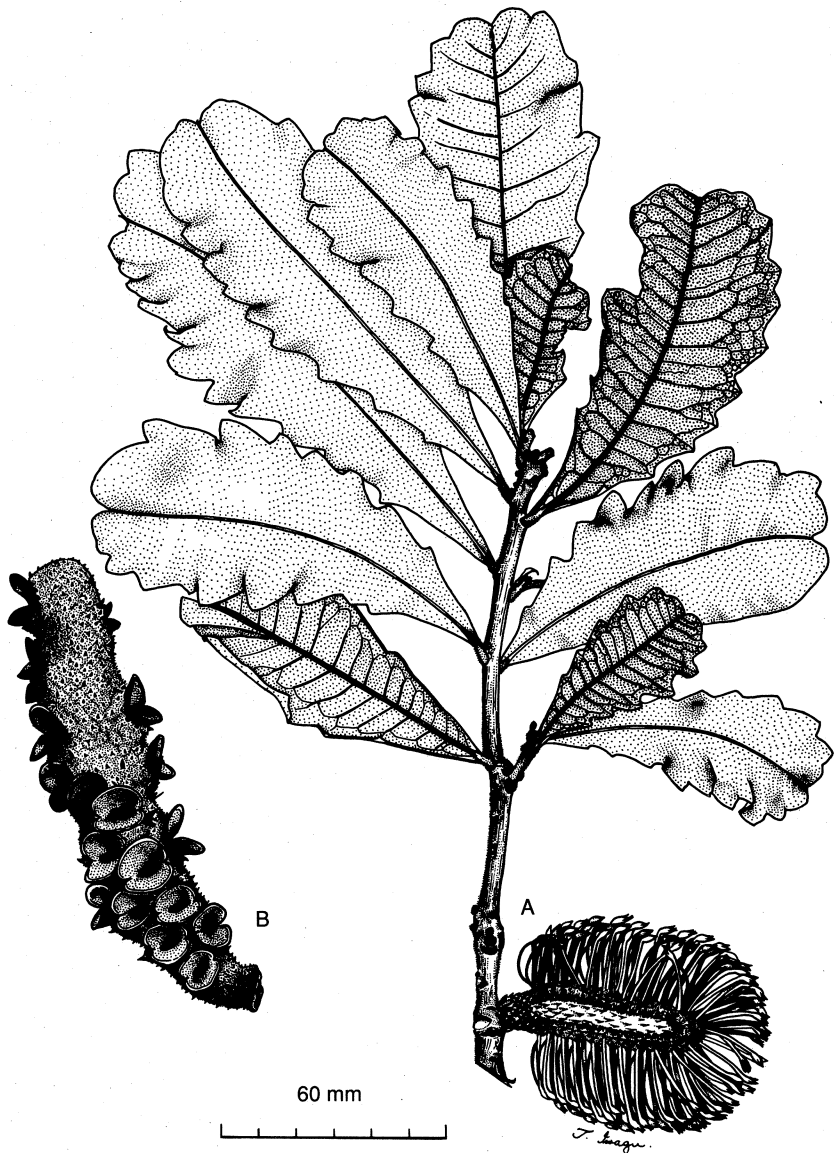


Fig. 58 *Banksia dentata* L. (A) flowering branchlet (B) infructescence (both *van Royen 4864*)

orthotropous; style recurved; pollen presenter clavate or disc-like, oblique; stigma small, lateral. Fruit indehiscent, \pm flattened laterally, with style persistent. Seed mostly solitary; cotyledons fleshy.

Distribution: Five species occurring from New Guinea, north Queensland (Australia), Vanuata and Fiji, with only one species in Papuasia.

Literature: A. C. Smith & J. E. Hass (1975), Studies of Pacific Island Plants, XXIX, *Bleasdalea* and related genera of Proteaceae, *Amer. J. Bot.* **62**: 133–147.

***Bleasdalea papuana* (Diels) Domin *Biblioth. Bot.* **89**: 32 (1921). Fig. 59.**

Euplassa papuana Diels (1916); *Gevuina papuana* (F. Muell.) Sleum. (1955).

Tree to 20 m high. Twigs dark ferruginous-velutinous. Leaves variable: either (a) with petiole up to 1.5 cm long, ferruginous-velutinous; lamina simple, narrowly obovate to obovate, 12–23 \times 3.5–7 cm, base gradually tapered onto the petiole, apex acuminate, nerves *c.* 12 pairs, ascending and interarched near the margin; or (b) leaves \pm similar to above, imperfectly 3-lobed; or (c) with petioles up to 5 cm long, ferruginous-velutinous; lamina imparipinnate, 3–9 pairs of leaflets (up to 13 pairs on juvenile leaves, occasionally more on coppice shoots), up to 43 cm long, petiolules up to 5 mm long, opposite to subopposite, lateral leaflets oblong-narrowly obovate to elliptic, 2.5–11 \times 1.5–4.5 cm, base cuneate or asymmetric, apex acuminate, terminal leaflet sessile, \pm elliptic up to 18 \times 6 cm, with base usually asymmetric and apex acute to acuminate; leaves and leaflets ferruginous-tomentose beneath; midrib raised and prominent above, raised and prominent beneath; margin mostly regularly serrate; rachis ferruginous-velutinous, winged, the wings constricted near the insertion of leaflets, with a similar indumentum and drying a similar colour as the leaves and leaflets. Inflorescence solitary, raceme-like, axillary, \pm erect, 15–32 cm long; rachis *c.* 3–4 mm diam., densely ferruginous-velutinous. Common bract small, *c.* 1 mm long, subpersistent, densely ferruginous-tomentose. Perianth 2.5–3 mm long, ferruginous-tomentose. Anthers 1–1.5 mm long. Disc 2 unfused hypogynous glands. Ovary sparsely hairy, soon becoming glabrous; style glabrous up to 7 mm long at anthesis; pollen presenter disc-shaped, oblique. Fruit obovoid, *c.* 1.5 cm in diameter; pericarp dark blue.

Field characters: Bark smooth, brown with a few white patches; inner bark light brown. Wood white to light brown to dark reddish brown towards the centre.

Distribution: Known from the Vogelkop, Jayapura, East Sepik and Morobe districts of New Guinea.

Ecology: In lower montane forest from 560 to 1200 m altitude. Flowering in February, April, June, August. Fruiting in August.

Notes: *Bleasdalea papuana* is closely allied to the north Queensland species *B. bleasdalei* (F. Muell.) A.C. Sm. & J. Hass. Both species have previously been referred to *Gevuina* which is now considered to be a monotypic genus restricted to central Chile and nearby areas of Argentina.



Fig. 59 *Bleasdalea papuana* (Diels) Sleum. flowering branchlet (LAE 52344)

FINSCHIA Warb.

Trees often with buttresses and stilt-roots. Leaves simple, entire; nerves pinnate, straight, parallel, connected by a distinct, looped intramarginal vein. Inflorescences axillary or ramiflorous. Peduncles absent. Flowers bisexual, pedicellate, in pairs; subtending bract very small, early caducous; floral bracts absent. Perianth curved, claws soon becoming free; limb subglobose. Receptacle oblique.

Anthers all perfect, \pm sessile in the concave segments; connective not prolonged. Disc entire or semi-annular, fleshy. Ovary stipitate, 1-locular; ovules 2, hemitropous, attached laterally; style slender, usually protruding from dorsal side of perianth tube in mature buds; pollen presenter turbinate; stigma terminal. Fruit indehiscent, globose, oblique, usually compressed laterally; pericarp with a thin fleshy outer zone and a thick, woody, \pm rough inner zone. Seeds 1 or 2; cotyledons thick and fleshy.

Distribution: Three species in Papuaia, two of which are endemic and have a restricted distribution, with *Finschia chloroxantha* extending to the Aru Islands, Solomon Islands, New Hebrides and Palau Islands.

Literature: C. T. White (1949), *Finschia*—A genus of “nut” trees of the south west Pacific, *Pacific Science* 3: 187–194.

KEY IN SPECIES

1. Leaves persistently rufous-tomentose beneath **F. rufa**
1. Leaves glabrous beneath or nearly so
2. Tepals and pedicels persistently ferruginous-tomentose; ovary ferruginous-tomentose **F. ferruginiflora**
2. Tepals and pedicels glabrescent, laxly ferruginous-sericeous in bud; ovary glabrous **F. chloroxantha**

Finschia chloroxantha Diels *Bot. Jb.* 54: 204 (1916); Sleum. *Fl. Males.* ser. 1, 5: 163, figs 9–11 (1955). **Fig. 60.**

Grevillea sp. Hemsl. (1885); *G. densiflora* C. T. White (1922); *G. eleoacarpifolia* Guill. (1932); *Helicia micronesica* Kan. (1933); *Finschia waterhousiana* Burt (1936); *F. micronesica* (Kan.) Sleum. (1939); *F. densiflora* C. T. White ex F. S. Walker (1948); *F. chloroxantha* var. *macrocarpa* Sleum. (1955).

Trees, up to 36 m high. Twigs at first with dense adpressed-ferruginous-pubescent, becoming \pm glabrous. Leaves variable. Petiole 1–3 cm long, slightly adpressed-pubescent or glabrous. Lamina \pm elliptic, narrowly obovate to oblong-obovate or narrowly ovate, 9.5–42 \times 2.6–13 cm, chartaceous to subcoriaceous, \pm glabrous; base \pm cuneate; apex acute, rounded or obtuse; midrib \pm prominent above, raised and very prominent beneath; nerves 11–23 pairs, raised and prominent on both surfaces, more so beneath; reticulations lax, clearly visible on both surfaces. Inflorescence axillary or ramiflorous, densely flowered, up to 30 cm long, laxly adpressed-ferruginous-pubescent. Pedicel 8–12 mm long. Perianth golden-yellow, 6–10 mm long, including a globose limb, laxly covered with fine brown hairs that extend down the pedicel. Disc horse-shoe shaped. Ovary glabrous on a stalk 3–4 mm long; style \pm glabrous, 9–15 mm long. Fruit \pm globose, compressed laterally, glabrous, 3–5.5 \times 2.5–4.5 cm, maturing yellow but rapidly turning black; stalk stout, 15 \times 3 mm. Seeds 2.

Field characters: Stilt-roots are often present; sometimes with buttresses at c. 1 m high. Bark strongly pustular, finely striated, dark brown to almost black, inner bark reddish brown. Wood light brown with prominent broad rays.

Distribution: Throughout the mainland of New Guinea, the Bismarck Archipelago, and the Solomon Islands. This species also extends to Aru Islands, Palau Island and the New Hebrides.

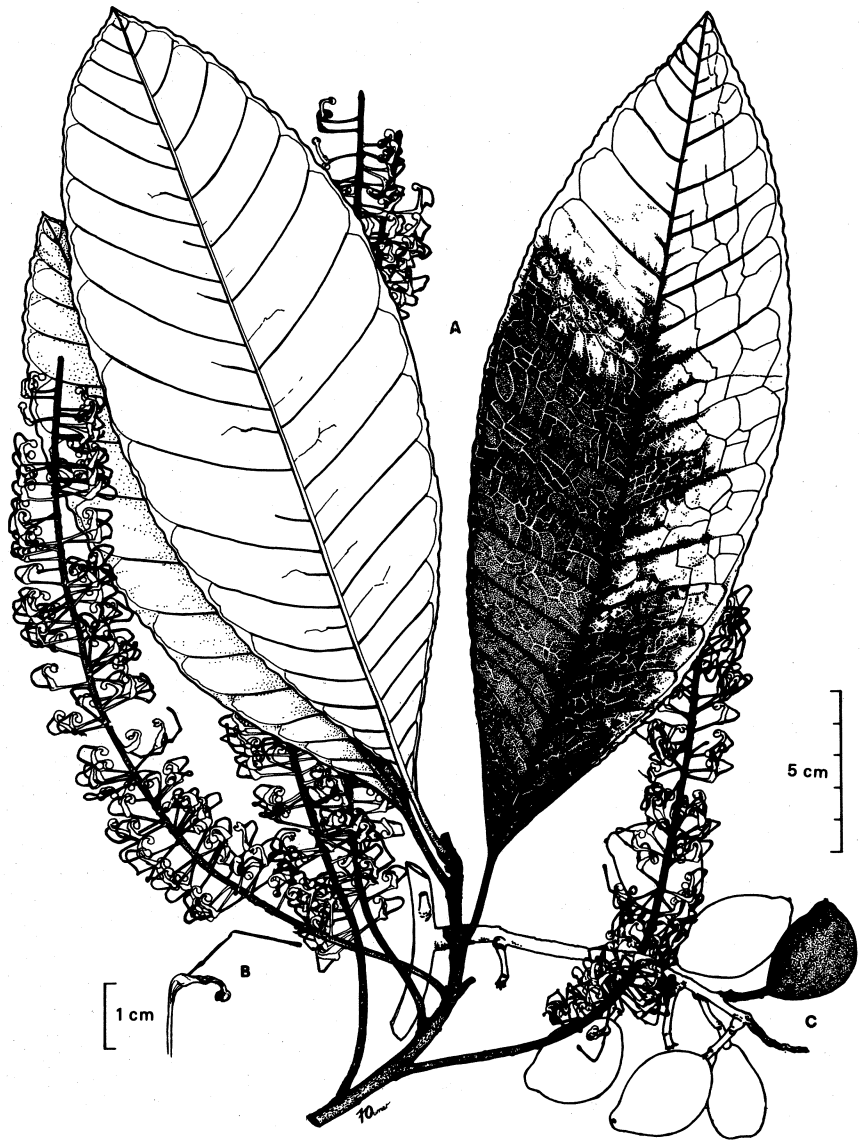


Fig. 60 *Finschia chloroxantha* Diels. (A) flowering branchlet (BSIP 5030) (B) flower (BSIP 5030) (C) infructescence (BSIP 12713)

Ecology: In primary and secondary rain forest, in swamps near the coast on ridges and slopes up to 2100 m altitude. It is sometimes planted near village sites.

Uses: The seeds are often cooked and eaten. Some trees are large enough to be useful for timber, but in New Guinea it is not an important commercial timber species and its use is usually restricted to local building and special veneer that utilizes the attractive oak-like grain.

Finschia ferruginiflora C. T. White *Pacific Science* 3: 190, f. 1 (1949).

Trees, up to 30 m high. Twigs glabrous. Leaves glabrous. Petiole 1–2.7 cm long. Lamina narrowly obovate to oblong-obovate, 14–30 × 4–8.3 cm; base cuneate or subattenuate; apex rounded or obtuse; midrib slightly raised above, raised and very prominent beneath; nerves up to 20 pairs, prominent on both surfaces; reticulations rather lax, visible on both surfaces. Inflorescences axillary, mostly ramiflorous, densely flowered, up to 33 cm long, densely ferruginous-tomentose all over (including the flowers). Pedicel 7–11 mm long. Perianth orange-brown, 6–8.5 mm long (including the subglobose to globose limb). Disc horse-shoe shaped. Ovary ferruginous-tomentose on a stalk 2.5 mm long; style c. 5.5 mm long; style and stalk glabrescent. Fruit ± globose, glabrous, 4.5 cm diameter. Seeds 2, ± rounded and compressed.

Field characters: Stilt-roots up to 1.5 m above soil level are sometimes present. Bark grey-brown, with small pustular lenticels in short longitudinal rows; under-bark purple; inner bark reddish brown with purplish markings. Sapwood pale brown; heartwood brown to pale red.

Distribution: Restricted to Eastern Highlands and Western Highlands of Papua New Guinea.

Ecology: In lower montane, secondary and primary forest from 1650 to 2200 m altitude. Flowering July, September, October. Fruiting October.

Uses: The seeds are cooked and eaten.

Finschia rufa Warb. *Bot. Jb.* 13: 298 (1891); Sleum. *Fl. Males.* ser. 1, 5: 160, f. 8 (1955).

Grevillea rufa (Warb.) Sleum. (1939); *G. carrii* Sleum. (1939); *Finschia carrii* (Sleum.) C. T. White (1949).

Trees, up to c. 28 m high. Twigs terete, distally rufous to ferruginous-tomentose. Petioles 1–2.5 cm long, ferruginous to rufous-tomentose. Lamina oblong to obovate-oblong, 13.4–42 × 5.5–17 cm, subcoriaceous; upper surface glabrous except for the midrib; lower surface ± densely rufous-tomentose to dark rufous-tomentose; base cuneate or lamina ± alternate and decurrent almost to the base of the petiole; apex obtuse to ± rounded; midrib slightly raised above, raised and very prominent beneath; nerves 14–25 pairs, slightly raised above, raised and prominent beneath; reticulations fine, visible on both surfaces. Inflorescences pendulous, axillary or ramiflorous, 15–38 cm long, all parts rufous-tomentose (including the flowers). Pedicel up to 13 mm long. Perianth golden-yellow, 10–12 mm long; limb globose. Disc horse-shoe shaped to almost annular. Ovary densely rufous-tomentose, on a glabrescent stalk 3–5 mm long; style up to 10 mm long,

± glabrous. Fruit ± globose, apex oblique, ± compressed laterally, 3.5–4 × 3.5 cm, maturing to yellow; stalk *c.* 1.5 cm long.

Field characters: Crown spreading. Bark grey-brown, vertically fissured; inner bark reddish. Wood ± cream-coloured with prominent rays.

Distribution: Known from the Madang, Morobe, Eastern Highlands, Western Highlands, Central and Milne Bay districts of Papua New Guinea.

Ecology: In open forest from 150 to 2400 m altitude.

GREVILLEA R. Br. ex Knight

Trees or shrubs. Leaves spiralled to alternate, simple or pinnate, usually with upper and lower surfaces different. Inflorescences terminal or axillary, panicles or raceme-like, sometimes with flowers borne on one side. Peduncles absent. Indumentum adpressed, hairs 2-branched or appearing to be attached near the middle. Flowers bisexual, pedicellate, in pairs, subtended by a small, non-persisting bract; floral bracts absent. Perianth mostly recurved; limb oblique, globular, segments coherent at limb for sometime after tube splits open. Anthers all perfect, ovate or oblong, sessile in the concave limb segments; connective not usually prolonged. Disc fleshy, semi-annular or annular, mostly entire or at times ± bilobed. Ovary shortly stipitate or sessile, 1-locular; ovules 2, hemitropous, attached laterally; style often elongated and protruding from a slit on the lower side of the tube, retained for some time by coherent limb segments, eventually free; pollen presenter ± dilated, straight, oblique or lateral and disc-like; stigma usually in the centre of the pollen presenter. Fruit a follicle, coriaceous to woody. Seeds 1 or 2, flat, orbicular or oblong, winged all around or occasionally wingless.

Distribution: A genus of *c.* 270 species occurring mostly in Australia; 3 species occur in Papuaia, one of which is endemic, whereas the other two also occur in northern Australia.

Literature: H. Sleumer (1955), *Grevillea*, *Fl. Males.* ser. 1, 5: 154–159; D. MacGillivray (1993), '*Grevillea*' (Melbourne Univ. Press: Carlton).

KEY TO SPECIES

1. Ovary hairy **G. papuana**
1. Ovary glabrous
 2. Leaves simple, greyish, permanently and densely silky on both surfaces; fruit dehiscent into 2 ± separate woody hemispherical valves **G. glauca**
 2. Leaves simple or pinnatifid, laxly hairy, finally glabrous above; fruit coriaceous, dehiscent down the dorsal side, boat-shaped **G. baileyana**

Grevillea baileyana McGillivray, *New names in Grevillea (Proteaceae)* 2 (1986); *Grevillea* 119 & 120 (1993).

Grevillea pinnatifida (F. M. Bail.) F. M. Bail. (1886), non Jacques (1843); *Grevillea* sp. F. Muell. (1885); *Kermadecia pinnatifida* F.M. Bail. (1886); *G. edelfeltii* F. Muell. (1885) nom. nud.

Small to medium-sized tree, up to 20(–30) m high. Twigs ± smooth, covered at first with whitish to rufous velutinous hairs extending up the petiole, becoming glabrous. Petiole 1.3–2.5 cm long. Leaves on young plants and coppice shoots often deeply lobed (pinnatifid) with up to 5 lobes, 20–28 × 2.5–3.5 cm; adult leaves simple, narrowly ovate to narrowly ovate-elliptic, 10.5–20 × 1.5–5.5 cm; base attenuate; apex ± acute to ± rounded and emarginate; lower surface covered with rufous to greyish silky hairs; upper surface glabrous; midrib prominent on both surfaces; nerves 10–15 pairs, ascending, interarching towards the margin, visible above and beneath; reticulations visible on both surfaces. Inflorescence panicle-like, 10–15 cm long, with raceme-like branches 8–10 cm long, covered with fine whitish-silky hairs which extend up the pedicels. Pedicel 2 mm long. Perianth greenish white, up to 8 mm long, covered outside with white silky hairs, glabrous inside; limb globose. Disc semi-annular. Ovary glabrous, with a short stalk 1–1.5 mm long; style filiform, c. 10 mm long; pollen presenter somewhat expanded, oblique. Fruit coriaceous, flattened, ± oblong, glabrous, 2 × 1.2 cm; style base persistent. Seeds 2, surrounded by a membranous wing.

Field characters: Outer bark round, fissured, dark brown; underbark reddish. Sapwood dark greyish to straw-coloured; heartwood red-brown.

Distribution: Extending from northern Australia to the Western, Gulf and Central districts of Papua New Guinea. McGillivray (1993) also records it from the Northern district.

Ecology: In dry savannah woodland and in monsoon forest up to c. 600 m, often in well-drained or dry sites on slopes and ridges, also common besides rivers. Flowering April to September; flowers fragrant or sweetly honey-scented.

Grevillea glauca Knight *Prot.* 121 (1809).

G. gibbosa R. Br. (1810).

Small tree, up to 10(–15) m high. Twigs and young shoots covered with silky, brownish to greyish hairs extending up the petiole and persisting on both surfaces of the leaf. Petiole 1–1.8 cm long. Lamina simple, entire, narrowly ovate to ± ovate, 10–19 × 2.5–4 cm, silky pubescent, brownish when young, becoming greyish; base attenuate; apex acuminate or acute; midrib ± prominent on both surfaces; nerves pinnate, 10–15 pairs, slightly raised above and beneath, ascending, ± parallel; reticulations faint on both surfaces. Inflorescence towards the end of twigs, loose, panicle-like with branches up to 15 cm long; covered with fine short hairs extending up the pedicels and perianth. Pedicel 2.5 mm long. Perianth recurved, whitish to greenish yellow, up to 6 mm long; limb globular. Disc cup-shaped, truncate, ± bilobed. Ovary glabrous, with a short stalk; style c. 12 mm long, filiform; pollen presenter conical. Fruit globose, oblique, 3–4.5 × 3 cm, dehiscent into 2 ± separate woody, hemispherical valves. Seeds 1 or 2, broadly winged, c. 2.5 cm diam.

Field characters: Bark rough, deeply fissured, dark grey to grey-brown; inner bark brown. Sapwood light brown; heartwood dark brown. Stilt-roots and buttresses absent.

Distribution: This species occurs on the Aru Islands, in northern Australia and in southern New Guinea, where it occurs in the Digul, Western and Central districts.

Ecology: In seasonally dry savannah woodland often in association with *Melaleuca* and *Banksia dentata* at low altitudes. Flowering August to October; flowers fragrant.

Vernacular name: 'Brambrai' (Arufi).

***Grevillea papuana* Diels *Bot. Jb.* 54: 205 (1916). Figs 61 & 62.**

Grevillea subargentea C. T. White (1922).

