

TREE FLORA of SABAH AND SARAWAK

Volume Four

edited by
E. Soepadmo, L.G. Saw and R.C.K. Chung



Government of Malaysia

TREE FLORA
of
SABAH AND SARAWAK

Produced with the financial support of



GOVERNMENT OF MALAYSIA

Tree Flora of Sabah and Sarawak Editorial Committee — Chairman: *E. Soepadmo* (Forest Research Institute Malaysia). Members: *A. Latiff* (Universiti Kebangsaan Malaysia), *Ruth Kiew* (Singapore Botanic Gardens), *H.S. Lee* (Sarawak Forestry Department), *L.G. Saw* (Forest Research Institute Malaysia), *R.C.K. Chung* (Forest Research Institute Malaysia). ***Advisors:*** *P.S. Ashton* (Harvard University, U.S.A.), *J. Dransfield* (Royal Botanic Gardens, Kew, U.K.), *T.C. Whitmore* (University of Cambridge, U.K.), *W.J.J.O. de Wilde* (National Herbarium of the Netherlands, Leiden Branch, the Netherlands).

TREE FLORA of SABAH AND SARAWAK

Volume Four

edited by

E. Soepadmo, L. G. Saw and R.C.K. Chung

A joint publication of



Sabah Forestry
Department, Malaysia



Forest Research
Institute Malaysia



Sarawak Forestry
Department, Malaysia

2002

Copyright © Forest Research Institute Malaysia (FRIM)
Sabah Forestry Department, Malaysia
Sarawak Forestry Department, Malaysia

Correspondence:

Forest Research Institute Malaysia (FRIM), Kepong, 52109 Kuala Lumpur, Malaysia

First published 30 April 2002

Perpustakaan Negara Malaysia Data Pengkatalogan-dalam-Penerbitan

Tree Flora of Sabah and Sarawak / edited by E. Soepadmo, L.G. Saw and
R.C.K. Chung

Includes Index

ISBN 983-2181-27-5 (Vol. 4)

1. Botany–Sabah. 2. Botany–Sarawak. 3. Botany–Classification.
4. Plant–Identification. I. Soepadmo, E., II. Saw, L.G., III. Chung, R.C.K.
581.095952

Front cover: Lowland and hill forests on ultramafic soil, Bt. Tawai FR, Sabah. (Photograph
by E. Soepadmo.)

Back cover: *Koompassia excelsa* (Becc.) Taub. with new growth. (Photograph by
E. Soepadmo.)

CONTENTS

	<i>Page</i>
Foreword	vii
Acknowledgements	ix
Dedication	xi
FAMILIES:	
1. Aquifoliaceae (<i>Susyn Andrews</i>)	1
2. Ebenaceae (<i>Francis S.P. Ng</i>)	29
3. Lecythidaceae (<i>Michelle A. Pinard</i>)	101
4. Oleaceae (<i>Ruth Kiew</i>)	129
5. Proteaceae (<i>R.C.K. Chung</i>)	169
6. Sapotaceae (<i>P.P.K. Chai & P.C. Yii</i>)	203
<i>Aulandra</i> H.J.Lam (<i>M. Mohizah</i>)	206
<i>Chrysophyllum</i> L. (<i>L.C.J. Julaihi</i>)	208
<i>Diploknema</i> Pierre (<i>M. Mohizah</i>)	211
<i>Eberhardtia</i> Lecomte (<i>P.C. Yii & P.P.K. Chai</i>)	215
<i>Isonandra</i> Wight (<i>L.C.J. Julaihi</i>)	216
<i>Madhuca</i> Buch.-Ham. ex J.F. Gmelin (<i>P.C. Yii & P.P.K. Chai</i>)	221
<i>Mimusops</i> L. (<i>L.C.J. Julaihi</i>)	269
<i>Palaquium</i> Blanco (<i>A.P. Abang Mohd. Mohtar</i>)	271
<i>Payena</i> A.DC. (<i>J.T. Pereira</i>)	312
<i>Pouteria</i> Aublet (<i>Stephen P. Teo</i>)	329
<i>Sarcosperma</i> Hook.f. (<i>A. Noorsiha</i>)	343
Appendix: New Taxa, Taxonomic Status and Combinations	347
Abbreviations of Frequently Cited References	353
Commonly Used Abbreviations for Localities	357
Index to Scientific Names	359
Index to Vernacular Names	383

FOREWORD

The appearance of *Tree Flora of Sabah and Sarawak* Volume 4, about one and a half years after the publication of the third volume in August 2000, is indeed a good sign that the project is progressing well. Particularly gratifying is the involvement of a number of local botanists attached to the Forest Research Institute Malaysia (FRIM) and the Forestry Departments of Sabah and Sarawak. We are most happy to note that this volume includes accounts of a number of families for which there is no recent regional revision. We believe that this is the fruit of various training courses organised by the *Tree Flora of Sabah and Sarawak Project* for the local botanists to tackle some of the more difficult families. The benefits of such training have gone beyond the *Tree Flora of Sabah and Sarawak Project*. Many of these botanists are now actively contributing to other regional projects, such as the *PROSEA* and *Guide to Brunei Trees Projects*. We shall continue to support the efforts by the team and hope that such active participation of both local and regional botanists in the projects can be sustained.

This volume contains accounts of six medium-sized and large families contributed by different authors. These are: Aquifoliaceae by Susyn Andrews of the Royal Botanic Gardens, Kew; Ebenaceae by Francis S.P. Ng of FRIM; Lecythidaceae by Michelle A. Pinard of the University of Aberdeen; Oleaceae by Ruth Kiew of the Singapore Botanic Gardens; Proteaceae by R.C.K. Chung of FRIM; and Sapotaceae by P.P.K. Chai and P.C. Yii, with contributions by A.P. Abang Mohd. Mohtar, L.C.J. Julaihi, M. Mohizah, A. Noorsiha, J.T. Pereira, and Stephen P. Teo of FRIM, Forestry Department of Sabah and Forestry Department of Sarawak. Of these, only the Proteaceae had been revised by Sleumer in 1955 (*Flora Malesiana* 1, 5). More significantly, members of the Ebenaceae and Sapotaceae are important sources of tropical timbers for Sabah and Sarawak. This volume provides detailed and up-to-date botanical information on 24 genera and 321 species supplemented with 64 line drawings of representative species. It has also made many new discoveries and given us better understanding of the diversity of tree species in Borneo. Among some of the findings are: 45 species (or about 14%) are new to science, 149 (or about 46.5%) are endemic to Borneo, 69 (or about 21.5%) are endemic to Sabah and/or Sarawak, and 45 (or about 14%) are rare species, i.e., known only by one or two collections or confined to specific habitats or with their distribution limited to one or two localities in Sabah and Sarawak.

Results published in this volume, demonstrate once again that continuous effort and well coordinated research on the *Tree Flora of Sabah and Sarawak* will yield valuable information pertaining to the species diversity, distribution and conservation status of tree resources of Sabah and Sarawak. In conjunction with similar studies carried out in Central and East Kalimantan (Kessler & Sidiyasa, 1994; Argent *et al.*, 1997), Brunei Darussalam (Coode *et al.*, 1996) and Mount Kinabalu Sabah (Beaman *et al.*, 2001), the continuation and completion of the *Tree Flora of Sabah and Sarawak Project* is of vital importance to our understanding of the biological diversity of the species-rich Borneo Island. To achieve such a goal, there is a need for closer collaboration between botanists and botanical institutions in the region as well as at international level. It is well known that while most of the biological diversity of the world is located in the tropics, the expertise and adequate facilities (herbaria, libraries and museums) are

largely concentrated in extra-tropical countries. Compounding this problem is the fact that in a developing country such as Malaysia, the area of species-rich natural forest is declining rapidly, and funding for basic botanical research is often not readily forthcoming. In this context, we are deeply indebted to the Malaysian Federal Government, the State Governments of Sabah and Sarawak, and the Malaysian Forestry Research and Development Board for the research grants for the 2000–2001 fiscal year. Without such a grant, the preparation and publication of the *Tree Flora of Sabah and Sarawak* Volume 4 would not have been possible.

We are very much obliged to the Directors/Heads of various national and international botanical institutions for their invaluable help and co-operation, and to members of the Editorial Advisory Committee for making the publication of *Tree Flora of Sabah and Sarawak* Volume 4 a reality. We would like to take this opportunity to congratulate the editors of this volume for their hard work and dedication, and to express our deepest appreciation to the botanists and botanical artists for a job well done. Finally, we are also very grateful to a number of staff of the Forest Research Institute Malaysia and the Forestry Departments of Sabah and Sarawak for their continuous assistance and support.

Dato' Dr. Abdul Razak Mohd. Ali

*Director-General
Forest Research Institute Malaysia*

Mr. Daniel Khiong Kok Sin

*Director
Sabah Forestry Department
Malaysia*

Mr. Cheong Ek Choon

*Director
Sarawak Forestry Department
Malaysia*

January 2002

ACKNOWLEDGEMENTS

Once again, it gives us great pleasure to acknowledge the help and co-operation rendered by various institutions and individuals in the course of the preparation and publication of the *Tree Flora of Sabah and Sarawak* volume 4. In particular, we are deeply indebted to the Federal Government of Malaysia as well as to the State Governments of Sabah and Sarawak for the much needed research grants. Tan Sri G.K. Rama Iyer and Datuk Lim Chong Keat, the former and current Chairman of the Malaysian Forestry Research and Development Board; Dato' Dr. Abdul Razak Mohd. Ali, Director-General of the Forest Research Institute Malaysia; Mr. Daniel Khiong Kok Sin, Director of the Sabah Forestry Department, and Mr. Cheong Ek Choon, Director of the Sarawak Forestry Department have provided guidance, leadership and encouragement to the project.

The Directors/Keepers/Curators of the Herbarium Bogoriense (BO), Herbarium, Department of Botany, the British Natural History Museum, London (BM), Herbarium of the Royal Botanic Gardens, Kew (K), Herbier, Laboratoire de Phaneorgamie, Museum National de'Histoire Naturelle, Paris (P), Herbarium, Forestry Department, Bandar Seri Begawan, Brunei Darussalam (BRUN), Herbarium of the Forest Research Institute Malaysia (KEP), National Herbarium of the Netherlands, Leiden Branch (L), Herbarium of the Forestry Department of Sabah (SAN), Herbarium of the Forestry Department of Sarawak (SAR), Herbarium of the Singapore Botanic Gardens (SING), and a few others have generously given permission to the project botanists to obtain information and services available at their institutions, and facilitated loans of specimens.

Prof. P.S. Ashton (Harvard University, U.S.A.), Dr. J. Dransfield (Royal Botanic Gardens, Kew, U.K.), Dr. T.C. Whitmore (University of Cambridge, U.K.), and Dr. W.J.J.O. de Wilde (National Herbarium of the Netherlands, Leiden Branch, the Netherlands) provided valuable advice and guidance on various editorial matters. Dr. J.F. Veldkamp (National Herbarium of the Netherlands, Leiden Branch), Mr. M.J.E. Coode (Herbarium of the Royal Botanic Gardens, Kew) and Prof. Christian Puff (University of Vienna, Austria) kindly provided Latin diagnoses of new taxa of *Chionanthus* (Oleaceae), *Diospyros* (Ebenaceae), *Helicia* and *Heliciopsis* (Proteaceae), and *Madhuca* and *Payena* (Sapotaceae) published elsewhere. We are extremely grateful to Dr. W. Vink (National Herbarium of the Netherlands, Leiden Branch) for his critical and constructive comments on the manuscript of the Sapotaceae.

We gratefully acknowledge the help, support and encouragement from Prof. P. Baas and Dr. Marco Roos (National Herbarium of the Netherlands, Leiden Branch), Dr. P. Bacon (Oxford Forestry Institute, University of Oxford, U.K.), Prof. Abdul Latiff Mohamad (Universiti Kebangsaan Malaysia), Dr. H.S. Lee (Sarawak Forestry Department), Dr. Sining Unchi and Mr. Robert Ong (Sabah Forestry Department), and Dr. S.C. Chin and Dr. Ruth Kiew (Singapore Botanic Gardens).

At home institutions, we would like to express our appreciation to many who have given support and encouragement; they are, at Kepong: Dato' Dr. Wan Razali Wan Mohd., Dr. N. Manokaran, Dr. Abdul Rahim Nik, Dr. H.T. Chan, Dr. Francis S.P. Ng, Dr. Lillian S.L. Chua, Ms. Noorsiha Ayop, Mr. Mat Asri Ngah Sanah, Mr. Kamarudin Saleh, Mr. Damahuri Sabari, Mrs. Zainun

Othman, Mrs. Asnah Hashim, and Mrs. Saripah Barom; in Sabah: Mrs. J.T. Pereira, Mr. J.B. Sugau, Mr. S.P. Lim, Mr. Leopold Madani, and Mr. Dewol Sundaling; and in Sarawak: Ms. Lucy Chong, Dr. Paul P.K. Chai, Mr. P.C. Yii, Mr. A.P. Abang Mohd. Mohtar, Mrs. Runi S. Pungga, Mr. L.C.J. Julaihi, Mr. Stephen P. Teo, and Ms. Mohizah Mohamad.

Finally, we would like to record our deepest gratitude to Ms. Rosemary Wise (Oxford Forestry Institute), Mr. Joseph Pao (Sarawak Forestry Department), Mr. Mohd. Nizam Isa (Universiti Kebangsaan Malaysia), Madam Yap Pak Hau (Sabah Forestry Department), and Mr. Zainal Mustafa (University of Malaya) for meticulously preparing the illustrations, and to congratulate as well as to thank the botanists for their excellent contributions.

January 2002

E. Soepadmo
L.G. Saw
R.C.K. Chung

DEDICATION

Timothy Charles Whitmore
(9th June 1935–14th February 2002)

This volume is respectfully dedicated to the memory of Timothy Charles Whitmore whose exemplary initiative, drive and dedication towards the *Tree Flora of Malaya* project had greatly inspired the current work on the *Tree Flora of Sabah and Sarawak*. At the age of 66 years, Tim passed away peacefully on the 14th February 2002 in Cambridge, United Kingdom. We, the botanical community in Malaysia, are deeply indebted to his invaluable contribution towards the advancement of botanical and ecological knowledge of tropical rain forest of the Malesian region.

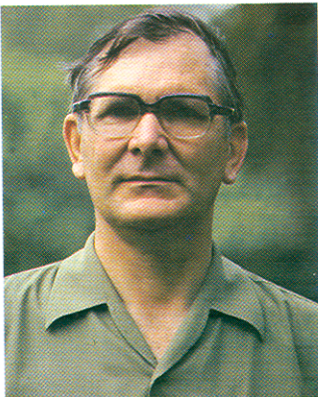
Kuala Lumpur
27th February 2002

E. Soepadmo
L.G. Saw
R.C.K.Chung

Tim Whitmore and the Tree Flora of Malaya

Tim was funded by the British Government under the Colombo Plan assistance programme to initiate the *Tree Flora of Malaya* and to train Malaysian counterparts in botanical research. Tim worked a total of 6 years on the Tree Flora Project, beginning in September 1965, and producing the first two volumes.

Originally the Tree Flora was to be called the *Forester's Manual of Non-Dipterocarps*, to complement C.F. Symington's *Forester's Manual of Dipterocarps* (published during the Japanese Occupation of Malaya). Tim calculated that the 'non-dipterocarp' manuals would be four times as voluminous as the dipterocarp manual and deserved a more positive title. After persuading the Forest Department to accept the title "*Tree Flora of Malaya*" he next persuaded the Department to have the book published commercially, by an international publisher, Longman. This was an unheard-of arrangement at that time, but Tim was very persuasive. As a result, the *Tree Flora of Malaya* did not cost the Government any money to print, was stocked by bookshops in Malaysia and overseas through three print runs, and paid a 10% royalty to Government every year.



Tim also broke new ground in visualising the *Tree Flora of Malaya* as a multi-author work, which meant getting K.M. Kochummen and myself trained for the work, and persuading other botanists elsewhere to contribute chapters.

In the 1960s, many parts of Peninsular Malaysia were just becoming accessible through the construction of new roads, so one of Tim's priorities was to organise a big plant collection effort, concentrating on new areas that had not been collected before. The plant collecting team was expanded by the recruitment of youngsters from the Orang Asli aboriginal community at Bukit Lanjan. Tim, Kochummen and I spent about a week every month collecting in the field. The revision of families for Volume 1 was begun immediately, based on materials available at Kepong and Singapore.

The *Tree Flora of Malaya* remains unique in being one of the few post-colonial floras to have been completed. Its completion was a tribute to the way in which Tim organised the work, put his reputation on the line, and set the precedents.

Tim, Wendy, and their children were housed in a big colonial bungalow (FD 15) at the far end of the arboretum of the Forest Research Institute in Kepong. The bungalow is now a nature study centre.

Tim was a big man with a booming voice and a ready laugh. He worked hard. Often, I would give him a paper to read, and he would promise to read it "at lunchtime". Sure enough, he would be ready to discuss it after lunch. Tim was highly disciplined, but he made tropical botany interesting rather than intimidating, following the tradition of Corner and Holttum, whom he joins in the gallery of illustrious British-Malayan botanists.

Kuala Lumpur
27th February 2002

Francis S.P.

AQUIFOLIACEAE

Susyn Andrews

Royal Botanic Gardens, Kew,
England, United Kingdom

Miquel, Fl. Ned. Ind. 1, 2 (1859) 593; Hooker *f.*, Fl. Brit. Ind. 1 (1875) 598; King, J. As. Soc. Beng. 64, 2 (1895) 133; Loesener, Monog. Aquifol. 1 (1901) 5; Ridley, FMP 1 (1922) 437; Browne, FTSB (1955) 200; Backer & Bakhuizen *f.*, FJ 2 (1965) 51; Meijer, Bot. News Bull. Herb. For. Dept. 9 (1967) 89; Kiew, TFM 3 (1978) 1; Anderson, CLTS (1980) 150; Mabberley, PB (1987) 18; Corner, WSTM 3rd. edition 1 (1988) 162; Keng, Conc. Fl. Sing. (1990) 114; Turner, Gard. Bull. Sing. 47 (1995) 131; Coode *et al.* (eds.), CLBD (1996) 30; Argent *et al.* (eds.), MNDDT-CK (1997) 85; Beaman *et al.*, PMK 4 (2001) 114.

Trees, shrubs, rarely climbers, evergreen or less often deciduous. **Stipules** minute, caducous. **Leaves** simple, alternate, rarely opposite or subopposite, coriaceous to chartaceous, punctate or epunctate beneath, margins entire, serrate or serrulate, rarely crenate. **Inflorescences** axillary, cymose, spicate, racemose, fasciculate or flowers solitary. **Flowers** small, radially symmetrical, unisexual (plants dioecious); sepals 4–6 (rarely more), fused at base, rarely free, persistent or semideciduous; petals (3–)4–8(–23) imbricate, fused at base or rarely free; stamens usually the same number as petals, alternate and slightly adherent to petals or free, anthers introrsely and longitudinally dehiscent; disk absent; ovary superior, 4–6(–23)-loculed, style short or absent, stigma capitate, mammiform or discoid, rarely cristate, ovules 1(–2) per locule, pendent from the apex. **Fruit** a berry-like drupe containing 1–12(–23) pyrenes (nutlets). **Seeds** pendulous surrounded by a stony endocarp; endosperm abundant, fleshy; embryo minute and straight.

Distribution. One genus, *Ilex*, with over 400 species and a discontinuous cosmopolitan distribution. Another genus, *Nemopanthus* Raf., has recently been reduced to synonymy of *Ilex* (Powell *et al.*, Kew Bull. 55 (2000) 341).

Ecology. From sea level including mangrove and peat swamp to montane forests, at altitudes to 3500 m.

Uses. Many *Ilex* taxa are of horticultural importance and are widely grown in parks and gardens for their foliage and decorative fruits. There are some 60 species whose leaves are used for beverages and the most widely known is *I. paraguariensis* J.St.-Hil., native to Argentina, Paraguay, Uruguay, and Brazil. Many species are used medicinally, while the wood is of local importance.

Taxonomy. A monograph of the Aquifoliaceae was written by Loesener *l.c.* (1901). Three small genera *Phelline* Labill., *Sphenostemon* Baill. and *Oncotheca* Baill. were once included in the Aquifoliaceae but they are now considered as separate families.

ILEX L.

(from the Latin name for the holm oak, *Quercus ilex* L.)

kerdam (preferred name), *kuku nglipan* (Iban), *peka* (Kayan),
sapo (Bidayuh, Bau), *sulau kelap* (Kenyah), *topu* (Bidayuh, Padawan)

Sp. Pl. 1 (1753) 125; Miquel, Fl. Ned. Ind. 1, 2 (1859) 594; Hooker *f.*, Fl. Brit. Ind. 1 (1875) 598; King, J. As. Soc. Beng. 64, 2 (1895) 133; Loesener, Monog. Aquifol. 1 (1901) 8; Backer & Bakhuizen *f.*, FJ 2 (1965) 52; Anderson, Trees Peat Swamp Forests (1972) 25, CLTS (1980) 150; Kiew, TFM 3 (1978) 1; Mabberley, PB (1987) 290; Coode *et al.* (eds.), CLBD (1996) 30; Argent *et al.* (eds.), MNDT-CK (1997) 85; Beaman *et al.*, PMK 4 (2001) 114.

Trees, erect or scandent shrubs, rarely climbers or epiphytes. **Leaves** evergreen, rarely deciduous, alternate, rarely opposite or subopposite. Sepals fused at base, persistent; petals imbricate and fused at base; stamens slightly adherent to corolla. Other foliage, floral, fruit and seed characters as for the family.

Distribution. There are some 120 species of *Ilex* known from South East Asia, with 35 species presently recorded from Sabah and Sarawak.

Ecology. As for the family.

Uses. A limited number of *Ilex* species furnish timber for local industry. A few species are used medicinally, while none of the SE Asian taxa are used horticulturally.