Small to medium-sized tree, 3.5–20 m high. Twigs with adpressed greyish to whitish pubescence distally, becoming glabrous. Petiole 5–15 mm long. Leaves of juvenile trees and on coppice shoots pinnatifid with 3–7 lobes up to 2.5 cm wide: adult leaves simple, sometimes slightly lobed towards the apex, narrowly ovate-elliptic, 11–20.5 × 2–5.5 cm; base gradually tapered to the petiole; apex mostly rostrate and ending in a small gland; lower surface covered with whitish or greyish adpressed silky hairs; upper surface glabrous; 5-nerved, primary nerves, secondary nerves and reticulations prominent on both surfaces. Inflorescence terminal, panicle-like, up to 20 cm long, consisting of several upwardly curved, greyish-sericeous raceme-like branches up to 9 cm long. Pedicel 3–5 mm long. Perianth tubular, densely silvery-sericeous outside, glabrous inside except for velutinous hairs at the base, greenish yellow when open, up to 8 mm long; limb globose, c. 1.3 mm diameter. Disc semi-annular. Ovary densely whitish pubescent, with a stalk up to 1 mm long; style slender, glabrous, curved; pollen presenter conical. Fruit coriaceous, flattened, ellipsoid, oblique, 2.5 × 1.5 cm; style base persistent. Seed 7 × 4 mm, surrounded by a membranous wing.

Field characters: Outer bark thin, greyish brown with small brown pustules; inner bark dark reddish brown. Wood light yellow-brown. Branches usually held erect; crown usually sparse.

Distribution: Endemic; widely distributed throughout the main island of New Guinea, not extending to the Bismarck Archipelago or the Solomon Islands.

Ecology: Found in a wide range of habitats from sea level to c. 1800 m, common in some areas along river banks, in seasonally dry savannah, *Eucalyptus* woodland to gallery rain forest, or dry rocky ridges, in anthropogenic grasslands and forest regrowth areas. Flowering February, April to November.

HELICIA Lour.

Trees or shrubs. Leaves mostly spirally arranged, rarely subopposite or 3- or 4-verticillate, sessile or petiolate, simple, entire or ± serrate. Inflorescences not branched, axillary or ramiflorous, occasionally subterminal or terminal. Peduncles present. Flowers bisexual, pedicellate, in pairs, subtended by a small caducous or subpersistent bract; floral bracts present, very small, caducous or subpersistent. Perianth straight, slender; limb straight, ± subglobose or clavate;

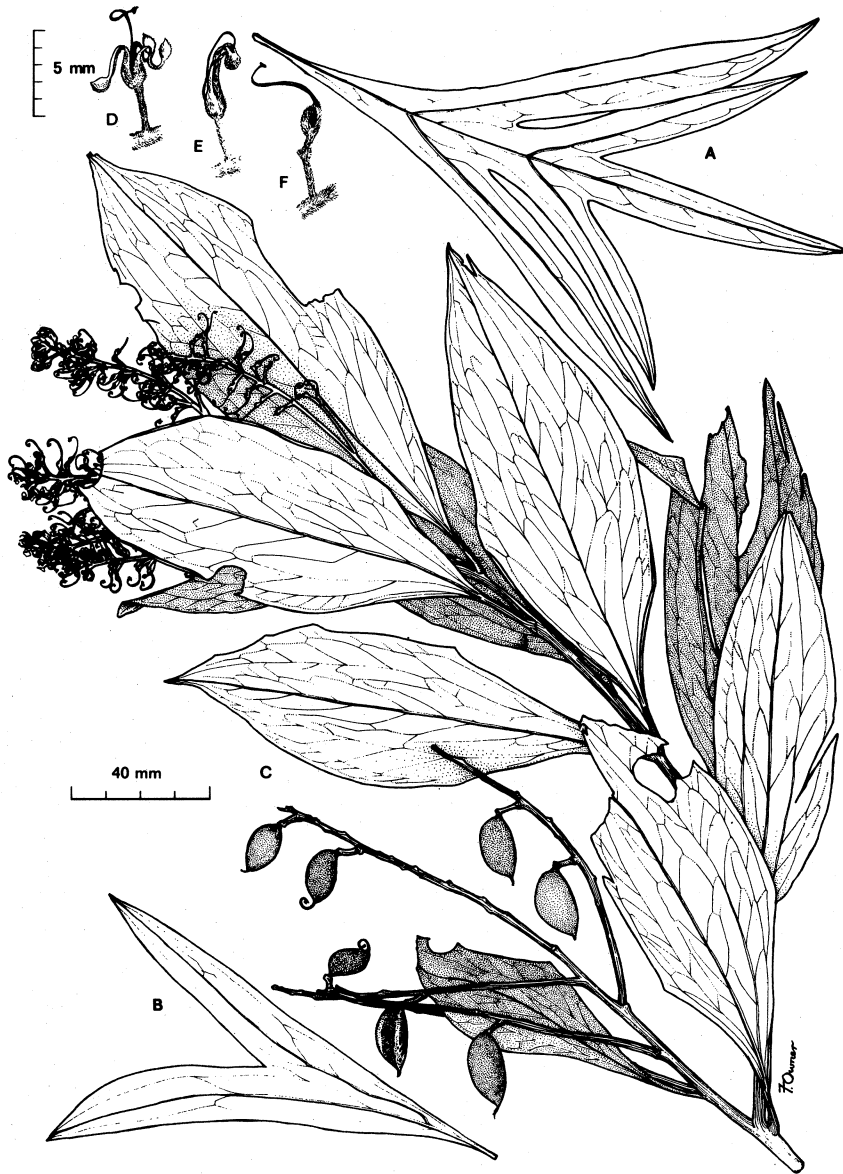


Fig. 61 *Grevillea papuana* Diels. (A & B) young leaves (*Heyliger 1280B*) (C) flowering and fruiting branchlet (*NGF 39998*) (D, E & F) flowers (*Heyliger 1280A*)

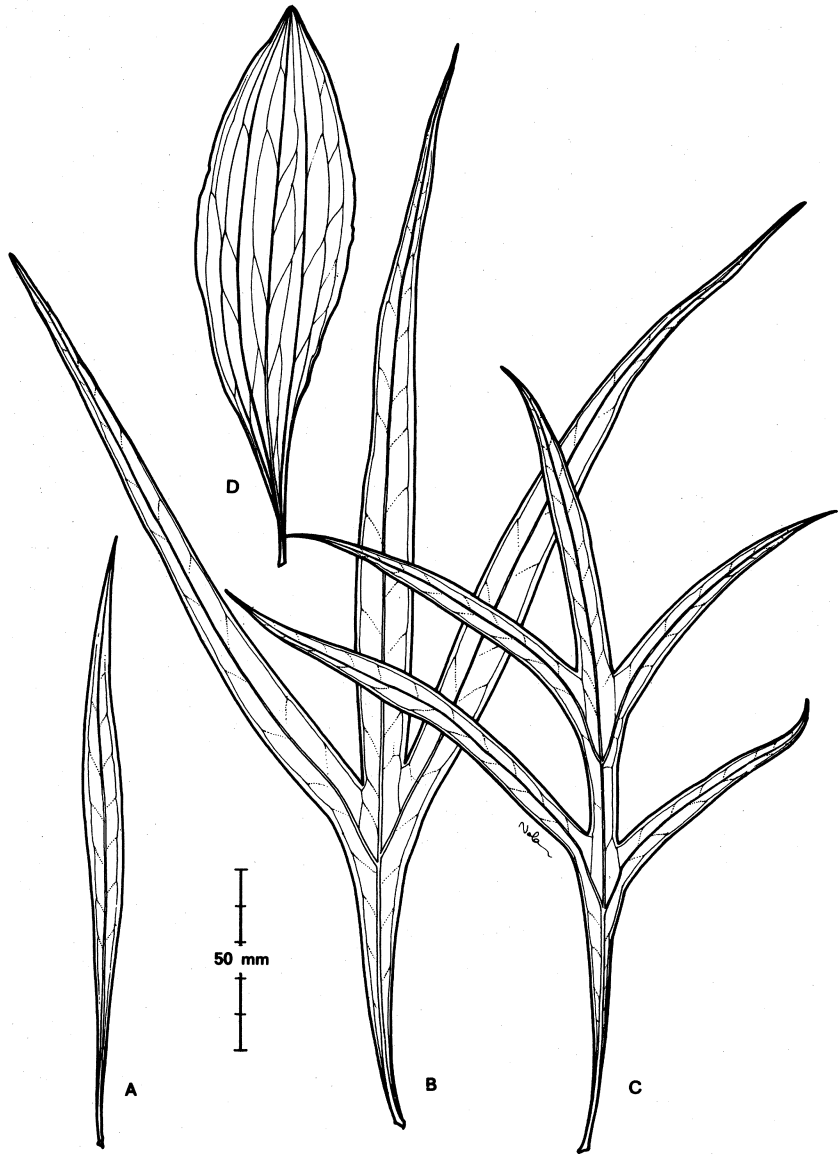


Fig. 62 *Grevillea papuana* Diels. (A) first leaf (B & C) divided juvenile leaf (D) adult leaf (all from live material, Lae Botanic Gardens)

perianth segments becoming free and revolute at anthesis. Anthers all perfect, oblong, sessile in the concave limb segments; connective apiculate. Disc free or \pm connate into a cup. Ovary sessile, glabrous or \pm tomentose, 1-locular; ovules 2, anatropous, attached at the base of the ovary or ventrally; style slender; pollen presenter straight, \pm clavate; stigma terminal, very small, \pm circular. Fruit indehiscent or tardily dehiscent; pericarp coriaceous, sometimes with a distinct zone of fibres or fibre-sclereids. Seeds usually one, rarely 2, usually subglobose; cotyledons fleshy.

Distribution: About 90 species, widely distributed from eastern Australia (9 species), to New Guinea (47 species) including the Bismarck Archipelago, but not extending to the Solomon Islands; throughout Malesia and Southeast Asia, where most of the remaining species occur, and extending to southern India, Sri Lanka and to southern Japan.

Literature: Sleumer, H. (1955), *Studies in Old World Proteaceae*, 5, A Revision of the genus *Helicia* Lour. *Blumea* 8: 7–79.

KEY TO SPECIES

1. Ovary hairy
2. Leaves glabrous
 3. Nerves deeply impressed in grooves above
 4. Petiole 5–10 mm long; lamina up to 30 × 10 cm; main nerves up to 12 pairs; pedicel 2 mm long; perianth 20 mm long, white **H. lauterbachiana**
 4. Petiole 10–35 mm long; lamina 10–24 × 7–8 cm; main nerves up to 15 pairs; pedicel 5 mm long; perianth up to 17 mm long, pale pink **H. stelechantha**
 3. Nerves not deeply impressed in grooves above
 5. Leaves entire
 6. Inflorescence laxly flowered; perianth 25 mm long **H. schlechteri**
 6. Inflorescence densely flowered; perianth 10–15 mm long **H. torricellensis**
 5. Leaves serrate or dentate, at least in their upper half
 7. Perianth 5–6 mm long; lamina 4–1 × 2–3.7 cm **H. microneura**
 7. Perianth 8–10(–15) mm long; lamina 6–23 × 4–8.5 cm **H. australasica**
2. Leaves with some hairs beneath, sometimes the hairs only persisting along the midrib and to a lesser extent along main nerves
 8. Leaves entire or almost so, sometimes a few irregularly spaced teeth present particularly on the young leaves
 9. Petiole at least 40 mm long; all parts covered with long, dense, dark reddish brown hairs **H. calocoma**
 9. Petiole < 40 mm long; indumentum shorter, sparser and usually a lighter colour than above
 10. Main nerves \pm impressed above; leaves mostly entire, but occasionally a few irregular teeth present; perianth 18–24 mm long, pink to dark red **H. oreadum**
 10. Main nerves not impressed above
 11. Perianth > 20 mm long; petiole 10–20 mm long; main nerves 5–7 pairs, curving along their entire length **H. carrii**
 11. Perianth up to 15 mm long
 12. Lamina up to 15 cm long
 13. Petiole 7–14 mm long; lamina mostly elliptical, 6–15 × 2.7 cm; nerves 9–10 pairs **H. laiagamensis**
 13. Petiole 4–5 mm long; lamina narrowly oblong or \pm obovate, 10–15(–30) × 4–12 cm; nerves 9–10 pairs **H. sellae-montis**
 12. Lamina > 15 cm long
 14. Petiole > 10 mm long
 15. Inflorescence 17–27 cm long; petiole up to 20 mm long **H. longespicata**
 15. Inflorescence 8–11 cm long; petiole c. 10 mm long **H. platyphylla**

14. Petiole < 10 mm long
16. Petiole up to 5 mm long
17. Perianth 10.5 mm long; petiole 4–5 mm long; lamina narrowly oblong to \pm obovate, 10–15(–30) \times 4–12 cm; nerves 9 or 10 pairs **H. sellae-montis**
17. Perianth 7 mm long; petiole 3–6 mm long; lamina oblong to \pm obovate, 17–22 \times 4–8.5 cm; nerves 12 pairs **H. uganensis**
16. Petiole > 5 mm long
18. Perianth 7 mm long; petiole 3–6 mm long; lamina \pm oblong to \pm obovate, 17–22 \times 4–8.5 cm **H. uganensis**
18. Perianth > 8 mm long; petiole up to c. 10 mm long; lamina larger than above
19. Lamina broadly elliptical or obovate, 20–45 \times 7–18 cm; petiole 8–9 mm long; perianth 8–10 mm long, cream-coloured **H. amplifolia**
19. Lamina broadly oblong, 3–45 \times 13–20 cm; petiole c. 10 mm long; perianth 10–12 mm long, pale pink **H. platyphylla**
8. Leaves mostly serrate or dentate, sometimes only in the upper part of the leaf
20. Petiole > 10 mm long; lamina 6–13 \times 2.5–5 cm; perianth 5–7 mm long, lilac-red **H. ledermannii**
20. Petiole < 10 mm long
21. Lamina narrowly ovate, 9–15 mm wide; apex rostrate **H. rostrata**
21. Lamina elliptic, oblong-elliptic or obovate, broader than above; apex not rostrate
22. Perianth 5–6 mm long; lamina 4–11 \times 2–3.7 cm; petiole 2.5 mm long **H. microneura**
22. Perianth 8–10 mm long **H. australasica**
1. Ovary glabrous
23. Leaves with some hairs present beneath, sometimes only persisting along the midrib
24. Leaves peltate **H. peltata**
24. Leaves not peltate
25. Lamina < 8 cm long
26. Petiole 2–4 mm long **H. cameronii**
26. Petiole at least 5 mm long
27. Perianth 30–35 mm long **H. insculpta**
27. Perianth up to 25 mm long
28. Petiole 10–15 mm long; perianth 20–25 mm long; pedicel 3 mm long **H. retusa**
28. Petiole 5–10 mm long; perianth 20 mm long; pedicel 4–6 mm long **H. microphylla**
25. Lamina > 8 cm long
29. Nerves 19–21 pairs; petiole 10 \times 3 mm; lamina oblong to obovate-oblong, 19–35 \times 6–13 cm **H. saurauioides**
29. Nerves up to c. 15 pairs
30. Main nerves impressed above
31. Lamina bullate, elliptic to elliptic-oblong, 12–20 \times 6–10 cm; nerves 10–24 pairs **H. bullata**
31. Lamina sub-bullate, ovate to elliptic, 4–15 \times 2–7.5 cm; nerves up to 10 pairs **H. insculpta**
30. Main veins not impressed above
32. Perianth 17–18(–20) mm long at anthesis; lamina usually drying a greenish yellow or brown, oblong to \pm narrowly ovate or narrowly elliptic, 8–14 \times 2–4.5 cm, base alternate, apex acuminate; petiole 10–30 mm long **H. hypoglauca**
32. Perianth > 20 mm long at anthesis; lamina drying olivaceous or to light to dark brown, oblong to elliptic or obovate, 4–20 \times 2.5–9 cm, base rounded, oblique or shortly attenuate, apex rarely acuminate; petiole 10–40 mm long
33. Lamina elliptic, 4–9 \times 2.5–5 cm, apex retuse; reticulations very dense and raised on both surfaces; petiole 10–15 mm long **H. retusa**
33. Lamina oblong to elliptic, 9–20 \times 5–9 cm, apex obtuse to bluntly acute or acuminate; reticulations dense; petiole 15–40 mm long **H. albiflora**
23. Leaves glabrous
34. Leaf-base subcordate; lamina obovate or pandurate, 24.5–33.5 \times 11.2 cm **H. subcordata**
34. Leaf-base not subcordate
35. Petiole at least 10 mm long
36. Perianth at least 20 mm long at anthesis
37. Pedicel up to 3 mm long; lamina reticulations very dense; lamina elliptic, 8–14 \times 4–6.2 cm; nerves c. 10 pairs; perianth 20–24 mm long at anthesis **H. archboldiana**

37. Pedicel 4–8 mm long; lamina reticulations lax
38. Nerves impressed above; perianth 30–35 mm long, dark pink **H. insculpta**
38. Nerves not impressed above; perianth not as above
39. Lamina elliptic, 12.5–27 × 5.5–11 cm; perianth 25 mm long at anthesis, white with a yellow limb; fruit ellipsoid, 15 × 10 mm, shiny, jet black **H. polyosmoides**
39. Lamina, perianth and fruits not as above
40. Lamina obovate to narrowly obovate, 15–40 × 5–9 cm, apex gradually acuminate; nerves 9–16 pairs; perianth 25–35 mm long, creamy-white **H. forbesiana**
40. Lamina broadly obovate, 10–17.5 × 5–10 cm, apex obtuse; nerves 6–10 pairs; perianth 20–30 mm long, white to pink with a white limb **H. obtusata**
36. Perianth < 20 mm long at anthesis
41. Nerves impressed above; lamina obovate, 12–15 × 5–7 cm; perianth light yellow, 15–16 mm long **H. wollastonii**
41. Nerves not impressed above; lamina elliptic to oblong-elliptic, 15–22 × 3.5–9 cm; perianth 15–20 mm long **H. pallescens**
35. Petiole < 20 mm long at anthesis
42. Perianth at least 20 mm long at anthesis
43. Lamina > 20 cm long; oblong to obovate, apex acute to obtuse; twigs sometimes swollen and inhabited by ants; perianth 20 mm long; pedicel 6 mm long **H. macrostachya**
43. Lamina < 20 cm long
44. Lamina broadly obovate, 10–17.5 × 5–10 cm, apex obtuse; twigs sometimes swollen and inhabited by ants; perianth white or pink with a white limb; pedicel 4–8 mm long; fruit globose, 20 × 18 mm **H. obtusata**
44. Not as above
45. Perianth 20–24 mm long; pedicel 3 mm long; lamina elliptic, 8–14 × 4–6.2 cm; reticulations very dense and clearly defined; nerves not impressed above **H. archboldiana**
45. Perianth 28–35 mm long; pedicel 4–6 mm long; lamina ovate, obovate or elliptic, 4–15 × 2–7.5 cm; reticulations not as clearly defined as above; main lateral veins sometimes impressed above
46. Perianth 28–30 mm long, blue-green, completely glabrous or nearly so **H. coeruleopurpurea**
46. Perianth 30–35 mm long, dark pink, rufous-pilose; pedicel 4.5–6 mm long; lamina ovate to elliptic, 4–15 × 2.7 cm; inflorescence rufous-pilose **H. insculpta**
42. Perianth < 20 mm long at anthesis
47. Perianth < 10 mm long at anthesis
48. Petiole slender; lamina up to 3.5 cm wide, apex acute **H. acutifolia**
48. Petiole stout; lamina > 3.5 cm wide, apex not acute
49. Perianth 6.5 mm long; pedicel 1.5–2 mm long; lamina oblong to elliptic, 8–14 × 3.5–4.5 cm; nerves 8–12 pairs; fruit 35 × 25 mm; pericarp up to 4 mm thick **H. olivacea**
49. Perianth 9 mm long; pedicel 2–4 mm long
50. Lamina oblong-elliptic to ± narrowly ovate, 15–22 × 4–7.5 cm; nerves up to 20 pairs, straight in the lower half then curved upwards; fruit 55 × 38 mm; pericarp 5 mm thick **H. commutata**
50. Lamina broadly elliptic, 15–24 × 8–11 cm; nerves 6–9 pairs, curving over their entire length; fruit 30–40 × 25 mm; pericarp 2–4 mm thick **H. latifolia**
47. Perianth 10–20 mm long at anthesis
51. Lamina > 14 cm long
52. Perianth up to 12 mm long at anthesis
53. Pedicel 6–7 mm long **H. peekelii**
53. Pedicel 3–5 mm long **H. saruwagedica**
52. Perianth at least 13 mm long at anthesis
54. Perianth 15–18 mm long at anthesis; petiole 5–7 mm long; lamina obovate to oblong-ovate, 20–34 × 8–12 cm **H. finisterrae**
54. Perianth up to 15 mm long at anthesis; petiole up to 5 mm long
55. Nerves up to 12–15 pairs; lamina oblong-elliptic, 20–25 × 8.5–9.5 cm; petiole 2–5 mm long; perianth 14 mm long **H. neglecta**
55. Nerves 5–9 pairs; lamina oblong to obovate-oblong, 16–27 × 5.5–9.5 cm; petiole 5 mm long; perianth 13–15 mm long **H. affinis**
51. Lamina < 14 cm long
56. Perianth at least 15 mm long at anthesis **H. retevenia**

56. Perianth < 15 mm long at anthesis
 57. Nerves poorly defined, particularly towards the margin; pedicel up to 3 mm long
 **H. insularis**
 57. Nerves well-defined, interarching near the margin; pedicel > 3 mm long
 58. Lamina oblong to broadly elliptic-oblong, 8–20 × 4–10 cm; inflorescence 15–22 cm
 long; perianth 12 mm long **H. saruwagedica**
 58. Lamina obovate to obovate-elliptic, 3–8.5 × 2–4.5 cm; inflorescence 6–11 cm long; peri-
 anth 10–12 mm long **H. odorata**

Helicia acutifolia Sleum. *Bot. Jb.* **70**: 140 (1939).

Tree, c. 6 m high. Twigs sparsely adpressed rufous-pilose, glabrescent. Petiole slender, 4–5 mm long. Lamina elliptic to narrowly ovate, 6–11 × 2.5–3.5 cm, chartaceous, glabrous; base acute, ± decurrent on to the petiole; margin entire or with up to 3 pairs of unevenly spaced teeth on either side (mainly on distal half); apex acute to acuminate; midrib flattened and inconspicuous above, more prominent below; nerves 7–9 pairs, curving upwardly, interarching inconspicuously near the margin, slightly raised on both surfaces. Inflorescence axillary, densely flowered, 8–12 cm long, sparsely rufous-pilose. Bracts very small. Peduncle c. 0.4 mm long. Pedicel c. 3 mm long. Perianth cream-coloured, c. 9 mm long; limb 3 × 1.5 mm long. Anthers 1–2 mm long. Disc glands connate at the base. Ovary glabrous; style slender, glabrous. Fruit not known.

Distribution: Restricted to New Guinea where it is known only from Mt Victoria in the Central district of Papua.

Ecology: In secondary forest at 2040 m altitude. Flowering January.

Helicia affinis Sleum. *Bot. Jb.* **70**: 137 (1939).

Helicia moluccana Laut. (1913), non (R. Br.) Bl. (1834).

Small tree, to 12 m high. Twigs glabrous. Petiole 5 mm long, stout, rugose. Lamina ± oblong to obovate-oblong, 16–27 × 5.5–9.5 cm; base cuneate and decurrent on to the petiole; margin entire, ± undulate; apex ± acute to obtusely acuminate; glabrous, ± chartaceous; midrib ± prominent above, flattened or slightly raised and prominent beneath; nerves 5–9 pairs, curved, ascending and inconspicuously interarched near the margin, slightly raised above, raised and prominent beneath, reticulations dense and slightly raised on both surfaces. Inflorescence axillary, densely flowered, up to 22 cm long; rachis 1.5 mm diameter, densely adpressed and shortly rufous-pilose. Bracts small, ovate; apex acute. Peduncle 0.4 mm long, laxly rufous-pilose. Pedicel c. 1–3 mm long. Anthers 2 mm long. Disc glands ± oblong, free or connate at the base. Ovary glabrous; style slender, glabrous. Fruit greyish white, ± ovoid, 4 × 2–2.5 cm; pericarp coriaceous, 5 mm thick; stalk stout, 2 × 4 mm. Seed c. 3 × 1 cm.

Field characters: Bark pale brown with longitudinal lines of lenticels; underbark orange; inner bark pale orange-brown. Wood orange-brown.

Distribution: Restricted to New Guinea where it is known only from the Madang district of Papua New Guinea.

Ecology: In forest from 30 to 600 m high. Flowering May. Fruiting January.

Helicia albiflora Sleum. *Bot. Jb.* **70**: 138 (1939).

Tree, up to 30 m high. Twigs densely rufous-tomentose, with hairs adpressed, glabrescent. Petiole 1.5–4 cm long, densely adpressed-tomentose at first, becom-

ing glabrous. Lamina oblong to \pm elliptic, 9–20 \times 5–9 cm, chartaceous to subcoriaceous; lower surface rufous-tomentose, becoming nearly glabrous; base rounded, sometimes slightly oblique, decurrent on to the petiole; margin entire; apex obtuse to broadly acute or acuminate, sometimes rounded or shortly attenuate; midrib \pm sunken above, prominent beneath, curving upwards, \pm distinctly interarching near the margin; reticulations dense, clearly defined on both surfaces. Inflorescence axillary or ramiflorous, 9–17 cm long; rachis with densely adpressed rufous tomentum extending up the peduncles, pedicels and to a lesser extent the perianth. Bracts 1.5–2 mm long. Peduncle 0.5–3 mm long. Perianth white, c. 25 mm long; limb c. 4.5 \times 1.5 mm. Anthers 3 mm long. Disc glands free or connate into a shallow cup. Ovary glabrous; style slender, glabrous. Fruit a drupe, \pm globose, 4 \times 3–4 cm, base rounded, slightly pointed at the apex; pericarp dark blue, almost black, with a whitish bloom, with a distinct layer of fibres 2 mm thick, outer zone fleshy, c. 3 mm thick; stalk c. 1 cm long. Seeds globose, to 2.7 cm diameter.

Field characters: Bark brown to light grey, slightly pustular; inner bark brown. Sapwood straw; heartwood reddish brown.

Distribution: Restricted to New Guinea where it is known from the Western Highlands, Eastern Highlands, Morobe, Central and Northern districts of Papua New Guinea.

Ecology: In rain forest, sometimes as a subcanopy tree in *Castanopsis-Nothofagus* forest at altitudes from 900 to 2050 m high. Flowering January, February, July, October, September. Fruiting August.

Helicia amplifolia Sleum. *Bot. Jb.* 70: 143 (1939).

Tree, up to 18 m high. Twigs rufous-tomentose particularly distally, becoming \pm glabrous lower down. Petiole 5–9 mm long, rufous-tomentose at first, glabrescent. Lamina broadly elliptical or obovate, 20–42 \times 7–18 cm, chartaceous to subcoriaceous, with a few hairs persisting along the midrib and main nerves; base cuneate to attenuate; margin entire or with a few irregularly spaced teeth; apex abruptly acute to obtuse; midrib prominent on both surfaces; nerves 10–17 pairs, curved, ascending, flattened or slightly raised above, raised beneath; reticulations lax, slightly raised beneath. Inflorescence ramiflorous or axillary, 9–11 cm long, densely flowered; rachis 1–2 mm diameter, with rufous indumentum extending up the pedicels and perianth. Bracts up to c. 1 mm long. Peduncle 0.3 mm long. Pedicel 1–2 mm long. Perianth 8–10 mm long, pale yellow to cream-coloured or creamy brown; limb 3 \times 1 mm. Anthers 2 mm long. Disc glands free or connate at the base. Ovary ferruginous- to rufous-pilose; style slender, glabrous. Fruit ellipsoid, up to 7 \times 5.5 cm, greyish mottled appearance; pericarp with a rather fibrous outer zone containing a purple pigment, 10 mm thick and an inner zone of fibres 2–3 mm thick; stalk stout, 3 \times 8 mm. Seed subglobose, 2.5–3 cm diameter.

Field characters: Bark light grey to grey-brown, finely fissured; inner bark straw-coloured. Wood pale yellow. Leaves tending to be clustered towards the ends of the branches.

Distribution: Restricted to New Guinea, where it is known from the Madang, Western Highlands, Eastern Highlands, Morobe and Southern Highlands districts of Papua New Guinea.

Ecology: In primary or secondary rain forest or submontane forest, sometimes associated with *Castanopsis* from 600 to 1340 m altitude. Flowering January, June, July, August, November, December. Fruiting February, May, June, July, October and December.

Helicia archboldiana Sleum. *Blumea* 8: 51 (1955).

Small tree, 2.5–9 m high. Twigs glabrous, shallowly fissured. Petiole 5–20 mm long, glabrous, base somewhat thickened and rugose. Lamina \pm elliptic, 8–14 \times 4–6.2 cm, coriaceous, \pm shiny above or not, glabrous; base cuneate, decurrent on to the petiole; margin \pm serrate particularly in the upper half; apex abruptly acuminate; midrib prominent and flattened above, very prominent beneath; nerves *c.* 10 pairs, \pm parallel and straight in the lower part, curved upwards and interarched near the margin, slightly raised on both surfaces; reticulations very dense and raised on both surfaces. Inflorescence ramiflorous, 8–13 cm long; rachis 2 mm diameter, covered with dense short adpressed rufous hairs extending up the peduncles and pedicels. Peduncle 0.3 mm long. Pedicel 3 mm long. Bracts \pm ovate, up to *c.* 1 mm long. Perianth up to 2.4 cm long at anthesis, minutely hairy, tube pink and limb whitish; limb 3 \times 1.5 mm. Anthers 2 mm long. Disc glands free, upper margin crenulate. Ovary glabrous; style glabrous. Fruit not known.

Field characters: Bark dark brown; inner bark reddish brown. Wood light-brown.

Distribution: Restricted to New Guinea where it is known from the Jayapura and Central districts.

Ecology: In the understorey of moss forest, in lower montane forest and secondary vegetation at altitudes from 1600 to 2600 m. Flowering January, February and August.

Helicia australasica F. Muell. *J. Bot. Kew Misc.* 9: 22 (1857).

Helicia dentellata Sleum. (1939); *Helicia glabrescens* C. T. White (1944).

Tree or treelet, 3–20 m high. Twigs terete, rufous- to ferruginous-tomentose distally, glabrous lower down. Petiole 2–10 mm long, ferruginous-tomentose, glabrescent. Lamina oblong, elliptic-oblong, narrowly ovate or oblong-lanceolate, 6–23 \times 4–8.5 cm, subcoriaceous to coriaceous, glabrous to laxly ferruginous-tomentose beneath mainly along the midrib and lateral nerves; base attenuate or rarely cuneate; margin irregularly serrate to dentate; apex acuminate, acute or sometimes obtuse; midrib flattened or slightly raised, flattened or slightly impressed above, raised and prominent beneath; nerves curving upward over their entire length, interarching near the margin; reticulations mostly lax, slightly raised on both surfaces. Inflorescence axillary or sometimes ramiflorous, 7–17 cm long, laxly rufous-pilose, densely flowered; rachis 1–1.5 mm diameter. Bracts ovate, small; apex acute. Peduncle 0.5 mm long, laxly ferruginous-pilose, glabrescent. Pedicel 1–3 mm long, laxly ferruginous-pilose, glabrescent. Perianth

cream-coloured, 8–15 mm long, laxly ferruginous-pilose; limb 3 mm long. Anthers 2 mm long. Disc glands free or connate at the base. Ovary ferruginous-tomentose. Fruit ovoid, 8–11 × 5–7.5 mm, glabrous; pericarp dark blue, outer zone fleshy, inner zone of fibres; stalk 5 mm long. Seed ovoid, 6–8 × 4–5 mm.

Field characters: Bark grey pustular; inner bark light brown. Wood with conspicuous rays.

Distribution: Extending from northern Australia to the Western district of Papua New Guinea.

Ecology: Usually in patches of rain forest along rivers and streams. Flowering March, August, September. Fruiting December.

Helicia bullata Sleum. *Blumea* 8: 63 (1955).

Tree, up to 12 m high. Twigs, petioles and young inflorescences dark ferruginous-tomentose. Petiole 5–15 × 2.5 mm. Lamina elliptic to elliptic-oblong, 12–20 × 6–10 cm, bullate; lower surface ferruginous-tomentose at first, later becoming glabrous except for a few hairs that persist along the midrib and main nerves; upper surface glabrous except for a few persistent dark brown hairs along the midrib; base obtuse to rounded; margin entire; apex bluntly acuminate; midrib slightly raised and ± lying in a groove above, prominent beneath; nerves impressed above, raised beneath, 10–14 pairs, curving over the entire length and interarching conspicuously near the margin; reticulations dense, well defined, impressed above and raised beneath. Inflorescence ramiflorous, 9–12 cm long, densely flowered; rachis 3 mm diameter. Bracts hairy, c. 1 mm long, ovate; apex acuminate. Peduncle 0.5–1 mm long. Pedicel 6–8 mm long, ferruginous-tomentose. Perianth white, c. 30 mm long, rufous-pilose; limb 5 × 2 mm. Anthers 3.5 mm long. Disc glands free, broadly ovate. Ovary glabrous; style rather stout. Fruit ovoid, 3.5 × 2.5 cm, style persisting; pericarp blue, c. 4 mm thick including a thin woody layer around the seed; stalk 5–7 × 3–4 mm. Seed globose, 3 × 2 cm.

Field characters: Bark grey, slightly rough; underbark light- to mid-brown. Wood mid- to light-brown.

Distribution: Restricted to New Guinea where it is known only from the Western Highlands district of Papua New Guinea.

Ecology: In montane forest, from 2100 to 2400 m altitude, as a canopy tree but not emergent. Flowering April. Fruiting November.

Helicia calocoma D. Foreman *Muelleria* 6: 79–81, f. 1 (1985). **Fig. 63.**

Tree, to 27 m high. Twigs terete, tomentose, with hairs dark reddish brown. Petiole 40–60 mm long, tomentose (similar to twigs). Lamina oblong to elliptic, 16–22 × 6–7.5 cm, subcoriaceous to coriaceous, at first tomentose throughout, with hairs dark reddish brown, later becoming glabrous above except for some hairs persisting along the midrib and main nerves; lower surface remaining dark reddish brown; base cuneate, sometimes oblique; margin entire; apex acute to acuminate; midrib slightly raised above, ± straight in the basal two-thirds, becoming curved and interarching towards the margin; reticulations dense, slightly

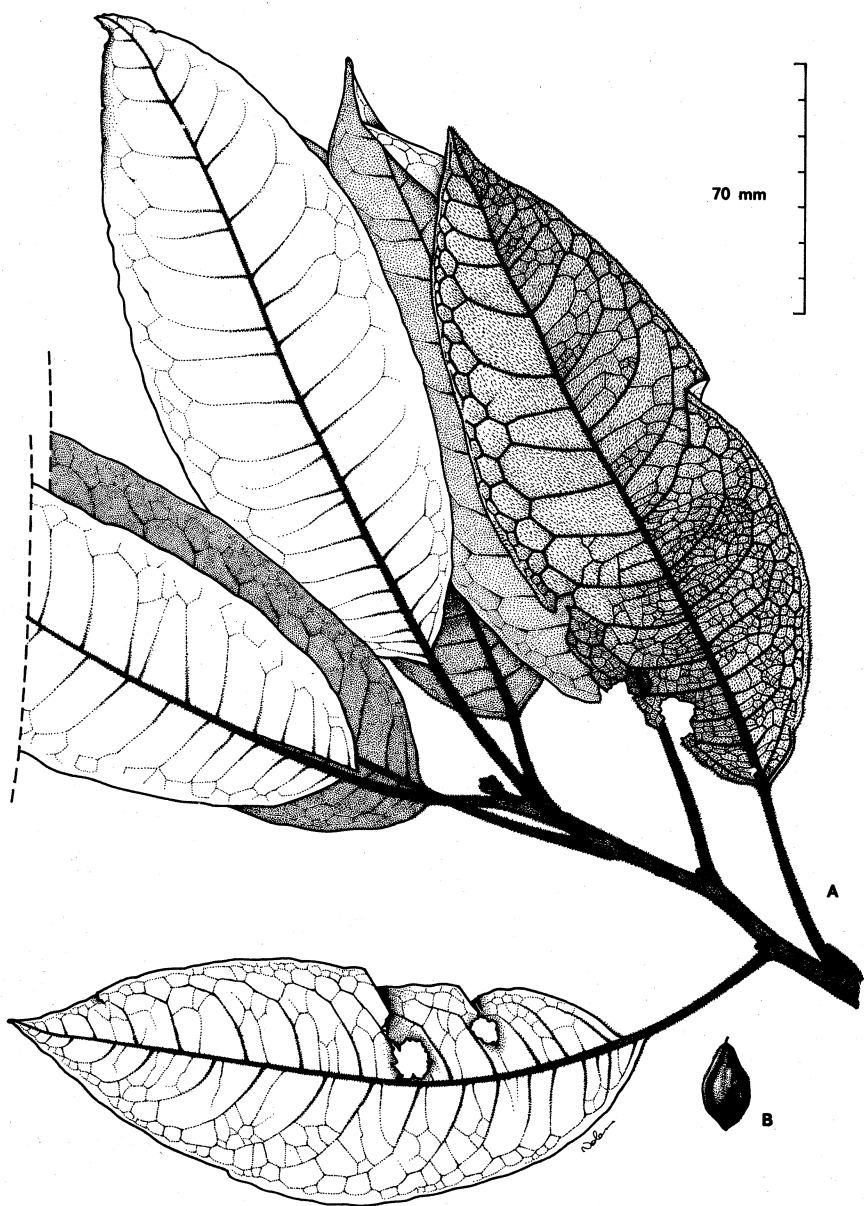


Fig. 63 *Helicia calocoma* D. Foreman (A) branchlet (B) fruit (both NGF 47647)

raised, clearly visible on both surfaces. Inflorescence ramiflorous, dark rufous-tomentose, densely flowered, 7–18 cm long; rachis *c.* 3 mm diameter. Bracts rufous-tomentose, ovate, *c.* 1.5 mm long; apex acute. Peduncle 2–2.5 mm long, rufous-tomentose, 15–22 mm long; limb 6 × 3.5 mm. Anthers 3–4 mm long. Disc glands free, obtuse. Ovary ferruginous-tomentose; style glabrous. Fruit (immature) ellipsoid to ovoid, *c.* 3 × 1.5 cm, rufous-tomentose, becoming glabrous; base rounded; apex ± pointed.

Distribution: Restricted to New Guinea where it is known from the Morobe district of Papua New Guinea.

Ecology: In *Nothofagus*-dominated forest on ridges up to 1820 m altitude. Flowering June. Immature fruit collected in March.

Helicia cameronii F. Muell. *Trans. Roy. Soc. Vict.* n.s. 1: 7 (1889).

Small tree, 4.5 m high. Twigs ferruginous-tomentose distally, glabrescent. Petiole 2–4 mm long, base slightly swollen. Lamina ± elliptic or ovate to obovate, 1.5–3 × 1–1.5 cm, subcoriaceous, glabrous except for a few hairs mainly along the midrib; base cuneate; margin entire; apex obtusely acuminate; midrib ± flattened above, prominent beneath; nerves 5 or 6 pairs, flattened and almost invisible above, raised beneath, ± straight in the lower half, curved and interarching inconspicuously near the margin; reticulations dense but ± invisible above, raised and visible beneath. Inflorescence axillary or ramiflorous, 6–8 cm long; rachis 1.5 mm diameter, ferruginous-tomentose indumentum present, extending up peduncles and pedicels. Bracts small, *c.* 1 mm long. Peduncle 0.4 mm long. Pedicel 3–4 mm long. Perianth pink to red, 20–30 mm long; limb 5–7 × 1.5 mm. Anthers 3–5 mm long. Disc glands free or connate at the base. Ovary glabrous; style glabrous, slender. Fruit globose, 3 cm diameter; pericarp coriaceous, 2–3 mm thick. Seed globose, *c.* 2 cm diameter.

Distribution: Restricted to New Guinea where it is known only from the Central district of Papua.

Ecology: In moss forest at 2700 m altitude. Flowering February and June. Fruiting in July.

Helicia carrii Sleum. *Bot. Jb.* 70: 145 (1939).

Helicia brassii Sleum. (1939); *Helicia divaricata* Sleum. (1939).

Tree, 4–23 m high. Twigs ferruginous-tomentose, becoming ± glabrous when older. Petiole 10–20 mm long, ferruginous-tomentose. Lamina oblong-elliptic to ± ovate, 7–12.5 × 2.5–5 cm, chartaceous, at first rufous-tomentose, becoming ± glabrous but with indumentum persisting along the midrib and to a lesser extent the main veins; base attenuate; margin entire; apex acute to acuminate; midrib flattened above, prominent beneath; nerves 5–7 pairs, flattened above, prominent beneath, curving and ascending, interarching near the margin; reticulations forming a dense network on both surfaces, slightly raised beneath. Inflorescence axillary, 9–11 cm long; rachis *c.* 2 mm diameter, ferruginous-tomentose. Bracts ovate, *c.* 2 mm long, rufous-tomentose; apex acuminate. Peduncle up to 3 mm

long, rufous-tomentose. Pedicel 3–5 mm long, rufous-tomentose. Perianth up to 25 mm long, ferruginous-tomentose; limb 7×2.5 mm. Anthers *c.* 4 mm long. Disc glands fused into a shallow cup. Ovary rufous-tomentose; style slender, glabrous. Young fruit ovoid, dark blue.

Field characters: Tree with dense spreading foliage.

Distribution: Restricted to New Guinea where it is known from the Morobe, Central and Milne Bay districts.

Ecology: In montane forest, frequently on ridges in moss forest and edge of grassland at altitudes between 1370 and 2400 m. Flowering January, May, June, October, November. Immature fruit collected in November.

Helicia coeruleopurpurea Royen *Alpine Fl. New Guinea* 4: 2576–2579, f. 745 (1983). **Fig. 64.**

Small tree, 3–10 m high. Twigs glabrous, terete, slender. Petiole glabrous, slightly swollen and rugose at the base, 5–7(–10) mm long. Lamina obovate to \pm elliptic, $5\text{--}12.5 \times 2.5\text{--}5.8$ cm, coriaceous, glabrous; base attenuate; margin nearly entire to irregularly serrate; apex acute, acuminate to obtuse; midrib lying in a groove above when dry, raised and prominent beneath; nerves 6–8 pairs, \pm straight and parallel in the lower half, curved and interarching near the margin, sunken above, raised beneath; reticulations dense, sunken above, raised beneath. Inflorescence ramiflorous, 5–11 cm long; rachis 1.5 mm diameter, laxly ferruginous-pilose or \pm glabrous. Bracts ovate, 1–1.5 mm long; apex acuminate. Peduncle 0.4 mm long. Pedicel 4 mm long, glabrous. Perianth blue-green, purplish towards base, 28–30 mm long; limb $5\text{--}6 \times 2$ mm. Anthers 4 mm long. Disc glands connate into a shallow crenulate cup. Ovary glabrous; style glabrous, blue-green. Fruit subglobose, 25–35 mm diam., smooth, glabrous; base rounded; apex slightly pointed; pericarp blue-green, thin-walled, 0.5–1 mm thick, coriaceous; stalk 5×3 mm.

Field characters: Bark grey, \pm smooth; inner bark yellowish brown. Wood yellowish brown with prominent rays.

Distribution: Restricted to New Guinea where it is known from the Eastern Highlands district.

Ecology: In moss forest, on slopes and ridges, at 2700–3000 m altitude. Flowering June, July. Fruiting July.

Helicia commutata Sleum. *Bot. Jb.* 70: 137 (1939).

Tree, to 15 m high. Twigs glabrous, brown to reddish brown, finely striate. Leaves glabrous. Petiole 3–6 mm long; base swollen and rugose. Lamina oblong-elliptic to oblong-narrowly ovate, $15\text{--}22 \times 4\text{--}7.5$ cm, chartaceous; base decurrent on to the petiole; margin entire or shallowly serrate; apex gradually acuminate; midrib \pm prominent on both surfaces; nerves up to 20 pairs, \pm straight and parallel in the lower half, then curving upwardly and anastomosing near the margin, slightly raised on both surfaces; reticulations dense, visible above and beneath. Inflorescence axillary, 9–15 cm long, \pm glabrous. Bracts minute, early caducous.

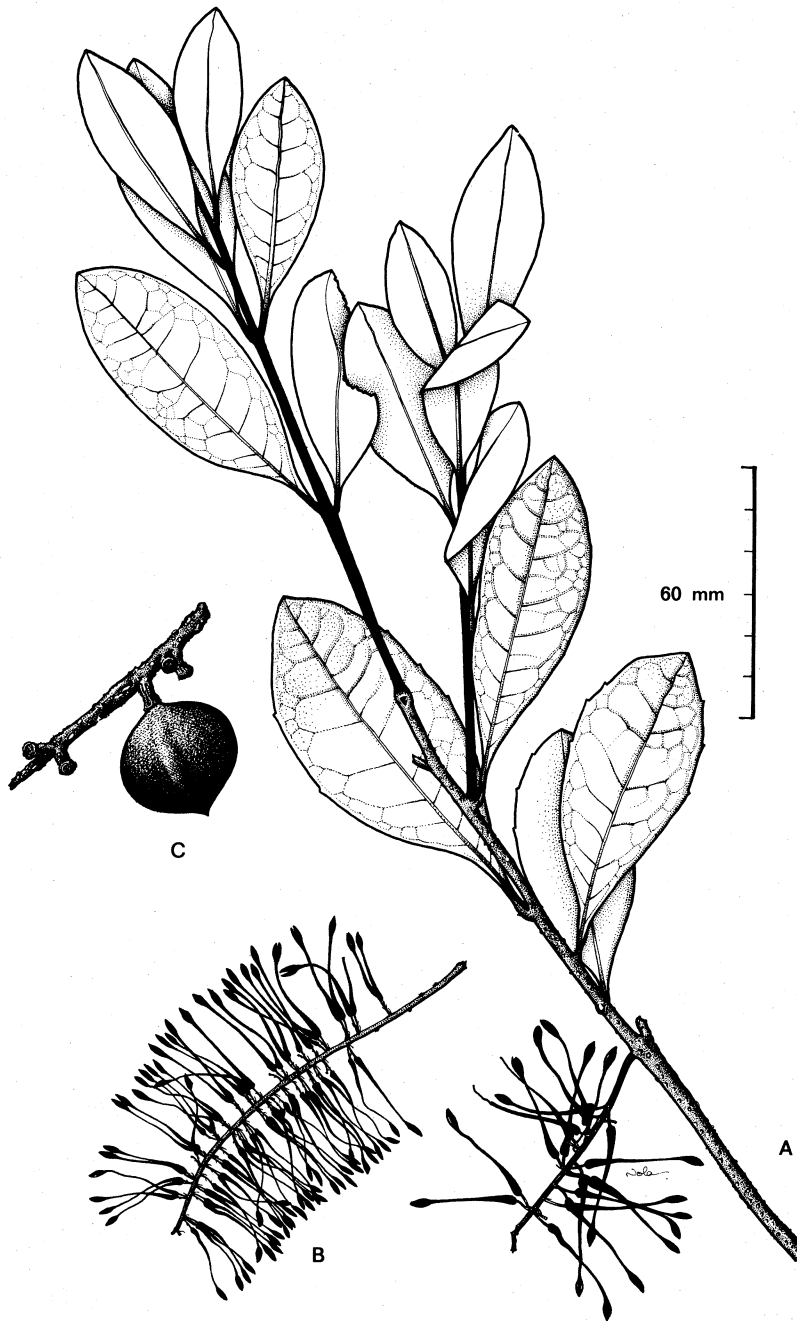


Fig. 64 *Helicia coeruleopurpurea* Royen (A) flowering branchlet (*Hoogland & Pullen 5583*) (B) inflorescence (*Grubb 289*) (C) fruit (*Brass 30563*)

Peduncle 0.5 mm long. Pedicel 2–4 mm long. Perianth creamy white, c. 9 mm long, glabrous; limb 2.5×1.5 mm. Anthers 1.5 mm long. Disc glands free or connate at the base. Ovary glabrous; style glabrous, slender. Fruits glabrous, obovoid, c. 5.5×4 cm; base and apex slightly pointed; pericarp speckled, 5 mm thick; stalk stout, 5×4 mm. Seed 3.5×2.5 cm, globose.