Key to *Ilex* species

1. Leaves subopposite or opposite. 2
Leaves alternate. 5
2. Leaves punctate below, base attenuate or cuneate, apex emarginate or retuse.
Inflorescences racemose or spicate. 3
Leaves epunctate below, base subcordate, cordate to amplexicaul, apex acute or mucronate.
Inflorescences in compound cymes. 4
3. Twigs glabrous, dark brown. Leaves bullate, spatulate or obovate, 6–7.5 × 3–5 cm,
base attenuate, apex emarginate; lateral veins 6–8 pairs; petiole glabrous, 0.7–0.8 cm
long. Inflorescences spicate. **14. I. mesilauensis**
Twigs puberulous, greyish brown. Leaves not bullate, obovate or oblong-ovate, 3.5–6.5
× 2–4.5 cm, base cuneate, apex retuse; lateral veins 3–5 pairs; petiole puberulous, *c.*
0.2 cm long. Inflorescences racemose. **17. I. orestes** (in part)
4. Leaves sessile, broadly elliptic to oblong-elliptic or broadly ovate, (4.5–)7–16(–20) × (3–
)5–8.5(–10.5) cm, base cordate to amplexicaul. **16. I. oppositifolia**
Leaves with petiole 0.2–0.7 cm long, ovate, obovate or elliptic, (1.5–)4–7 × 1.5–4.5
(–5) cm, base subcordate. **22. I. zygophylla**

5. Leaves sessile or subsessile. 6
 Leaves petiolate. 7
6. Terrestrial shrubs to 2.5 m tall. Leaves thickly coriaceous, epunctate below, apex acute. Inflorescences in axillary compound cymes.
- I. laurocerasus** Airy Shaw
 (Latin, *laurus* = laurel, *cerasus* = cherry tree; with leaves like those of *Laurus*, and fruits resembling cherry)
 Bull. Misc. Info., Kew 9 (1939) 509; Masamune, EPB (1942) 415; Anderson *l.c.* (1980) 151; Coode *et al.* (eds.) *l.c.* 30. Type: *Native Collector 1939*, Borneo, Sarawak, Ulu Koyan (holotype K; isotype S).
Terrestrial shrub to 2.5 m tall. Leaves alternate, thickly coriaceous, glossy and glabrous above, dull brown below when dried, epunctate below, subsessile; broadly oblong-elliptic, 12–21 × 5.5–9 cm, base rounded or cordate, margin entire, somewhat revolute, apex acute; petiole glabrous. Inflorescences puberulous, in axillary compound cymes. Male flowers 4–5-merous, white; female flowers and fruits not seen.
 Found in forest on sandy soils. Endemic to Borneo. In Sarawak, recorded only from Ulu Koyan (*Native Collector 1939*). Also found in Brunei (e.g., *BRUN 1175* and *BRUN 1280*).
- Epiphytes. Leaves coriaceous, punctate below, apex acuminate. Inflorescences or infructescences spicate.....
- I. apiensis** S.Andrews
 (of G. Api, Sarawak)
 Sandakania 11 (1998) 1. Type: *Anderson S 29878*, Borneo, Sarawak, G. Api (holotype SAR; isotypes A, E, K, L, SING).
Epiphyte. Leaves alternate, coriaceous, glabrous and dull brown when dried, punctate below, sessile; oblong to broadly oblong, 10–15 × 6–8 cm, base rounded or cordate, margin entire, apex acuminate. Inflorescences unknown. Infructescences glabrous, spicate. Fruits (immature) globose, pubescent, c. 4.5 mm in diameter, green ripening to purple-red; pyrenes 5, round and lineate.
 Found in primary forest on limestone hills. Endemic to Borneo; recorded only from G. Api in Sarawak (*S 29878*). Previously identified as *Ilex* sp. 10 in many herbaria.
7. Leaves subchartaceous to chartaceous.....8
 Leaves subcoriaceous to thickly coriaceous.....10
8. Leaves epunctate and somewhat glaucous below, base obtuse; petiole glabrous. Inflorescences in lax compound cymes. Fruits always ribbed when dried; pyrenes 8–10, deeply sulcate..... **5. I. cymosa**
 Leaves punctate and not glaucous below, base acute, rounded or cordate; petiole puberulous or pubescent. Inflorescences in fascicles or few-flowered cymes or spicate. Fruits not ribbed when dried; pyrenes 5–8, shallowly sulcate or striate.....9
9. Twigs glabrous. Leaves elliptic or lanceolate, 6–9.2 × 2–3.4 cm, base acute, apex caudate and obtuse; petiole 0.5–0.8 cm long. Inflorescences in fascicles or few-flowered cymes. Fruits 4–4.5 mm diameter.....**3. I. celebensis**
 Twigs pubescent. Leaves ovate-elliptic to ovate-oblong, 7–15 × 3–5 cm, base rounded

- or cordate, apex acuminate; petiole 0.8–1.3 cm long. Inflorescences spicate. Fruits 2–2.5 mm diameter..... **4. I. cissoidea**
10. Leaves epunctate below..... 11
 Leaves punctate below or on both surfaces..... 17
11. Leaves larger, 19–35 × 5.5–13 cm. Inflorescences in axillary compound cymes.....
 **13. I. megaphylla**
 Leaves smaller, 5–16(–20) × 3–9.5 cm. Inflorescences or infructescences cymose or
 spicate..... 12
12. Leaf apex long-acuminate..... **9. I. jacobsii**
 Leaf apex acute, obtuse, mucronate, retuse or acuminate..... 13
13. Inflorescences or infructescences spicate..... 14
 Inflorescences or infructescences cymose..... 15
14. Epiphyte. Leaves broadly oblong, apex acuminate; petiole *c.* 0.3 cm long. Fruits *c.* 4 mm
 diameter.....
I. ijuensis S. Andrews
 (of Bt. Iju, Sarawak)
 Sandakania 11 (1998) 4. Type: *Kudi S 23783*, Borneo, Sarawak, Bt. Iju (holotype SAR; isotypes
 A, BO, CGE, K, L, MEL, MOSC, SAN, SING).
*Epiphyte. Leaves alternate, coriaceous, glossy and glabrous, epunctate below; broadly
 oblong, 14–15 × 4.5–7 cm, base shortly attenuate, margin entire, apex acuminate; petiole
 glabrous, c. 0.3 cm long. Inflorescences unknown. Infructescences pubescent, spicate.
 Fruits (immature) ovoid, c. 4 mm diameter; pyrenes 4–5, deeply sulcate, glossy.*
 Endemic to Borneo; recorded only from Bt. Iju, Balingian in Sarawak (*S 23783*).
 Previously identified as *Ilex* sp. 9 in many herbaria.
- Climber. Leaves elliptic-lanceolate, ovate or broadly oblong, apex obtuse; petiole 0.6–0.8 cm
 long. Fruits *c.* 2 mm diameter.....
I. stapfiana Loes.
 (O. Stapf, 1857–1933, Austrian botanist, sometimes Keeper of the herbarium, Royal
 Botanic Gardens, Kew)
 Monogr. Aquifol. 1 (1901) 431; Merrill, EB (1921) 353; Masamune *l.c.* 417; Anderson *l.c.* (1980)
 151; Coode *et al.* (eds.) *l.c.* 30. Type: *Haviland & Hose 3357*, Borneo, Sarawak (holotype B†;
 isotypes K, L, SAR).
*Glabrous climber. Leaves alternate, coriaceous, epunctate below; elliptic-lanceolate,
 ovate or broadly oblong, 7.5–16 × 3–6 cm, base attenuate, margin entire, apex obtuse
 with acumen; petiole 0.6–0.8 cm long. Inflorescences spicate. Flowers yellow, 4-merous.
 Fruits ovoid, c. 2 mm diameter, dark red; pyrenes 8–11, smooth.*
 In hillsides and forest ridges on sandy clay soils. Endemic to Borneo and known from
 Sarawak (e.g., *Haviland 2279, Haviland 3357, S 13654, S 33549, and S 36837*), Brunei
 (e.g., *SAN 17390*) and Kalimantan (e.g., *Hallier 690, Shea 20648 and Shea 26711*).
15. Leaf base cuneate. Inflorescences (primary peduncles) glabrous. Fruits 8.5–9.5 mm
 diameter..... **21. I. wallichii**
 Leaf base attenuate or truncate. Inflorescences pubescent. Fruits 4.5–7 mm diameter.....
 16

16. Twigs glabrous. Leaves 6–9 × 3–4.5 cm, apex shortly acute, rarely retuse; petiole glabrous, 0.5–0.8 cm long..... **1. I. beccariana**
Twigs pubescent. Leaves (9–)11.5–20 × (4–)5.5–9.5 cm, apex acute or acuminate; petiole pubescent, rarely glabrous, 0.7–1.2 cm long..... **11. I. macrophylla**
17. Leaves smaller, 1–6.5(–9.7) × 0.2–4.5 cm.....18
Leaves larger, 4–20(–22.5) × 2–10 cm.....23
18. Leaf margin entire.....19
Leaf margin undulate with a few spines or revolute with several small teeth or serrate on upper half only or crenate or serrate throughout.....21
19. Leaves bullate, apex bluntly acuminate. Inflorescences or infructescences spicate.....
I. fruticosa S.Andrews
(Latin, *fruticosus* = shrubby; the habit)
Sandakania 11 (1998) 4. Type: *Ilex* S 26571, Borneo, Sarawak, Bt. Salong, Ulu Samparau (holotype SAR; isotypes K, L).
Shrub to 2.5 m tall, occasionally epiphytic. *Leaves alternate, coriaceous*, glabrous above, glabrous and *punctate below, bullate*; elliptic-ovate, 3–4.2 × 1–1.6 cm, base cuneate, *margin entire, apex bluntly acuminate; petiole* pubescent, *c. 0.2 cm long*. Inflorescences unknown. *Infructescences* pubescent, *spicate*. Fruits (immature) globose, *c. 2.2 mm diameter, green; pyrenes 4, smooth*.
Found in montane forest and on the edge of Kakus sandstone scarp. Endemic to Borneo; only recorded from Bt. Salong and Bt. Lumat in Sarawak (e.g., S 21258 and S 26571). Previously identified as *Ilex* sp. 6 in many herbaria.
Leaves not bullate, apex emarginate or retuse. Inflorescences or infructescences racemose.....20
20. Leaves prominently punctate below, obovate to elliptic, smaller 1–3.5 × 0.2–2.5 cm, apex emarginate; petiole 0.1–0.6 cm long. Pyrenes 3–5, smooth.....**7. I. havilandii**
Leaves punctate on both surfaces, obovate or oblong-ovate, larger 3.5–6.5 × 2–4.5 cm, apex retuse; petiole *c. 0.2 cm long*. Pyrenes 6–8, sulcate to somewhat smooth.....
..... **17. I. orestes** (in part)
21. Leaf margin serrate in upper half only; petiole winged.....
I. kinabaluensis S.Andrews
(of Mt. Kinabalu, Sabah)
Sandakania 11 (1998) 8; Beaman *et al. l.c.* 116. Type: *Andrews 890*, Borneo, Sabah, Mt. Kinabalu (holotype SNP; isotypes K, SAN). Synonym: *Ilex* sp. 1, Andrews, Sandakania 5 (1994) 49.
Shrub to 2.5 m tall. *Leaves alternate, coriaceous*, glabrous above, glabrous and *punctate below*; elliptic to obovate, 1.5–3 × 0.8–1 cm, base cuneate, *margin serrate in upper half*, apex mucronate; *petiole* glabrous and *winged, 0.4–0.5 cm long*. Inflorescences glabrous, males in fascicles, females in fascicles or solitary. Flowers white with pink or deep red on reverse of lobes, 4-merous. Fruits ovoid, *c. 10 mm diameter, dark red to purple; pyrenes 4, striate*.
Found in open montane *Leptospermum*-forest on sunny slopes on ultramafic soils. Endemic to Borneo and known only from Mt. Kinabalu area in Sabah (e.g., *Andrews 884, Clemens 32313 and SAN 117233*).

- Leaf margin undulate with a few spines or revolute with several small teeth or crenate or serrate throughout; petiole not winged.....22
22. Leaf margin revolute with several small teeth; leaf apex mucronate. Shrub less than 5 m tall.....
- I. revoluta** Stapf
(Latin, *revolutus* = roll in; the leaf margin)
In W.J. Hooker, *Icon. Plant. ser. 4* (1893) pl. 2263, FMK (1894) 139; Loesener *l.c.* 422; Gibbs, *J. Linn. Soc. Bot.* 42 (1914) 64; Masamume *l.c.* 416; Meijer, *Bot. News Bull. Herb. For. Dept.* 9 (1967) 90; Anderson *l.c.* (1980) 151; Andrews *l.c.* (1994) 46; Beaman *et al. l.c.* 117. Type: *Haviland 1087*, Borneo, Sabah, Mt. Kinabalu (holotype K).
Shrub less than 5 m tall. Leaves alternate, coriaceous, glabrous, punctate below; elliptic to obovate, 1.3–3 × 0.5–1.5 cm, base cuneate, margin revolute with several small teeth, apex mucronate; petiole puberulous, 0.3–0.5 cm long. Inflorescences puberulous. Male flowers in few-flowered cymes; female flowers solitary or in few-flowered cymes, white or pale pink, 4-merous. Fruits globose, 0.5–0.8 mm diameter, purplish black; pyrenes 3, minutely streaked.
In open montane Leptospermum-forest on shallow ultramafic soils. Endemic to Borneo, known only from Mt. Kinabalu area in Sabah (e.g., Andrews 897, Clemens 50806, SAN 28559, SAN 29253, and SAN 82974).
- Leaf margin crenate or serrate throughout; leaf apex acute or acuminate. Shrub or small tree to 8 m tall, 10 cm diameter, occasionally epiphytic.....**20. I. triflora**
23. Petiole channelled above. Inflorescences in axillary fascicles. Fruits 10–26 diamter.....24
Petiole not channelled above. Inflorescences or infructescences cymose or spicate. Fruits less than 10 mm diameter.....25
24. Twigs channelled when dried. Leaf base attenuate, margin undulate with a few spines, apex long-acuminate with rounded acumen.....**6. I. glomerata**
Twigs smooth when dried. Leaf base broadly cuneate, margin serrulate, apex acute or acuminate.....**2. I. borneensis**
25. Leaf base rounded, rotundate, oblique, obtuse or acute.....26
Leaf base cuneate or broadly cuneate.....29
26. Leaves orbicular to elliptic, base oblique or obtuse, apex mucronate or sharply acute.....
- I. clethriflora** S.Andrews
(Latin, *clethriflorus* = with flowers resembling those of *Clethra*, Clethraceae)
Sandakania 11 (1998) 3. Type: *Wood SAN A 4188*, Borneo, Sabah, Mt. Silam (holotype KEP; isotypes A, BO, K, L, SING).
Shrub to 4 m high. Leaves alternate, thickly coriaceous, glabrous above, glabrous and punctate below; orbicular to elliptic, 4–10.5 × 3–6.6 cm, base oblique or obtuse, margin entire, apex mucronate or sharply acute; petiole not channelled above, glabrous, 0.2–0.4(–1) cm long. Inflorescences pubescent, spicate. Flowers white, 4–5-merous. Fruits (immature) globose, c. 3 mm diameter; pyrenes 4(–5), sulcate.
*Found in montane forest on ultramafic ridges. Endemic to Borneo; only recorded from Bt. Silam in Sabah (SAN A 4188). Previously identified as *Ilex* sp. 3 in many herbaria.*
- Leaves of other shapes, base rounded or acute or rotundate.....27

27. Leaf base rotundate, apex long-acuminate.....**19. I. spicata**
 Leaf base rounded or acute, apex acute or acuminate.....28
28. Leaf margin revolute. Fruits barrel-shaped, 3–3.5 mm diameter; pyrenes 16–23, marked with fine irregular streaks. Tree or shrub to 37 m tall, 60 cm diameter, or occasionally epiphytic climber.....**12. I. malaccensis**
 Leaf margin not revolute. Fruits globose, 7–9 mm diameter; pyrenes 4–5, densely villous, matted glutinous. Epiphytic shrub or climber.....
- I. clemensiae** Heine
 (M.S. Clemens, 1873–1968, wife of J. Clemens, plant collector)
 Bot. Munchen 6 (1953) 208; Andrews *l.c.* (1994) 42; Coode *et al.* (eds.) *l.c.* 30; Beaman *et al. l.c.* 115. Syntypes: *Clemens 31218* (BM, BO, K, L, M), *Clemens 32083* (A, BM, G, K, L, M), and *Clemens 50259* (G, K, L, M), Borneo, Sabah, Mt. Kinabalu.
Epiphytic shrub or climber. Leaves alternate, coriaceous, glabrous above, glabrous and punctate below; ovate-oblong, or elliptic to broadly elliptic, 7.5–10.5 × 3.5–5(–6.5) cm, base rounded, margin entire, not revolute, apex acuminate; petiole not channelled above, glabrous or puberulous, 3–5 mm long. Inflorescences pubescent, spicate. Flowers creamy white, 4–5-merous. Fruits globose, 7–9 mm diameter, dark purple; pyrenes 4–5, densely villous, matted glutinous.
 On montane ridges. Endemic to Borneo; recorded from Penibukan, Mt. Trus Madi FR and Mt. Lotung in Sabah (e.g., *Clemens 32083*, *Clemens 31218*, *Clemens 40607*, and *Clemens 50259*), and from several locations in Sarawak (e.g., *S 25721*, *S 30847*, *S 33012*, and *S 52534*). Also found in Brunei (e.g., *Coode 7547* and *Dransfield JD 7203*).
29. Leaf apex acute or acuminate.....30
 Leaf apex retuse, obtuse or mucronate.....33
30. Petiole 0.3–1 cm long. Inflorescences or infructescences spicate.....31
 Petiole 1–2 cm long. Inflorescences or infructescences cymose.....32
31. Climbers. Petiole 0.3–0.4 cm long. Pyrenes 8–11.....
- I. poiensis** S.Andrews
 (of G. Poi, Sarawak)
 Sandakania 11 (1998) 10. Type: *Clemens 22582*, Borneo, Sarawak, G. Poi (holotype SAR; isotypes BO, K).
Glabrous climber. Leaves alternate, coriaceous, punctate below; broadly oblong, elliptic or broadly elliptic, 8.5–11 × 4–6 cm, base broadly cuneate, margin entire, apex acute; petiole not channelled above, 0.3–0.4 cm long. Inflorescences unknown. Infructescences spicate. Fruits (unripe) globose, 4–5 mm diameter, yellowish green; pyrenes 8–11, centrally sulcate.
 In primary forest, near summits on tertiary granodiorite. Endemic to Borneo; so far only recorded from G. Gading and G. Poi in Sarawak (e.g., *Chew CWL 584*, *Clemens 20365*, *Clemens 22582*, and *S 18467*). Previously identified as *Ilex* sp. 17 in many herbaria.
- Shrubs. Petiole *c.* 1 cm long. Pyrenes 6.....
- I. sarawaccensis** Loes.
 (of Sarawak)
 Monogr. Aquifol. 1 (1901) 434; Merrill *l.c.* (1921) 353; Masamune *l.c.* 416. Type: *Beccari PB 2122*, Borneo, Sarawak, Santubong (holotype FI).

Shrub. Leaves alternate, coriaceous, glabrous, punctate below; oblong to broadly oblong or broadly elliptic, 10–13.5 × 4.5–7.5 cm, base cuneate, margin entire, apex acuminate or acute; petiole glabrous, not channelled above, c. 1 cm long. Inflorescences unknown. Infructescences glabrous, spicate. Fruits globose, c. 4.5 mm diameter, red; pyrenes 6, centrally sulcate.

Endemic to Borneo and only known from Mt. Santubong in Sarawak.

32. Twigs pubescent (when young), black when dried. Leaves glaucous below. Pyrenes 8–10, sulcate..... **8. I. hypoglauca**
 Twigs glabrous, greyish to brownish when dried. Leaves not glaucous below. Pyrenes 4, striate..... **15. I. nervulosa**
33. Petiole 0.3–0.8 cm long..... 34
 Petiole 1–3 cm long..... 35

34. Leaves glossy above, prominently punctate below; margin entire or undulate with a few minute spines. Inflorescences cymose. Tree to 7 m tall..... **10. I. kelabitana**
 Leaves dull above, faintly punctate below; margin entire and revolute. Inflorescences or infructescences in lax compound cymes. Shrub or treelet less than 5 m tall.....

I. keranjiensis S. Andrews

(of Tg. Keranji, Sarawak)

Sandakania 11 (1998) 7. Type: *Anderson S 19123*, Borneo, Sarawak, Tg. Keranji (holotype SAR; isotypes K, L, SAN, SING).

Treelet less than 5 m tall. Leaves alternate, coriaceous, glabrous and dull above, faintly punctate and paler below; obovate, elliptic or obovate-oblong, 5.5–12 × 2–5 cm, base cuneate, margin entire and revolute, apex obtuse and retuse; petiole puberulent, not channelled above, 0.3–0.8 cm long. Inflorescences unknown. Infructescences puberulous, in lax compound cymes. Fruits (unripe) narrowly ovoid and ribbed, green.

Occurring in *alan bunga* forest type of peat swamp forest. Endemic to Borneo (Sarawak, Tg. Keranji; e.g., *S 14216*, *S 19123* and *S 26693*). Previously identified as *Ilex* sp. 16 *p.p.* in many herbaria.

35. Leaves oblong, obovate-oblong, or broadly obovate-oblong, base cuneate, apex mucronate or retuse (rarely obtuse). Inflorescences glabrous (only rarely puberulous), in compound cymes. Fruits 5–9 mm diameter. Tree to 25 m tall..... **18. I. promecophylla**
 Leaves ovate, broadly ovate, or oblong-ovate, base broadly cuneate, apex obtuse. Inflorescences puberulous, cymose. Fruits 3–3.5 mm diameter. Shrub less than 5 m tall.....

I. renae S. Andrews

(Rena George, 1955–1994, former officer-in-charge of the Semengoh Botanical Research Centre, Sarawak)

Sandakania 11 (1998) 12. Type: *Haviland & Hose 2011*, Borneo, Sarawak, Bt. Lambir (holotype BO; isotypes BM, L).

Shrub or small treelet less than 5 m tall. Leaves alternate, coriaceous, glabrous and glossy above, glabrous and slightly punctate below; ovate, broadly ovate or oblong-ovate, 6–12.5 × 4–6.5(–9.5) cm, base broadly cuneate, margin entire, apex obtuse; petiole

glabrous, *not channelled above*, 1–2.5 cm long. *Inflorescences puberulous, cymose*. Male flowers 4(–5)-merous. Female flowers unknown. *Fruits* (unripe) globose, 3–3.5 mm in diameter, green; pyrenes 5, sulcate.