Distribution: Restricted to New Guinea where it is known from the Madang, Eastern Highlands and Central districts.

Ecology: In primary or secondary forest from 460 to 1600 m altitude.

***Helicia finisterrae* Laut. Bot. Jb. 50: 332 (1913). Fig. 65.**

Tree, up to 12 m high. Twigs glabrous, sometimes hollow. Petiole 5–7 mm long, stout, rugose. Lamina obovate or oblong-ovate, $20\text{--}34 \times 8\text{--}12$ cm, chartaceous to subcoriaceous, glabrous; margin entire (young leaves serrate); apex obtuse to obtusely acuminate; midrib prominent on both surfaces, more so beneath; nerves in 9–12 pairs, slightly raised above, prominent beneath, curved upward and running parallel to the margin for a short distance then interarching inconspicuously near the margin; reticulations lax, slightly raised on both surfaces. Inflorescence ramiflorous, sometimes axillary, 17–40 cm long; rachis 2–3 mm diameter, with adpressed rufous-pilose hairs extending to a lesser extent up the peduncles, pedicels and perianth. Bracts c. 1 mm long. Peduncle 0.5 mm long. Pedicel 3–7 mm long. Perianth white, 15–18 mm long; limb 5×2 mm. Anthers c. 3 mm long. Disc glands free. Ovary glabrous; style glabrous, slender. Fruit ellipsoid, c. 4×3 cm; pericarp brown, fleshy, 5–6 mm thick; stalk 10×3 mm. Seed c. 3×2 cm.

Field characters: Bark brown, finely vertically fissured; inner bark yellow-brown, fibrous. Twigs sometimes swollen and hollow, small black ants are often found inhabiting these hollows.

Distribution: Restricted to New Guinea where it is known from the Vogelkop, Madang and Morobe districts.

Ecology: In primary rain forest up to 1200 m altitude, often by streams. Flowering March to May and November. Fruiting May to June.

***Helicia forbesiana* F. Muell. Vict. Nat. 3: 63 (1886).**

Tree, 6–21 m high. Twigs adpressed rufous-pilose to \pm glabrous. Leaves glabrous. Petiole $10\text{--}25 \times 2\text{--}4$ mm, rugose and thickened towards the base. Lamina obovate to narrowly obovate, $15\text{--}40 \times 5\text{--}9$ cm, subcoriaceous; base cuneate, decurrent onto the petiole; margin entire or with a few irregularly spaced teeth; apex gradually acuminate; midrib prominent on both surfaces, more so beneath; nerves 9–16 pairs, curved upward and curved along the margin for a short distance before interarching, impressed above or slightly raised, prominent beneath; reticulations lax, usually visible on both surfaces. Inflorescences ramiflorous, up to 15 cm long; rachis 3 mm diameter, adpressed rufous-pilose extending up peduncles and pedicels and to a lesser extent on to the perianth. Bracts 1–1.5 mm long. Peduncle 0.5 mm long. Pedicel 4–8 mm long. Perianth creamy white, $2.5\text{--}3.5$ cm long; limb $5\text{--}6 \times 2.5$ mm. Anthers 5 mm long. Disc glands

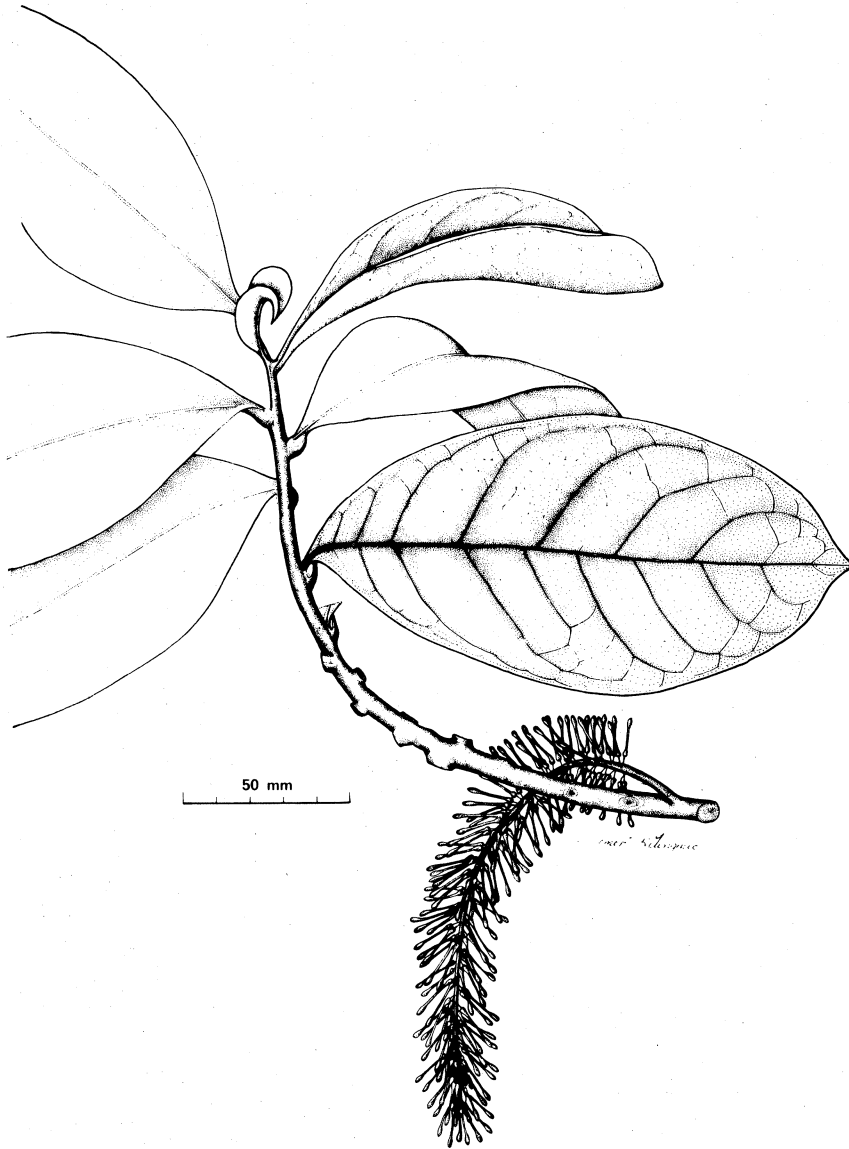


Fig. 65 *Helicia finisterrae* Laut. flowering branchlet (from live material, Lae Botanic Gardens)

connate into a crenulate cup. Ovary and style glabrous. Fruit subglobose, up to 6.5×4.5 cm; pericarp fibrous, 2–8 mm thick, sometimes with a thin woody layer around the seed. Seed subglobose, up to 50×40 mm.

Field characters: Bark dark grey to brown; inner bark reddish. Wood light yellow.

Distribution: Restricted to New Guinea where it is known from the Western Highlands, Eastern Highlands, Morobe, Southern Highlands, Central and Northern districts.

Ecology: Usually an understorey tree in lowland rain forest or lower montane forest up to 2070 m altitude. Flowering February, May to August, October to November. Fruiting June to November.

***Helicia hypoglauca* Diels *Bot. Jb.* 54: 202 (1916).**

Shrub to small tree, up to 9 m high. Twigs rufous-tomentose, glabrescent. Petiole 10–30 mm long, glabrescent. Lamina oblong to oblong-narrowly ovate to narrowly elliptic, 8–14 \times 2–4.5 cm, subcoriaceous, glabrous above and below except for a few persistent brownish hairs; base attenuate; margin usually entire or with a few minute teeth; apex acuminate; midrib slightly raised above, prominent beneath; nerves 8–11 pairs, curved towards and along the margin, raised above and beneath, interarching inconspicuously near the margin; reticulations dense, slightly raised on both surfaces. Inflorescences axillary or ramiflorous, 7.5–17 cm long, rather sparsely flowered; rachis c. 2 mm diameter, with a rufous-tomentose indumentum extending up pedicels and perianth. Bracts ovate to narrowly ovate, c. 1 mm long, rufous-tomentose. Peduncle c. 0.5 mm long. Pedicel c. 5 mm long. Perianth whitish to yellowish, 17–18(–20) mm long; limb 4 \times 1.5 mm. Anthers 2.5 mm long. Disc glands free or connate into an undulate cup. Ovary glabrous; style glabrous, slender. Fruit subglobose, 1.5 \times 1 cm, black.

Field characters: Bark dark brown to grey, fissured; inner bark cream-coloured to dark yellow. Sapwood yellowish brown; heartwood pale yellow to brown.

Distribution: Restricted to Papuasia where it is known from Vogelkop, Geelvink Bay, Sepik, Eastern Highlands, Morobe and New Britain districts.

Ecology: Upper lowland rain forest to mid-montane forest, sometimes with *Nothofagus* and *Castanopsis*, usually between 600 and 1850 m altitude. Flowering February to August. Fruiting May and September.

***Helicia insculpta* Sleum. *Bot. Jb.* 70: 141 (1939).**

Helicia biformis Sleum. (1939).

Shrub, to 7.6 m high. Twigs rufous-tomentose distally. Petiole 5–15 mm long, rufous-tomentose, glabrescent. Lamina \pm ovate to elliptic, 4–15 \times 2–7.5 cm, sub-bullate, young leaves rufous-tomentose, becoming \pm glabrous with age but usually a few hairs persisting along the midrib; base cuneate; margin entire, or a few irregularly spaced teeth mostly on the upper-half; apex acute or abruptly acuminate to rounded or emarginate; midrib prominent, impressed in a groove above, raised beneath, curved upwardly, interarched towards the margin;

reticulations lax but well defined, impressed above, slightly raised beneath. Inflorescence axillary or ramiflorous, 9–14 cm long; rachis *c.* 1.5 mm diameter, rufous-pilose extending up the peduncle, pedicels and to a lesser extent the perianth. Bracts ovate-acuminate, *c.* 2.5 mm long. Peduncle *c.* 0.4 mm long. Pedicel 4.5–6 mm long. Perianth dark pink, 3–3.5 cm long; limb 6 × 2 mm. Anthers *c.* 5 mm long. Disc glands connate into a low annular cup. Ovary glabrous; style glabrous, slender. Fruit ± globose, *c.* 3 × 3 cm; pericarp smooth 1.5 mm thick. Seed 2.7 cm diameter.

Field characters: Bark dark grey with white patches. Wood light brown.

Distribution: Restricted to New Guinea where it is known from the Eastern Highlands, Morobe and Central districts of Papua New Guinea.

Ecology: In montane forest between 2300 and 3300 m. Flowering in January, April, May, July, August, and December. Fruiting in July.

Helicia insularis D. Foreman *Muelleria* 6: 81 & 82, f. 2 (1985).

Tree, 8–15 m high. Twigs glabrous, *c.* 3 mm diameter, with prominent leaf base scars. Petiole stout, 5–8 mm long. Lamina ± elliptic, 5.5–12.5 × 3.5–6 cm, chartaceous to subcoriaceous, glabrous; base attenuate, decurrent on to the petiole; margin entire; apex mucronate to obtuse; midrib raised above, prominent beneath; nerves *c.* 8 pairs, curved upwardly becoming faint towards the margin, slightly raised above, raised but fine beneath; reticulations dense, slightly raised on both surfaces. Inflorescences axillary, borne towards the ends of the twigs, 5.5 cm long; rachis 1.5 mm diameter, glabrous. Bracts ovate, 1 mm long; apex acute. Peduncle *c.* 0.4 mm long. Pedicels *c.* 3 mm long. Perianth white, 13 mm long; limb 3.5 × 1.5 mm. Anthers 3 mm long. Disc glands connate into a crenulate cup. Ovary glabrous; style glabrous. Fruit glabrous (immature); pericarp appears to be a single layer.

Distribution: Known only from Fergusson and Normanby Islands, Papuan Islands district of Papua New Guinea.

Ecology: In mossy forest on ridge crests, at 820–950 m altitude. Flowering May; young fruit June.

Helicia laiagamensis D. Foreman *Muelleria* 6: 83 & 84, f. 3 (1985). **Fig. 66.**

Small tree or treelet, up to 10 m high. Twigs darkly ferruginous-tomentose distally, glabrescent lower down. Petiole 7–14 mm long, darkly ferruginous-tomentose, glabrescent. Lamina mostly elliptic, occasionally obovate, 6–15 × 2.7–6.2 cm, chartaceous to subcoriaceous, young leaves ferruginous-tomentose on both surfaces, becoming glabrous above or with a few hairs persisting along the midrib, hairs persisting beneath especially along the midrib and main veins; base cuneate; margin sometimes with 1 or 2 pairs of irregularly spaced teeth on the young leaves, mature leaves entire; apex acute; midrib slightly raised above, raised and prominent beneath; nerves 7–10 pairs, slightly curved, slightly impressed or flattened above, prominent beneath; reticulations impressed above, slightly raised beneath. Inflorescence axillary or ramiflorous, 11 cm long; rachis 1.5–2 mm diameter, densely ferruginous-tomentose, with hairs adpressed and

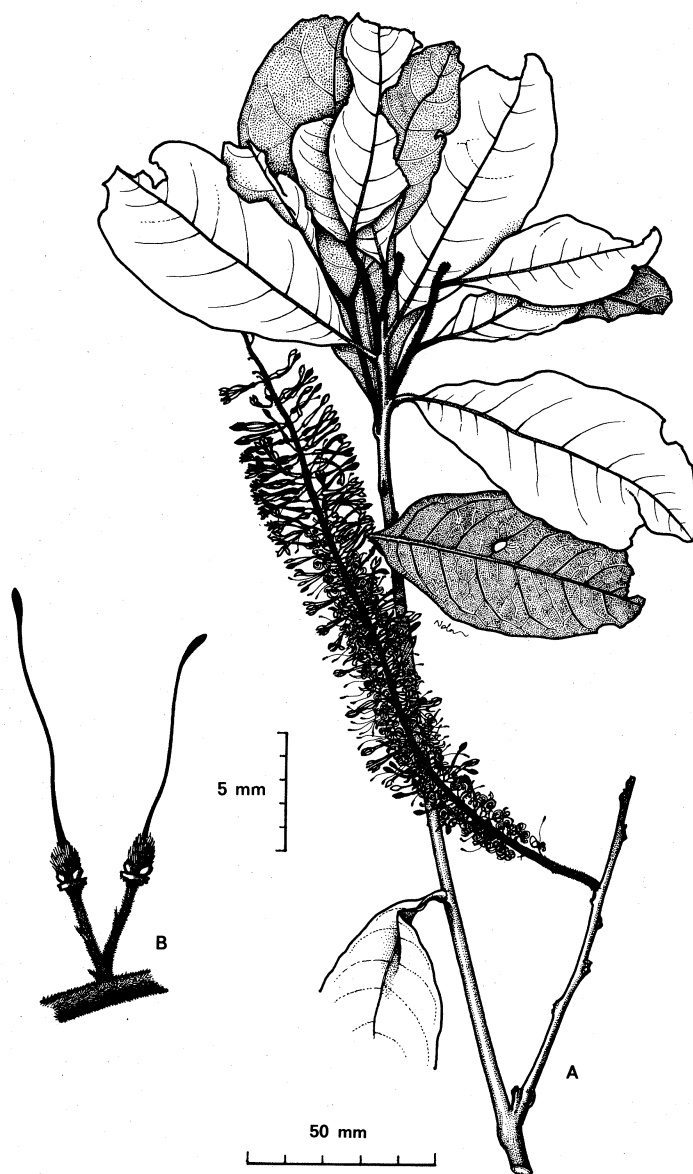


Fig. 66 *Helicia laiagamensis* D. Foreman (A) flowering branchlet (NGF 43771) (B) immature fruits with stigma and style present (ANU 2768)

extending up the pedicels and perianth. Bracts ovate, 1 mm long; apex acute. Peduncle 0.4 mm long. Pedicel 3–4.5 mm long, slender. Perianth creamy white, 8.5–11 mm long; limb 4×1.5 mm. Anthers 2.5–3 mm long. Disc glands free, broadly rounded. Ovary rufous-tomentose; style slender, glabrous. Fruit \pm globose, *c.* 25 mm diameter.

Field characters: Bark brown; inner bark orange. Wood creamy white.

Distribution: Restricted to New Guinea where it is known only from the Western Highlands district of Papua New Guinea.

Ecology: In primary or secondary montane forest, from 2100 to 2600 m altitude. Flowering May to August. Fruiting May.

Helicia latifolia C.T. White *Proc. Roy. Soc. Qld* **34**: 26 (1922).

Tree, up *c.* 24 m high. Twigs glabrous. Petiole stout, 2–6 mm \times 3–4 mm, rugose. Lamina broadly elliptic, 15–24 \times 8–11 cm, coriaceous, glabrous; base cuneate, slightly decurrent onto the petiole; margin entire; apex bluntly acuminate to obtuse; midrib prominent above, more so beneath; nerves 6–9 pairs, curved upwardly, interarching inconspicuously near the margin, \pm prominent above, prominent beneath; reticulations dense slightly raised above and beneath. Inflorescence axillary or ramiflorous, up to 20 cm long, \pm glabrous, a few short rufous hairs sometimes present and extending up the pedicels; rachis 1.5 mm diameter. Bracts ovate, *c.* 0.5 mm long; apex acute. Peduncle 0.4 mm long. Pedicel 2–4 mm long. Perianth creamy yellow, *c.* 9 mm long; limb 3–4 \times 2 mm. Anthers 3 mm long. Disc glands free, \pm ovate. Ovary glabrous, style glabrous, slender. Fruit obovoid, 3–4 \times 2.5 cm; pericarp smooth.

Field characters: Spur roots and narrow buttresses are sometimes present. Outer bark grey-brown to brown, underbark orange-brown to reddish brown, inner bark yellow-brown with reddish brown streaks. Sapwood dark yellow; heartwood brown with wide rays. Twigs sometimes swollen and hollow, inhabited by small black ants.

Distribution: Restricted to Papuaia where it is known from the Gulf, Central, Northern, Milne Bay and New Britain districts.

Ecology: On slopes and ridges in primary and secondary rain forest from sea level to *c.* 800 m. Flowering April, August to September. Fruiting February to March, May to July.

Helicia lauterbachiana Sleum. *Bot. Jb.* **70**: 147 (1939).

Helicia grandifolia Laut. (1910), non Lecomte (1910).

Treelet, 3–4 m high. Twigs glabrous. Petiole stout, 5–10 mm long, rugose, glabrous. Lamina \pm elliptic, 20–32 \times 7–11 cm, coriaceous, glabrous; base cuneate; apex gradually acuminate; midrib raised and prominent on both surfaces; nerves up to 12 pairs, sunken in grooves above, markedly prominent beneath, curved upwardly and interarching near the margin; reticulations dense, slightly raised on both surfaces. Inflorescence ramiflorous, 40 cm long, laxly rufous-pilose; rachis 1.5 mm diameter. Bracts narrowly ovate, *c.* 1 mm long, laxly

ferruginous-pilose. Peduncle 0.3 mm long. Pedicel c. 2 mm long. Perianth white, c. 20 mm long; limb 3×1.5 mm. Anthers 2 mm long. Disc glands free, \pm ovate. Ovary rufous-pilose; style glabrous, slender. Fruit not known.

Distribution: Known only from the Noord River (Mimika district), in western New Guinea.

Ecology: In rain forest at low altitude. Flowering July.

Helicia ledermannii Diels *Bot. Jb.* **54:** 204 (1916).

Shrub to small tree, up to 5 m high. Twigs \pm glabrous, slender. Petiole 10–20 mm long, \pm swollen and rugose at the base, glabrescent. Lamina elliptic to oblong-ovate, $6\text{--}13 \times 2.5\text{--}5$ cm, chartaceous, glabrous with a few hairs persisting, especially along the midrib; base attenuate; margin irregularly serrate mainly in the upper part or entire; apex cuspidate, acuminate to acute; midrib \pm lying in a groove above, prominent beneath; nerves 6–8 pairs, curving upwardly and interarching near the margin, raised slightly on both surfaces; reticulations dense, visible on both surfaces. Inflorescence ramiflorous, 4–10 cm long; rachis 1 mm diameter, densely ferruginous-tomentose, with hairs adpressed and extending up the peduncle, pedicels and to a lesser extent on to the perianth. Bracts \pm narrowly ovate, 1.5 mm long. Peduncle up to 1.5 mm long. Pedicel 0.5 mm long. Perianth lilac-red, c. 5–7 mm long; limb 2×1 mm. Anthers 1.5 mm long. Disc glands small, thick, free. Ovary densely rufous-tomentose; pericarp 1 mm thick.

Distribution: Known from the West Sepik district of Papua New Guinea.

Ecology: In dense rain forest and Fagaceous moss forest from 850 to 2000 m altitude. Flowering August and October. Fruiting in October.

Helicia longespicata Sleum. *Bot. Jb.* **70:** 143 (1939).

Tree, 8 m high. Twigs rufous-tomentose, glabrescent. Petiole up to 20 mm long, rufous-tomentose, stout at the base. Lamina oblong, $24\text{--}30 \times 7.5\text{--}9$ cm, chartaceous to subcoriaceous, glabrous above except for a few hairs along the midrib, glabrous beneath except for some hairs persisting along the midrib and nerves; base attenuate, very slightly oblique; margin entire; apex rounded; midrib prominent on both surfaces; nerves up to c. 11 pairs, curved upwardly, flattened above, prominent beneath; reticulations \pm lax, slightly raised beneath. Inflorescence ramiflorous, 17–27 cm long, rufous-tomentose; rachis c. 1 mm diameter. Peduncle up to 0.5 mm long. Pedicel 0.5–1 mm long. Perianth pale green, 8 mm long; limb 3×1 mm. Anthers 1.5 mm long. Disc glands connate at the base. Ovary ferruginous-tomentose; style glabrous. Fruit not known.

Distribution: Known only from Isuarava, inland from Port Moresby in the Central district of Papua New Guinea.

Ecology: Occurs in forest at 1520 m altitude. Flowering February.

Helicia macrostachya Laut. *Bot. Jb.* **50:** 332 (1913).

Tree, 5–12 m high. Twigs glabrous, striate. Petioles stout, c. 5 mm long. Lamina oblong to \pm obovate, $20\text{--}30 \times 8\text{--}11.5$ cm, coriaceous to subcoriaceous,

glabrous; base cuneate, decurrent on to the petiole; margin entire sometimes with a few irregular teeth present near the apex (young leaves serrate); apex acute to obtuse; midrib slightly raised above and prominent beneath; nerves 6–9 pairs, curving towards and running for some distance along the margin; reticulation lax, slightly raised on both surfaces. Inflorescence axillary, minutely rufous-pilose, 15–30 cm long, rachis 2 mm diameter. Bracts ovate, *c.* 1 mm long; apex acuminate. Peduncle 0.5 mm long. Pedicel *c.* 6 mm long, \pm glabrous. Perianth yellowish, 20 mm long; limb 5×2 mm. Anthers *c.* 3 mm long. Disc glands ovate, free. Ovary glabrous; style glabrous, slender. Infructescence up to 40 cm long. Fruit \pm ovoid, 4.5×2.5 cm, apex \pm pointed, base \pm rounded. Seed yellowish.

Field characters: Twigs often swollen and hollow, inhabited by small black ants. Bark grey-brown, finely fissured; wood yellowish. Trees often poorly formed.

Distribution: Known only from the Morobe district of Papua New Guinea, where it is locally common along the Waria River near Garaina.

Ecology: By rivers and streams at the edge of rain forest, mostly in sandy soil, from 30 to 730 m altitude. Flowering May to December. Fruiting January, May, December.

Helicia microneura C. T. White *J. Arnold Arbor.* **10:** 209 (1939).

Helicia arguta Sleum. (1939).

Small tree, up to 4 m high. Twigs rufous-tomentose, with hair adpressed, glabrescent. Petiole 2–5 mm long \pm base swollen. Lamina elliptic to obovate, $4\text{--}11 \times 2\text{--}3.7$ cm, subcoriaceous, glabrous or lower surface with a few hairs persisting along the midrib; base cuneate, slightly decurrent on to the petiole; margin serrate sometimes only a few irregularly spaced teeth present towards the apex; apex acuminate; midrib flattened above, prominent beneath; nerves 6–8 pairs, curved, interarching near the margin, slightly raised beneath, visible on both surfaces; reticulations dense, mostly invisible above, clearly visible beneath. Inflorescence axillary or ramiflorous, 4–10 cm long; rachis 0.5 mm diameter, densely rufous-pilose, with adpressed hairs extending up the peduncle, pedicels and to a lesser extent up the perianth. Bracts 1 mm long. Peduncle 0.5 mm long. Pedicel 2–3 mm long. Perianth white to yellowish or the base dull red and tube yellowish, 5–6 mm long; limb 2×1 mm. Ovary rufous to dark-ferruginous-tomentose; style slender, glabrous. Anthers *c.* 1 mm long. Disc glands free or connate at the base. Fruit globose, 10 mm diameter, glabrous; pericarp purple with a distinct zone of fibres surrounding the seed and an outer succulent zone. Seed globose, 7–8 mm diameter.

Distribution: Restricted to New Guinea where it is known from the Central and Milne Bay districts of Papua.

Ecology: In open forest, on ridges in lower montane forest sometimes in association with *Castanopsis* from 900 to 2400 m altitude. Flowering January, February, May, June, August and November. Fruiting June, July.

Helicia microphylla Diels *Bot. Jb.* **54**: 201 (1916).

Helicia microcarpa Sleum. (1955).

Shrub or small tree, to 18 m high. Twigs rufous-tomentose to \pm glabrous, 5–10 mm long. Lamina \pm elliptic to narrowly obovate, 3–7.5 \times 1–3.5 cm, coriaceous; lower surface rufous-tomentose at first, with only a few hairs persisting along the midrib on the older leaves; upper surface glabrous; base attenuate; margin entire; apex acuminate to bluntly acute; midrib flattened above, prominent beneath; nerves not clearly defined, 5–9 pairs, curved and interarching near the margin; reticulations dense, impressed above, slightly raised beneath. Inflorescence axillary, sometimes ramiflorous, 8.5–17 cm long, rufous-tomentose; rachis 1.5–2 mm diameter. Bracts narrowly ovate, 1.5 mm long. Peduncle 1 mm long, rufous-tomentose. Pedicel 3–5 mm long. Perianth yellow, 20 mm long, \pm rufous-tomentose; limb 5.5 \times 2 mm. Anthers 3 mm long. Disc glands free, obtuse. Ovary glabrous; style slender, glabrous. Fruit globose, c. 15 mm diameter; pericarp blue-black, c. 1 mm thick.

Field characters: Bark grey or grey-brown, smooth; inner bark greenish; wood white.

Distribution: Restricted to New Guinea where it is known from the Madang, Eastern and Western Highlands districts of Papua New Guinea.

Ecology: In moss forest, montane forest often in the forest/grassland margin, sometimes extending into the grasslands, often adjacent to rivers and streams, at 2000–3000 m altitude. Flowering in September to May. Fruiting September, November and January.

Helicia neglecta Diels ex Sleum. *Bot. Jb.* **70**: 135 (1939).

Tree, up to 18 m high. Twigs glabrous. Petiole short, stout, 2–5 mm long, rugose. Lamina oblong-elliptic, 20–25 \times 8.5–9.5 cm, shiny olivaceous to brown above, brownish and dull beneath, coriaceous, glabrous; base cuneate, slightly decurrent on to the petiole; margin coarsely serrate to \pm entire; apex obtusely acuminate; midrib prominent on both surfaces; nerves up to 15 pairs, curved upwardly, \pm parallel, impressed above, clearly defined below. Inflorescence axillary or ramiflorous, up to 20 cm long; rachis 2 mm diameter, laxly rufous-pilose. Bracts \pm ovate. Peduncle 1–1.5 mm long. Pedicel 5–7 mm long. Perianth up to 14 mm long; limb c. 3 \times 1.5 mm. Anthers c. 2 mm long. Disc glands \pm connate. Ovary glabrous; style slender, glabrous. Immature fruit narrowly ellipsoid; apex curved; pericarp homogeneous.

Field characters: Narrow buttresses sometimes present. Bark grey-brown. Wood dark yellow.

Distribution: In Papuasia it is restricted to the New Britain and New Ireland districts of the Bismarck Archipelago.

Ecology: In primary and secondary forest, from sea level to about 400 m altitude. Flowering March, April and July. Fruiting February to March.

Helicia obtusata* Sleum. Bot. Jb. 70: 139 (1939).Helicia clemensiae* Sleum. (1939).

Tree, up to 16 m high. Twigs glabrous. Petioles 5–20 mm long, rugose near the base. Lamina broadly obovate, 10–17.5 × 5–10 cm, coriaceous, glabrous; base cuneate, decurrent on to the petiole; margin of juvenile leaves serrate, adult leaves entire; apex obtuse; midrib prominent on both surfaces, more so beneath; nerves c. 6–10 pairs, curved upward, slightly raised above, prominent beneath, interarching near the margin; reticulations rather lax, slightly raised on both surfaces. Inflorescences axillary or ramiflorous, 10–15 cm long; rachis 2 mm diameter, pilose, with adpressed hairs extending up the peduncle, pedicels and to a lesser extent on to the perianth. Bracts ovate, c. 1 mm long; apex acute. Peduncle 1–2 mm long. Pedicel 4–8 mm long. Perianth white or tube pink with a white limb, 20–30 mm long; limb 3–4 × 2 mm. Anthers 2–3 mm long. Disc glands connate into a minutely denticulate cup. Ovary and style glabrous. Fruit brown, ± globose, 20 × 18 mm; pericarp homogeneous, 1.5–2 mm thick. Seed c. 15 mm diameter.

Field characters: Twigs sometimes swollen and hollow, inhabited by small black ants. Outer bark grey to chocolate-brown, slightly fissured; inner bark reddish brown to cream-coloured. Wood light brown to straw-coloured.

Distribution: Restricted to New Guinea where it is known, with certainty, from the Morobe district of Papua New Guinea. Several collections from the Papuan Islands district of Papua have tentatively been assigned to this species.

Ecology: In lowland rain forest or fagaceous forest up to 2500 m altitude. Flowering January to February, May, July and December. Fruiting May, July, August and November.

***Helicia odorata* Diels Bot. Jb. 54: 201 (1916).**

Tree, 4–15 m high. Twigs ± glabrous, rufous-pilose when young, finely striate. Petiole 3–6 mm long, rufous-pilose, becoming ± glabrous. Lamina obovate or obovate-elliptic, 3–8.5 × 2–4.5 cm, subcoriaceous, glabrous; base cuneate, decurrent on to the petiole; margin entire; apex rounded to acute or obtusely acuminate; midrib flattened or slightly raised above, fairly prominent beneath; nerves 4–6 pairs, flattened above, raised but not conspicuous beneath, curving upwardly, interarching near the margin; reticulations ± lax. Inflorescence axillary or ramiflorous, 6–11 cm long; rachis 1–2 mm diameter, glabrous. Bracts ovate, c. 0.8 mm long; apex acuminate. Peduncle c. 1–1.5 mm long. Pedicel 4–7 mm long. Perianth cream-coloured to pink, 10–12 mm long; limb 3.5 × 1.5 mm. Disc glands connate into a low annular cup. Ovary glabrous; style glabrous, slender. Fruit glabrous, ± ovoid to ellipsoid, 6 × 5.5 cm, brown; base ± rounded to slightly pointed; apex pointed; pericarp 5 mm thick, with a coriaceous outer zone and a rather irregular inner zone of fibres. Seeds ± globose, 4 × 3.5 cm.

Field characters: Outer bark light to dark brown; inner bark light brown or orange. Wood light brown.

Distribution: Widely distributed throughout Papua New Guinea but not extending to the Bismarck Archipelago.

Ecology: Mostly in montane forest or moss forest but sometimes in the upper limits of lowland rain forest, sometimes in forest/grassland margin, usually at altitudes from 1000 to 2900 m. Flowering March, May to August. Fruiting May to September.

Helicia olivacea Sleum. *Bot. Jb.* **70**: 136 (1939).

Tree, 6–15 m high. Twigs reddish brown to greyish brown, smooth to slightly striate with numerous white lenticels. Leaves glabrous. Petiole 3–5 mm long, stout and rugose at the base. Lamina oblong to elliptic, 8–14 × 3.5–4.5 cm, chartaceous; base attenuate, decurrent on to the petiole; margin entire; apex obtusely acuminate; margin raised on both surfaces; nerves 8–12 pairs, straight and parallel in the lower half to two-thirds then curving upwardly and interarching near the margin, slightly raised on both surfaces; reticulations dense, slightly raised on both surfaces. Inflorescence mostly ramiflorous or occasionally axillary, 10–11.5 cm long, laxly rufous-tomentose on rachis, peduncle, pedicels and to a lesser extent on to the perianth. Bracts small, ovate; apex acute. Peduncle 0.4 mm long. Pedicel 1–1.5 mm long. Perianth yellow to cream-coloured, up to 6.5 mm long; limb 3 × 1.5 mm. Anthers 1.5–2 mm long. Disc glands ± oblong, free or connate at the base. Ovary glabrous. Fruit ellipsoid, 35 × 25 mm; pericarp brown with a speckled appearance, homogeneous, up to 4 mm thick.

Distribution: Restricted to New Guinea where it is known from the Western Highlands and Morobe districts.

Ecology: In *Castanopsis-Nothofagus* forest in primary or secondary forest, from 600 to 1500 m altitude. Flowering January, March, November. Fruiting March, November.

Notes: One collector reports flowers to be 'evil' smelling and attracting flies. Twigs are occasionally swollen, hollow and inhabited by ants.

Helicia oreadum Diels *Bot. Jb.* **54**: 203 (1916).

Helicia phaeotricha Diels (1916); *H. validinervis* C. T. White (1922); *H. purpurascens* Sleum. (1955).

Tree or treelet, 1.8–15 m high. Twigs ferruginous-tomentose, glabrescent. Petiole 5–30 mm long, rugose at the base. Lamina elliptic, oblong-elliptic, narrowly ovate or ± obovate, 10–30 × 3–8 cm, coriaceous to sub-bullate; lower surface ferruginous-pilose especially on the main veins and midrib when young, becoming ± glabrous with age; upper surface glabrous; base cuneate or attenuate, decurrent on to the petiole; margin mostly entire or with a few unevenly spaced teeth; apex gradually to abruptly acuminate; midrib prominent on both surfaces, more so beneath; nerves 9–15 pairs, ± curved, the basal portion sometimes straight, ± interarched near the margin, impressed above, prominent beneath; reticulations dense, ± raised on both surfaces. Inflorescence axillary or ramiflorous, 15–51 cm long; rachis 1.5–3 mm diameter, ferruginous-tomentose, with hairs extending up the peduncle and pedicels. Bracts ± narrowly ovate, up to 2 mm long. Peduncle 0.5–1.5 mm long. Pedicel (2–)3–4(–7) mm long. Perianth pink to dark red, 18–24 mm long, rufous-pilose; limb 4 × 1.5–2 mm. Anthers 2 mm long. Disc glands fleshy, free or sometimes ± connate at the base. Ovary rufous-pilose; style glabrous, slender. Fruit boat-shaped, sparsely rufous-pilose,

90 × 30 mm, compressed laterally; base narrowed into a pseudostalk *c.* 12 mm long; apex attenuate; pericarp slightly rugose, 1 mm thick. Seed ± oblong (in outline), pointed at each end.

Field characters: Bark dark grey-brown or brown; underbark yellow-brown. Wood yellow or light brown.

Distribution: Widely distributed throughout New Guinea; occurring in the West Sepik, Western Highlands, Eastern Highlands, Southern Highlands and Morobe districts.

Ecology: In lower montane forest, often in association with *Nothofagus* and *Castanopsis*, in primary and secondary forests on slopes and ridges up to 2500 m altitude. Flowering throughout the year. Fruiting May, August, November.

***Helicia pallescens* Diels *Bot. Jb.* 54: 200 (1916).**

Small tree, 2–3 m high. Twigs glabrous. Petiole *c.* 13 mm long, becoming stout towards the base. Lamina elliptic to oblong-elliptic, 15–22 × 3.5–9 cm, subcoriaceous, glabrous; base attenuate, decurrent on to the petiole; margin entire; apex gradually acuminate; midrib ± flattened above, prominent beneath; nerves 7 or 8 pairs, curved upwardly and then excurrent along the margin, raised above, prominent beneath; reticulations rather dense, slightly raised on both surfaces. Inflorescence ramiflorous or axillary, 6.5–8.5 cm long; rachis 1.5–2 mm diameter, ± glabrous. Bracts *c.* 1 mm long; apex acute. Peduncle *c.* 0.5 mm long. Pedicel 2–2.5 mm long. Perianth white, 15–20 mm long, ± glabrous; limb 3 × 2 mm. Anthers 2.5 mm long. Disc glands broadly obovate, free. Ovary glabrous; style glabrous, slender. Fruit globose, 35 mm diameter; pericarp with an outer bluish, coriaceous zone, 4–5 mm thick and inner zone of fibres, *c.* 1 mm thick. Seed globose, 24 mm diameter.

Distribution: Restricted to New Guinea where it is known from the West Sepik, Western and Gulf districts.

Ecology: On riverine flood plains and in forest up to 1000 m altitude. Flowering August, December. Fruiting April, May, August.

***Helicia peekelii* Laut. *Bot. Jb.* 45: 359 (1911).**

Tree. Twigs rufous-pilose distally. Petiole stout, 2–5 × 2.5 mm. Lamina oblong-elliptic, 16–19 × 7 cm, chartaceous to subcoriaceous, glabrous; base cuneate, decurrent on to the petiole; margin entire; apex abruptly acuminate; midrib prominent on both surfaces; nerves 6 or 7 pairs, curved upward, indistinctly interarching near the margin, flattened above, prominent beneath; reticulations dense but faint. Inflorescence ramiflorous, 12–16.5 cm long; rachis 1.5–2 mm diam., laxly rufous-tomentose, with hairs extending up pedicels. Bracts ovate, *c.* 1 mm long; apex acuminate. Peduncle 1–1.5 mm long. Pedicel 6–7 mm long. Perianth 10–11 mm long, ± glabrous; limb 3 × 1.5 mm. Anthers 2 mm long. Disc glands connate into a crenate cup. Ovary glabrous; style glabrous, slender. Fruit not known.

Distribution: Known only from Namatanai, New Ireland district of the Bismarck Archipelago.

Ecology: Probably coastal forest at low altitude.

Helicia peltata C. T. White *J. Arnold Arbor.* **10:** 210 (1929).

Tree, 18–24 m high. Twigs darkly rufous-tomentose. Petiole rufous-tomentose, 25–40 × 3 mm. Lamina ovate to elliptic-ovate or elliptic, 16–25 × 10–11 cm, ± coriaceous, rufous-tomentose on both surfaces when young, later becoming ± glabrous and shiny above with a few hairs persisting along the midrib and main veins, dark rufous-velutinous beneath; base rounded, peltate; margin entire; apex obtusely acuminate; midrib prominent on both surfaces; nerves 12–18 pairs, ± straight and parallel, interarching towards the margin, flattened above, raised and fairly prominent beneath; reticulations lax. Inflorescence ramiflorous, 12–22 cm long; rachis c. 2 mm diameter, rufous-tomentose and indumentum extending up peduncle and pedicels. Bracts small, ovate; apex acute. Peduncle 1.5–2.5 mm long. Pedicel 1.5–3 mm long. Perianth cream-coloured, up to 25 mm long, ± densely rufous-pilose; limb 3 × 2.5 mm. Anthers 3 mm long. Disc glands thick, truncate, free. Ovary glabrous; style slender, glabrous. Fruit not known.

Field characters: Bark light brown; inner bark brown. Sapwood pale brown; heartwood light brown.

Distribution: Known only from Bisiatabu in the Central district of Papua New Guinea.

Ecology: In forest at 450 m altitude. Flowering November.

Helicia platyphylla Sleum. *Bot. Jb.* **70:** 144 (1939).

Small tree. Twigs rufous-tomentose distally, becoming glabrous basally. Petiole c. 10 × 3–4 mm, rufous-tomentose. Lamina broadly oblong, 30–45 × 13–20 cm, subcoriaceous; lower surface rufous-tomentose, especially along the midrib and nerves; upper surface glabrous; base cuneate; margin entire; apex acuminate; midrib prominent above, very prominent beneath; nerves 15–17 pairs, curved upwards, flattened to slightly impressed above, prominent beneath; reticulations lax. Inflorescence ramiflorous, 8–11 cm long; rachis 2 mm diameter, rufous-tomentose. Bracts minute. Peduncle 0.5 mm long, rufous-tomentose. Pedicel 0.5–2 mm long, rufous-tomentose. Perianth pale pink, 10–12 mm long, rufous-pilose; limb 4 × 1.5 mm. Anthers 3 mm long. Disc glands free. Ovary rufous-tomentose; style slender, glabrous. Fruit not known.

Distribution: Known only from the lower Fly River, opposite Sturt Island, in the Western district of Papua New Guinea.

Ecology: At low altitudes in rain forest on ridges. Flowering October.

Helicia polysmoides D. Foreman *Muelleria* **6:** 84–86, f. 4 (1985). **Fig. 67.**

Tree, 6–15 m high. Twigs glabrous, striate. Petiole 15–30 mm long, with base swollen and rugose. Lamina elliptic, 12.5–27 × 5.5–11 cm, coriaceous, glabrous; base attenuate, decurrent on to the petiole; margin entire (seedling leaves regularly serrate); apex acute; midrib slightly raised above, prominent beneath; nerves up to 10 pairs, curving upward, interarching near the margin, slightly raised and

well defined above, raised and clearly defined beneath; reticulations lax, sunken above, slightly raised beneath. Inflorescence axillary to subterminal, c. 13–22 cm long; rachis 2 mm diameter, sparsely ferruginous-pilose. Bracts 1.5 mm long; apex acuminate. Peduncle 0.5–1 mm long, ferruginous-pilose. Pedicel up to 6 mm long, ferruginous-pilose. Perianth white with cream-coloured limb, c. 25 mm long, glabrous; limb 3–3.5 × 1.5 mm. Anthers 2 mm long. Disc glands free or connate at base, truncate. Ovary glabrous; style slender, glabrous. Infructescence 15–19 cm long. Fruit ellipsoid, 15 × 10 mm, shiny, very dark blue to almost black; pericarp smooth, 1 mm thick.

Distribution: Known only from Manus Island (Manus district) in the Bismarck Archipelago of Papua New Guinea.



Fig. 67 *Helicia polysmoides* D. Foreman fruiting branchlet (LAE 53659)

Ecology: In ridge forest at altitudes from 100 to 550 m. Flowering and fruiting June and October.

Helicia retevenia Sleum. *Bot. Jb.* 70: 141 (1939).

Small tree, 3-6 m high. Twigs minutely adpressed-pilose, becoming glabrous. Leaves glabrous. Petiole 8-10 mm long. Lamina obovate-oblong, 6-8 × 3-3.5 cm, subcoriaceous; base attenuate; margin entire or with 1 or 2 teeth present near the apex; apex ± rounded or retuse; midrib prominent on both surfaces; nerves 7 or 8 pairs, ± straight and parallel in their lower half, curved upwardly and interarched near the margin, flattened above, raised beneath; reticulations dense, slightly raised beneath, faint. Inflorescence axillary, 8 cm long; rachis c. 1 mm diameter, glabrous. Bracts narrowly ovate, c. 1 mm long. Peduncle c. 1.5-2 mm long. Pedicel 4-5 mm long. Perianth 15-16 mm long; limb 2.5 × 1.5 mm. Anthers c. 2 mm long. Disc glands connate at the base forming a cup. Ovary glabrous. Fruit not known.

Distribution: Known only from the Central district of Papua New Guinea.

Ecology: In forest at 2000 m altitude. Flowering December.

Helicia retusa D. Foreman *Muelleria* 6: 86 & 87, f. 5 (1985).

Tree, 3-8 m high. Twigs ferruginous-tomentose towards the apex, becoming glabrous lower down. Petiole 10-15 mm long, ferruginous-tomentose at first, becoming ± glabrous. Lamina elliptic, 4-9 × 2.5-5 cm, coriaceous, at first ferruginous-tomentose, becoming glabrous between the nerves, some hairs persisting along the midrib, rufous or darkly ferruginous-tomentose beneath, later becoming ± glabrous; base shortly attenuate; margin entire; apex retuse; midrib slightly raised above, very prominent beneath; nerves 5-7 pairs, curved upward, interarching near the margin, slightly raised above, prominent beneath; reticulations dense, raised and clearly on both surfaces. Inflorescence ramiflorous, 6-8.5 cm long; rachis 2.5 mm diameter, ferruginous-tomentose extending up the peduncle, pedicels and to a lesser extent on to the perianth. Bracts acuminate, 2 mm long. Peduncle 0.5 mm long. Pedicel c. 2.5 mm long. Perianth 20-25 mm long; limb 3 × 1.5 mm. Anthers 2.5 mm long. Disc glands fused into a low crenulate cup. Ovary glabrous; style glabrous, yellowish. Fruit ± globose, 50 × 35 mm, apex ± pointed, base narrowed into a short pseudostalk; pericarp smooth, 5 mm thick, outer zone coriaceous, purplish, inner zone of fibres 3 mm thick. Seed ± globose, c. 35 × 25 mm.

Distribution: Restricted to New Guinea where it is known only from the Milne Bay district of Papua.

Ecology: Ridge forest, between 1600 and 1900 m altitude. Flowering February. Fruiting February and June.

Helicia rostrata D. Foreman *Muelleria* 6: 87-89, f. 6 (1985).

Treelet, 1-5 m high. Twigs terete, slender, rufous-tomentose, glabrescent. Petiole 1-4 mm long, laxly rufous-tomentose, base slightly swollen. Lamina narrowly ovate, 3.5-5.5 × 0.9-1.5 cm, chartaceous; lower surface sparsely ferrugi-

nous-tomentose to almost glabrous; upper surface glabrous; base attenuate, decurrent on to the petiole almost to the base; margin serrate; apex rostrate; midrib sunken above, \pm prominent beneath; nerves 7–9 pairs, \pm straight and parallel in the lower part, curved upwardly and interarching near the margin, slightly raised on both surfaces; reticulations dense and well defined on both surfaces. Inflorescence axillary, 4–6 cm long; rachis 0.6 mm diameter, laxly rufous-tomentose. Bracts small, ovate, rufous-tomentose; apex acute. Peduncle 0.5 mm long. Pedicel 2–2.5 mm long, rufous-tomentose. Perianth brownish white, 8–10 mm long, \pm glabrous; limb 3×1.4 mm. Anthers c. 2 mm long. Disc glands free, \pm rounded. Ovary rufous-tomentose; style filiform, glabrous. Fruit not known.