On summits of hills in *kerangas* forest on Kakus sandstone. Endemic to Borneo. In Sarawak, recorded only from the Lambir Hills NP (e.g., *S 3022, S 21229, S 38354, S 40406, and S 43111*). Previously identified as *Ilex* sp. 18 in many herbaria.

1. *Ilex beccariana* Loes.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Monogr. Aquifol. 1 (1901) 96; Merrill *l.c.* (1921) 352; Masamune *l.c.* 414; Andrews *l.c.* (1998) 17. **Lectotype** (Andrews, 1998): *Beccari PB 1482*, Borneo, Sarawak, Mt. Matang (hololectotype FI; isolectotypes BO, K).

Shrub or tree. **Twigs** somewhat thickened, knobby, *glabrous*, lenticellate and exfoliating. **Leaves** *alternate, subcoriaceous to coriaceous*, glabrous, drying blackish above, greyish with a bloom and *epunctate below*; obovate or elliptic or ovate, 6–9 × 3–4.5 cm, *base attenuate*, margin entire, *apex shortly acute, rarely retuse*; midrib glabrous, sunken above, prominent below; lateral veins 7–12 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, obscure above, prominent below; intercostal venation broadly reticulate, obscure on both surfaces; *petiole glabrous, 0.5–0.8 cm long*. **Inflorescences** *pubescent, cymose*. **Flowers**: males 4–5-merous; females unknown. **Fruits** (immature) globose, 6–7 mm diameter, smooth; stalk pubescent, *c.* 5 mm long; pyrenes 7–8.

Distribution. Endemic to Borneo; recorded only from Mt. Matang, Sarawak (*Beccari PB 1482, Beccari PB 1879 and Beccari PB 2056*).

2. *Ilex borneensis* Loes.

(of Borneo)

Monogr. Aquifol. 1 (1901) 248; Merrill *l.c.* (1921) 352; Masamune *l.c.* 415; Andrews *l.c.* (1998) 21. **Lectotype** (Andrews, 1998): *Beccari PB 1652*, Borneo, Sarawak, Mt. Matang (hololectotype FI). **Synonym**: *Diospyros sororia* Bakh., Bull. Jard. Bot. Buitenz. 15, 2 (1937) 125.

Tree to 18 m tall; bole fluted at base; without buttresses. **Bark** smooth, thin, grey or light brown, somewhat powdery or flaked; inner bark greenish. **Sapwood** yellowish. **Twigs** slender, *smooth when dried*, glabrous. **Leaves** *alternate, coriaceous*, drying brownish, glabrous, *slightly punctate below*; oblong-elliptic to broadly elliptic, or ovate-oblong, or narrowly obovate to broadly obovate, (9.5–)12–20.5(–22.5) × 4–7.5(–9) cm, *base broadly cuneate, margin serrulate, apex acute or acuminate*; midrib glabrous, sunken above, prominent below; lateral veins 6–12 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, subprominent above, prominent below; intercostal venation broadly reticulate, subprominent to obscure above, prominent below; *petiole glabrous, deeply channelled above when dried, 1–2(–3.2) cm long*. **Inflorescences** glabrous, *in axillary fascicles*. **Flowers** 4–5-merous, greenish white. **Fruits** (immature) globose to oblong, 20–26

mm diameter, green to orange; stalk glabrous, *c.* 5 mm long; pyrenes 4, open rugose.

Distribution. Endemic to Borneo. In Sarawak, recorded from Semengoh FR, Mt. Matang, Mt. Penrissen, Bt. Alak, Serian, Bt. Senyandang, and Sg. Pesu (e.g., *Jacobs 5103, S 16647, S 37172, S 44023, and S 48909*). Also known from Kalimantan (e.g., *Burley et al. 2475, Hallier 3077 and Shea 26880*).

Ecology. In primary lowland and hill mixed dipterocarp forests, rarely in secondary forest, at altitudes to 1000 m.

Notes. *Ilex borneensis* has unusually large fruits for the genus and thus has been confused with several other taxa. These include *Salacia castaneifolia* Ridl. (Celastraceae), *Matthaea sancta* Blume (Monimiaceae), *Erycibe* spp. (Convolvulaceae), *Symplocos* spp. (Symplocaceae), Flacourtiaceae, Euphorbiaceae, and Ebenaceae.

3. *Ilex celebensis* Capit.

(of Celebes)

Bull. Soc. Bot. Fr. 57 (1910) 236; Beaman *et al. l.c.* 114. **Type:** *Teijsmann 13707*, Sulawesi (holotype BO; isotype K).

Distribution. Sumatra, Borneo, Sulawesi, Maluku, and the Lesser Sunda Islands.

var. **ranauana** S. Andrews

(of Ranau, Sabah)

Sandakan 11 (1998) 2. **Type:** *Clemens 29245*, Borneo, Sabah, Mt. Kinabalu, Kundasang (holotype SING; isotypes BM, BO, G, K, L, NY). **Synonym:** *Ilex* sp. *aff. wightiana* auct. non Wall. ex Wight: Andrews *l.c.* (1994) 49.

Tree to 18 m tall. **Bark** smooth, dark greenish; inner bark white. **Sapwood** hard, yellowish or sandy coloured. **Twigs** *glabrous*, new growth shortly pubescent. **Leaves** *alternate, subchartaceous*, glabrous on both surfaces, *not glaucous and slightly punctate below; elliptic or lanceolate*, 6–9.2 × 2–3.4 cm, *base acute*, margin entire, *apex caudate and obtuse*; midrib glabrous and sunken above, prominent with scattered hairs below; lateral veins 6–9 pairs, subopposite to alternate, irregularly spaced, more or less parallel, ascending and looping before leaf margin, obscure to subprominent on both surfaces; intercostal venation broadly reticulate, obscure on both surfaces; *petiole puberulous*, 0.5–0.8 cm long. **Inflorescences** *in fascicles or few-flowered cymes, hispid or pubescent*. **Flowers** 5–6-merous, white. **Fruits** globose, 4–4.5 mm diameter, *not ribbed*, brownish red, hispid when young; pericarp chartaceous; stalk pubescent, 7–8 mm long; *pyrenes 5–7, shallowly sulcate*.

Distribution. Sumatra and Borneo. In Borneo, recorded from Sosopodon, Kundasang and Tenompok in Sabah (e.g., *Clemens 28808, SAN 42466, SAN 42476, SAN 46711, and SAN 60625*).

Ecology. In primary lower montane forest, at about 1500 m altitude.

Notes. The other variety, var. *celebensis*, occurs in Sulawesi, Maluku and the Lesser Sunda Islands.

4. *Ilex cissoidea* Loes.

(Greek, *cissoideus* = resembling *Cissus*, Vitaceae)

Monogr. Aquifol. 1 (1901) 430; Merrill *l.c.* (1921) 352; Airy Shaw *l.c.* (1939) 511; Masamune *l.c.* 415; Meijer *l.c.* 90; Anderson *l.c.* (1980) 150; Andrews *l.c.* (1994) 42; Coode *et al.* (eds.) *l.c.* 30; Argent *et al.* (eds.) *l.c.* 85. **Type:** *Beccari PB 3144*, Borneo, Sarawak, Batang Lupar (holotype FI; isotype K). **Synonym:** *Octas spicata* auct. non Blume: Jack, Malay. Misc. 2, 7 (1822) 64, Merrill, J. Arn. Arb. 33 (1952) 238, Airy Shaw, Kew Bull. 16 (1962) 84.

Tree to 38 m tall; buttresses rarely noted. **Bark** smooth, thin, grey or greenish white or dark brownish with some mottling; inner bark variable in colour, often with yellow sclerotic masses. **Sapwood** watery, pale yellow to brown or pale orange. **Twigs** slender, *pubescent*, channelled and black when dried. **Leaves** *alternate*, *chartaceous* to *subchartaceous*, drying blackish, usually glabrous above, *punctate* and *not glaucous below*; *ovate-elliptic* to *ovate-oblong*, 7–15 × 3–5 cm, *base rounded* or *cordate*, margin entire, *apex acuminate* or shortly so; midrib pubescent and deeply sunken above, sparsely pubescent and prominent below; lateral veins 8–10 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, obscure above, prominent below; intercostal venation broadly reticulate, sunken and obscure above, subprominent below; *petiole pubescent*, channelled above, 0.8–1.3 cm long. **Inflorescences** densely pubescent, *spicate*. **Flowers** white or greenish white, (4–)5(–6)-merous. **Fruits** globose, 2–2.5 mm diameter, *not ribbed*, reddish black; stalk densely pubescent, 1–1.5 mm long; *pyrenes* 5–8, *striate*.

Vernacular names. Sabah—*loboh* (Malay), *lundudon payon* (Kadazan), *magis agis*, *magisugis* (Dusun, Ranau), *marogis*, *morogis* (Dusun, Kundasang and Bundu Tuhan), *morogis sawa* (Dusun). Sarawak—*aras* (Iban), *geredam pangi* (Dulit area), *kemuding* (Punan), *langidan*, *lengidan* (Kelabit).

Distribution. Sumatra, Borneo and Sulawesi. In Sabah and Sarawak, common and widespread (e.g., *Andrews 1577*, *SAN 32297*, *SAN 58429*, *S 33388*, and *S 42051*). Also known from Brunei (e.g., *Dransfield JD 7495* and *Sands 5711*) and Kalimantan (e.g., *Argent et al. 93116*, *Endert 1732* and *Shea 26054*).

Ecology. Locally common, found in primary and secondary forests, along shady ridges or streams, at altitudes to 1850 m.

Uses. The wood is mainly used for firewood, but suggestions have been made that it is also suitable for making matches and for construction. Dry leaves are pounded and stored in bamboo internodes and the powder is used as bathing soap. In former days, the Kelabit people dried the yeast for alcohol brewing in the smoke from *I. cissoidea*, as it has no smell.

Notes. Malformed sepals and petals are a common feature.

5. *Ilex cymosa* Blume

(Latin, *cyma* = cyme; referring to the cymose inflorescences)

Bijdr. Fl. Ned. Ind. (1827) 1149; Hooker *f.l.c.* 605; King *l.c.* 136; Loesener *l.c.* 74; Merrill *l.c.* (1921) 352; Ridley *l.c.* (1922) 442; Masamune *l.c.* 415; Browne *l.c.* 200; Meijer *l.c.* 91; Anderson *l.c.* (1972) 25, *l.c.* (1980) 150; Corner *l.c.* 163; Keng *l.c.* 114; Turner, Gard. Bull. Sing. 45 (1993) 37; Kessler & Sidiyasa, TBSA-EK (1994) 54; Andrews *l.c.* (1994) 43; Turner *l.c.* (1995) 131; Coode *et al.* (eds.) *l.c.* 30; Argent *et al.* (ed.) *l.c.* 85; Andrews *l.c.* (1998) 22; Beaman *et al.* *l.c.* 115. **Lectotype** (Andrews, 1998): *Blume s.n.* (= RHL Sheet No. 90413497), Java (hololectotype L). **Synonyms**: *Prinos cymosa* (Blume) Hassk., Tijdschr. Nat. Gesch. & Phys. 10 (1843) 140; *I. philippinensis* Rolfe, J. Linn. Soc. Bot. 21 (1884) 308; *I. cumingiana* Rolfe *l.c.* 308; *I. cymosa* var. *cumingiana* (Rolfe) Loes. *l.c.* 76.

Tree to 30 m tall, rarely with small buttresses. **Bark** thin, smooth or slightly rough, occasionally lenticellate or hooped, grey or greyish brown, pale brown or white, somewhat spotted; inner bark variable in colour, often yellowish to orange, or brown, or with a tinge of green, coarse (gritty) and fibrous. **Sapwood** white to greyish white or yellow, watery. **Twigs** glabrous, green when young, grey or white, somewhat spotted with prominent lenticels, peeling. **Leaves** *alternate*, *chartaceous*, glabrous and glossy above, glabrous, *epunctate* and *somewhat glaucous below*; elliptic to broadly elliptic, or obovate, narrowly oblong to oblong-ovate or lanceolate, 5.3–14 × 2.3–5.7 cm, *base obtuse*, margin entire, apex obtusely acuminate or obtuse; midrib glabrous, sunken above, prominent below; lateral veins 6–12 pairs, subopposite to alternate, irregularly spaced, more or less parallel, ascending and looping before leaf margin, sunken and subprominent above, prominent to subprominent below; intercostal venation broadly reticulate, subprominent on both surfaces; *petiole glabrous*, 0.5–1.3 cm long. **Inflorescences** puberulous, *in lax compound cymes*; bracts glabrous, acute or acuminate, subsistent. **Flowers** olive-green, greenish white or white, slightly fragrant; males 4–5-merous; females 10–12-merous. **Fruits** globose, 3–3.5 (–4) mm diameter, red ripening black, *always ribbed when dried*; pericarp chartaceous; stalk pubescent, 5–6 mm long; *pyrenes 8–10, deeply sulcate*, almost glossy.

Vernacular names. Sabah—*bangkulat* (Kadazan), *bangkulatan*, *bengkulatan* (Malay), *belimbing hutan* (Tidong), *bingkolat* (Dusun), *mangkulat*, *mogkulat* (Kadazan), *mer pinggau* (Dusun, Kinabatangan), *sidapong* (Tidong), *tampulan* (Dusun, Kinabatangan). Sarawak—*bengkulat* (Iban), *kerdam ayer* (preferred name), *perdoh* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, and Maluku. In Sabah and Sarawak, common (e.g., *Clemens 9706*, *Elmer 20841*, *SAN 34563*, *SAN 68039*, *SAN 123445*; *S 9789*, *S 25114*, *S 37421*, and *S 48678*). Also known from Brunei (e.g., *Coode 7654*, *S 7854* and *Simpson 2576*) and Kalimantan (e.g., *Ambriansyah & Arifin W 968*, *Kostermans 21685* and *Sidiyasa & Arifin 1071*).

Ecology. Locally common in coastal padang vegetation on white sandy soils, peat swamp, riverine and mangrove forests, and in mixed dipterocarp forests on hilltops or slopes, at altitudes to 750(–1200) m.

Uses. The timber is used for firewood. The root is said to have medicinal properties and is mainly used in the treatment of fever, while the leaves are used for sprains.

Notes. A common, widespread and morphologically variable species, *Ilex cymosa* is often misidentified as *Chionanthus laxiflorus* Blume, *C. ramiflorus* Roxb. (Oleaceae), *Syzygium* Gaertn. (Myrtaceae), *Maesa* Forssk. (Myrsinaceae), or *Xanthophyllum* Roxb. (Polygalaceae). A form with pubescent twigs, petioles and calyces is found sporadically throughout the range (13 collections seen).

6. *Ilex glomerata* King

(Latin, *glomeratus* = collected closely together into a head; referring to the flowers).

J. As. Soc. Beng. 64, 2 (1895) 135; Loesener *l.c.* 325; Ridley *l.c.* (1922) 439; Kiew, TFM 3 (1978) 5; Andrews *l.c.* (1994) 43; Turner *l.c.* (1995) 131; Coode *et al.* (eds.) *l.c.* 30; Andrews *l.c.* (1998) 25; Beaman *et al. l.c.* 115. **Lectotype** (Andrews, 1998): *King's Collector 6926*, Peninsular Malaysia, Perak, Larut (hololectotype CAL; isolectotypes BO, CAL, K, SING). **Synonym:** *Ilex cf. triflora auct. non* Blume: Meijer *l.c.* 90.

Shrub or tree to 20 m tall; often with low rounded buttresses. **Bark** dark, smooth; inner bark thin, variable in colour, often pale green to greenish yellow or somewhat brown. **Sapwood** pale yellow or orange to whitish brown. **Twigs** glabrous, *channelled when dried*. **Leaves** *alternate, subcoriaceous*, glabrous, slightly *punctate below*; elliptic to oblong-elliptic, 6.5–12.5(–13.5) × 2–5 cm, *base attenuate, margin undulate with few minute spines, apex long-acuminate with rounded acumen*; midrib glabrous, deeply sunken above, prominent below; lateral veins 6–7 pairs, subopposite to alternate, irregularly spaced, more or less parallel, ascending and looping before leaf margin, obscure above, prominent below; intercostal venation broadly reticulate, obscure above, obscure to subprominent below; *petiole* glabrous, *channelled above, 1–2 cm long*. **Inflorescences** pubescent, *in axillary fascicles*. **Flowers** 4-merous, yellow green or yellow. **Fruits** globose, *c. 10 mm diameter*, red; pericarp thick, wrinkled when dried; stalk pubescent, 7–10 mm long; pyrenes 4, rugose.

Distribution. Burma, Sumatra, Peninsular Malaysia, and Borneo. In Sarawak, found in Bt. Salong and Bt. Taji Buloh (e.g., *S 14394* and *S 25842*). In Sabah, known from Mt. Kinabalu and surrounding areas and Mt. Lotung (e.g., *Clemens 28843*, *RSNB 4983*, *SAN 25328*, *SAN 76473*, and *SAN 124490*). Known also from Brunei (e.g., *S 0941*, *S 12357* and *Wong WKM 822*).

Ecology. In primary and secondary hill and lower montane forests, on slopes and ridges, at altitudes to 1700 m.

Notes. Fruiting specimens may be confused with species of *Drypetes* Vahl. (Euphorbiaceae).

7. *Ilex havilandii* Loes.

(G.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Monogr. Aquifol. 1 (1901) 423; Merrill *l.c.* (1921) 352; Masamune *l.c.* 415; Meijer *l.c.* 90; Anderson *l.c.* (1980) 150; Andrews *l.c.* (1994) 44; Coode *et al.* (eds.) *l.c.* 30; Beaman & Anderson, Contrib. Univ. Mich. Herb. 21 (1997) 112; Andrews *l.c.* (1998) 27; Beaman *et al. l.c.* 116. **Lectotype** (Andrews, 1998): *Haviland 1114*, Borneo, Sabah, Mt. Kinabalu (hololectotype K; isolectotypes SAR, SING). **Synonyms:** *I. vacciniifolia auct. non* Klotzsch *ex* Reiss: Stapf *l.c.* 140, Masamune *l.c.* 415; *I. vacciniifolia* var. *camptoneura* Stapf *l.c.* 140, Masamune *l.c.* 415; *I. vacciniifolia* var. *subenervis* Stapf *l.c.* 140, Masamune

l.c. 415; *I. havilandii* Loes. var. *camptoneura* (Stapf) Loes. *l.c.* 423; *I. havilandii* Loes. var. *subenervis* (Stapf) Loes. *l.c.* 423; *I. confertifolia* Merr., Sarawak Mus. J. 3 (1928) 526; *I. orestes* Ridl. var. *dulitensis* Airy Shaw *l.c.* (1939) 510, Masamune *l.c.* 416.

Stiffly erect shrub, sometimes epiphytic, often multistemmed tree to 14 m tall. **Bark** not smooth, grey to white; inner bark often brownish or yellowish green, with a sticky sap. **Sapwood** pale yellow to pale brown. **Twigs** *short-puberulous*, channelled when dried. **Leaves** *alternate, coriaceous*, glabrous above, glabrous or sparsely puberulous and *prominently punctate below*; *obovate to elliptic*, 1–3.5 × 0.2–2.5 cm, base cuneate, *margin entire* often revolute, *apex emarginate*; midrib glabrous and sunken above, glabrous or sparsely puberulous and prominent to subprominent below; lateral veins 3–6 pairs, alternate, ascending, obscure above, subprominent below; intercostal venation obscure on both surfaces; *petiole* glabrous or puberulous, 0.1–0.6 cm long. **Inflorescences** puberulous, *in axillary racemes*. **Flowers** white or pink to purple-tinged on outer lobes, 3–5-merous. **Fruits** globose, 2–3.5 mm diameter, purplish black or reddish, closely wrinkled when dried; stalk puberulous, 2–7 mm long; *pyrenes* 3–5, *smooth*.

Vernacular names. Sarawak—*temi* (Kenyah), *temiang* (Iban).

Distribution. Endemic to Borneo. In Sabah, recorded from Mt. Kinabalu, Mt. Tambulanan, Mt. Alab, Mt. Trus Madi, Mt. Meliau, and Mt. Taviu (e.g., *Andrews 899*, *Clemens 32330*, *SAN 41870*, *SAN 81781*, and *SAN 83000*). In Sarawak, found on Mt. Murud NP, Mt. Mulu NP, Bt. Lawi, Mt. Dulit, Merurong plateau, Ulu Sg. Tutoh, Bt. Batanga, Mt. Munro, Mt. Kalulon, Tama Abu Range, and Bt. Pagon Kecil (e.g., *Richards 1886*, *S 33041*, *S 38754*, *S 50860*, and *S 51144*). Also occurs in Brunei (e.g., *Coode 7462*) and Kalimantan (e.g., *Kato et al. 11055*).

Ecology. Locally common. Found on ridges in hill to montane forests, at altitudes to 3500 m.

Notes. An extremely variable species in its leaf morphology. Not to be confused when sterile with *Vaccinium stapfianum* Sleumer (Ericaceae), which has dash-shaped glands on the lower leaf surface, as opposed to the circular glands of *I. havilandii*.

8. *Ilex hypoglauca* (Miq.) Loes.

Fig. 1.

(Latin, *hypoglaucus* = glaucous beneath; referring to the lower leaf surface)

Monogr. Aquifol. 1 (1901) 80; Anderson *l.c.* (1972) 25, *l.c.* (1980) 150. **Basionym:** *Prinos hypoglauca* Miq., Fl. Ned. Ind. Suppl. 1 (1860) 201, 514. **Type:** *Horsfield 21*, Sumatra, Bangka (holotype K; isotypes BM, L).