Distribution: Known only from Mt Dayman in the Milne district of Papua New Guinea.

Ecology: In lower montane forest at 2000–2200 m altitude. Flowering in May or June.

***Helicia saruwagedica* Sleum. *Bot. Jb.* 70: 138 (1939).**

Small tree, up to 18 m high. Twigs glabrous, smooth. Petiole stout, 3–8 mm long, slightly rugous. Lamina \pm oblong to broadly elliptic-oblong, 8–20 \times 4–10 cm, subcoriaceous, glabrous; base cuneate, decurrent on to the petiole; margin entire; apex acute, acuminate or abruptly acuminate; midrib \pm flattened or slightly raised above, prominent beneath; nerves 5–7 pairs, curved upwardly, \pm interarching towards the margin, flattened to slightly raised above, raised beneath; reticulations dense, slightly raised on both surfaces. Inflorescence axillary or ramiflorous, glabrous, 15–22 cm long; rachis 2 mm diameter. Bracts very small; apex \pm acute. Peduncle 0.5–1 mm long. Pedicel 3–5 mm long. Perianth white, 12 mm long; limb 3–4 \times 2 mm. Anthers 2 mm long. Disc glands free. Ovary glabrous; style slender, glabrous. Fruit \pm obovoid to obliquely narrow-ellipsoid, 30–65 \times 25–35 mm, brown; apex acuminate into a curved beak; base \pm truncate; pericarp homogenous, coriaceous, 2–3 mm thick. Seed subglobose, 20–25 mm diameter.

Field characters: Bark grey-brown, finely fissured; underbark yellow. Wood white to brown.

Distribution: Restricted to New Guinea where it is known from the Morobe, Eastern Highlands and Western Highlands districts.

Ecology: In montane or lower montane forest, sometimes in association with *Nothofagus* and *Castanopsis*, from 1200 to 2700 m altitude. Flowering January to April, June, September, November. Fruiting July to September.

***Helicia saurauoides* Sleum. *Blumea* 8: 46 (1955).**

Small tree. Twigs smooth, densely rufous-pilose, with hairs adpressed, glabrescent. Petiole stout, 10 \times 3 mm, rugose, \pm glabrous or laxly ferruginous-pilose. Lamina \pm oblong to obovate-oblong, 19–35 \times 6–13 cm, subcoriaceous, at first rufous-pilose on both surfaces, with hairs adpressed, becoming \pm glabrous above, indumentum persisting beneath, particularly along midrib and nerves; base cuneate, decurrent on to the petiole; margin \pm serrate mainly in the upper

two-thirds of the leaf; apex obtusely-acuminate; midrib raised on both surfaces; nerves 19–21 pairs, slightly curved, \pm parallel, interarching inconspicuously at the margin, \pm flattened above, prominent beneath; reticulations dense, slightly raised on both surfaces. Inflorescence axillary, 10–16 cm long, rufous-pilose, with hairs adpressed; rachis 1.5 mm diameter. Bracts ovate-lanceolate, 1 mm long. Peduncle 0.3 mm long. Pedicel 1 mm long. Perianth: only small buds seen. Ovary glabrous. Fruit (immature) obovoid, 25×15 mm, brown; pericarp appears to be homogeneous.

Distribution: Known only from the Vogelkop and Snow Mountains districts of western New Guinea.

Ecology: In primary rain forest up to 300 m altitude. Flowering October and November. Fruit in November.

Helicia schlechteri Laut. in K. Sch. and Laut. *Nachtr.* 256 (1905).

Small tree. Twigs rufous-tomentose, glabrescent. Petiole 2–8 mm long, thickened, rugose, sometimes with a few short rufous hairs. Lamina oblong-elliptic to \pm narrowly ovate, $10\text{--}18 \times 2\text{--}4$ cm, subcoriaceous to chartaceous, glabrous; base cuneate; margin entire; apex acuminate; midrib prominent; nerves 8–10 pairs, straight and parallel in the lower half then curving upwardly and interarching near the margin, \pm flattened above, raised beneath; reticulations dense. Inflorescence ramiflorous, 13–30 cm long, laxly flowered; rachis rufous-pilose, with hairs extending up pedicels and to a lesser extent on to the perianth. Bracts small, ovate; apex acuminate. Peduncle 0.5–1.5 mm long. Pedicel up to 1.5 mm long. Perianth white, up to 25 mm long; limb 3×1.5 mm. Anthers *c.* 2 mm long. Disc glands free, small. Ovary rufous-pilose; style slender, glabrous. Fruit not known.

Distribution: Known only from the Torricelli Mountains in the West Sepik district of Papua New Guinea.

Ecology: In forest up to 600 m. Flowering April.

Helicia sellae-montis Sleum. *Bot. Jb.* 70: 142 (1939).

Small tree, up to 6 m high. Twigs terete, densely and darkly rufous-tomentose at the apex, with hairs adpressed, glabrous lower down. Petiole stout, up to 4–5 mm long, rugose, \pm glabrous to rufous-tomentose. Lamina narrowly oblong to \pm obovate, $10\text{--}30 \times 4\text{--}12$ cm, subcoriaceous; lower surface rufous-tomentose particularly along the midrib and main veins; base cuneate, decurrent on to the petiole; margin entire or with a few irregularly spaced teeth; apex acuminate; midrib slightly raised above, prominent beneath; nerves 9 or 10 pairs, curved upwardly, flattened above, prominent beneath; reticulations lax, impressed above, raised beneath. Inflorescence axillary or ramiflorous, up to 15 cm long, rufous-tomentose, with hairs extending up the peduncle, pedicels and perianth; rachis 1.5 mm diameter. Bracts, minute, lanceolate. Peduncle 0.3 mm long. Pedicel *c.* 0.7 mm long. Perianth brownish to yellowish, 10.5 mm long; limb 3×1.3 mm. Anthers 2 mm long. Disc glands connate in the lower half. Ovary rufous-pilose; style glabrous, slender. Fruit ellipsoid, $45\text{--}50 \times 30\text{--}35$ mm, glabrous; pericarp homogeneous, 2.5 mm thick. Seed 38×25 mm.

Field characters: Outer bark grey, peeling in small flakes; middle bark reddish brown; inner bark cream-coloured. Wood straw-coloured.

Distribution: Restricted to New Guinea where it is known from the Eastern Highlands and Morobe districts.

Ecology: In lower montane forest from 1000 to 2400 m altitude, in open forest sometimes by streams. Flowering January, March, April, August. Fruiting February and December.

Helicia stelechantha Diels *Bot. Jb.* 54: 202 (1916).

Tree, to 6 m high. Twigs ferruginous-pilose distally, with hairs adpressed, glabrescent. Petiole 10–35 mm long, stout and rugose at the base. Lamina \pm elliptic, 10–24 \times 7–8 cm, subcoriaceous, glabrous; base cuneate, decurrent on to the petiole, slightly oblique; margin serrate; apex acute to shortly acuminate; midrib deeply impressed above, prominent beneath; nerves *c.* 15 pairs, deeply impressed above, prominent beneath, \pm parallel, curved and interarching near the margin; reticulations dense and slightly raised on both surfaces. Inflorescences ramiflorous, up to 25 cm long; rachis 1.5 mm diameter, rufous-pilose, with adpressed hairs extending up peduncle, pedicels and perianth. Bracts linear, up to 2 mm long. Peduncle 0.5–1 mm long. Pedicel 4 mm long. Perianth pale pink, up to 17 mm long; limb 3 \times 1.5 mm. Anthers 1.5 mm long. Disc glands free, broadly ovate. Ovary rufous-tomentose; style filiform, glabrous. Fruit not known.

Distribution: Restricted to New Guinea where it is known from the Sepik and Western Highlands districts.

Ecology: In understorey of mixed montane forest at 2070–2740 m altitude. Flowering in March and June.

Helicia subcordata D. Foreman *Muelleria* 6: 89–91, f. 7 (1985). **Fig. 68.**

Tree, 24 m high. Twigs glabrous, stout, terete. Petiole stout, 6–10 \times 7–8 mm, rugose. Lamina obovate to slightly pandurate, 24.5–33.5 \times 11 cm, coriaceous, glabrous; base subcordate; margin entire; apex rounded; midrib slightly raised above, much raised beneath; nerves *c.* 17 pairs, curved upwardly, \pm flattened above, prominent beneath, \pm parallel; reticulations dense, slightly raised on both surfaces. Inflorescence ramiflorous, 10–16 cm long, glabrous; rachis 2 mm diameter. Bracts ovate, 1 mm long; apex acute. Peduncle 1–2 mm long. Pedicel slender, 7–8 mm long. Perianth pale cream-coloured, 28–32 mm long; limb 5–6 \times 1.5 mm. Anthers 4 mm long. Disc glands free, broadly rounded. Ovary glabrous; style slender, glabrous, tipped with bright blue. Fruit not known.

Field characters: Tall forest tree with erect branching.

Distribution: Once found near Wagau in the Morobe district of Papua New Guinea.

Ecology: In rather open, mid-montane forest at 1370 m altitude. Flowering September.

Helicia torricellensis Laut. in K. Sch. & Laut. *Nachtr.* 257 (1905).

Small tree. Twigs fuscous-tomentose, glabrescent. Petiole 2–10 mm long. Lamina narrowly ovate, 7–16.5 \times 2–6 cm, subcoriaceous, glabrous above, young

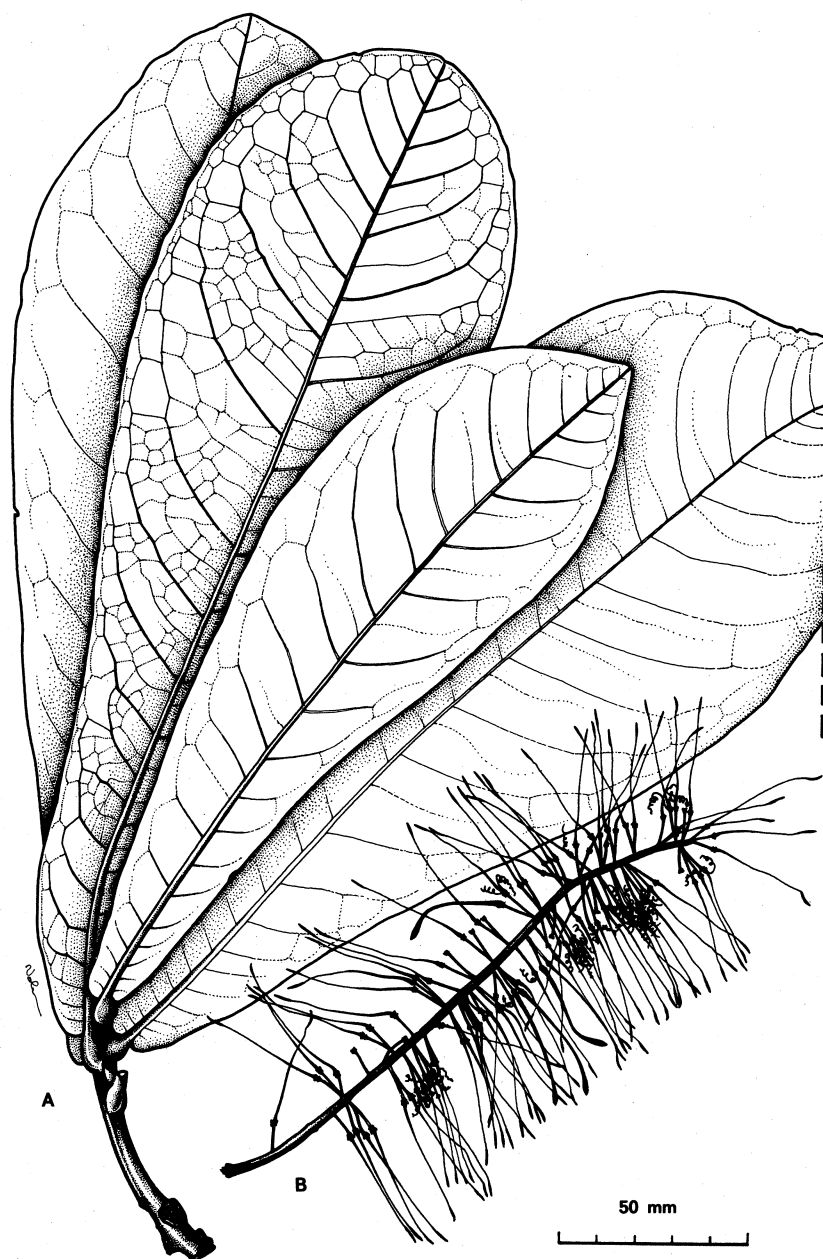


Fig. 68 *Helicia subcordata* D. Foreman (A) branchlet (B) inflorescence (both NGF 17903)

leaves with a few adpressed-ferruginous hairs but soon becoming glabrous; base cuneate, decurrent on to the petiole; margin entire; apex acute to gradually acuminate; midrib slightly raised above, very prominent beneath; nerves 10 pairs, \pm straight and parallel, curved and interarching near the margin, \pm flattened above, prominent beneath; reticulations dense, slightly raised on both surfaces. Inflorescences ramiflorous, 12–14 cm long; rachis densely flowered, rufous-tomentose, with hairs extending up the peduncle, pedicels and perianth. Bracts \pm narrowly ovate, 2 mm long. Peduncle *c.* 1–1.5 mm long. Pedicel 0.5–1 mm long. Perianth white (buds deep purple), 10–15 mm long; limb 3×1.2 mm. Anthers 2 mm long. Disc glands free, rather thick. Ovary rufous-tomentose; style slender, glabrous. Fruit not known.

Distribution: Known only from the Torricelli Mountains in the West Sepik district of Papua New Guinea.

Ecology: In forest up to 1000 m altitude. Flowering April and August.

Helicia uganensis Diels ex Sleum. *Bot. Jb.* **70**: 145 (1939).

Small tree. Twigs rufous-tomentose distally, glabrous lower down. Petiole short and stout, $3-6 \times 3$ mm, rufous-tomentose. Lamina \pm oblong to \pm obovate, $17-22 \times 4-8.5$ cm, subcoriaceous; lower surface laxly ferruginous- or rufous-tomentose, especially along the midrib and nerves; upper surface glabrous above except for a few sparse hairs on the midrib and main nerves; base cuneate, decurrent on to the petiole; margin entire; apex acuminate to \pm rounded; midrib prominent beneath; nerves *c.* 12 pairs, curving upward towards the margin, flattened above, raised beneath. Inflorescence ramiflorous, densely flowered, 11–15 cm long, rachis 2 mm diameter, rufous-tomentose extending up peduncle, pedicel and to a lesser extent on to the perianth. Bracts ovate-lanceolate, 1–2 mm long. Peduncle *c.* 0.5–0.8 mm long. Pedicel 0.5–0.8 mm long. Perianth yellowish brown, 7 mm long; limb 2×1 mm. Anthers 1 mm long. Disc glands free, \pm oblong. Ovary rufous-villous; style filiform, glabrous. Fruit ellipsoid, $50-70 \times 35-40$ mm, glabrous; pericarp with a dark purple outer zone, 4–8 mm thick, succulent at first becoming fibrous, the inner zone woody, 2–3 mm thick. Seed ellipsoid 40×20 mm.

Distribution: In Papuaia it is known from the New Britain and New Ireland districts of the Bismarck Archipelago, Papua New Guinea.

Ecology: In secondary forests at low altitudes. Flowering August and December. Fruiting August and December.

Helicia wollastonii Ridl. *Trans. Linn. Soc. Bot.* **9**: 145 (1916).

Small tree. Twigs glabrous \pm shiny. Petiole rather stout, 10–15 mm diameter. Lamina \pm obovate, $12-15 \times 5-7$ cm, subcoriaceous, glabrous; base cuneate; margin entire; apex abruptly acuminate to obtuse; midrib prominent on both surfaces; nerves 8–11 pairs, curved upward, interarching near the margin, impressed above, very prominent beneath; reticulations dense, slightly raised on both surfaces. Inflorescence ramiflorous, laxly flowered, 10–15 cm long, glabrous; rachis

1 mm diameter. Bracts minute. Peduncle 1–2 mm long. Pedicel 4–5 mm long. Perianth light yellow, 15–16 mm long; limb 3×1.5 mm. Anthers 2 mm long. Disc glands \pm fleshy, free. Ovary glabrous; style slender, glabrous. Fruit \pm ellipsoid, 25×18 mm, pericarp homogeneous, c. 2 mm thick.

Distribution: Known only from Utakwa River, Mimika district of western New Guinea.

Ecology: Lowland rain forest, at 45 m altitude. Flowering and fruiting October.

STENOCARPUS R. Br. (nom. cons.)

Trees. Leaves alternate or spiral, simple or deeply pinnatifid with few to many lobes. Inflorescence umbellate, with the umbels terminal or in axils of upper leaves, solitary or in several short racemes of umbels. Common bract small, early caducous; floral bracts absent. Flowers pedicellate; perianth slightly irregular, yellowish, greenish or red; perianth tube elongated, split down one side at first, eventually the segments becoming free; limb subglobose, recurved; pedicellate. Anthers sessile; connective not produced. Disc glands united into a shallow cup, or semiannular disk or \pm reduced. Ovary stipitate; style elongated. Pollen presenter oblique, expanded, turbinate, with a small central stigmatic surfaces. Fruit a follicle, usually \pm narrowly ellipsoid, coriaceous. Seeds \pm flattened with a terminal, membranous wing.

Distribution: About 18 species of which 12 occur in New Caledonia; c. 8 species occur in Australia; 2 species occur in Papuaia, one of which extends into Australia.

KEY TO SPECIES

1. Perianth greenish to yellowish, c. 10 mm long; leaves 5-plinerved from the base *S. moorei*
1. Perianth red, 25–30 mm long; leaves with 10–15 pairs of nerves, nerves pinnate . . . *S. sinuatus*

Stenocarpus moorei F. Muell. *Fragm.* 1: 134 (1859).

Stenocarpus salignus R. Br. var. *moorei* (F. Muell.) Benth. (1870); *Stenocarpus papuanus* Laut. (1916).

Tree, 2–27 m high. Twigs glabrous, distally minutely adpressed pubescent. Mature leaves: Petiole 10–20 mm long. Lamina simple, elliptic, ovate to narrowly ovate, $6\text{--}14 \times 1.5\text{--}7$ cm, subcoriaceous, glabrous; base attenuate; margin entire; apex acute, slightly acuminate to obtuse; 5-plinerved from the base. Juvenile leaves: Petiole 7–25 mm long. Lamina highly lobed (pinnatifid), segments 2 mm wide or even smaller. Inflorescence either a solitary umbel or in short panicles with 2–7 umbels, ferruginous-pubescent, up to 30 greenish to yellowish flowers per umbel; pedicels 4.5–6.5 mm long, ferruginous-sericeous. Perianth ferruginous-sericeous; tube 6–8 mm long; limb recurved, \pm globose, 1.2–1.5 mm diameter. Ovary ferruginous-sericeous on a ferruginous stipe, up to 6 mm long; style glabrous, 4–5 mm long. Fruit narrowly ellipsoid, $4\text{--}10 \times 0.3\text{--}0.5$ cm, slightly curved, glabrous, splitting along the ventral surface, the 2 halves finally becoming \pm flattened; stipe (gynophore) woody, 5–7 mm long; stalk 10–13 mm long. Seeds 1–6, thin, narrowly transverse-oblong, up to 22×5 mm, including a wing 10–15 mm long, each seed separated by a thin papery lamella the same size and shape as the seed.

Field characters: Bark thin, greyish brown, pustular, slightly fissured; underbark reddish brown; inner bark light-brown. Wood light reddish brown, with prominent broad rays.

Distribution: Widely distributed with most collections coming from the Jayapura district of western New Guinea and the Morobe, Western and Central districts of Papua New Guinea. Outside New Guinea, this species extends to the Aru Islands.

Ecology: Found in a variety of habitats ranging from primary or secondary dry rain forest to open savannah forests, often by rivers and streams from sea level to 200 m altitude. Flowering January, April to August. Fruiting in January and from August to September.

Stenocarpus sinuatus Endl. *Pl. Suppl.* 4: 88 (1847). **Fig. 69.**

Tree, 9–30 m high. Twigs terete, youngest parts tomentulose, becoming glabrous with age, \pm smooth to slightly striate. Leaves glabrous. Petiole 8–25 mm long. Lamina subcoriaceous, either simple, oblong-lanceolate, 13–30 \times 3–7 cm, or \pm deeply lobed, the lobes irregular in number, shape and length, the lobed leaves 36–38 cm long; base attenuate; margin (apart from lobes) entire; apex obtuse to bluntly acute; midrib slightly prominent above, very prominent beneath; nerves pinnate, 10–15 pairs, \pm flattened above and raised beneath; reticulations fine, dense on both surfaces. Inflorescence axillary or terminal or short axillary shoots, either solitary umbels or several together forming \pm loose panicles, each umbel with up to 18 flowers. Pedicels 8–12 mm long, shortly ferruginous-pubescent, radiating like the spokes of a wheel. Perianth red to orange-red, shortly ferruginous-pubescent, tubular part 30 mm long, at first splitting along one side but eventually the four perianth segments becoming free; limb recurved, globose, 4 mm in diameter. Anthers 2–3 mm long. Disc glands 2 mm long, semiannular. Ovary densely light brown pubescent, glabrous below, up to 20 mm long. Fruit \pm boat-shaped, 8–10 \times 1.5–2.5 cm, attenuate at both ends, opening lengthwise along dorsal surface and becoming \pm flattened; pericarp coriaceous; stripe (gynophore) woody, 12–15 mm long; stalk bent at right angles to stipe, c. 25 mm long. Seeds narrowly transverse-oblong, up to 32 \times 8–10 mm, including a terminal wing 20 \times 8–10 mm, separated by a thin papery lamella the same size and shape as the seed.

Field characters: Bark mid-brown, strongly fissured; underbark mid- to dark-brown; inner bark light-brown. Wood light- to mid-brown with an attractive grain.

Distribution: Known from the Central and Western districts of Papua New Guinea and from the east coastal rain forests of Queensland and New South Wales, Australia.

Ecology: In primary and secondary rain forest from about sea level to 1400 m altitude. Flowering July, September, October, November. Fruiting July and September.

Notes: This species is widely cultivated because of its attractive flowers. The timber of the larger trees is used for special purposes such as veneer.



Fig. 69 *Stenocarpus sinuatus* Endl. (A) flowering branchlet with polymorphic leaves (B) fruit (C) fruit—longitudinally section to show arrangement of seeds (D) seed (all NGF 49385)

Appendix

SPECIES OF *OSMOXYLON* (ARALIACEAE) IN THE SOLOMON ISLANDS

(with additional notes on New Guinean species)

*B. J. Conn and D. G. Frodin*¹

The following concise account of *Osmoxylon* in the Solomon Islands is provided as W. R. Philipson did not include all known species in his treatment of the Araliaceae (pp. 18–27 in this volume). Unfortunately, the lack of adequate herbarium material has made it difficult to circumscribe several taxa; in addition, some islands are very under-collected.

Inflorescence terminology: The inflorescence consist of numerous umbellate flowers (fertile and infertile) which are arranged in triadic units. Although the primary axis of each unit is morphologically homogeneous from its base (on the main axis which is continuous with the vegetative axes) to the base of the central umbel of infertile flowers, the internode between this terminating umbel and the more basal node is referred to as the central secondary axis. The term 'primary axis' is restricted to the internode below this basal node. The two lateral 'branches' of the triad (those producing fertile flowers) are referred to as the lateral secondary axes.

Literature: W. R. Philipson (1951), Contributions to our knowledge of Old World Araliaceae. *Bull. Brit. Mus. (Nat. Hist.) Bot.* **1**: 3–20; B. C. Stone (1962), *Boerlagiodendron* (Araliaceae) in eastern Melanesia. *Proc. Biol. Soc. Washington* **75**: 25–32; (1983), Contributions to the Flora of the Solomon Islands. II Five new combinations in Araliaceae. *Gardens Bull. Singapore* **36**: 101 & 102.

KEY TO SPECIES

1. Leaves simple, without lobes
2. Leaves broadly obovate, 17–30 × 10–15 cm; inflorescences with primary axes stout (> 5 mm diameter) **O. spathipedunculatum**
2. Leaves narrowly elliptic to narrowly obovate, 20–21 × 6–6.5 cm; inflorescences with primary axes more slender (c. 2–3 mm diameter) **O. corneri**
1. Leaves palmately lobed
3. Leaves with lower surface of lamina persistently hairy, often furfuraceous (hairs frequently minute)
4. Leaves with lobes secondarily divided into subacute lobes; margin shortly to minutely serrate; inflorescences with primary axes stout (2.5–4 mm diameter; 5–15 cm long), with central secondary axes 1.2–2.7 cm long

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5. Inflorescences with lateral secondary axes 5–6 cm long, with primary axes *c.* 5 cm long; fertile flowers *c.* 7 per umbel ***O. russellense***
5. Inflorescences with lateral secondary axes to 4.2 cm long, with primary axes to 15 cm long (usually greater than 5 cm); fertile flowers to *c.* 30 per umbel
6. Inflorescences with central secondary axes about as long as lateral secondary axes; petiolar crests strongly pectinate; fertile flowers and fruits in congested head-like umbels; pedicels of pseudofruits 13–18 mm long ***O. chrysanthum***
6. Inflorescences with central secondary axes *c.* 1/2 as long as lateral secondary axes; petiolar crests shortly pectinate; fertile flowers in somewhat more open umbels (fruits not known); pedicels of pseudofruits 5–10 mm long ***O. superantiflorum***
4. Leaves with lobes secondarily undivided or barely notched; margin distinctly serrate; inflorescences with primary axes slender (to 2 mm diameter; to 5.5 cm long), with central secondary axes 1–1.8 cm long
7. Petioles and branchlets bristly-scaly; leaves puberulent beneath and bristly on nerves; inflorescences bristly-puberulent; stamens 5 or 6; ovary 9- or 10-locular ***O. reburum***
7. Petioles, branchlets, leaves and inflorescences furfuraceous, not bristly; stamens *c.* 12 (not known in *O. striatiflorum*); ovary *c.* 10–14-locular
8. Inflorescences with lateral secondary axes 5–9 cm long, with primary axes 5–14 cm long; lamina with lower surface minutely hairy (hence, may appear glabrous); petiole with shortly pectinate crests near base ***O. striatifructum***
8. Inflorescences with lateral secondary axes 0.9–1.5 cm long, with primary axes 3.2–5.2 cm long; lamina with lower surface distinctly furfuraceous; petiole with strongly pectinate crests near base ***O. whitmorei***
3. Leaves with lower surface glabrous
9. Leaves not lobed or shallowly 3–5-lobed (secondary lobes absent); lamina chartaceous; margin coarsely serrate; fruit (6–)7- or 8-locular; petiolar crest solitary, relatively small (0.4–0.5 cm long) ***O. tetrandrum***
9. Leaves usually deeply lobed (secondary lobes usually present); lamina chartaceous to coriaceous; margin serrate, often indistinctly so; fruits larger (>0.5 cm long); petiolar crests many, small to large
10. Fruits sessile or subsessile; fertile flowers sessile or with pedicel to *c.* 2 mm long
11. Central secondary axes >1 cm long
12. Petiole with shortly pectinate crests near base; ovary 5–9-locular; inflorescences with bracts at base of ultimate triads narrowly lanceolate, 0.6–0.7 cm long, smaller (to 0.2 cm long) and soon caducous from fertile flower buds, slightly more persistent at base of pseudofruits; petiole apparently with shortly pectinate crests near base ***O. ellipsoideum***
12. Ovary 14-locular; inflorescences with bracts ovate, boat-shaped, 1.6–2 cm long, similar in size and shape and persistent at base of fertile flowers buds and base of pseudofruits (although often only fragments remaining); petiole with strongly pectinate crests near base ***O. confertiflorum***
11. Central secondary axes to 0.5 cm long
13. Ultimate triads with pseudofruits small to *c.* 0.4 cm diameter; lateral secondary axes *c.* 5 times length of central secondary axes ***O. rectibrachiatum***
13. Ultimate secondary axes congested, with pseudofruits large, *c.* 0.7–0.9 cm diameter; lateral secondary axes *c.* 2 times length of central secondary axes ***O. arrhenicum***
10. Fruits distinctly pedicellate; fertile flowers with pedicel usually at least 4 mm long, or as short as 2 mm long (in bud)
14. Pseudofruits *c.* 2–3 mm diameter; lamina base deeply lobed to base of ribs, such that each lobe attenuate with petiolules to 6.5 cm long (lobes appearing like separate leaflets); inflorescences with primary axes \pm slender and 2–3.5 mm diam., and with lateral secondary axes longer than central secondary axes ***O. pseudofoliatum***
14. Pseudofruits 3–8 mm diameter; lamina base deeply lobed almost to base of ribs but lobes never appearing like separate leaflets, or if divided to base (in *O. puniceopolleniferum*) then petiolules to *c.* 3 cm long and inflorescences with primary axes stout and lateral secondary axes equal to central secondary axes
15. Fruits globose, 6–15 mm diam.; pseudofruits 6–8 mm long; inflorescences with primary axes generally stout and (3–)4–5 mm diam. (in flower) ***O. puniceopolleniferum***
15. Fruits ovoid to ellipsoid, 5–6 mm diam.; pseudofruits 3–5 mm diam.; inflorescences with primary axes \pm slender and 2–3.5 mm diam. (in flower) ***O. novoguineense***

Osmoxylon arrhenicum Conn & Frodin, sp. nov.

Osmoxylon rectibrachiatum Conn et Frodin aemulans, sed differt axibus laterali-secundariis inflorescentiae duplo longioribus quam centrali-secundariis, nec quinquens, et pseudofructibus 0.7–0.9 cm diameter, nec ad 0.4 cm diameter. **Holotype:** Solomon Islands: Santa Isabel: near Maringe Lagoon, S side of W ridge of Mt Sasari, *Whitmore BSIP 2451*, 27 Oct 1963 (K).

Tree, c. 14 m high, glabrous. Leaves with petiole c. 20 cm long, moderately stout (c. 0.8 cm diameter), grooved above, with stipular ligule not known, with slightly spirally arranged, \pm appressed, distinctly pectinate crests encircling lower 1/3 of petiole. Lamina glabrous, c. 57 \times to at least 35 cm, with 3–5 strong radiating ribs, 3–5-lobed; base shallowly cordate; lobes apparently entire; margin minutely and distantly toothed (hence indistinctly serrulate); apex not known, possible \pm acuminate. Inflorescence with primary axes 4.5–9.5 cm long, caducous bracts c. 1.2–1.5 cm long at base of secondary axes; central secondary axis 0.6–1 cm long, pseudofruits c. 9 or 10, pedicel 7–10 mm long; 2 lateral secondary axes 2–2.5 cm long, with 2 subopposite bracts inserted near middle; pedicel 3–5 mm long, c. 7-flowered. Calyx rim obsolete, undulate, truncate. Corolla obovoid (in bud), 6–8 mm long, ?2-lobed (possibly an artifact of pressing). Stamens ?10–14, exserted. Ovary 14-locular; disc raised in centre to 2 rows of 14 stylopodia. Fruits not known.

Field characters: A tree with an obconical crown; girth 100 cm.

Distribution: Endemic to Santa Isabel, Solomon Islands. Only known from the type collection.

Ecology: Occurring in steep hill forest, at altitudes of c. 700 m.

Vernacular names: 'Gwalifunu Gwane' (Kwara'ae)(note: same name used for *O. superantiflorum*). 'Gwane' = man, referring to the hairy, hence pectinate crests at the base of the petiole (refer to *O. puniceopolleniferum* for discussion of vernacular name).

Notes: This species is characterized by stout inflorescences which have a relatively short central secondary axis compared with the lateral secondary axes (c. 1/2 as long), by large pseudofruits, strongly pectinate petiolar crests near base of petiole, and by its palmately 3–5-lobed leaves which appear to lack secondary lobing.

The specific epithet ('arrhenicum' – male) acknowledges the reference by the people of the Kwara'ae language group to this plant as a 'Man' plant.

Osmoxylon chrysanthum Conn & Frodin, sp. nov.

O. superantifloro Conn et Frodin affinis, sed differt pedicello florum longiore, staminibus carpelisque paucioribus. **Holotype:** Solomon Islands: Guadalcanal: Hidden Valley tributary, below upper camp, *Dennis RSS 2126*, 9 Jul 1965 (K, 3 sheets).

Small tree, c. 7 m high; branches thick. Leaves with petiole c. 30–40 cm long, stout (almost 1 cm diameter), grooved above, with stipular ligule c. 4 cm long, and with several slightly spirally arranged, pectinate crests encircling lower 1/3 of petiole. Lamina 37–60 \times 60–120 cm, with 5 strong radiating ribs, 5-lobed; base cordate; lobes \pm deeply 2- or 3-lobed; margin shortly serrate; apex subacute; lower surface moderately hairy (slightly rough to touch), with golden-coloured curly hairs. Inflorescences moderately to densely hairy with golden-coloured, \pm appressed to spreading, curled hairs (appearing furfuraceous); primary axes

10–13, to 15 cm long, caducous bracts (not seen); central secondary axis 2.2–2.7 cm long, pseudofruits *c.* 12–22, pedicel 13–18 mm long; 2 lateral secondary axes 2.5–3.2 cm long, with 2 opposite or subopposite bracts inserted up to 1/2 way from base; pedicel 7–10 mm long, to *c.* 20-flowered, ?not articulated. Calyx rim obsolete, undulate, truncate. Corolla tubular, 5–6 mm long (immature). Stamens 9. Ovary 9-locular; disc raised in centre to 9 elliptically arranged stylopodia. Fruits not seen.

Distribution: Endemic to the Guadalcanal, Solomon Islands. Only known from the type collection.

Ecology: Collected from a riverine community, on debris banks of deep gorge (at 300 m altitude).

Vernacular name: 'Gwalifunu' (Kwara'ae) (refer to *O. puniceopolleniferum* for discussion of vernacular name).

Notes: This species is superficially similar to *O. superantiflorum*. However, it differs by its pedicellate flowers (flowers almost sessile in *O. superantiflorum*), 9 stamens and 9-locular ovary (whereas *O. superantiflorum* has 14 stamens and 14-locular ovary).

The specific epithet ('chrysanthum') refers to the golden-coloured indumentum of the flowers and the lower surface of the leaves.

***Osmoxylon confertiflorum* Conn & Frodin, sp. nov.**

Quoad folia *O. rectibrachiato* Conn et Frodin similis, sed praecipue differt inflorescentia conferta, nec laxa, et cristis petioli pectinatis, nec fere laevibus. **Holotype:** Solomon Islands: Choiseul: Rob Roy Island, *Whitmore's collectors BSIP 5410*, 13 Mar 1964 (K).

Shrub or small tree, 3.5–14 m high. Leaves with petiole 20–37 cm long, moderately stout (0.7–1.3 cm diameter), flattened and grooved above, with stipular ligule to at least 5 cm long, and with slightly spirally arranged, \pm appressed, distinctly pectinate crests encircling lower 1/6 to 1/3 of petiole. Lamina glabrous, 33–54 \times to *c.* 60 cm, with 6 or 7 strong radiating ribs, 6- or 7-lobed; base slightly cordate; lobes entire or \pm deeply 2- or 4-lobed; margin slightly undulate and indistinctly serrate; apex \pm acuminate. Inflorescences glabrous; primary axes at least 7, 5–14 cm long, caducous bracts boat-shaped, *c.* 2 cm long; central secondary axis 1.3–2 cm long, pseudofruits *c.* 9–15, pedicel 4–10 mm long; 2 lateral secondary axes 0.7–1.5 cm long, with 2 subopposite bracts inserted in lower 1/2 of axis; pedicel 6–7 mm long, *c.* 14-flowered. Calyx rim obsolete, undulate, truncate. Corolla obovoid (in bud), 6–7 mm long (immature), ?2-lobed (possibly an artifact of pressing). Stamens ?10–14, exserted. Ovary 14-locular; disc raised in centre to 14 stylopodia arranged in 2 lines. Fruits ovoid to subglobose, *c.* 1 cm diameter, *c.* 14-locular.

Field characters: Bole straight or crooked; girth 30–90 cm; bark smooth, soft, light brown; wood soft, straw-coloured.

Distribution: Endemic to the Solomon Islands, occurring in the Choiseul and New Georgia districts.

Ecology: Occurring in well-drained primary and secondary forests, at low altitudes (to *c.* 59 m).

Vernacular name: 'Gwalifunu' (Kwara'ae)(including spelling variants)(refer to *O. puniceopolleniferum* for discussion of vernacular name).

Notes: This species is superficially similar to *O. rectibrachiatum*, especially in foliage. However, the central secondary axes of the inflorescences of *O. confertiflorum* are greatly reduced, much shorter than the secondary lateral axes, whereas this central axis is not reduced in *O. rectibrachiatum*. Since these lateral axes are elongated in the latter species, the inflorescences appear to be relatively open, whereas *O. confertiflorum* has congested inflorescences, especially when the flowers are in bud. The petiolar crests are strongly pectinate in *O. confertiflorum*, whereas those of *O. rectibrachiatum* are almost smooth.

Even though the primary axes of the inflorescence are well developed, the specific epithet ('confertiflorum') refers to the crowded inflorescence, at least in the early stages of development, caused by the relatively short secondary axes.

***Osmoxylon corneri* Conn & Frodin, sp. nov.**

Quoad folia simplice angusta et inflorescentias ad *O. lanceolatum* Philipson accedens, sed differt receptaculo inflorescentiae non dilatato et absentia cristiae petioli. **Holotype:** Solomon Islands: Guadalcanal: Popomanasiu, *Corner R.S.S. 160*, 31 Oct 1965 (K).

A small tree, c. 12 m high, sparingly branched (branches erect), glabrous. Leaves with petiole 8–15 cm long, terete, slender, bearing a short stipular ligule, 1.5–2 mm long (not extending around base of petiole as a crest). Lamina narrowly elliptic to narrowly obovate, 20–21 × 6–6.5 cm; base attenuate; margin entire; apex subacute; midrib prominent, lateral veins arched ascending, 1–1.5 cm apart. Inflorescences almost sessile, caducous bracts (not seen); primary axes c. 22, c. 6.5–8 cm long, flattened, 2.5–4 mm wide; central secondary axis 3.5–5 cm long, apex not expanded, bearing a spherical head of 10–20 sessile pseudofruits (c. 4–5 × 3–3.5 mm, when dry); 2 lateral secondary axes c. 2.5–3 cm long (in bud), with an articulation near base, bearing 2 helmet-shaped bracts which fall to reveal the terminal head of c. 20 sessile flowers, receptacle not or only very slightly expanded. Calyx rim obsolete. Corolla known only in early bud. Stamens, ovary and fruit unknown.

Field characters: The simple paddle-shaped leaves of this species, are also characteristic of *O. lanceolatum* and *O. spathipedunculatum* (both of which occur in this region).

Distribution: Endemic to the Guadalcanal, Solomon Islands. Only known from the type collection.

Ecology: Not known. Type collected from c. 1470 m altitude.

Notes: The simple narrowly elliptic to narrowly obovate leaves and the lax inflorescences are reminiscent of *O. lanceolatum* (of New Ireland) and to a lesser extent to *O. spathipedunculatum* (Bougainville and also on Guadalcanal, Solomon Islands). However, there is a distinctly enlarged receptacle in the latter two species, not present in this species; no articulation on the secondary axes in *O. lanceolatum* (present in this species and although variable, usually present in *O. spathipedunculatum*). *Osmoxylon lanceolatum* has a distinct ligular crest encircling the base of the petiole, whereas it is almost completely reduced in *O. spathipedunculatum* and is absent in this new species. *Osmoxylon spathipedun-*

culatum appears to be a much more robust plant than *O. corneri*, with stouter petioles and inflorescences, and more coriaceous leaves.

This species is named after E. J. H. Corner in acknowledgement of his outstanding contribution to our understanding of the flora of the Malesian region, and also because he collected the type material of this new species.

***Osmoxylon ellipsoideum* Conn & Frodin, sp. nov.**

Species nova *O. insidiatorem* Becc. appropinquat, sed differt tota planta glabra, nec plus minusve furfuracea, axibus laterali-secundariis inflorescentiae brevibus, calyce laevi, nec fimbriato, et stylopodius 5–9, nec 13–25. **Holotype:** Papua New Guinea: Milne Bay (Esa'ala subdistrict): Inland from Miadeba, Normanby Island, *Croft et al LAE 68899*, 24 Nov 1976 (K, 2 sheets); iso (not seen): A, BISH, BM, BO, BRI, CANB, E, L, LAE, M, NSW, PNH, QRS, SING, US.

Tree, 15 m high, many-branched, glabrous. Leaves with petiole to 0.4 m long, stout (c. 1.5 cm broad), flattened and grooved above (sheathing base not preserved in herbarium material), petiolar crests (old) slightly spirally arranged, partly encircling lower part of petiole, ± smooth, not pectinate. Lamina up to 70.6 m diameter, with 8 strong radiating ribs, 8-lobed; base slightly cordate; lobes in turn lobed (central lobes not known); margin sparsely serrate; apices ± acuminate. Inflorescences with primary axes numerous, 4.5–7.5 cm long at anthesis (16–17 cm long in fruit), c. 2 mm thick, caducous bracts (to 10 mm long) at apex; central secondary axis c. 2 cm long, pseudofruits c. 5, c. 5 mm diameter (when dry), pedicel 10–15 mm long; 2 lateral secondary axes to c. 2.6 cm long, with 2 opposite bracts distally; umbels probably globular, to at least c. 20-flowered (based on infructescence); pedicel short, c. 2 mm long. Calyx rim obsolete, undulate. Corolla and stamens not known. Ovary somewhat angled; glabrous, 5–9-locular, disc flat, raised in centre to 2 rows of 5–9 stylopodia. Fruits subsessile, ellipsoid, 0.6–0.8 cm diameter, ribbed (when dry), to 5–9-locular.

Field characters: Bole 5 m; d.b.h. 80 cm; outer bark grey-brown, corky; inner bark orange straw-coloured; wood orange straw-coloured.

Distribution: Endemic to the Milne Bay district of Papua New Guinea.

Ecology: Secondary or disturbed lowland hill forest, at 250 m altitude.

Notes: This new species is similar to *O. insidiator*; however, it is completely glabrous (whereas the latter is various hairy), the lateral secondary inflorescence axes are much shorter (to c. 2.6 mm long cf. c. 6 mm long in *O. insidiator*), the calyx rim undulate and lacking projections (cf. fimbriate in *O. insidiator*), and the ovary has 5–9 stylopodia (cf. 13–25 in *O. insidiator*).

This species probably extends westward on to mainland eastern New Guinea, possibly as far as the Central district. For example, *NGF 19634* (Abau subdistrict) may belong to this new species. Philipson (in this volume) included this species in *O. insidiator*.

The specific epithet ('ellipsoideum') refers to the ellipsoidal fruits of this species.

***Osmoxylon novoguineense* (Scheff.) Becc. *Malesia* 1: 197 (1877)** (refer text for synonymy, pp. 24 & 25).

Tree or shrub, to 16 m high, unbranched or sparingly branched, young parts rufous furfuraceous, becoming glabrous. Leaves with petiole to 100 cm long,

stout (1–2 cm broad), flattened above, with a strong stipular ligule to 7 cm long, and with fimbriate crests encircling lower part of petiole. Lamina to 120 cm diameter, with 5–7 strong radiating ribs; base deeply lobed almost to base of the ribs, lobes in turn deeply lobed and incised, central lobes strongly pinnatisect or digitately tripartite; margin serrate; apices acute: upper leaves associated with inflorescences may be smaller, more simply lobed, or entire. Inflorescences bowl-shaped, to 35.5 cm diameter; primary axes usually 50–70, mostly 12–15 cm long, c. 3 mm thick, caducous bracts (10 mm long) at apex; central secondary axis c. 2 cm long, pseudofruits c. 20–40, c. 3.5 mm diameter (when dry), pedicel c. 10 mm long; 2 lateral secondary axes c. 4–6 cm long, with 2 opposite or subopposite bracts about middle, terminating in a subspherical umbel 2.5–3 mm diameter, of 30–50 flowers; pedicel mostly 8–10 mm long. Calyx rim obsolete, undulate. Petals tubular below; lobes erect, irregular. Stamens 6–10, exerted. Ovary turbinate, somewhat angled; glabrous, 6–14-locular, disc flat, raised in centre to 2 rows of 6–14 stylopodia. Fruits ovoid to ellipsoid, 0.5–0.6 mm diameter, ribbed (when dry).

Field characters: Refer Philipson (p. 24, this volume).

Distribution: Endemic to Papuaia, occurring in the Vogelkop and Japen Island (Geelvink) of Irian Jaya, and then in the West and East Sepik, Western, Gulf, Central, Madang, Morobe and the Bismarck Archipelago of Papua New Guinea (refer 'Notes' below).

Ecology: Refer Philipson (p. 24, this volume).

Vernacular names: 'Aimaini' (Mamig); 'Akriek' (Biak); 'Ap gan dandam' (Mamig); 'Faliifalii' (Tifal); 'Hoppung' (Hottam); 'Ida'pfopforsami' (Kutubu) (note: same name used for *O. geelvinkianum*); 'Lebe' (Mooi); 'Pulaka' (Gazelle Peninsula); 'Uger' (Wagu).

Notes: This species has been included in this treatment because it is morphologically similar to *O. puniceopolleniferum* and the following notes should be read in conjunction with those on this latter species (refer below). Whether or not *O. puniceopolleniferum* is (at least in part), conspecific with *O. novoguineese* is not known. Philipson (refer text, p. 24) has applied a much broader species concept for *O. novoguineese* than is accepted here. Populations from the Solomon Islands (excluding Santa Cruz) which have previously been assigned to this species are here classified as belonging to *O. puniceopolleniferum* (sens. lat.). The collections from the Santa Cruz Islands are also excluded from this species. They are here classified as *O. orientale* (Guillaumin) B. C. Stone.

Variations observed within the populations of *O. novoguineese*, based on herbarium material, cannot be fully evaluated because of inadequate material. Until the within-population variation is better known, it is not possible to identify whether there is any regional differences represented by the populations currently included in *O. novoguineese*. For example, although the leaves are generally secondarily deeply lobed, the collections show a great deal of variation in this feature.

There are two main types of inflorescences in this taxon. The nominate variant has the central secondary inflorescence axes up to about half the length of the

lateral secondary axes, with the flowers being distinctly pedicellate. However, collections from the Finisterre/Saruwaged Ranges (Morobe), which occur at higher altitudes than much of the previous variant, have almost palmate leaves and have almost equivalent central and lateral secondary inflorescence axes. One collection from the Naru River basin (Madang), west of the foregoing populations, has a similar inflorescence architecture and may belong to this entity. A collection from the Fakfak district (Irian Jaya) has a very immature inflorescence with secondary axes almost equal in length. However, in all other respects, this collection appears to be similar to the nominate variant. Furthermore, the lateral axes may elongate as the flowers mature.