Tree to 18 m tall. **Bark** smooth and grey, with numerous white corky lenticels; inner bark hard and brittle, pale grey and white, mottled with orange brown fibres. **Sapwood** white, darkening to pale yellow. **Twigs** *pubescent* when young, later *glabrous, black when dried*. **Leaves** *alternate, thickly coriaceous*, glabrous, *glaucous and punctate below*; elliptic or oblong to broadly oblong, 9–22.5 × 5–10 cm, base cuneate, *margin entire, apex acuminate*; midrib covered with scattered hairs, sunken above, prominent below; lateral veins 6–10 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping, becoming more obscure before leaf margin, sunken and prominent on both surfaces; intercostal venation broadly reticulate, sunken and

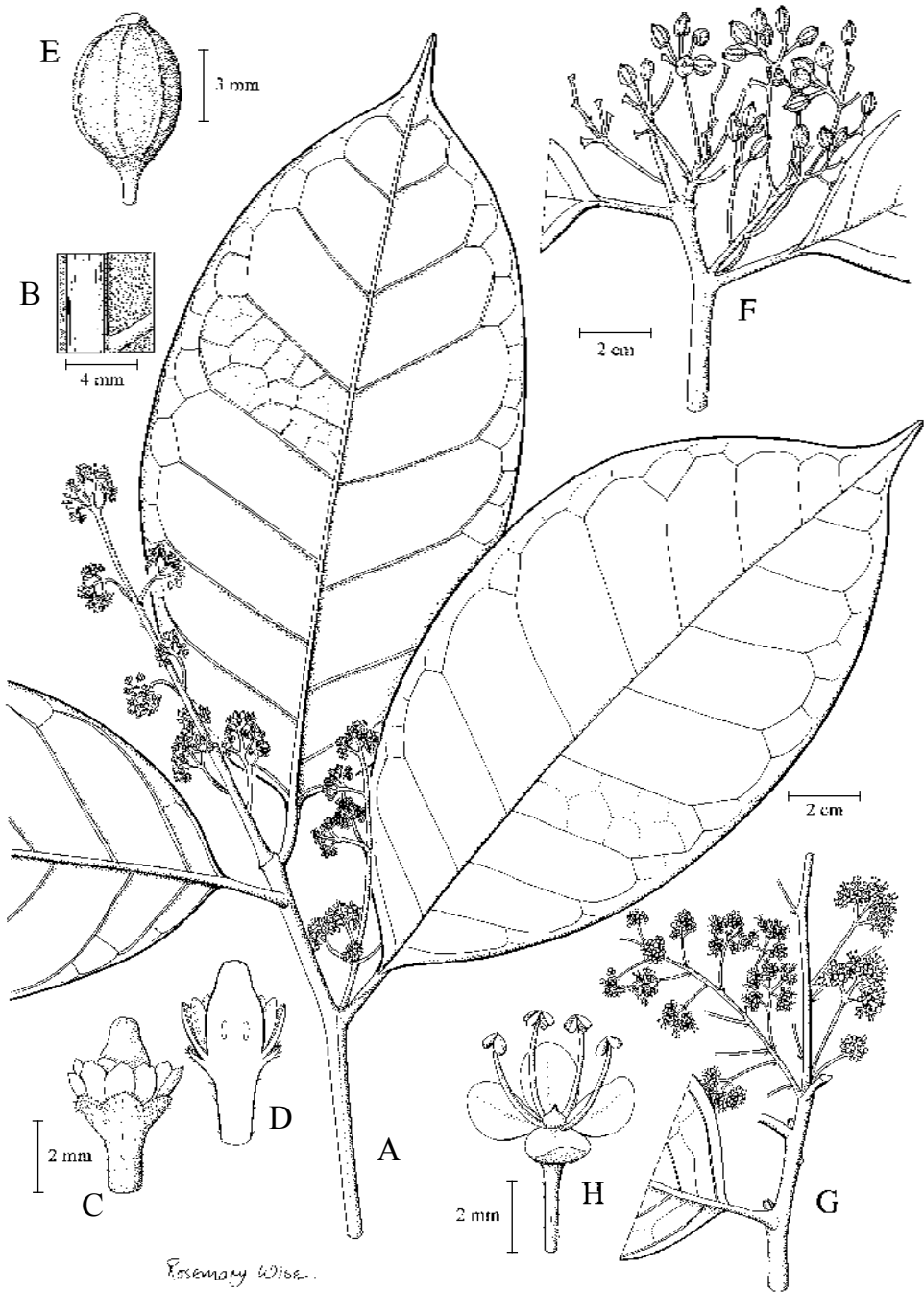


Fig. 1. *Ilex hypoglauca*. A, flowering (female) leafy twig; B, detail of lower leaf surface; C, female flower; D, longitudinal section through female flower; E, fruit; F, part of infructescence; G, part of male inflorescences; H, male flower. (A–D from *S* 30575, E–F from *Hallier* 2875, G–H from *Haviland & Hose* 3744.)

subprominent above, prominent below; *petiole* puberulous or glabrous, somewhat stout, *not channelled above*, 1–2 cm long. **Inflorescences** pubescent, *in axillary, long compound cymes*. **Flowers** white; males 4–5-merous; females 16-merous. **Fruits** ovoid or globose, 3–4 mm diameter, black, strongly ribbed (when mature); stalk pubescent, *c.* 6 mm long; *pyrenes* 8–10, *sulcate*.

Vernacular names. Sarawak—*kerdam mungkulat* (preferred name), *lengebah* (Milanau, Matu), *mungkulat* (Milanau, Matu).

Distribution. Sumatra and Borneo. In Sarawak, known from a few localities in Baram, Kuching and Sibu districts (e.g., *Haviland* 2872, *S* 3153, *S* 3271, and *S* 8536). Also known from Brunei (e.g., *Simpson* 2276 and *Wong WKM* 1040) and Kalimantan (e.g., *bb.* 35977, *Hallier* 2875 and *Kostermans* 12957).

Ecology. Found in primary peat swamp forest, at low altitudes.

Uses. The wood could be useful in the dowel and moulding industry and for the manufacture of small articles (Anderson *l.c.* (1972) 25).

9. *Ilex jacobsii* S. Andrews

(M. Jacobs, 1929–1983, former botanist at the Rijksherbarium, Leiden)

Sandakania 11 (1998) 5. **Type:** *Jacobs* 5057, Borneo, Sarawak, Mt. Penrissen (holotype SAR; isotypes B, G, K, L, US). **Synonym:** *Ilex* sp. 8, Coode *et al.* (eds.) *l.c.* 31.

Small tree to 7 m, or epiphytic climber. **Leaves** *alternate, subcoriaceous*, glabrous, drying dull brown and *epunctate below*; elliptic-oblong to broadly elliptic-oblong, 9–16.5 × 3.5–7 cm, base shortly attenuate, margin entire, *apex long-acuminate*; *petiole* glabrous, 0.4–0.7 cm long. **Inflorescences** glabrous, *spicate*. **Flowers:** females greenish white to white, 5–6-merous; males unknown. **Fruits** globose, ellipsoid when young, *c.* 5 mm diameter, glossy red; *pyrenes* 5–6, smooth, glossy, tear-like.

Distribution. Endemic to Borneo; recorded from several localities in Sarawak (e.g., *Jacobs* 5057, *S* 21159, *S* 25824, *S* 36523, and *S* 43164). Also found in Brunei (e.g., *Coode & Wong* 6500 and *Coode & Wong* 6574).

Ecology. Found in lowland mixed dipterocarp forest on shale in river valley, sandstone substrate and basalt hillside.

10. *Ilex kelabitana* S. Andrews

(of Kelabit Highlands, Sarawak)

Sandakania 11 (1998) 6. **Type:** *Awa et al.* *S* 50466, Borneo, Sarawak (holotype SAR; isotypes K, KEP, L, MO, SAN).

Tree to 7 m tall. **Twigs** slightly puberulous, brownish. **Leaves** *alternate, coriaceous* and brittle, glabrous and *glossy above*, glabrous and *prominently punctate below*; broadly elliptic or broadly

oblong, 9–14.5 × 5–9 cm, base broadly cuneate, margin entire or undulate with a few minute spines, apex retuse; midrib glabrous, deeply sunken above, prominent below; lateral veins 7–10 pairs, subopposite to alternate, widely spaced, ascending and obscure before leaf margin, subprominent above, prominent below; intercostal venation obscure above, subprominent below; petiole glabrous, not channelled above, 0.4–0.7 cm long. **Inflorescences** pubescent, cymose. **Flowers:** males white, 5-merous; females unknown. **Fruits** (immature) ellipsoid, pale green to red; stalk pubescent, c. 2.5 mm long; pyrenes 5–6, sulcate.

Vernacular names. Sarawak—*bupok* (Kelabit). Kalimantan—*bupuk* (Dayak).

Distribution. Endemic to Borneo. Recorded from the Kelabit Highlands and Bt. Pagon Kecil in Sarawak (e.g., *Nooteboom & Chai 02172*, *S 35361*, *S 47737*, and *S 50466*). Also occur in Kalimantan (e.g., *Geesink 8946* and *Kato et al. 8469*).

Ecology. In *kerangas* forest, at altitudes to 1300 m.

Notes. This taxon was previously identified as *Ilex* sp. 20 in many herbaria.

11. *Ilex macrophylla* Wall. ex Hook.f.

(Greek, *makro* = long, *phullon* = leaf; long-leaved)

Fl. Brit. Ind. 1 (1875) 604; King *l.c.* 136; Loesener *l.c.* 84; Ridley *l.c.* (1922) 442; Kiew, TFM 3 (1978) 8; Anderson *l.c.* (1980) 151; Corner *l.c.* 164; Keng *l.c.* 114; Turner *l.c.* (1993) 38, *l.c.* (1995) 131. **Type:** *Wallich 4331*, Peninsular Malaysia, Penang (holotype G-DC; isotype K). **Synonyms:** *I. macrophylla* var. *ovata* Loes. *l.c.* 85; *I. macrophylla* var. *angustata* Loes. *l.c.* 85, Masamune *l.c.* 416.

Tree to 24 m tall; buttresses to 60 cm tall, 60 cm wide, 5 cm thick. **Bark** smooth or rarely rough, dark grey to greyish brown or greyish white, occasionally mottled, lenticellate; inner bark often fibrous or coarsely granular, ochre-fawn to greenish brown or yellow. **Sapwood** watery, orange or white. **Twigs** pubescent, grey (brown when young), rarely glabrous, older twigs densely lenticillate. **Leaves** alternate, subcoriaceous, glabrous and glossy above, glabrous, paler and *epunctate* below; oblong, oblong-elliptic or ovate, (9–)11.5–20 × (4–) 5.5–9.5 cm, base attenuate or truncate, margin entire, apex acute or acuminate; midrib pubescent, sunken above, glabrous and prominent below; lateral veins 6–9 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, subobscure above, prominent below; intercostal venation broadly reticulate, obscure above, prominent below; petiole pubescent, rarely glabrous, 0.7–1.2 cm long. **Inflorescences** pubescent, cymose. **Flowers** white; males (3–)4(–5)-merous; females 8–10-merous. **Fruits** globose, (4.5–)5–6.5 mm diameter, glossy scarlet; stalk puberulous, c. 3 mm long; pyrenes 6–9, sulcate.

Distribution. Peninsular Malaysia, Singapore and Borneo (Sarawak). In Sarawak, recorded only from the Semengoh FR near Kuching (e.g., *S 33000*, *S 35290* and *S 37730*).

Ecology. In primary lowland forest, at c. 150 m altitude.

Uses. In Peninsular Malaysia, the wood is used locally for house building, and the leaves when made into a poultice are applied to the head to cure headaches.

12. *Ilex malaccensis* Loes.

(of Malacca, Peninsular Malaysia)

Monogr. Aquifol. 1 (1901) 432; Merrill *l.c.* (1921) 353; Ridley *l.c.* (1922) 437; Masamune *l.c.* 416; Kiew, TFM 3 (1978) 8; Andrews *l.c.* (1994) 45; Turner *l.c.* (1995) 132; Coode *et al.* (eds.) *l.c.* 30; Andrews *l.c.* (1998) 30; Beaman *et al.* *l.c.* 117. **Lectotype** (Andrews, 1998): *Beccari PB 3273*, Borneo, Sarawak, Batang Lupar, Marop Sul (holotype FI; isotypes K, P). **Synonym**: *Ilex spicata* auct. non Blume: Hooker *f. l.c.* 598, King *l.c.* 134, Ridley *l.c.* (1922) 437.

Tree to 37 m tall or shrub, or occasionally epiphytic climber. Bark spotted, greenish yellow or greyish brown, non-fissured. **Twigs** puberulous. **Leaves** *alternate, subcoriaceous to coriaceous, glabrous, prominently punctate below; oblong-elliptic, rarely linear-elliptic, elliptic or ovate, 7–14(–17) × (1–)3–5.5 cm, base rounded or acute, margin entire and revolute, apex acuminate, or obtusely acuminate with a rounded acumen or caudate; midrib with scattered pubescence and sunken above, sometimes puberulous and prominent below; lateral veins 7–9 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, obscure on both surfaces; intercostal venation reticulate, usually obscure above, subprominent to obscure below; petiole pubescent or glabrous, not channelled above, 0.2–0.8 cm long. Inflorescences* pubescent, *spicate. Flowers* white, 4–5-merous. **Fruits** *barrel-shaped, 3–3.5 mm diameter, dark red; stalk puberulous, 2–3 mm long; pyrenes 16–23, marked with fine irregular streaks.*

Vernacular name. Sarawak—*kerdam* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi, Maluku, and New Guinea. In Sabah and Sarawak, widespread (e.g., *RSNB 4429, S 28525, S 33079, S 44931, SAN 25114, SAN 34851, SAN 54760, and SAN 131396*). Also recorded from Brunei (e.g., *Coode 6580*) and Kalimantan (e.g., *Ambriansyah AA 796, Endert 3558, Kostermans 7677, and Kostermans 13065*).

Ecology. Found on hillsides and ridges in lowland mixed dipterocarp forest, in *kerangas* forest, and in forest on ultramafic soils or limestone, at altitudes to 1500 m.

Notes. Malformed corollas can often be seen in specimens collected from Sarawak.

13. *Ilex megaphylla* S. Andrews

(Greek, *mega* = large, *phullon* = leaf; with large leaves)

Sandakania 11 (1998) 9. **Type**: *Anderson S 4750*, Borneo, Sarawak, G. Api (holotype SAR; isotypes A, K, L, SING).

Tree to 9 m tall. **Bark** smooth, greyish. **Twigs** thickish, drying blackish, glabrous, lenticellate. **Leaves** *alternate, coriaceous and brittle when dried, glabrous and drying blackish above, brownish and glabrous and epunctate below; somewhat falcate, broadly oblong or oblong lanceolate, 19–35 × 5.5–13 cm, base cuneate or cordate, margin entire, apex acuminate; midrib glabrous, sunken above, prominent below; lateral veins 18–25 pairs, subopposite to alternate, more or less parallel, ascending and looping before leaf margin, subprominent to obscure above, prominent beneath; intercostal venation broadly reticulate, sunken or subprominent above,*

prominent to subprominent below; *petiole* glabrous, thick, channelled above, 1–1.5 cm long. **Inflorescences** glabrous, in *axillary compound cymes*. **Flowers** white, 4-merous. **Fruits** (very immature) ovoid, smooth.

Distribution. Endemic to Borneo. Recorded from G. Api and G. Buda in Sarawak (e.g., *S 4750*, *S 30364* and *S 39907*).

Ecology. In forest on limestone hills and cliffs, at altitudes to 1000 m.

Notes. This taxon was previously identified as *Ilex* sp. 11 in many herbaria.

14. *Ilex mesilauensis* S. Andrews (of Mesilau, Pinosuk Plateau, Sabah)

Sandakania 11 (1998) 9; Beaman *et al.* *l.c.* 117. **Type:** *Chew & Corner RSNB 4885*, Borneo, Sabah, Mesilau R. (holotype SAN; isotypes A, K, L, SAR, SING). **Synonym:** *Ilex* sp. 2, Andrews *l.c.* (1994) 49.

Tree to 15 m tall. **Bark** irregularly fissured, with very large and numerous lenticels; sap from outside of wood turns green on exposure. **Twigs** glabrous, dark brown, lenticels white. **Leaves** opposite or subopposite, coriaceous, bullate, glabrous, punctate below; spatulate or obovate, 6–7.5 × 3–5 cm, base attenuate, margin entire, slightly revolute, apex emarginate; midrib glabrous and sunken above, prominent below; lateral veins 6–8 pairs, opposite to subopposite, widely spaced, more or less parallel, ascending and occasionally looping before leaf margin, obscure above, subprominent below; intercostal venation broadly reticulate, sunken and obscure above, subprominent below; *petiole* glabrous, 0.7–0.8 cm long. **Inflorescences** puberulous, spicate. **Flowers** 4-merous in bud. **Fruits** unknown.

Distribution. Endemic to Borneo; known only by a single record (*RSNB 4885*) from the Mesilau River in Sabah.

Ecology. In lower montane forest, at c. 1500 m altitude.

15. *Ilex nervulosa* (Loes.) S. Andrews (Latin, *nervulosus* = finely veined; the leaves)

Fig. 2.

Sandakania 11 (1998) 14. **Basionym:** *I. venulosa* Hook.f. var. *nervulosa* Loes. *l.c.* 90, Ridley *l.c.* (1922) 442, Kiew, Gard. Bull. Sing. 31 (1978) 82, TFM 3 (1978) 8, Turner *l.c.* (1995) 131. **Type:** *Beccari s.n.*, Singapore, Woodlands (holotype FI). **Synonyms:** *I. sclerophylloides* Loes. *forma* Airy Shaw *l.c.* (1939) 509; *Ilex* sp. 4, Coode *et al.* (eds.) *l.c.* 31.

Tree to 38 m tall. **Bark** smooth or slightly fissured, white, grey or whitish green with some mottling, somewhat corky. **Twigs** glabrous, greyish to brownish or tan, peeling. **Leaves** alternate, coriaceous to thickly coriaceous, glabrous, punctate and not glaucous below; oblong-ovate, elliptic to broadly elliptic, 7.5–15 × 3.5–6.5 cm, base cuneate, margin entire, apex acute or

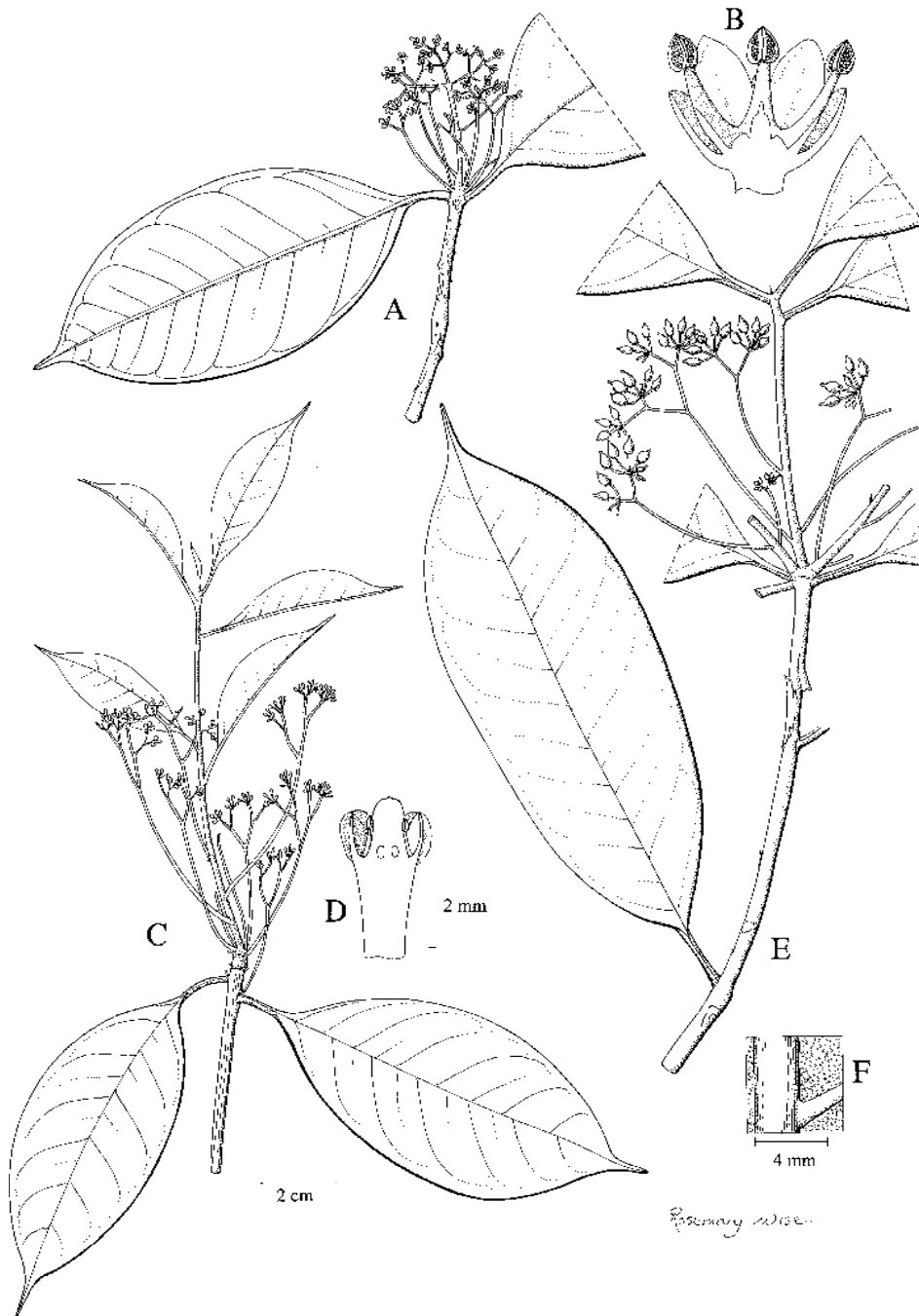


Fig. 2. *Ilex nervulosa*. A, flowering (male) leafy twig; B, longitudinal section through male flower; C, flowering (female) leafy twig; D, longitudinal section through female flower; E, fruiting leafy twig; F, detail of lower leaf surface. (A–B from *Kostermans 12790*, C–D from *SAN 102957*, E–F from *S 42203*.)

obtusely acuminate; midrib glabrous, deeply sunken above, prominent below; lateral veins 6–10 pairs, subopposite to alternate, fairly widely spaced, more or less parallel, ascending and looping before leaf margin, obscure above, prominent below; intercostal venation broadly reticulate, obscure on both surfaces; *petiole* glabrous, thick, *not channelled above*, 1–2 cm long. **Inflorescences** glabrous, axillary, *in lax compound cymes*. **Flowers** greenish white; males 4-merous; females 4–7-merous. **Fruits** globose, 3–3.5 mm diameter, red; stalk glabrous or slightly pubescent, 4–5 mm long; *pyrenes 4, striate*.

Vernacular names. Sabah—*kayu djung* (Obah). Sarawak—*bokol* (Land Dayak), *merkulat* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Sabah, known from Sipitang, Weston and Lumat (e.g., *SAN 24321*, *SAN 73239*, *SAN 86354*, *SAN 105163*, and *SAN 127067*). In Sarawak, recorded from Kuching, G. Santubong East, Bako NP, Bungoh Range, Mt. Stupong and Limbang (e.g., *S 7705*, *S 17298*, *S 29047*, *S 37160*, and *S 42203*). Also known from Brunei (e.g., *S 1061* and *S 4930*) and Kalimantan (e.g., *Hallier B 2422*, *Kostermans 9290* and *Kostermans 12790*).

Ecology. Found in seasonal swamp forest, *kerangas* forest, and rocky beach forest, at altitudes to 850 m.

16. *Ilex oppositifolia* Merr.

(Latin, *oppositifolius* = with opposite leaves)

J. Arn. Arb. 20 (1939) 223; Masamune *l.c.* 416; Andrews *l.c.* (1994) 46; Beaman *et al. l.c.* 117. **Type:** *Clemens 31108*, Borneo, Sabah, Penibukan (holotype A; isotypes BM, BO, G, K, L).

Erect shrub or small tree to 20 m tall. **Bark** greyish white; inner bark greenish brown. **Sapwood** pale grey. **Twigs** puberulous, rarely glabrous. **Leaves** *sessile, opposite, rarely subopposite*, coriaceous, glabrous, *epunctate below; broadly elliptic to oblong-elliptic or broadly ovate*, (4.5–)7–16(–20) × (3–)5–8.5(–10.5) cm, *base cordate to subamplexicaul*, margin entire, *apex shortly acute*; midrib glabrous, sunken above, occasionally with scattered hairs below, prominent; lateral veins 5–10 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, sunken above, prominent below; intercostal venation laxly reticulate, sunken or subprominent above, prominent below. **Inflorescences** puberulous, *in compound cymes*. **Flowers** white or pink or purplish pink edged with white outside, white inside; males 5–6(–8)-merous; females 8–14-merous. **Fruits** globose, 2–5 mm diameter, reddish black; stalk puberulous, *c.* 3 mm long; *pyrenes 4–9, sulcate*.

Distribution. Endemic to Borneo (Sabah). In Sabah, recorded from Mt. Kinabalu, Bt. Taviu and Mt. Silam (e.g., *Andrews 866*, *Andrews 870*, *Clemens 32557*, and *Clemens 40539*).

Ecology. Occurring in hill to lower montane forests on ultramafic soils near ridge tops or crests of rocky spurs, at 500–1500 m altitude.

Notes. *Ilex oppositifolia* is closely related to *I. zygophylla* but the latter only occurs in Mt. Kinabalu area, and usually seen as a shrub with petioles 2–7 mm long and the leaf base is subcordate, never subamplexicaul.

17. *Ilex orestes* Ridl.

(Greek, *orestes* = of the mountain; its natural habitat)

Bull. Misc. Inf., Kew 1 (1931) 35; Masamune *l.c.* 416; Anderson *l.c.* (1980) 151. **Type:** *Native Collector D167*, Borneo, Sarawak, Mt. Santubong (holotype E; isotypes K, SAR). **Synonym:** *I. havilandii* Loes. var. *major* W.W.Smith, Notes Roy. Bot. Gard. Edin. 4, 40 (1915) 323, Masamune *l.c.* 415.

Shrub or tree to 8 m tall. **Twigs** greyish brown, *puberulous*, somewhat channelled when dried. **Leaves** *alternate*, or *subopposite*, rarely *opposite*, *coriaceous*, not *bullate*, glabrous, *punctate* on both surfaces; *obovate* or *oblong-ovate*, 3.5–6.5 × 2–4.5 cm, base *cuneate*, margin *entire*, *revolute*, apex *retuse*; midrib glabrous and deeply sunken above, with scattered hairs and prominent below; *lateral veins* 3–5 pairs, *subopposite* to *alternate*, widely spaced, ascending and obscure before leaf margin, sunken above, prominent to subprominent below; *intercostal venation* obscure on both surfaces; *petiole* *puberulous*, *c.* 0.2 cm long. **Inflorescences** *puberulous*; male flowers *in axillary racemes*; female flowers *in condensed axillary racemes*. **Flowers** white or pale cream, 4–5-merous. **Fruits** globose, *c.* 3 mm diameter, purplish and closely wrinkled when dried; stalk *pubescent*, 1.5–2.5 mm long; *pyrenes* 6–8, *sulcate* to *somewhat smooth*.

Vernacular names. Sarawak—*kerdam* (Malay), *termiang* (Iban).

Distribution. Endemic to Borneo (Sarawak). Recorded from Mt. Matang, Mt. Santubong, and Bungoh Ranges in Sarawak (e.g., S 7616, S 37114, S 43652, and S 44763).

Ecology. In forest on summit ridges, at altitudes to 1000 m.

18. *Ilex promecophylla* S.Andrews

(Greek, *promecophylla* = with oblong leaves)

Sandakania 11 (1998) 11; Beaman *et al. l.c.* 117. **Type:** *Fedilis & Sumbing SAN 110918*, Borneo, Sabah, Ulu Sg. Pingas-Pingas (holotype SAN; isotypes K, KEP, L, SAR). **Synonym:** *Ilex* sp. 5, Coode *et al.* (eds.) *l.c.* 31.

Tree to 25 m tall. **Bark** smooth, dark brown, grey, whitish cream or yellowish grey, granular; inner bark very thin, variable in colour, often brownish grey or yellow. **Sapwood** pale yellow or almost white. **Twigs** glabrous, pale coloured, not peeling. **Leaves** *alternate*, *coriaceous*, glabrous above, glabrous, pale coloured, and *punctate* below; *oblong*, *obovate-oblong* or *broadly obovate-oblong*, 10.5–17(–24) × 4.5–6.5(–10) cm, base *cuneate*, margin *entire*, apex *mucronate* or *retuse*, rarely *obtuse*; midrib glabrous, sunken above, prominent below; *lateral veins* 6–8(–13) pairs, *subopposite* to *alternate*, more or less parallel, ascending and looping before leaf margin, obscure above, prominent below; *intercostal venation* broadly reticulate, obscure above, subprominent below; *petiole* glabrous, *not channelled* above, 2–3 cm long. **Inflorescences**

glabrous, rarely puberulous, in compound cymes. Flowers: males white to greenish white, 4–6-merous; females unknown. **Fruits** globose, 5–9 mm diameter, red; stalk glabrous, rarely puberulous, 5–10 mm long; pyrenes 4–6, striate-sulcate.

Distribution. Endemic to Borneo. In Sabah, found in Nabawan and Trus Madi FR in Keningau district, Ulu Sg. Pingas Pingas in Kinabatangan district, G. Lumaku FR in Sipitang district, and in a few other localities (e.g., *SAN 43152*, *SAN 104342*, *SAN 110918*, and *SAN 119226*). In Sarawak, recorded only from the Lambir NP (e.g., *S 40251*). Known also from Brunei (e.g., *BRUN 1*, *S 1504* and *S 3114*).

Ecology. Primary forest on slopes and along ridges, on sandy yellowish and black rocky soils, at altitudes to 1500 m.

19. *Ilex spicata* Blume

(Latin, *spicatus* = bearing a spike; referring to the spicate inflorescence)

Bijdr. Fl. Ned. Ind. (1827) 1149; Stapf *l.c.* 139; Loesener *l.c.* 428; Merrill *l.c.* (1921) 353; Masamune *l.c.* 412; Backer & Bakhuizen *f. l.c.* 52; Meijer *l.c.* 89; Andrews *l.c.* (1994) 47; Beaman *et al. l.c.* 118. **Type:** *Blume s.n.*, Java (holotype L). **Synonym:** *Prinos spicata* (Blume) Miq. *l.c.* (1859) 594.

Shrub or tree to 13.5 m tall, or more often epiphytic or climbing. **Bark** smooth, white or silvery grey; inner bark white. **Sapwood** white. **Twigs** glabrous. **Leaves** *alternate, coriaceous*, glabrous, *punctate below; elliptic, ovate or oblong-ovate, 5–8.5(–13) × 2.5–4.5(–6) cm, base rotundate, margin entire, apex long-acuminate*; midrib glabrous and deeply sunken above, glabrous and prominent below; lateral veins 5–7(–8) pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, obscure above, prominent below; intercostal venation broadly reticulate, sunken and obscure above, subprominent below; *petiole* glabrous, *not channelled above, 0.1–1.2 cm long*. **Inflorescences** glabrous, *spicate* and slightly twisted. **Flowers** creamy white, 4–6-merous. **Fruits** globose, *2.5–5 mm diameter*, reddish ripening to purplish black; stalk glabrous, 3–5 mm long; pyrenes 4–6, centrally sulcate.

Key to varieties

Petiole 0.7–1.2 cm long.....

var. **spicata**

Sumatra, Java, Borneo, and Sulawesi. In Sabah, known from Lamag area, Mt. Alab, Mt. Kinabalu and Mt. Tambuyukon (e.g., *Andrews 1593*, *Clemens 31557*, *SAN 42798*, *SAN 60360*, and *SAN 60643*). Also known in Kalimantan (e.g., *Hallier 1691*, *Hallier 3419*, *Mogea 3942*, and *Mogea 3968*). In primary lower montane forest, at altitudes to 1800 m altitude.

Petiole 0.1–0.2(–0.4) cm long.....

var. **harmsiana** (Loes.) S.Andrews

(H.Harms, 1870–1942, former botanist at the Botany Museum, Berlin, Germany)
Sandakania 11 (1998) 13. Basionym: *I. harmsiana* Loes. *l.c.* 433, Merrill *l.c.* (1921) 352, Masamune

l.c. 415, Beaman & Anderson *l.c.* 112. Type: unknown. Synonym: *Ilex* sp. 1 ? *spicata* auct. non Blume: Coode *et al.* (eds.) *l.c.* 30.

Endemic to Borneo. In Sarawak, recorded from several localities (e.g., *Argent & Jermy 1031*, *Beaman 11468*, *S 25739*, *S 30927*, and *S 52485*). In hill and montane forests and on limestone ridges, at altitudes to 2300 m. Also occurs in Brunei (e.g., *Coode 7421*, *Dransfield JD 7153* and *Wong WKM 757*). Vernacular names: Sarawak—*bupok*, *wa bupok* (Kelabit). Uses: For stomach ache. Boil young leaves in water to make a drink (Sarawak). Notes: This taxon has been confused with *Diplycosia heterophylla* Blume var. *latifolia* (Blume) Sleumer in the Ericaceae.

20. *Ilex triflora* Blume

(Latin, *triflorus* = three-flowered; the inflorescence)

Bijdr. Fl. Ned. Ind. (1827) 1150; Loesener *l.c.* 344; Ridley *l.c.* (1922) 438; Backer & Bakhuizen *f. l.c.* 52; Kiew, Gard. Bull. Sing. 31, 2 (1978) 81; Corner *l.c.* 65; Andrews *l.c.* (1994) 48; Turner *l.c.* (1995) 132; Coode *et al.* (eds.) *l.c.* 31; Beaman *et al.* *l.c.* 118. **Type:** *Blume s.n.*, Java (holotype L; isotypes BO, K). **Synonyms:** *I. horsfieldii* Miq. *l.c.* (1859) 594; *I. lobbiana* Rolfe *l.c.* 309; *I. griffithii* Hook. *f. l.c.* 601, King *l.c.* 135; *I. triflora* Blume var. *lobbiana* (Rolfe) Loes. *l.c.* 346, Merrill *l.c.* (1921) 353, Ridley *l.c.* (1922) 438, Masamune *l.c.* 417; *I. triflora* Blume var. *horsfieldii* (Miq.) Loes. *l.c.* 347; *I. triflora* Blume var. *javensis* Loes. *l.c.* 347; *I. polyphylla* Ridl., J. Fed. Mal. St. Mus. 6 (1915) 45, Ridley *l.c.* (1922) 438, Kiew, TFM 3 (1978) 81; *I. triflora* Blume var. *longifolia* Ridl. *l.c.* (1922) 438, Airy Shaw *l.c.* (1939) 511.

Shrub or small tree to 8 m tall, occasionally epiphytic. Bark smooth, silvery grey to brownish grey. **Twigs** shortly puberulous, rarely densely so, channelled when dried. **Leaves** *alternate, coriaceous*, glabrous above, usually glabrous and *prominently punctate below*; elliptic to ovate, 1–9.7 × 0.6–4 cm, base cuneate, *margin crenate or serrate throughout, apex acute or acuminate*; midrib puberulous and sunken above, scattered puberulous and prominent below; lateral veins 4–7 pairs, subopposite to alternate, irregularly spaced, more or less parallel, ascending and looping before leaf margin, obscure to subprominent on both surfaces; intercostal venation broadly reticulate, obscure on both surfaces; *petiole* puberulous, 0.2–1 cm long. **Inflorescences** puberulous, cymose. **Flowers** white or pale pink to purplish, 4-merous. **Fruits** ellipsoid or globose, 6.5–7.5 mm diameter, purplish black to black, closely wrinkled when dried; stalk puberulous, 5–13 mm long; pyrenes 4, striate.

Distribution. N India, tropical China, Hong Kong, Thailand, Laos, Vietnam, Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, and Maluku. In Sabah, uncommon, found on Mt. Kinabalu and Mt. Lotung (e.g., *Andrews 824*, *Clemens 26995* and *SNP 2738*). In Sarawak, recorded from Mt. Dulit, Mt. Mulu, Bt. Lawi, Bt. Pagon Kecil and Bt. Braang (e.g., *Nielsen 852*, *Nooteboom & Chai 2264*, *S 37385*, *S 38769*, and *S 50883*). Also known from Brunei (e.g., *BRUN 2348*, *S 8316* and *Wong WKM 1857*) and Kalimantan (e.g., *Donald & Ismail 4155*, *Hallier 2483* and *Teijsmann 11237*).

Ecology. In hill and lower montane forests or on ridge tops, at altitudes to 2300 m.

Notes. A widespread and extremely variable species in its leaf morphology, which is impossible to separate out on a geographic basis. Small-leaved collections have previously been identified as *Ilex* sp. 19 in several herbaria.

21. *Ilex wallichii* Hook.f.

Fig. 3.

(Nathaniel Wallich, 1786–1854, Danish botanist at Calcutta)

Fl. Brit. Ind. 1 (1875) 605; Loesener *l.c.* 72; Coode *et al.* (eds.) *l.c.* 31; Beaman *et al.* *l.c.* 118. **Type:** Gomez 150, Burma, Tavoy (holotype K; isotype K-W). **Synonyms:** *I. sclerophylloides* Loes. *l.c.* 77, Merrill *l.c.* (1921) 353, Ridley *l.c.* (1922) 440, Masamune *l.c.* 416, Anderson *l.c.* (1972) 26, Kiew, TFM 3 (1978) 9, Anderson *l.c.* (1980) 151, Turner *l.c.* (1995) 132; *I. mattangicola* Loes. *l.c.* 115, Merrill *l.c.* (1921) 353, Masamune *l.c.* 416.

Shrub or tree to 18 m tall. **Bark** smooth, white or grey; inner bark yellow, brown or greenish opaque, with fine striations near the cambium, brittle. **Sapwood** white to yellow. **Twigs** glabrous, white, peeling. **Leaves** *alternate, coriaceous*, glabrous on both surfaces, *epunctate below*; oblong to elliptic-oblong or obovate, (5–)6.5–13 × (1.5–)4–7 cm, *base cuneate*, margin entire, *apex mucronate, retuse or acuminate*; midrib glabrous, sunken above, prominent below; lateral veins 5–7 pairs, subopposite to alternate, widely spaced, more or less parallel, ascending and looping before leaf margin, subprominent above, prominent to subprominent below; intercostal venation broadly reticulate, obscure on both surfaces; *petiole* glabrous, 0.6–1 cm long. **Inflorescences** *cymose*, usually *glabrous on primary pedicels*, pubescent on secondary pedicels. **Flowers** greenish white; males 4–6-merous; females 10–13-merous. **Fruits** oblong or globose, smooth, 8.5–9.5 mm diameter, dark red to blackish red; stalk pubescent, thickened at apex, 1.3–4.5 mm long; pyrenes (7–)9–12, smooth.

Vernacular names. Sabah—*mengkulat* (preferred name). Sarawak—*kerdam* (Melanau), *kerdam daun kechil* (preferred name).

Distribution. Burma, Thailand, Indo-China, Sumatra, Peninsular Malaysia, and Borneo. In Sabah and Sarawak, common (e.g., *SAN* 36256, *SAN* 49607, *S* 32771, *S* 42748, and *S* 48104). Also known from Brunei (e.g., *BRUN* 2463, *SAN* 17459 and *S* 2857) and Kalimantan (e.g., *Endert* 2013, *Kostermans* 9259, *Kostermans* 9590, *Kostermans* 13076, and *Meijer* 1037).

Ecology. Locally common, occurring in *Dacrydium-Casuarina kerangas* forest and primary peat swamp forest, at altitudes to 1000 m.

22. *Ilex zygophylla* Merr.(Greek, *zygophyllum* = with paired or opposite leaves)

J. Arn. Arb. 20, 2 (1939) 224; Masamune *l.c.* 417; Meijer *l.c.* 89; Andrews *l.c.* (1994) 48; Beaman *et al.* *l.c.* 118. **Type:** *Clemens* 51073, Borneo, Sabah, Mt. Kinabalu, Gurulu Spur (holotype A; isotypes G, L, UC).

Shrub or treelet to 5(–10) m tall. **Leaves** *opposite or subopposite*, coriaceous, puberulous, rarely glabrous above, less so and *epunctate below*; *ovate, obovate or elliptic*, (1.5–)4–7 × 1.5–4.5(–5) cm, *base subcordate*, margin entire, revolute, *apex acute or mucronate*; *petiole* puberulous, 0.2–0.7 cm long. **Inflorescences** puberulous, *in compound cymes*. **Flowers:** males 4–6-merous; females 6–13-merous, pink in bud, opening white. **Fruits** globose, 4–5 mm diameter, purple; pyrenes 6–9, sulcate to striate.

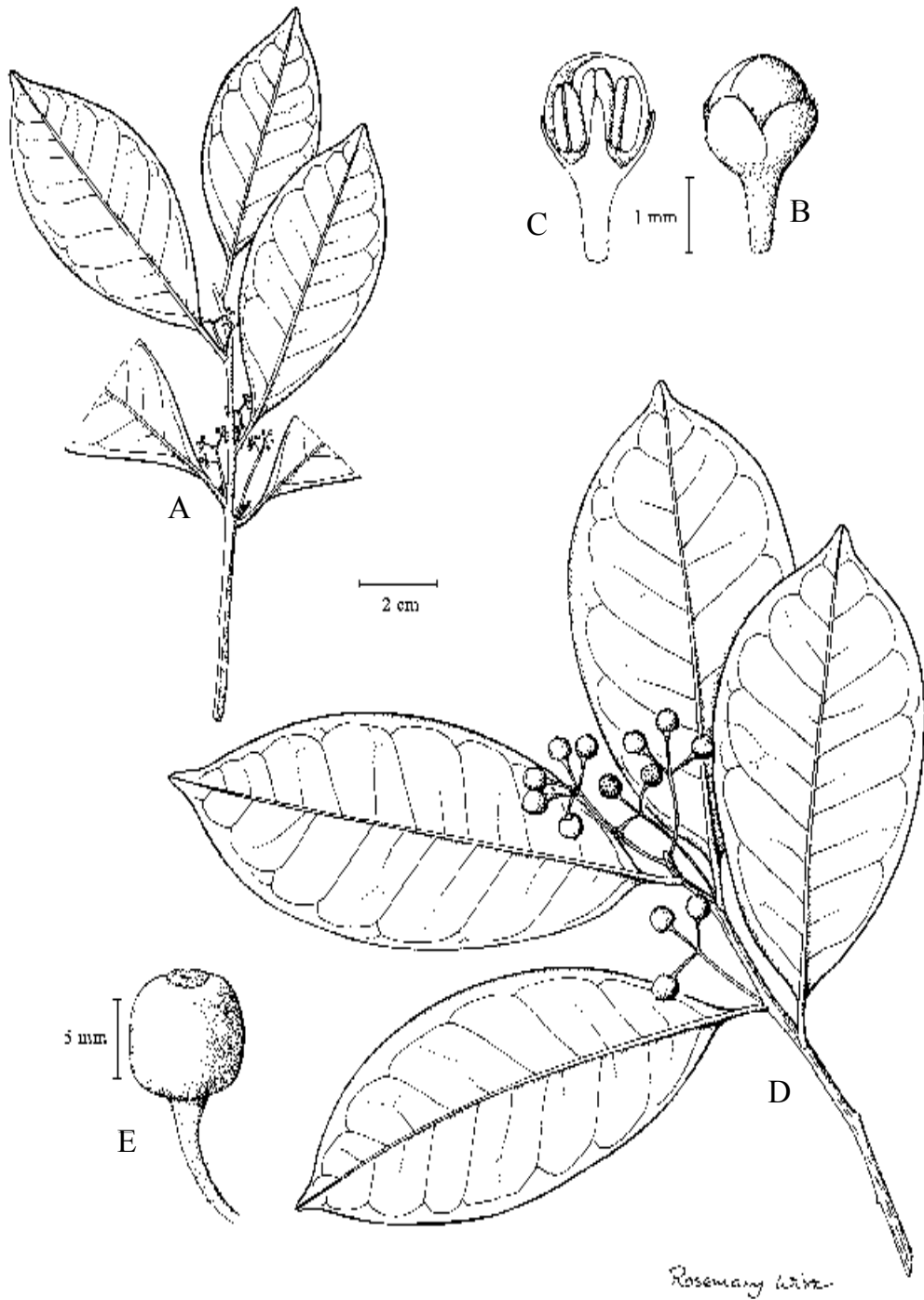


Fig. 3. *Ilex wallichii*. A, flowering (male) leafy twig; B, immature male flower bud; C, longitudinal section through immature male flower bud; D, fruiting leafy twig; E, fruit and stalk. (A–C from *S* 23148, D–E from *SAN* 49518.)