A collection from about 750 m altitude in the Telefomin subdistrict (West Sepik), *Frodin & Morren 3436* (K, LAE), is sufficiently distinct to be perhaps worthy of formal recognition. It has sessile flower buds, whereas the flowers are normally pedicellate in this species. The immature flowers are surrounded by small broadly ovate bracts, with narrowly ovate bracts occurring amongst them. Such bracts do not appear to be present in collections of a similar stage of development in other populations included in this species.

***Osmoxylon pseudofoliatum* Conn & Frodin, sp. nov.**

Foliis glabris et ovarii multilocularibus ut in *O. rectibrachiatum* Conn et Frodin, sed differt foliis basi profunde divisio, nec basi non divisio, et floribus pedicellatis, nec sessilibus. **Holotype:** Solomon Islands: Guadalcanal: W of Kombe Village, Small Nggela, *Gafui & collectors BSIP 15300*, 3 Jul 1969 (K).

Small tree, 7–10 m high or as short as 2.5 m (possibly immature). Leaves glabrous; petiole 18–37 cm long (slender, to 0.6 cm diameter), slightly flattened to grooved above, with stipular ligule 5–10 cm long, and with a few, sparsely and shortly pectinate crests encircling near base of petiole. Lamina to *c.* 30 × to *c.* 38 cm, with 5–7 radiating ribs; base deeply lobed to base of ribs, such that each lobe attenuate with petiolules to 6.5 cm long; each lobe ± 2–4-lobed (central lobe more lobed than lateral lobes); margin serrate; apices shortly acuminate. Inflorescences glabrous; primary axes numerous, 4–11 cm long, bracts caducous (not seen); central secondary axis 0.8–2 cm long, pseudofruits *c.* 2–3 mm diameter, pedicel 9–11 mm long; 2 lateral secondary axes 2.7–5 cm long, with 2 subopposite caducous bracts (one inserted 1/3 from base, other *c.* 2/3 from base, or both inserted near middle), pedicels 2–6 mm long. Calyx rim obsolete, truncate to slightly undulate. Corolla obovoid (in bud), apparently primarily 2-lobed and secondarily 5–6-lobed. Stamens *c.* 9. Ovary *c.* 10–14-locular; disc almost flat, raised in centre to (?10–)12–14 elliptically arranged stylopodia. Fruits not known.

Field characters: Bole straight or crooked; girth 30–60 cm; d.b.h. 3 cm; buttresses absent; bark soft, medium to light brown, smooth, with many lenticels; wood soft, light brown.

Distribution: Endemic to the Solomon Islands; occurring in the Malaita, Guadalcanal and San Cristobal districts.

Ecology: This species occurs in near-coastal, well-drained secondary forests, at 7–10 m altitude.

Notes: This species appears to be closely related to *O. rectibrachiatum*, both glabrous and both with many-locular ovaries. However, *O. pseudofoliatum* has

leaves which are divided to the base (cf. the leaves of *O. rectibrachiatum* which are not so deeply divided), and pedicellate true flowers (pedicel 2–6 mm long), whereas *O. rectibrachiatum* has sessile flowers. There is some similarity between this new species and *O. striatifructum*; however, the latter species is readily distinguished by its hairy leaves and inflorescences.

Vernacular names: 'Gogomu' (To'obaila); 'Gwalifunu' (Kwara'ae) (refer to *O. puniceopolleniferum* for discussion of vernacular name).

Notes: The specific epithet ('pseudofoliatum') refers to the deeply lobed leaves which superficially appear to consist of separate leaflets with petiolules.

Osmoxylon puniceopolleniferum (B. C. Stone) B. C. Stone *Gardens Bull. Singapore* **36**: 101 (1983).

Boerlagiodendron puniceopolleniferum B. C. Stone (1962).

Small tree, c. 5–12(–15) m high, sparingly branched, almost glabrous. Leaves with petiole c. 15–25 cm long, stout (c. 1 cm diameter), slightly flattened to grooved above, with stipular ligule at least 5 cm long, and with irregularly and slightly sinuate crests encircling lower part of petiole. Lamina to 70 × 80 cm, with 5–9 strong radiating ribs; base of lobes with petiolules c. 3 cm long and narrowly winged, lobes deeply 3–5-pinnatifid, with central lobes longer (to 60–70 cm long, to 17 cm wide), especially deeply lobed; margin ± serrate (often appearing entire); apex obtuse. Inflorescences with primary axes numerous, to 22 cm long, caducous bracts (not seen); central secondary axis 1.5–2 cm long, pseudofruits c. 12–30, c. 6–8 mm diameter, pedicel 14–18 mm long; 2 lateral secondary axes c. 7–8 cm long, with 2 opposite or subopposite bracts inserted from 1/3 to 2/3 from base; pedicel c. 4–10 mm long. Calyx rim obsolete, undulate, truncate. Corolla tubular basally (tube to 4.7 mm long), distally 3- or 4-lobed. Stamens (5–)9–11, exserted. Ovary (5–)9–11-locular; disc almost flat, raised in centre to (5–)9–12 elliptically arranged stylopodia. Fruits globose, 0.6–1.5 cm diameter

Field characters: Bole straight or crooked; girth 30 cm; bark light to dark brown, smooth or fissured; slash wood usually soft, brown.

Distribution: Endemic to Solomon Islands, occurring in all districts (excluding the Santa Cruz Islands).

Ecology: Frequenting well-drained coastal and near-coastal forests, at altitudes up to 700 m.

Vernacular names: 'Gwalifunu', 'Gwalifunu kini' (Kwara'ae). 'Kini' = woman, referring to the glabrous crests at the base of the petiole. 'Gwalifunu' (including spelling variants) refers to several distinct species of *Osmoxylon*.

Notes: This species is closely related to *O. novoguineense*; however, the usually larger pseudofruits, the larger globose fruits (cf. ellipsoid in *O. novoguineense*), and the generally more robust inflorescences of *O. puniceopolleniferum* appear readily to distinguish it from the latter species. Detailed field work is required to evaluate the taxonomic status of these two taxa.

There are several subtle, although probably taxonomically significant variants within the Solomon Islands. In particular, variations occur within the foliage and infructescences. In the western arc of the Solomon Islands (particularly New

Georgia and San Cristobal), one variant is characterized by apparently large fruits; by somewhat shortened, stout fruiting pedicels; by the primary lobes of the leaves being only slightly lobed or unlobed; and by the primary ribs of the leaves being more slender than in the nominate variant. These populations are less distinct from one another than are the populations in the eastern arc of the Solomon Islands. The latter populations represent the nominate variant which shows more similarities with *O. novoguineense* of mainland New Guinea.

The nominate variant has leaves which have exceedingly deeply divided lobes, such that they appear almost pinnatifid. It is also characterized by generally smaller fruits on more slender pedicels, and by primary ribs of the leaves being \pm terete. Populations from Santa Isabel have almost sessile fruits, with pseudofruits apparently on relatively short pedicels.

Some material from Santa Isabel and New Georgia, which have foliage similar to the nominate form, have inflorescences with short central secondary axes and subsessile fertile flowers.

Osmoxylon reburum (B. C. Stone) B. C. Stone *Gardens Bull. Singapore* **36**: 102 (1983).

Boerlagiodendron reburum B. C. Stone (1962).

Small tree, to 8 m high or more, sparingly branched; branches bristly-scaly. Leaves with petiole 30–45 cm long (stout, to 1.6 cm diameter), densely bristly-scaly, with pectinate crests almost encircling lower part of petiole. Lamina to 60 cm diameter, with 5–7 strong radiating ribs, 5–7-lobed; central lobes longer, to 60 \times 15 cm; base cordate; margin slightly lobed, coarsely serrate to dentate; apex subacute; lower surface densely and minutely puberulent, with larger bicellular bristly trichomes on nerves. Inflorescences furfuraceous to bristly-puberulent; primary axes numerous, caducous bracts (not seen); central secondary axis to 1.8 cm long, pseudofruits (c. 5 mm diameter), pedicel to 6–7 mm long; 2 lateral secondary axes shorter than central axis when immature, with 2 narrowly ovate bracts (c. 1 cm long) inserted near base, with flowers subsessile. Calyx rim obsolete, truncate. Corolla c. 4.5 mm long, tubular basally. Stamens 5 or 6. Ovary 9- or 10-locular; disc almost flat, raised in centre to 5 or 6 (–?10) elliptically arranged stylopodia. Fruits not seen.

Distribution: Endemic to the Malaita district, Solomon Islands. Only known from the type collection.

Ecology: Not known.

Notes: The above description is based on Stone (1962).

Osmoxylon rectibrachiatum Conn & Frodin, sp. nov.

Osmoxylon pseudofoliatum Conn et Frodin aemulans, sed differt foliis basi non divisis, axibus centrali-secundariis inflorescentiae brevibus (usque ad 0.4 cm nec 0.8–2 cm longis). **Holotype**: Papua New Guinea: Milne Bay (Losuia subdistrict): near Gusweta, *Gillison NGF 25284*, 1 Oct 1966 (K); iso (not seen): A, BRI, CANB, L, LAE.

Shrub to small tree, 3.5–13 m high, \pm branched or unbranched, glabrous. Leaves with petiole 25–50 cm long, slender to stout (mostly to 0.8 cm diameter, rarely to c. 1.4 cm), flattened to grooved above, with stipular ligule at 3–6 cm

long, and with irregular, almost smooth crests encircling lower part of petiole (crests \pm appressed). Lamina to 50 \times 60 cm, with 5–9 strong radiating ribs, with central lobes longer (to 30 cm long, to 20 cm wide) and often deeply lobed; base slightly cordate; margin \pm sparsely serrate; apex obtuse to slightly acuminate. Inflorescences with primary axes numerous, to 10 cm long, bearing boat-shaped caducous bracts (c. 6 mm long); central secondary axis subsessile to c. 0.4 cm long, bearing c. 10 pseudofruits (c. 5 mm diameter), pedicel 7–10 mm long; 2 lateral secondary axes c. 3.5–7 cm long, with 2 subopposite bracts inserted from middle to 2/3 from base (each subopposite bract sometimes distantly inserted); flowers sessile. Calyx rim obsolete, undulate, truncate. Corolla (in bud) tubular basally (tube to 4.5 mm long), distally 4- or 5-lobed. Stamens 10. Ovary 8–10(–?12)-locular; disc almost flat, raised in centre to 2 rows of 8–10(–?12) stylopodia. Fruits globose to slightly ellipsoid, 0.8–0.9 cm diameter

Field characters: Bole straight or crooked; girth 18–90 cm; bark soft, light brown, smooth; slash wood soft, light brown.

Distribution: Endemic to eastern Papuasia, occurring in the Trobriand Islands (Milne Bay district, Papua New Guinea) and possibly in the New Georgia and Santa Isabel districts of the Solomon Islands.

Ecology: Occurring in well-drained, coastal or near-coastal secondary and primary forests, at altitudes up to 35 m.

Vernacular names: 'Gwalifunu' (including spelling variants) (Kwara'ae) (refer to *O. puniceopolleniferum* for discussion of vernacular name).

Notes: This species is characterized by its very short central inflorescence secondary axis (which usually persists) and by its palmately lobed leaves which appear to usually lack secondary lobing.

The specimens from the Solomon Islands which have been included with this species may not be conspecific. More complete material is required before these populations can be fully evaluated.

The specific epithet ('rectibrachiatum') refers to the characteristically straight primary axes of the inflorescence.

Osmoxylon russellense (Philipson) B. C. Stone *Gardens Bull. Singapore* **36**: 102 (1983).

Boerlagiodendron russellense Philipson (1951) (as 'russellensis').

Shrub, to 3.5 m high, branches thick. Leaves glabrous; petiole at least 30 cm long, stout, with stipular ligule c. 5 \times 2.5 cm, and with spirally arranged, \pm appressed, pectinate crests near base of petiole. Lamina to 60 cm long, deeply 5-lobed; base cordate; lobes elliptic, 2-lobed with secondary lobes subacute; apex subacute. Inflorescences sparsely furfuraceous; primary axes 12, c. 5 cm long, caducous bracts (not seen); central secondary axes not known (caducous); 2 lateral secondary axes c. 5–6 cm long, with 2 opposite or subopposite bracts inserted near base; pedicel c. 10 mm long, c. 7-flowered, articulated near base. Flowers not known. Fruits depressed-globose, subcompressed, c. 0.9 \times 1.1 cm, c. 14-locular; stylopodia (presumably) 14, arranged in 2 lines.

Distribution: Endemic to the Russell Islands, Solomon Islands. Only known from the type collection.

Ecology: Occurring 'in deep jungle' (from type collection).

Notes: Description based on Philipson (1951) and photograph of type.

Osmoxylon spathipedunculatum (Philipson) Philipson *Blumea* **23**: 103 (1976) (refer text for synonymy, p. 27).

Tree to 20 m high, branches spreading, glabrous. Leaves with petiole to 14 cm long with a small clasping base bearing a stipular ligule and a rim-like crest around base of petiole. Lamina obovate 17–30 × 10–15 cm; base attenuate; margin entire, apex obtuse; midrib prominent, secondary veins arched and uniting, 15–20 mm apart. Inflorescences with primary axes *c.* 12, stout, compressed, 9–17 cm long; central secondary axis and sterile flowers unknown; 2 lateral secondary axes 9–14 cm long with an articulation 10–20 mm from base, bearing helmet-shaped bracts which fall to reveal the terminal head of *c.* 12 flowers sessile on an expanded receptacle with an involucre rim *c.* 10 mm diameter. Calyx rim obsolete. Corolla split in 5 lobes above, tubular below. Stamens 5. Ovaries subcylindric, ± 9-locular, disc raised in centre to pustulate stigmas. Drupes in a spherical head, globose, ± 12 mm diameter, *c.* 9-ribbed when dry, crowned with prominent persistent confluent stigmas.

Field characters: The simple paddle-shaped leaves are characteristic of this species.

Distribution: Endemic to the Bougainville (Papua New Guinea) and Guadalcanal (Solomon Islands) districts of Papuasias.

Ecology: In rain forest, from 800–1200 m altitude.

Osmoxylon striatifructum Conn & Frodin, sp. nov.

Foliis ut in *O. whitmorei* Conn et Frodin, sed differt cristis petioli paucioribus et pedicello florum longiore; fructu ut in *O. spathipedunculatum* (Philipson) Philipson, sed differt forma foliorum. **Holotype**: Solomon Islands: Guadalcanal: Monitor Creek, *Corner RSS 2111*, 9 Jul 1965 (K; 2 sheets).

Shrub to small treelet, 2.5–5 m high, unbranched. Leaves with petiole 23–26 cm long (slender, to 0.4 cm diameter), slightly flattened to grooved above, glabrous, with a few, ± appressed, small shortly pectinate crests (slightly spirally arranged) almost encircling near base of petiole. Lamina 35–39 × 27–45 cm, with 6 or 7 strong radiating ribs, 5- or 6-lobed; central lobes longer, 29–31 × 10–14 cm; base ± cordate; margin serrate; apex subacute to shortly acuminate; lower surface sparsely to moderately and minutely hairy, hairs straight to curled. Inflorescences densely and minutely hairy (as for lamina) (infructescence sparsely hairy or almost glabrous); primary axes *c.* 9, 5–14 cm long, bracts caducous (not seen); central secondary axis 3–3.5 cm long, bearing pseudofruits (*c.* 2.5–3 mm diameter), pedicel 15–20 mm long; 2 lateral secondary axes 5–9 cm long, with 2 subopposite caducous bracts (one inserted near base, other *c.* 1/2 way from base), with pedicels 10–20 mm long. Calyx rim obsolete, truncate. Corolla and stamens not known. Ovary 6- *c.* 11-locular; disc almost flat, raised in centre to 2 rows of 6–11 stylopodia. Fruits ellipsoid, 0.7–0.9 × 0.6–0.7 cm, 9–10-ribbed when dry, crowned with prominent persistent confluent stigmas.

Field characters: Bole crooked; girth c. 10 cm; buttresses absent; outer bark grey, scaly; inner bark greenish; wood soft.

Distribution: In the Solomon Islands it occurs in the Guadalcanal district and possibly in the Santa Cruz district (*BSIP 17122*), with one collection (*NGF 16688*) from the Morobe district (Papua New Guinea) seemingly conspecific.

Ecology: In near coastal, well-drained rain forest and riverine communities, at 33–230 m altitude.

Vernacular names: 'Gwalifunu' (including spelling variants) (Kwara'ae) (refer to *O. puniceopolleniferum* for discussion of vernacular name).

Notes: This species appears to be closely related to *O. whitmorei*, both having similar shaped leaves, but *O. striatifractum* has fewer petiolar crests with a less distinct pectinate margin than does the latter species. The fertile flowers of this species are distinctly pedicellate (pedicel 10–20 mm long) whereas those of *O. whitmorei* are only 1.5–3.5 mm long.

The specific epithet ('striatifractum') refers to the fruits being distinctly striate when dried.

***Osmoxylon superantiflorum* Conn & Frodin, sp. nov.**

O. chrysantho Conn et Frodin affinis, sed differt floribus subsessilibus, staminibus carpellisque pluribus. **Holotype:** Solomon Islands: Santa Isabel: Tatamba, *Henderson 263*, anno 1989 (K; 2 sheets).

Shrub or small tree, 3.5–10 m high, branches thick. Leaves with petiole 30–34 cm long, stout (0.7–1.4 cm diameter), flattened and grooved above, with stipular ligule c. 5 cm long, and with a few slightly spirally arranged, ± appressed, pectinate crests (often shortly so) encircling lower quarter of petiole. Lamina 37–60 × 60–120 cm, with 5–7 strong radiating ribs, 5–7-lobed; base cordate; lobes ± deeply 2–3-lobed; margin slightly serrate (often indistinctly so); apex subacute; lower surface moderately to densely hairy (slightly rough to touch), with golden-coloured curly hairs. Inflorescences moderately to densely hairy with golden-coloured, ± appressed to spreading, curled hairs (appearing furfuraecous)(note: infructescence sparsely hairy or glabrous); primary axes 11–13, 5–15 cm long, caducous bracts (not seen); central secondary axes 1.2–2 cm long, pseudofruits c. 8–14, pedicel 5–10 mm long; 2 lateral secondary axes 3–4.2 cm long (4–6.5 cm long in fruit), with 2 opposite or subopposite bracts inserted up to 1/3 way from base; pedicel to 3 mm long, 20–30-flowered, articulated near base. Calyx rim obsolete, undulate, truncate. Corolla obovoid (in bud), 5–6 mm long (immature). Stamens 14. Ovary 14-locular; disc raised in centre to 2 rows of 14 stylopodia. Fruits subglobular, slightly compressed laterally, 0.7–0.9 cm diameter, c. 14-locular.

Field characters: Bole straight or crooked, 8–9 m long; d.b.h. 10–20 cm; girth 10–11 cm; bark smooth or dipped, light brown to yellow-brown; wood usually soft, light brown.

Distribution: Endemic to the Solomon Islands, occurring in the New Georgia, Santa Isabel and Guadalcanal districts.

Ecology: Occurring in near-coastal, well-drained secondary forest and old garden sites, at low altitudes.

Vernacular name: 'Ngwalihunu Gwane' (Kwara'ae) ('Ngwalihunu' is regarded as an orthographic variant of 'Gwalifunu') (note: same name used for *O. arrhenicum*) (refer to *O. puniceopolleniferum* for discussion of vernacular name).

Notes: The specific epithet ('superantiflorum') refers to the relatively long lateral secondary axes of the inflorescence which result in the fertile flowers overtopping the central pseudofruits of each triad.

Osmoxylon tetrandrum (F. S. Walker ex C. T. White) B. C. Stone *Gardens Bull. Singapore* 36: 101 (1983).

Boerlagiodendron tetrandrum F. S. Walker ex C. T. White (1950).

Small tree, 6–13 m high (extent of branching not known), glabrous. Leaves with petiole (7–)10–20(–28) cm long, slender (c. 0.2–0.4 cm diameter), ± terete, with stipular ligule at least 1–2 cm long, and with one ± smooth (unfringed) crest encircling base of petiole. Lamina 10.5–24 × 8.5–21 cm, 3–5-lobed, with 5–7 fine radiating ribs; base truncate or subcordate, with central lobe longer (7–12.5 cm long, 6.5–13 cm wide), or rarely reduced, ovate (especially below inflorescence), and slightly lobed to almost entire; margin mucronate-serrate; lobes with apex subacute. Inflorescences with primary axes to at least 30, 5–9 cm long, striate and minutely rugulose-scabrous, caducous bracts (not seen); central secondary axis reduced, pseudofruits > 5 (?12), c. 5 mm diameter, pedicel c. 8–10 mm long; 2 lateral secondary axes c. 3.5–6 cm long, with c. 20 flowers, caducous bracts inserted at apex (not inserted along axes); pedicel c. 4–10 mm long. Calyx rim obsolete, undulate, truncate. Corolla c. 3 mm long, tubular basally, distally 4-lobed. Stamens 4, exserted. Ovary (6-)7- or 8-locular; disc almost flat, raised in centre to usually 7 or 8 hemispherically arranged stylopodia. Fruits globose to ovoid, 0.4–0.5 cm diameter

Field characters: Buttresses sometimes present; bole often crooked; d.b.h. 45 cm; girth 1.5–2 m; bark yellowish grey-brown, generally smooth, with slight longitudinal lenticular ridging; slash pale, yellowish brown; wood pale straw-coloured to light brown, soft.

Distribution: Endemic to the Solomon Islands, occurring in Choiseul, Santa Isabel, New Georgia and San Cristobal districts.

Ecology: Occurring in well-drained coastal and near-coastal forests, from near sea level to 330 m altitude.

Osmoxylon whitmorei Conn & Frodin, sp. nov.

Cristis petioli et serraturis foliorum ut in *O. reburum* B. C. Stone, sed differt indumento non setoso, numero staminum carpellorumque. **Holotype**: Solomon Islands: Guadalcanal: Tina River, c. 12 miles inland from coast, *Womersley & Whitmore BSIP 1153*, 14 Nov 1962 (K).

Small tree, to 7 m high, branching arrangement not known. Leaves with petiole c. 32 cm long (slender, to 0.6 cm diameter), grooved above, moderately to densely hairy (hairs not persistent), with hairs curled and ± appressed to spreading, with numerous strongly pectinate crests almost encircling near base of peti-

ole. Lamina with 4 or ?5 strong radiating ribs, 4- or ?5-lobed; central lobes longer, to 34×12 cm; base slightly cuneate; margin \pm coarsely serrate to dentate; apex rounded; lower surface densely and minutely hairy (appearing furfuraceous, as for petiole). Inflorescences densely and minutely hairy (as for petiole); primary axes c. 10, to 3.2–5.2 cm long, caducous bracts at base (not seen); central secondary axis 1–1.2 cm long, pseudofruits c. 1.5 mm diameter, pedicel to 7–8 mm long; 2 lateral secondary axes 0.9–1.5 cm long, with 2 caducous bracts inserted at base (not seen), pedicels 1.5–3.5 mm long. Calyx rim obsolete, truncate. Corolla c. 2 mm long (immature), obovoid (buds), tubular basally. Stamens c. 12. Ovary c. 12-locular; disc almost flat, raised in centre to c. 12 elliptically arranged stylopodia. Fruits not seen.

Distribution: Endemic to the Guadalcanal district, Solomon Islands. Only known from the type collection.

Ecology: In near coastal rain forest, at c. 200 m altitude.

Notes: This species appears to be closely related to *O. reburrum*, both having distinctly pectinate petiolar crests and serrate leaves. However, this species lacks the bristly-scaly indumentum of *O. reburrum*, and has c. 12 stamens and ovary locules, whereas the latter has 5 or 6 stamens a 9- or 10-locular ovary.

This species is named after T. C. Whitmore in acknowledgement of his outstanding contributions to our understanding of the flora of the Solomon Islands, and also because he jointly collected the type material of this new species.

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