Distribution. Endemic to Borneo, occurring on Mt. Kinabalu, Pig Hill and Mt. Tambuyukon in Sabah (e.g., *Andrews 887*, *Clemens 51073*, *SAN 21054*, *SAN 29260*, and *SAN 38419*).

Ecology. In open montane forest on ultramafic soils, at 2300–3300 m altitude.

EBENACEAE

Francis S.P. Ng

Forest Research Institute Malaysia,
Kepong, Malaysia

Hiern, Trans. Cambr. Phil. Soc. 12, 2 (1873) 27; King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 412; Merrill, EB (1921) 601, PEB (1929) 240; Ridley, FMP 2 (1923) 278; Bakhuizen, Gard. Bull. S. S. 7 (1933) 161, Bull. Jard. Bot. Buitenz. 3, 15, Part 1 (1936) 3, Part 2 (1937) 50, Part 3 (1938) 179, Part 4 (1941) 369, and Part 5 (1955) plates 1–92; Masamune, EPB (1942) 601; Backer & Bakhuizen *f.*, FJ 2 (1965) 184; Ng, Malay. For. 40 (1977) 210, TFM 3 (1978) 56; Anderson, CLTS (1980) 167; Whitmore, Tantra & Sutisna, CLK 1 (1990) 88; Turner, Gard. Bull. Sing. 47 (1995) 196; Coode *et al.* (eds.), CLBD (1996) 87; Argent *et al.* (eds.), MNMT-CK 1 (1997) 176; Beaman *et al.*, PMK 4 (2001) 226.

A family of two genera of small to big trees: *Euclea* (12 species in Africa) and *Diospyros* (c. 500 species worldwide).

DIOSPYROS L.

(Greek, *dios* = god, *puros* = wheat or fruit; alluding the edible persimmon fruit)

kayu arang, kayu malam (Malay)

Sp. Pl. 2 (1753) 1057, Gen. Pl. 5th edition (1754) 478; King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 417; Merrill, EB (1921) 601, PEB (1929) 240; Ridley, FMP 2 (1923) 281; Bakhuizen, Gard. Bull. S. S. 7 (1933) 161; Bull. Jard. Bot. Buitenz. 3, 15, Part 1 (1936) 6; Backer & Bakhuizen *f.*, FJ 2 (1965) 184; Ng, TFM 3 (1978) 57; Anderson, CLTS (1980) 167; Whitmore, Tantra & Sutisna, CLK 1 (1990) 88; Coode *et al.* (eds.), CLBD (1996) 87; Argent *et al.* (eds.), MNMT-CK 1 (1997) 176; Beaman *et al.*, PMK 4 (2001) 226. **Synonym:** *Maba* J.R. & G.Forst., Char. Gen. Pl. (1776) 121, King & Gamble *l.c.* 412, Ridley *l.c.* (1923) 279.

Dioecious (very rarely monoecious) trees *without latex*. Outer bark in most species characteristically thin, black, hard and finely longitudinally cracked or fissured; slash inner bark and sapwood mostly white to cream but in some species bright yellow, immediately or soon after exposure to air. **Leaves** *simple, alternate, entire, exstipulate, petiolate*, drying yellowish, dark brown or black on one or both sides. **Inflorescences** *cymose* (with basic cymose unit of 3, 5 or 7 flowers, sometimes reduced to one flower, sometimes branching to carry multiple units), axillary (except for *D. dipehorstii* where inflorescences are borne on larger branches and tree trunk), bracteate, usually shorter than leaves, males tending to have more flowers per inflorescence than females. **Flowers** *unisexual* (sporadically bisexual), *articulated at base, radially symmetrical, 3–5(–8)-merous; calyx* united at base, distally divided into lobes or teeth, or truncate (not so

divided), if lobed, the lobes imbricate (overlapping) or valvate (not overlapping), *persistent in fruit*; corolla with a narrow (salverform) or bulging (urceolate) tube bearing spreading lobes at the mouth. **Male flowers:** stamens (3)–12–20(–100), attached to the base of corolla tube, rarely towards the mouth, sometimes on the receptacle, usually not or only slightly protruding out of the mouth, often in two whorls; anthers *basifixed*, usually longer than filaments, 2-locular, dehiscent by longitudinal slits; filaments free or united in pairs, triads or larger fascicles, or even into a single column; pistillode represented by a small sterile lump of tissue or absent or sometimes well-formed enough in the central flower of a male cyme to be functionally female. **Female flowers:** *ovary superior, multilocular, 2–8-carpellate as indicated by the number of styles or stigmatic lobes, each carpel corresponding to one biovulate locule or two uniovulate locules* (the uniovulate condition resulting from the development of a ‘false’ septum between the primarily paired ovules); ovules *pendulous*, anatropous, bitegmic; staminodes reduced to a single whorl of sterile epipetalous lobes or absent. **Fruit** a *berry*; pericarp fibrous or fleshy, in some species, differentiated into three layers: an inner fleshy endocarp around each seed which may be mistaken for a sarcotesta, a fleshy to fibrous mesocarp, and an outer exocarp (skin). **Fruit calyx** remaining the same size as in flowers (not accrescent), or becoming enlarged in fruit (accrescent). **Seeds** 1–16, *arranged in a single whorl around central axis*, with thin coriaceous testa and *thick horny endosperm*; embryo straight or slightly curved, with flat leafy cotyledons and a *prominent radicle as long as or longer than cotyledons*; where there are three or more seeds in a fruit, the *seeds wedge-shaped, like segments of an orange, with an unbranched circumperipheral vascular strand running along the inner edge and round the back*; in only a few species (e.g. *D. maingayi*) is the vascular strand branched over the surface of the seed. **Germination** of most species epigeal; a few hypogeal or durian.

Other vernacular names. Sabah—*parong* (Dusun), *sitam* (Murut). Sarawak—*bagoa* (Bidayuh, Bau), *balih* (Iban), *gigi* (Bidayuh, Bau), *kayu birang* (Berawan), *kayu lusang* (Kenyah), *kayu padang* (Punan, Tutoh), *kayu tam* (Kayan), *merpinang* (Iban), *pangkabar* (Bidayuh, Padawan).

Distribution. About 500 species, in Asia, Africa, N, S and C America, Australia and the South Pacific Islands, mostly tropical or subtropical. Absent in Europe except for *D. lotus*, naturalised in the Mediterranean region, which may have been introduced from east Asia along the ancient overland trading routes (Ng, Malay. For. 42 (1979) 165). In Sabah and Sarawak, a total of 75 species are recognised.

Ecology. Species of *Diospyros* are found from coastal sandy or rocky shores up to lower montane mossy forests, including limestone hills and peat swamps. They are absent from mangrove forests. Regeneration failure (in species with epigeal germination) may occur due to mortality at the germination stage after the hypocotyl has begun to elongate and lift the seed body out of the soil. At this stage, the seed coat should be cast off by the expansion of the cotyledons and plumule; if not, the trapped cotyledons and plumule will decay and the seedling will die. Wright (Ann. Roy. Bot. Gard. Peradeniya 2 (1904) 1) called this “suicidal germination”, a phenomenon also observed in some other plants, e.g. in Euphorbiaceae and Flacourtiaceae (Ng, MFFSS 1 (1991) 61 & 67). Such seedlings may be saved if the seed coat and endosperm are manually removed before decay sets in.

Timber. The timber is very fine-grained, dense, dimensionally stable, usually pale yellow in colour, and anatomically quite uniform throughout the genus. In a few species, the heartwood is

durable and dark brown to black or streaked black; these are the famous ebonies of commerce, now very scarce. The main producers of ebony are tropical Africa, India, Sri Lanka and the islands of eastern Indonesia, where there is a prolonged dry season. The wood of ordinary (non-ebony) *Diospyros* is less durable but nevertheless attractive because of its density, fineness of grain, and dimensional stability; it can be stained black if so desired. As timber, *Diospyros* spp. have been ignored in Malaysia because the trees are mostly medium-sized, while the industry has been shaped and dominated by the availability of big trees such as those of Dipterocarpaceae. *Diospyros* would be an excellent candidate for consideration in any programme to grow high value timber.

Uses. Ebony has been traded for over 2000 years as a fancy wood for fine furniture, wood carvings, the black keys of classic pianos, etc. The wood of the American *D. virginiana* has been used for the heads of golf clubs.

The fruits of several species are edible, and the name of the genus alludes to this. Of these, the most popular is the oriental persimmon, *D. kaki*, one of the classic fruits of China and Japan. This is a hexaploid ($2n = 90$), probably derived from the diploid ($2n = 30$) subtropical *D. roxburghii* (Ng, Malay. For. 41 (1978) 43) by polyploidy and selection for frost hardiness. *D. kaki* is now cultivated in many temperate countries and in the tropical highlands; a few trees have been grown in Kuching at almost sea level, and have fruited regularly. Other edible cultivated persimmons are *D. lotus* (Japan, across Eurasia to the West Asia and the Mediterranean, with a subspecies *brideliifolia* in the Philippines), *D. digyna* (C America) and *D. blancoi* (the Philippines). In this revision a forest species in Borneo is determined as the wild type of *D. blancoi*. Other wild species in SE Asia known to have edible fruits include *D. argentea*, *D. diepenhorstii*, *D. macrophylla* and *D. pyrrhocarpa*. The species with most potential are those with the whole pericarp edible, but in most forest species, the edibility is restricted to the thin layer of endocarp (pseudo-sarcotesta) around the individual seeds.

The fruits of all species are high in tannin-content which make them completely inedible until fully ripened. The tannin has been used to toughen and preserve fishing nets.

The fruits of several species (e.g. *D. piscicarpa*, *D. styraciformis* and *D. wallichii*) are used to stupefy fish. The species used in this way are usually called *tuba* or some variation of it (*buah tuba*, *tuba api*, *tuba monyet*, etc). The name *tuba* is also applied to *Derris elliptica* and some other species of *Derris*, the roots of which are pounded to release sap, which when cast into a river, cause fish to be stunned. Such fish float to the surface and can be easily scooped up. The (immature) fruits of *Diospyros* are pounded in the same way to release a red or black sap and cast into the water to produce the same result. This method of fishing has been discovered independently on the opposite side of the world, in the West Indies, where the immature fruits of the local species *D. ebenaster* (a synonym of *D. digyna*) are used (Burkill EPMP 1 (1966) 842). This parallels the use of *Derris* in fishing which has also developed independently in tropical Asia and tropical America.

The fruits of several species of *Diospyros* were believed by Bakhuizen to be palatable but poisonous to humans. Among these he named *D. perfida*, *D. insidiosa* and *D. daemonia* in allusion to their allegedly perfidious, insidious and demonic nature. Eight men on patrol in Sigli, Sumatra had reportedly eaten the fruits of *D. insidiosa* (which must have been very tasty) and become ill; one of them died. The identification was based on a half-eaten fruit, but Bakhuizen was not

sure whether it was *D. insidiosa* or *D. perfida*, so he gave both a bad name. *D. daemona* was considered poisonous by taxonomic association because in Bakhuisen's classification scheme, it came next to *D. insidiosa*. However, another species placed next to *D. insidiosa* was *D. dipehorstii*, which is safely edible. The claim that some *Diospyros* fruits can be palatable but poisonous is therefore unproven. The men could have been struck by virus. The poisoning of fish using immature astringent fruits is a different matter.

In India, a local industry is based on *D. melanoxydon* leaves, which are dried, rolled and used as *bidi* cigarettes.

In ornamental horticulture, small-leaved species are valued for bonsai culture, especially in Thailand. In Malaysia, *D. ferrea* may be used for the same purpose. In the Philippines, *D. blancoi* is a popular ornamental roadside tree.

Reproductive biology. *Diospyros* is generally dioecious, i.e. with separate male and female trees, but there is some variation in the expression of sexuality. In *D. wallichii*, which is a common wild tree in secondary forest in Kepong, the sexes seem to be absolutely separate. In this species, a male tree never bears fruits. However, the situation is different with *D. ismailii*, where trees grown from seeds produce female trees which are consistently female, and male trees which regularly bear a small percentage of bisexual flowers, usually the central flower in a cyme. Such bisexual flowers may produce fruits. In *D. digyna*, a planted single female tree has been observed to bear seedless fruits only, but on one occasion, it produced a fruit with a full complement of seeds even when there were no male trees anywhere in the vicinity. The cultivated *D. kaki* is usually monoecious, with the central flower of the cyme bisexual, flanked by male flowers.

Taxonomy. Despite the large number of species and the wide geographical distribution of *Diospyros*, all members of the genus are easy to recognise in the field because of their consistent and characteristic architecture of monopodial trunk bearing spirally arranged leaves, and intermittent pseudowhorls of distichous branches. Such trees belong to the architectural model of Massart (Halle, Oldeman & Tomlinson, *Tropical Trees and Forests* (1978) 1). Other common trees belonging to this model are the Myristicaceae (which can be distinguished by the red sap when the bark is slashed) and *Dipterocarpus* (which is distinguished by stipules). The Malay name *kayu arang* (= charcoal wood) alludes to the black hard outer bark which in some species may become thick and conspicuous. Such bark also develops in some members of the Myristicaceae which are called *penarahan arang*. The Ibans in Brunei apply the name *kayu balik* to several species of *Diospyros* (*D. borneensis*, *D. elliptifolia*, *D. lanceifolia*, *D. styraciformis*, and *D. wallichii*) of which the inner bark and sapwood turn bright yellow when cut.

The ovary, fruit and seed of *Diospyros* are anatomically absolutely distinctive and diagnostic of the genus. The form of the persistent calyx of *Diospyros*, together with the fruit size and stalk length, provide important characters for the delimitation of species. It is important to distinguish between calyx lobes that are imbricate (overlapping), valvate (not overlapping) or truncate (without lobes) and calyces which are accrescent (enlarged with the fruit) or not accrescent.

Bakhuizen *l.c.* (1936–41) divided the genus into 4 subgenera and 34 sections. His classification proved to be unsustainable. Three of his species, although described in detail, were not even *Diospyros* (Ng, *Blumea* 18 (1970) 412): *D. hierniana* (King & Gamble) Bakh. proved to be *Salacia grandiflora* Kurz (Celastraceae), *D. micromera* Bakh. was *Cleistanthus nitidus* Hook. *f.* (Euphorbiaceae) and *D. sororia* Bakh. was *Ilex borneensis* Loes. (Aquifoliaceae). In other cases, species that he placed in different sections have turned out to be components of a single variable species.

Most of the species are variable within narrow limits, but a few are extremely variable, either in leaf morphology (e.g., *D. andamanica* and *D. sumatrana*) or fruit calyx morphology (e.g., *D. mindanaensis*), or both (*D. pilosantha*). Wherever possible, the variable species have been divided into varieties but in some cases, subdivision cannot be carried out without leaving many specimens without a home. For example, if varieties are defined by the form of the fruiting calyx, many non-fruiting specimens (including male specimens) would be homeless. In such species, no subspecific subdivision is recognised. In 1977, Kostermans described many new species of *Diospyros*. Many of these have turned out to be no more than extreme forms of previously described variable species.

Key to *Diospyros* species

1. Leaves with invisible intercostal venation.....2
 Leaves with visible (faint to prominent) intercostal venation on one or both sides of the leaf..... 17
2. Twigs and both sides of leaves drying consistently black.....3
 Twigs and leaves drying not so..... 6
3. Leaves elliptic or ovate.....4
 Leaves obovate, oblong-ovate, oblong-elliptic, or oblong and parallel-sided.....5
4. Leaves 8–20 × 5–11 cm.....**44. D. maingayi**
 Leaves 3.5–10 × 1.2–4 cm.....**57. D. puncticulosa**
5. Leaves coriaceous, mostly obovate, with apex rounded, retuse or acute (rarely acuminate).....**26. D. evena**
 Leaves membranaceous, oblong-ovate or oblong and parallel-sided, with apex acuminate..... **12. D. confertiflora** (in part)
6. Leaves oblong and parallel-sided.....7
 Leaves of other shapes and not parallel-sided.....8
7. Twigs bearing spreading 0.2 cm long hairs. Leaves 1.5–4 × 0.5–1 cm.....
 **11. D. clementium**
 Twigs glabrous or bearing hairs shorter than 0.1 cm. Leaves 2.5–9 × 1–3.5 cm.....
 **12. D. confertiflora** (in part)

8. Leaves glaucous below.....	36. D. havilandii
Leaves not glaucous below.....	9
9. Leaves narrow and willow-like, 6–11 × 0.7–2 cm, long-tapered to apex and base.....	40. D. lanceifolia (in part)
Leaves not narrow and willow-like.....	10
10. Leaves longer than 7 cm.....	11
Leaves shorter than 7 cm.....	13
11. Lateral veins 3–5 pairs.....	64. D. singaporensis (in part)
Lateral veins 7–10 pairs.....	12
12. Twigs and leaves glabrous.....	51. D. pendula
Twigs and leaf undersurface densely appressed hairy, at least in young parts.....	5. D. blancoi (in part)
13. Female inflorescences (excluding flowers) 0.1–0.2 cm long. Fruits sessile... 14	
Female inflorescences (excluding flowers) 0.5–2.5 cm long. Fruits stalks 0.5–2.5 cm long.....	15
14. Leaf base attenuate; male flowers solitary, corolla salverform, <i>c.</i> 0.8 cm long. Fruits globose.....	65. D. squamaefolia
Leaf base cuneate, rarely attenuate; male flowers in clusters of 2–5, ovoid or globose in bud, <i>c.</i> 0.2 cm long. Fruits ellipsoid.....	9. D. buxifolia
15. Leaves obovate, with apex rounded, acute or shortly acuminate. Fruits ellipsoid.....	50. D. parabuxifolia
Leaves elliptic or rhombic, with apex acuminate to caudate. Fruits globose....	16
16. Fruits <i>c.</i> 1.5 cm diameter, thin-walled (wall brittle and often crushed in drying).....	34. D. graciliflora
Fruits 2.5–3.5 cm diameter, thick-walled (wall not puckered nor crushed in drying).....	64. D. singaporensis (in part)
17. Leaves with pronounced intramarginal veins (result of lateral veins inarching and linking up at the margins and the linked portions strengthened as a continuous vein).....	18
Leaves without intramarginal veins (lateral veins diminishing till inconspicuous, or if inarching, the arches not strengthened as a continuous vein).....	23
18. Leaves densely hairy below.....	40. D. lanceifolia (in part)
Leaves glabrous below.....	19
19. Intramarginal veins distant from leaf margin, leaving a marginal space about one-third of the midrib-to-margin width.....	20
Intramarginal veins very close to the margin.....	21

20. Lateral veins and intercostal venation sunken on the leaf uppersurface. Fruits on 0.8–1.3 cm stalks; fruit calyx leafy-coriaceous, erect, outstretched and prominently veined...
.....**48. D. neurosepala**
Lateral veins and intercostal venation flush or prominulous on the leaf uppersurface.
Fruits sessile; fruit calyx lobes with sides reflexed to almost touch each other,
not visibly veined.....**7. D. brainiana**
21. Intercostal venation reticulate.....**31. D. foxworthyi**
Intercostal venation scalariform.....22
22. Calyx (both male and female) truncate. Leaves oblong, elliptic or ovate.....
.....**6. D. borneensis**
Calyx divided into 4–5 valvate lobes. Leaves oblong or oblong-obovate.....
.....**4. D. beccarioides**
23. Intercostal venation scalariform, spaced 0.1–0.2 cm apart.....24
Intercostal venation reticulate, areolate, or laxly scalariform.....27
24. Leaf base subcordate. Twigs and leaf undersurface densely hairy with spreading
hairs all over.....**52. D. penibukanensis** (in part)
Leaf base rounded to cuneate. Twigs and leaf undersurface not densely hairy all over...
.....25
25. Fruits ellipsoid, *c.* 1 × 0.5 cm.....**23. D. eriantha**
Fruits globose to depressed ovoid, 2.6–5.5 cm diameter.....26
26. Fruits on 0.5–1 cm long stalks.....**37. D. keningauensis**
Fruits sessile on 0.1–0.2 cm long stalks.....**41. D. lateralis**
27. Leaves subglaucous below, elliptic. Trees of peat swamps.....**62. D. siamang**
Not this combination.....28
28. Leaves oblong-obovate, 20–40 cm long, with rounded, subcordate or cordate base.
Bark of twigs corky.....**25. D. euphlebica**
Not this combination.....29
29. Leaves oblong, 13–50 cm long, with rounded to subcordate base. Inflorescences borne on the
larger branches and on the trunk. Fruits to *c.* 10 × 6 cm, vertically ribbed; fruit calyx forming
a shallow cup with 6 shallow lobes.....**20. D. diepenhorstii**
Not this combination.....30
30. Leaves narrow, willow-like, tapered gradually to base and apex.....
.....**24. D. eucalyptifolia**
Not this combination.....31
31. Leaves elliptic to obovate, with attenuate base; lateral veins 5–12 pairs, prominulous
on both sides of the leaf, steeply ascending and forming multiple loops in the apical half of
the leaf.....**21. D. discocalyx**
Not this combination.....32

32. Leaves 8–32 × 4–12 cm, with attenuate base and very short petiole (leaves almost subsessile); midrib grooved above and with prominently raised rims alongside the groove, especially towards the petiole..... **22. D. elliptifolia**
 Not this combination..... 33
33. Leaves oblong-elliptic to elliptic, 7–21 × 3–7 cm, with somewhat undulate margins and acute to rounded apex. Trees of seacoasts..... **45. D. maritima**
 Not this combination..... 34
34. Calyx lobes elongated or filiform, 0.1–0.2 cm wide and 4–15 times as long... 35
 Calyx unlobed (truncate) or lobed with the lobes not so elongated..... 36
35. Calyx lobes glabrous..... **18. D. densa**
 Calyx lobes covered with spreading rusty hairs..... **28. D. ferox**
36. Calyx truncate (with neither lobes nor teeth)..... 37
 Calyx divided into lobes or teeth..... 38
37. Leaves 10–20 cm long, with 5–8 pairs of lateral veins..... **73. D. ulu**
 Leaves 21–26 cm long, with *c.* 12 pairs of lateral veins..... **68. D. subtruncata**
38. Calyx lobes imbricate (overlapping)..... 39
 Calyx lobes (or teeth) valvate (not overlapping)..... 52
39. Leaf base mostly cordate, subcordate or rounded..... 40
 Leaf base mostly cuneate or attenuate..... 46
40. Intercostal venation scalariform..... 41
 Intercostal venation reticulate..... 42
41. Fruits to 6 cm diameter, on 1–3.5 cm long stalks..... **17. D. daemonia**
 Fruits to *c.* 2.5 cm diameter, on *c.* 0.5 cm long stalks... **52. D. penibukanensis** (in part)
42. Lateral veins faint on the leaf undersurface..... **5. D. blancoi** (in part)
 Lateral veins prominently raised on the leaf undersurface..... 43
43. Twigs bearing 0.2–0.3 cm long spreading hairs..... **13. D. cordata**
 Twigs bearing short appressed hairs..... 44
44. Fruits glabrous to sparsely appressed hairy; fruit calyx lobes 0.6 × 0.6 cm.....
 **42. D. lunduensis**
 Fruits densely velvety or bearing bristly hairs; fruit calyx lobes to 0.3 × 0.3 cm.....
 45
45. Midrib sunken above. Fruits velvety..... **27. D. everettii**
 Midrib prominent above. Fruits (and ovary) bristly hairy..... **47. D. muricata**
46. Male inflorescence (excluding flowers) 2–4.5 cm long..... **15. D. crockerensis**
 Male inflorescence (excluding flowers) 0.1–1.5(–3) cm long..... 47

47. Fruit calyx, including the lobes, forming a cup tightly fitting the base of the fruit.....
..... **53. *D. perfida*** (in part)
Fruit calyx not forming a tightly fitting cup.....48
48. Fruits oblong-ellipsoid..... **56. *D. plectosepala***
Fruits globose.....49
49. Fruit calyx lobes up to 0.6×0.6 cm..... **10. *D. cauliflora***
Fruit calyx lobes up to 0.3×0.2 cm.....50
50. Fruits sparsely appressed hairy or glabrous..... **49. *D. oligantha***
Fruits densely hairy or velvety.....51
51. Inflorescence (excluding flowers) 0.2–0.5 cm long..... **67. *D. subrhomboidea***
Inflorescence (excluding flowers) 0.6–2 cm long..... **63. *D. simaloerensis***
52. Calyx divided into 3 (rarely 4) lobes.....53
Calyx divided into 4 or 5 (rarely 3) lobes or teeth.....56
53. Fruits to 5 cm diameter when dried..... **71. *D. toposia*** (in part)
Fruits to 3 cm diameter when dried.....54
54. Fruit calyx lobes reflexed backwards..... **74. *D. venosa***
Fruit calyx lobes not reflexed backwards.....55
55. Fruit calyx forming a shallow 3-pointed dish or cup of about the same diameter as the
fruit..... **29. *D. ferrea***
Fruit calyx small and dwarfed by the fruit..... **2. *D. andamanica***
56. Fruits 2.5 cm diameter or smaller when dried.....57
Fruits 2.5–7.5 cm diameter when dried.....69
57. Fruits asymmetric, one side with a longer curve than the opposite side.....
..... **72. *D. tuberculata***
Fruits symmetric (sometimes curved in *D. sumatrana*).....58
58. Fruits ovoid, ellipsoid, oblong or spindle-shaped.....59
Fruits globose or nearly so.....61
59. Inflorescence (excluding flowers) 1–6.5 cm long..... **33. *D. fusiformis***
Inflorescence (excluding flowers) 0.1–0.5 cm long.....60
60. Fruit calyx lobes erect or spreading..... **70. *D. sumatrana***
Fruit calyx lobes reflexed..... **39. *D. kurzii***
61. Lateral veins prominulous to almost flush with the leaf undersurface.....62
Lateral veins prominent on the leaf undersurface.....63

62. Midrib velvety hairy below.....**30. D. ferruginescens** (in part)
 Midrib glabrous below.....**54. D. pilosanthera** (in part)
63. Lateral veins 11–30 pairs.....64
 Lateral veins 4–11 pairs.....65
64. Fruit calyx lobes leafy-coriaceous and outstretched...**54. D. pilosanthera** (in part)
 Fruit calyx lobes woody and short.....**75. D. wallichii**
65. Leaves densely hairy below.....66
 Leaves glabrous below.....67
66. Petioles 0.8–1.2 cm long.....**40. D. lanceifolia** (in part)
 Petioles 0.5–0.7 cm long.....**30. D. ferruginescens** (in part)
67. Leaves membranaceous.....**32. D. frutescens**
 Leaves chartaceous to coriaceous.....68
68. Fruit calyx veins faint or invisible.....**40. D. lanceifolia** (in part)
 Fruit calyx distinctly veined.....**16. D. curranii**
69. Fruit calyx prominently veined.....70
 Fruit calyx veins very faint or invisible.....73
70. Leaves oblong, 15–45 × 6.5–14 cm, coriaceous, drying subglaucous below;
 intercostal veins forming a very close and prominent reticulation on the leaf
 undersurface.....**60. D. rigida**
 Leaves elliptic, ovate, narrowly oblong-elliptic or obovate, up to 22 × 10 cm,
 chartaceous, not subglaucous below; intercostal veins prominulous below.....71
71. Leaves narrowly oblong-elliptic, up to 15 × 4.3 cm, with lateral veins tending to form
 intramarginal loops.....**14. D. coriacea**
 Not this combination.....72
72. Petiole and midrib below coarsely wrinkled on drying.....**19. D. dictyoneura**
 Petiole and midrib not coarsely wrinkled on drying.....**55. D. piscicarpa**
73. Fruit calyx, including the lobes, shaped into a tight-fitting cup clasping the base
 of the fruit.....**53. D. perfida** (in part)
 Fruit calyx (or at least the lobes) not shaped into a tight-fitting cup.....74
74. Leaves oblong-elliptic to oblong-obovate, intercostal venation forming a very fine
 and prominulous reticulo-scalariform pattern in which the scalariform lines are about
 0.2 cm apart.....**35. D. hallieri**
 Not this combination.....75
75. Leaves oblong to oblong-elliptic, with minute reticulations of less than 0.1 cm width
 on both sides, often bullate between the veins.....**71. D. toposia** (in part)
 Not this combination.....76

76. Fruits with 9–16 vertical ribs or furrows, corresponding to the number of seeds developed within.....**1. *D. alatella***
Fruits not ribbed.....77
77. Leaves narrow, 1.5–3 cm wide.....**8. *D. britanno-borneensis***
Leaves mostly wider than 3 cm.....78
78. Basal part of the fruit calyx forming a conspicuous cup fitting the basal quarter to half of the fruit.....79
Basal part of the fruit calyx not distinctly cup-like.....80
79. Fruits solitary, on 0.2–0.6 cm long stalks.....**38. *D. korthalsiana***
Fruits in clusters of 1–3, on 1–2 cm long stalks.....**66. *D. styraciformis***
80. Fruit calyx lobes to 0.5 × 0.5 cm, flattened against the base of the fruit...**61. *D. rufa***
Fruit calyx lobes not so.....81
81. Fruit calyx lobes *c.* 1 cm long and with the two sides of each lobe folded back to almost meet each other.....**69. *D. sulcata***
Fruit calyx lobes not so.....82
82. Fruits densely velvety, conspicuously puckered on drying.....**58. *D. pyrrhocarpa***
Fruits glabrous to velvety, not puckered on drying.....83
83. Fruits up to 3.5 cm diameter; fruit calyx lobes usually much folded (plicate).....
.....**54. *D. pilosanthera*** (in part)
Fruits 4–7.5 cm diameter; fruit calyx lobes less plicate.....84
84. Leaves densely to sparsely hairy on the midrib and lateral veins below.....
.....**43. *D. macrophylla***
Leaves glabrous.....85
85. Leaf uppersurface smooth and shiny.....**3. *D. areolata***
Leaf uppersurface dull.....86
86. Fruit calyx forming a flat 4–5-pointed woody plate, not as wide as the fruit, with the edges of the lobes stretched until no longer evident or persisting as a narrow reflexed fringe.....**59. *D. ridleyi***
Fruit calyx very variable, erect or reflexed, with the base of the calyx tube greatly thickened or not, and the lobes greatly expanded or not, often wider than the fruit
.....**46. *D. mindanaensis***

1. ***Diospyros alatella*** Kosterm.

Fig. 2C.

(Latin, *alatellus* = furnished with small wing/expansion; referring to the fruit)

Blumea 23 (1977) 451. **Type:** *Ashton S 18083*, Borneo, Sarawak, Bintulu district, Ulu Saran, Labang (holotype L; isotypes FHO, K, SAR, SING).

Tree to 33 m tall. **Twigs** velvety when young, terminating in large velvety-hairy buds, becoming glabrous with age. **Leaves** chartaceous, *glabrous, not subglaucescent below; oblong, 28–37 × 9–13 cm, base cuneate, margin not undulate, apex acute to acuminate; midrib sunken above; lateral veins prominent below, to 15 pairs, inarching and joining to form intramarginal vein-loops at a distance from leaf margin; intercostal venation prominent on both sides, laxly reticulate; petiole 1.5–2 cm long.* **Male inflorescences and flowers** unknown. **Female inflorescences** c. 0.3 cm long, arising on thick branches of c. 1.3 cm diameter, each bearing solitary flower. **Female flowers** with calyx deeply divided into 5–6 valvate ovate lobes. **Fruits** solitary, on c. 0.3 cm stalks, densely velvety when young, depressed ovoid-globose, to c. 4.5 cm diameter, deeply 9–16-ribbed corresponding to the number of seeds developed within, glabrous. **Fruit calyx** accrescent; lobes coriaceous, plicate, velvety, c. 3 × 2.5 cm, at first erect, then spreading; veins very faint to invisible.

Distribution. Endemic to Borneo and confined to Sarawak (e.g., *S 13968* from the Semengoh Arboretum and *S 18083* from Bintulu).

Ecology. In lowland mixed dipterocarp to lower montane forest, to 1200 m altitude.

Notes. The combination of large leaves and large ribbed fruits is diagnostic. *D. sulcata* also has large leaves and ribbed fruits but the two sides of each lobe are bent back-to-back.

2. *Diospyros andamanica* (Kurz) Bakh.

(of the Andamans)

Bull. Jard. Bot. Buitenz. 3, 15 (1937) 74, 382; Ng *l.c.* (1977) 211, *l.c.* (1978) 61; Turner *l.c.* 196; Ng, Gard. Bull. Sing. 53 (2001) 309; Beaman *et al. l.c.* 226. **Basionym:** *Macreightia andamanica* Kurz, Rep. Veg. Andam. 2 (1870) 42. **Syntypes:** *Novara 148* and *Jelinek 105*, Andamans (*n.v.*). **Synonyms:** *Maba andamanica* (Kurz) Kurz, J. As. Soc. Beng. 45, 2 (1876) 138, For. Fl. Brit. Burma 2 (1877) 140; *Maba carpinifolia* Ridl., Kew Bull. Misc. Inf. 2 (1926) 73; *D. carpinifolia* (Ridl.) Bakh. *l.c.* (1933) 162, *l.c.* (1937) 72; *D. malayana* Bakh. *l.c.* (1933) 163, *l.c.* (1937) 75; *D. tahananensis* Bakh. *l.c.* (1933) 163, *l.c.* (1937) 69, Ng *l.c.* (1978) 89, Anderson *l.c.* 169; *D. longepedunculata* Kosterm. *l.c.* 462; *Maba punctata* Hiern *l.c.* 136, Merrill *l.c.* (1921) 483, *l.c.* (1929) 240, Masamune *l.c.* 607.

Tree to 20 m tall. **Twigs** densely velvety to glabrous, rusty brown or blackish. **Leaves** chartaceous, velvety hairy to glabrous on veins and *not subglaucescent below; oblong-elliptic, elliptic or ovate, 7–27 × 2.5–10.5 cm* (with a narrow-leafed riverine form 12.5–21 × 1.4–3.7 cm), *base cuneate, rounded or subcordate, margin not undulate, apex acuminate; midrib sunken above, groove often filled with hairs; lateral veins 7–10 pairs, prominent below, arching and diminishing toward leaf margin; intercostal venation prominent below, laxly scalariform* (reticulate in the narrow-leafed forms); *petiole 0.2–1 cm long.* **Male inflorescences** 0.3–1.5 cm long, each bearing 6–30 or more flowers. **Male flowers** with calyx divided a quarter or a third down into 3 valvate triangular lobes; corolla salverform, 0.5–0.9 cm long. **Female inflorescences** 0.5–2.5 cm long, each bearing 1–3 flowers. **Female flowers** with calyx divided into 3 (rarely 4) triangular valvate lobes. **Fruits** 1–3 or more, on 0.5–1.5 cm long stalks, globose, ovoid or ellipsoid, 1.5–3 cm diameter, with slightly to prominently pimpled surface, densely hairy. **Fruit calyx** not accrescent, remaining small and 3-lobed; lobes not reflexed backwards, to 0.3 × 0.2 cm.

Distribution. Andamans, Sumatra, Peninsular Malaysia, and Borneo. In Borneo common, known from Sabah (e.g., *Elmer 20098*, *SAN 25812*, *SAN 30083*, *SAN 100329*, and *SAN 134545*), Sarawak (e.g., *S 13601*, *S 21351*, *S 50106*, and *S 63182*) and Kalimantan (e.g., *Kessler 1866*, *Kostermans 2645*, *Kuswata 852*, and *Mogea 3540*).

Ecology. In lowland and hill mixed dipterocarp forests, to 700 m altitude.

Notes. This species has numerous synonyms and is very often misidentified. The variation in leaf size and shape is great but the scalariform intercostal venation, the calyx (both male and female) divided into three valvate lobes, and the pimply-surfaced fruit with small (non-acrescent) valvate calyx are diagnostic. Glabrous specimens from Peninsular Malaysia were previously kept separate as *D. tahanensis* Bakh., but with the examination of more specimens, the separation cannot be justified. The intercostal venation is reticulate close to the midrib but scalariform towards the margins; that of narrow-leafed forms tend to be reticulate. The extreme narrow-leafed riverine form may be mistaken for *D. eucalyptifolia* or *D. lanceifolia* var. *saliciformis*.

3. *Diospyros areolata* King & Gamble

Fig. 4K.

(Latin, *areolatus* = net-like; referring to the intercostal venation)

J. As. Soc. Beng. 74, 2 (1906) 228; Bakhuizen *l.c.* (1938) 365; Ng *l.c.* (1977) 212, *l.c.* (1978) 63; Turner *l.c.* 196; Ng *l.c.* (2001) 309. **Syntypes:** *King's Collector 5813* (K, SING) and *Scortechini 476* (K), Peninsular Malaysia, Perak. **Synonyms:** *D. bantamensis* Koord. & Valetton *ex* Bakh. *l.c.* (1933) 165, *l.c.* (1938) 322, Anderson *l.c.* 167, Argent *et al.* (eds.) *l.c.* 178; *D. malam* Bakh. *l.c.* (1933) 176, *l.c.* (1938) 324, Masamune *l.c.* 604; *D. pseudomalabarica* Bakh. *l.c.* (1933) 182, Anderson *l.c.* 170, Coode *et al.* (eds.) *l.c.* 89.

Tree to 30 m tall. **Twigs** reddish tomentose when young, becoming glabrous with age. **Leaves** coriaceous, *glabrous, often drying with a yellow tinge, upper surface smooth and shiny; ovate, elliptic, or oblong, 8–16(–26) × 3–6(–9) cm, base broadly cuneate to rounded, margin not undulate, apex acuminate; midrib prominent, shallowly impressed or sunken above; lateral veins prominent below, (3–)4–8 pairs, with a tendency to form intramarginal vein-loops near leaf margin; intercostal venation prominent below, areolate; petiole 0.8–1.5 cm long.* **Male inflorescences** 0.5–1 cm long, each bearing usually 3 flowers, sometimes grouped on 5–6 cm long pseudo-racemes formed by the suppression of leaves on a flowering shoot. **Male flowers** with *calyx densely velvety, divided into 4 triangular valvate lobes; corolla cylindric, about 0.8 cm long, divided at the tip into four teeth.* **Female inflorescences** 0.2–0.8 cm long, each usually bearing solitary flower. **Female flowers** with *calyx densely velvety, divided into 4 valvate, broadly triangular-auriculate erect lobes.* **Fruits** solitary, on 0.2–0.8 cm long stalks, *globose, to c. 4 cm diameter, woody, velvety when young, not puckered or ribbed on drying.* **Fruit calyx** densely velvety, moderately accrescent, woody, *forming a shallow 4-pointed plate; veins invisible.*

Distribution. Sumatra, Peninsular Malaysia, Java, and Borneo. In Borneo, known from Sabah (e.g., *SAN 22954*, *SAN 30142*, *SAN 61478*, *SAN 90903*, and *SAN 141376*), Sarawak (e.g., *S 5051*, *S 9032*, *S 11935*, *S 16663*, and *S 30561*), Brunei (e.g., *Coode 6944*), and Kalimantan (e.g., *bb. 6335*, *bb. 8037*, *bb. 18170*, *Kuswata 1418*, and *Meijer 2194*).

Ecology. Common in lowland mixed dipterocarp and freshwater swamp forests.

Notes. The swamp form tends to have ovate leaves, while the dryland form tends to have oblong leaves. In Peninsular Malaysia, the oblong leafed form predominates. *D. areolata* can be distinguished from *D. brittano-borneensis* by its broader leaves, and from *D. ridleyi* by its shiny (not dull) leaf uppersurface.

4. *Diospyros beccarioides* Ng (resembling *Diospyros beccarii* Hiern)

Fig. 1A–B.

Gard. Bull. Sing. 53 (2001) 291. **Type:** *Yii et al. S 50325*, Borneo, Sarawak (holotype KEP; isotype SAR).

Tree to 20 m tall. **Twigs** densely reddish brown pubescent, becoming glabrous with age. **Leaves** membranaceous to chartaceous, glabrous; oblong or oblong-obovate, 16–30 × 5.5–11 cm, base cuneate and slightly attenuate, rarely rounded, apex acuminate; midrib above sunken, flat, or sunken with raised sides; lateral veins prominent below, 7–13 pairs, inarching and joining to form a more-or-less distinct intramarginal vein close to leaf margin; intercostal venation prominulous below, laxly scalariform; petiole 0.8–1.5 cm long. **Male inflorescences** subsessile condensed cymes of 3 or more flowers. **Flowers** unknown. **Fruits** 1–3, on 0.3–0.8 cm long stalks, depressed globose, to c. 2.5 cm diameter, glabrous, smooth to slightly puckered. **Fruit calyx** accrescent, divided into 4–5 valvate lobes; lobes erect, leafy-coriaceous, plicate, to c. 2 × 1.5 cm.

Distribution. Sumatra, Borneo, and Sulawesi. In Borneo, known from Sarawak (*S 8633*, *S 16177*, *S 31817*, *S 32625*, *S 50325*, *S 65187*, *Chew CWL 1100*, and *Chew CWL 1141*) and Kalimantan (*Endert 5164*, *Endert 5380*, *Kessler et al. 824*, and *Kessler et al. 969*).

Ecology. In Sarawak, the species is known from limestone hills in the lowlands, to 200 m altitude.

Notes. Bakhuizen (*l.c.* (1938) 239) had three species mixed up under his '*D. beccarii*'. The two syntypes of *D. beccarii* Hiern belong to *D. sumatrana* (hence *D. beccarii* has to be reduced to *D. sumatrana*). At least two others of his cited specimens, *bb. 12051* and *bb. 14750*, belong to *D. daemonia*. The third element, represented by e.g. *Endert 5164* represents a new species, *D. beccarioides*, which can be distinguished from *D. sumatrana* by its larger fruits with accrescent calyx lobes up to 2 cm long, and larger leaves, with a stronger tendency to form intramarginal veins.

5. *Diospyros blancoi* A.DC.

(F.M. Blanco, 1778?–1845, Spanish priest and botanist in the Philippines)

Prod. 8 (1844) 237; PROSEA 2 (1991) 151; Ng *l.c.* (2001) 309. **Type:** unknown. **Synonyms:** *D. discolor* Willd., Sp. Pl. 4 (1805) 1108, *nom. illeg.*, Merrill *l.c.* (1921) 484, Bakhuizen *l.c.* (1937) 145, Masamune *l.c.* 602, Ng *l.c.* (1978) 70; *D. durionoides* Bakh. *l.c.* (1933) 169, *l.c.* (1937) 133, Masamune *l.c.* 602, Argent *et al.* (eds.) *l.c.* 182; *D. argentea auct. non Griff.*: Anderson *l.c.* 167; *D. celebica auct. non Bakh.*: Anderson *l.c.* 167.

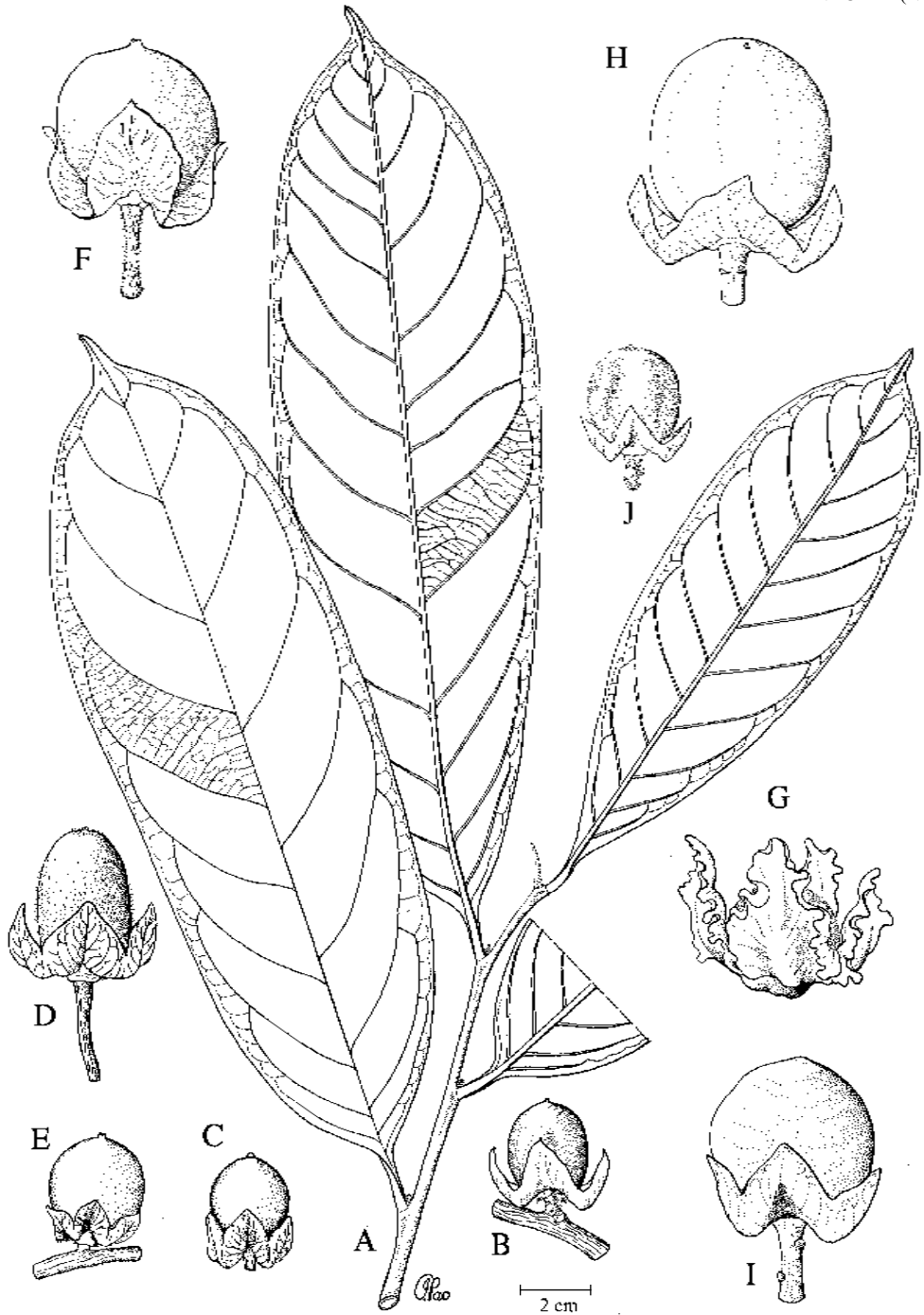


Fig. 1. *Diospyros beccarioides* (A–B); *D. coriacea* (C); *D. dictyoneura* (D); *D. elliptifolia* (E); *D. neurosepala* (F); *D. pilosanthera* var. *elmeri* (G); *D. piscicarpa* (H); *D. rigida* (I); *D. tuberculata* (J). A, leafy twig; B–J, fruits. (A–B from Chew CWL 1100, C from Hallier 1318, D from S 38428, E from SAN 64571, F from Church & Mahyar 1654, G from SAN 77815, H from Chin 2694, I from FRI 19275, J from SAN 84954.)

Tree to 36 m tall. **Twigs** appressed hairy when young, becoming glabrous with age, growing and flowering in flushes; basal leaves reduced to scales which are closely spaced. **Leaves** coriaceous, drying not black on both sides, without yellowish tinge, not glaucous below, young leaves densely appressed silky-hairy below, usually maturing glabrous; oblong to oblong-obovate, 11–30 × 3.5–8 cm, base rounded to subcordate, rarely cuneate, margin not undulate, apex acuminate; midrib sunken above; lateral veins faint below, 8–10 pairs, inarching and joining to form faint intramarginal vein-loops or arching and diminishing near leaf margin; intercostal venation invisible or faint and finely reticulate below; petiole 0.5–1 cm long. **Male inflorescences** c. 0.2 cm long, each bearing 3–5 crowded flowers. **Male flowers** with calyx divided more than halfway into 4 oblong-ovate imbricate lobes; corolla c. 1 cm long, salverform. **Female inflorescences** 0.1–0.3 cm long, each bearing solitary flower. **Female flowers** with calyx divided almost to base into 4 rounded imbricate lobes. **Fruit** solitary, subsessile, on 0.1–0.3 cm stalks, globose, depressed-globose or oblong, to 4 cm diameter (but fruits of cultivated trees to 5 cm diameter or larger), densely velvety, puckered when dry. **Fruit calyx** not or only slightly accrescent; lobes 0.3–1.5 × 0.3–1 cm.

Distribution. Borneo and the Philippines. In Borneo, known from Sabah (e.g., *FMS 44581*, *SAN 9407*, *SAN 27040*, *SAN 27554*, *SAN 49996*, and *SAN 63683*), Sarawak (e.g., *S 14606*, *S 23748*, *S 27988*, *S 28092*, *S 32142*, *S 32665*, *S 40027*, *S 45293*, and *Chew CWL 673*) and Kalimantan (e.g., *bb. 7978*, *bb. 10050*, *bb. 12456*, *bb. 18922*, *bb. 19038*, *bb. 19070*, *Kostermans 4874*, and *Kostermans 13929*).

Ecology. In lowland mixed dipterocarp, limestone and coastal forests.

Notes. *D. blancoi* is widely cultivated in the Philippines for its edible fruits and wood (used in handicrafts) and as an ornamental tree. It is sporadically cultivated in Borneo and the rest of SE Asia. Among the wild types in the forests of Borneo and the Philippines (Palawan), some closely match the cultivated forms while others (e.g., “*D. durionoides*”) have leaves and fruits distinctly smaller, but there are intermediate forms which smoothly link up the extremes. Anderson misidentified *S 23748* as *D. argentea*, and *S 27988* and *S 28092* as *D. celebica*. Neither of these occur in Borneo. *D. argentea* (a forest tree with edible fruits, restricted to Peninsular Malaysia) differs in the calyx being much larger.

6. *Diospyros borneensis* Hiern

(of Borneo)

Trans. Camb. Phil. Soc. 12, 2 (1873) 173; Merrill *l.c.* (1921) 484; Fischer, Kew Bull. (1932) 293; Bakhuizen *l.c.* (1938) 314; Masamune *l.c.* 601; Ng *l.c.* (1978) 64; Anderson *l.c.* 167; Turner *l.c.* 197; Coode *et al.* (eds.) *l.c.* 87 (including *D. cf. borneensis*); Argent *et al.* (eds.) *l.c.* 178. **Type:** *Motley 7*, Borneo, Sarawak (K). **Synonym:** *D. tawaensis* Merr. *l.c.* (1929) 244, Masamune *l.c.* 606.

Tree to 20 m tall. **Twigs** densely reddish brown tomentose when young, becoming glabrous with age, tending to dry black. **Leaves** chartaceous to coriaceous, glabrous, tending to dry black on both sides; oblong, elliptic, or ovate, 11–30 × 4–12.5 cm, base cuneate or rounded, apex acuminate; midrib sunken above; lateral veins prominent below, 8–14 pairs, tending to dry blacker than the rest of the leaf, joining to form an intramarginal vein very close to leaf margin; intercostal venation prominulous to prominent below, scalariform; petiole 0.8–2 cm

long. **Male inflorescences** condensed cymes 0.5–1 cm long, each bearing 3–20 or more flowers, the size of the clusters increasing with the size of the branches on which they are borne. **Male flowers** with *calyx shaped like a cone with truncate top*, *c.* 0.7 cm long; corolla *c.* 1.5 cm long, salverform. **Female inflorescences** 0.5–1.5(–2.5) cm long, each bearing usually solitary flower. **Female flowers** with *calyx in the form of a truncate cup of c. 1 × 1 cm*, often split into two parts, and split further as the fruit develops. **Fruits** usually solitary, on 0.5–1.5(–2.5) cm long stalks, globose, to *c.* 4.2 cm diameter, often vertically split on drying, drying black, glabrous. **Fruit calyx** not accrescent, *c.* 2 cm wide, split irregularly and flattened, or slightly reflexed.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN 16465*, *SAN 30534*, *SAN 62444*, *SAN 87635*, and *SAN 108010*), Sarawak (e.g., *Pennington 7964*, *S 30698*, *S 40519*, *S 43856*, and *S 66240*), Brunei (e.g., *BRUN 871*, *Coode 6753*, *Dransfield JD 6900*, *Niga 210*, and *SAN 17420*), and Kalimantan (e.g., *Arifin & Ambriansyah 1013*, *Jarvie & Ruskandi 5636*, and *Kostermans 10675*).

Ecology. Common in lowland, hill mixed dipterocarp and lower montane forests, to 1000 m altitude.

Notes. Easy to recognise by the intramarginal veins running close to the leaf margins, the scalariform intercostal venation, and the tendency of the leaves and especially the veins, to dry black. However, in Sarawak, two specimens (*S 32307* and *S 30698*) diverge from the norm in not forming an intramarginal veins and also their intercostal venation is less scalariform.

7. *Diospyros brainiana* Ng

Fig. 2A–B.

(Brain anak Tada, plant collector of the Sarawak Forest Department 1961–1970)

Gard. Bull. Sing. 53 (2001) 292. **Type:** *Brain anak Tada S 15932*, Borneo, Sarawak (holotype SAR; isotypes SAN, SING).

Tree to 29 m tall. **Leaves** chartaceous, *glabrous*; narrowly oblong-obovate, 11.5–19.5 × 2.5–6 cm, base cuneate, apex acuminate; midrib sunken above; *lateral veins* prominent to prominent below, *flush* or *prominulous above*, 8–13 pairs, *inarching and joining to form intramarginal vein at about one third of the distance from margin to midrib*; *intercostal venation faint, reticulate*; *petiole 1–1.5 cm long*. **Male and female inflorescences and flowers** unknown. **Fruits** solitary, *subsessile*, depressed globose with sunken top, to 4.5 cm diameter, drying shallowly lobed or ridged, glabrous. **Fruit calyx** accrescent, divided deeply into 4–5 velvety, leafy coriaceous, *faintly veined valvate lobes c. 1.5 cm long*; *main axis of each lobe curved upwards following the curvature of the fruit base, but the sides bend backwards towards each other*.

Distribution. Endemic to Borneo and confined to Sarawak (e.g., *S 15932* and *S 27961*).

Ecology. In lowland mixed dipterocarp forest.

Notes. The location of the intramarginal vein at some distance from the margin reminds of *D. neurosepala*, which differs in having leafy calyx lobes. The fruit calyx reminds that of *D. sulcata*, which differs in the lack of an intramarginal vein in the leaves.

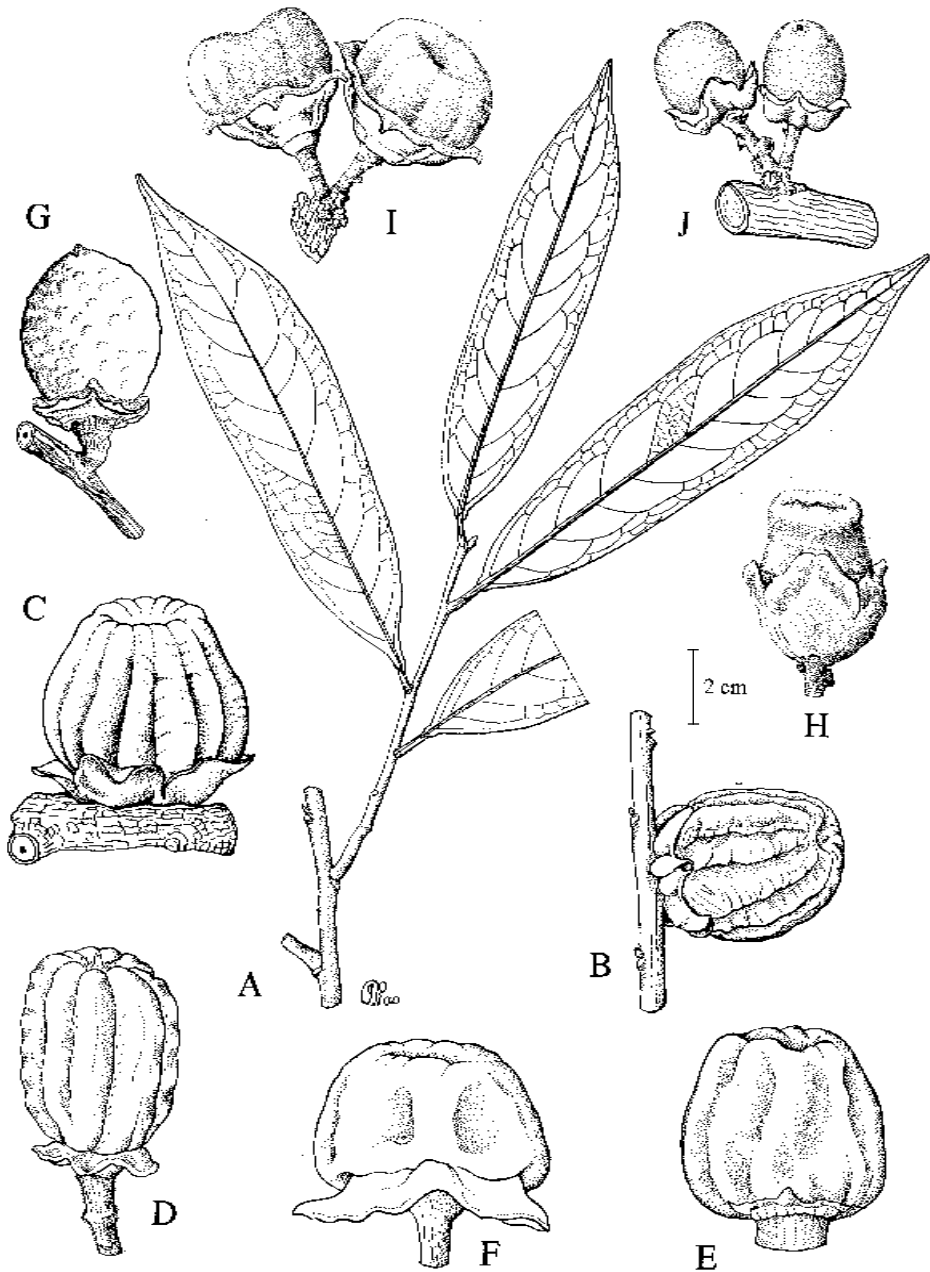


Fig. 2. *Diospyros brainiana* (A–B); *D. alatella* (C); *D. foxworthyi* (D); *D. hallieri* (E); *D. macrophylla* (F); *D. ridleyi* (G); *D. siamang* (H); *D. styraciformis* (I); *D. wallichii* (J). A, leafy twig; B–J, fruits. (A–B from *S* 15932, C from *S* 13968, D from *S* 43584, E from *SAN* 69454, F from *S* 32171, G from *S* 28024, H from *FRI* 2069, I from *S* 54204, J from *S* 49198.)

8. *Diospyros britanno-borneensis* Bakh.

(of British Borneo = Sabah)

Bull. Jard. Bot. Buitenz. 3, 15 (1938) 333; Anderson *l.c.* 167; Beaman *et al. l.c.* 226. **Type:** *Clemens 31934*, Borneo, Sabah (holotype BO; isotypes KEP, L).

Tree to 30 m tall. **Twigs** terete, *sparsely lenticellate, drying greyish or blackish*. **Leaves** coriaceous, *not bullate between veins, glabrous, not glaucous beneath; narrowly oblong-elliptic, 6–13 × 1.5–3 cm, base cuneate, margin not undulate, apex acuminate; midrib sunken to flat above; lateral veins prominent below, 6–10 pairs, arching and diminishing toward leaf margin; intercostal venation prominulous below, finely reticulate; petiole 0.5–1 cm long*. **Male inflorescences and flowers** unknown. **Female inflorescences** 0.8–2 cm long, each bearing solitary flower. **Female flowers** with *calyx divided into 4 or 5 broadly triangular valvate lobes*. **Fruits** solitary, *on 0.4–2 cm long stalks, ovoid to globose, to 5.5 cm diameter, smooth and glabrous*. **Fruit calyx** *accrescent; lobes 4–5, valvate, thin, brittle, unveined, erect or reflexed, up to 2 cm long*.

Distribution. Endemic to Borneo and known from Sabah (e.g., *Chew et al. 1851* and *Clemens 31935*) and Sarawak (e.g., *S 12608*, *S 13176*, *S 34446*, *S 35469*, *S 37925*, *S 37930*, *S 45052*, and *S 59214*).

Ecology. In hill mixed dipterocarp to mossy montane forests, at 630–2000 m altitude.

Notes. The fruit calyx is apparently erect at first, then spreading and finally reflexed as the fruit grows. *D. britanno-borneensis* is distinguished from *D. coriacea* by the long fruit stalk (0.8–2 cm), the calyx lobes unveined and non-plicate, and the absence of intramarginal veins in the leaves. It can be distinguished from *D. areolata* by its narrower leaves and cuneate leaf base.

9. *Diospyros buxifolia* (Blume) Hiern

(Latin, *buxifolius* = with leaves resembling those of *Buxus*)

Fig. 6C.

Trans. Cambr. Phil. Soc. 12, 2 (1873) 218; Merrill *l.c.* (1921) 484; Bakhuizen *l.c.* (1937) 97; Masamune *l.c.* 601; Ng *l.c.* (1978) 64; Anderson *l.c.* 167; Coode *et al. (eds.) l.c.* 88 (including *D. cf. buxifolia*); Argent *et al. (eds.) l.c.* 179; Ng *l.c.* (2001) 309; Beaman *et al. l.c.* 227. **Basionym:** *Leucoxyllum buxifolium* Blume, Bijdr. Fl. Ned. Ind. (1825) 1169. **Type:** *Blume s.n.*, Java (holotype L). **Synonym:** *D. elegantissima* Bakh. *l.c.* (1933) 169, *l.c.* (1937) 103, Ng *l.c.* (1978) 70.

Tree to 20 m, rarely to 30 m tall. **Twigs** velvety when young, glabrescent, *not tending to dry black*. **Leaves** chartaceous, *dull greenish and glabrous to hairy below; rhombic-elliptic (with 4 opposite sides parallel to each other) or ovate, 1.3–5(–6) × 0.5–2.2 cm, base cuneate, apex acute to acuminate; midrib above prominulous and hairy; lateral veins faint, arching and diminishing toward leaf margin; intercostal venation invisible; petiole c. 0.1 cm long*. **Male inflorescences** 0.1–0.5 cm long, *each bearing 2–5 clustered tiny flowers*. **Male flowers** *ovoid or globose in bud, c. 0.2 cm long; calyx hairy, divided almost to base into 4 imbricate ovate lobes; corolla to c. 0.2 cm long, ovoid or globose*. **Female inflorescences** 0.1–0.2 cm long, each bearing tiny solitary flower. **Female flowers** with calyx hairy, divided almost to base into 4 imbricate ovate

lobes. **Fruits** solitary, *subsessile*, on 0.1–0.2 cm long stalks, *ellipsoid*, to c. 1.6 × 1 cm. **Fruit calyx** not accrescent; lobes c. 0.1 × 0.2 cm.

Distribution. India and Sri Lanka to Indo-China and Malesia as far as New Guinea. In Borneo, known from Sabah (common, e.g., *SAN 22240*, *SAN 54042*, *SAN 71535*, *SAN 97953*, and *SAN 138855*), Sarawak (e.g., *S 6859*, *S 45910* and *SFN 10255*), Brunei (e.g., *BRUN 293*, *BRUN 299*, *Coode 6753*, and *S 5567*), and Kalimantan (e.g., *Burley et al. 2364*).

Ecology. In lowland, hill mixed dipterocarp and lower montane forests, to 1000 m altitude.

Notes. *D. elegantissima* of Peninsular Malaysia, previously considered distinct because of its very small leaves, is bridged smoothly to *D. buxifolia* by intermediate specimens and does not deserve to be recognised as a separate species. *D. buxifolia* differs from *D. squamaefolia* and the rhombic-leafed form of *D. graciliflora* by the cuneate, rarely acuminate, leaf base. Other differences are that in *D. squamaefolia* and *D. graciliflora*, corolla of the male flowers are salverform and the fruits globose. *D. parabuxifolia* differs by its long, 1.5–2 cm fruit stalks.

10. *Diospyros cauliflora* Blume

(Latin, *cauliflorus* = flowering on the tree trunk)

Bijdr. Fl. Ned. Ind. (1825) 668; Fischer *l.c.* 293; Bakhuizen *l.c.* (1937) 134; Masamune *l.c.* 601; Ng *l.c.* (1978) 64; Anderson *l.c.* 167; Turner *l.c.* 197; Argent *et al.* (eds.) *l.c.* 179; Beaman *et al.* *l.c.* 227. **Type:** *Blume s.n.*, Java, G. Parang (holotype L; isotype BO). **Synonyms:** *D. pergamena* Hiern *l.c.* 243, Merrill *l.c.* (1921) 485, Masamune *l.c.* 605; *D. fasciculiflora* Merr., Philip. J. Sci. 9 (1914) 334, *l.c.* (1929) 241 (including var. *pubinervia* Merr.), Masamune *l.c.* 603.

Tree to 17 m tall; trunk with swollen callus-like knobs from which inflorescences appear. **Twigs** reddish brown pubescent, becoming glabrous with age. **Leaves** membranaceous, *not glaucous* and glabrous to finely velvety *below*; *obovate*, 10–40 × 3–13 cm, *base cuneate*, rarely rounded, *margin not undulate*, *apex acuminate*; *midrib shallowly depressed above*, *sunken or flush* with blade surface; *lateral veins prominent below*, 5–14 pairs, usually *arching and diminishing toward leaf margin*; *intercostal venation prominulous below*, *reticulate to laxly scalariform*; *petiole 0.6–1.5 cm long*. **Inflorescences** borne on twigs, branches or trunk. **Male inflorescences** 0.2–1.2 cm long, each bearing several to numerous tiny flowers. **Male flowers** with *calyx divided into (3–)4(–5) imbricate ovate lobes*; corolla less than 0.2 cm long, ovoid in bud. **Female inflorescences** c. 0.5 cm long, each bearing several to numerous flowers. **Female flowers** with *calyx divided almost to base into (3–)4(–5) imbricate lobes*. **Fruits** on c. 0.5 cm long stalks, on twigs, branches or trunk, *globose*, to c. 2.5 cm diameter, usually beaked at apex, *smooth to broadly lobed with as many lobes as seeds contained within*, up to a maximum of 4 seeds only. **Fruit calyx** accrescent; *lobes up to c. 0.6 × 0.6 cm*, thickened, reflexed, velvety, *not forming a tightly fitting cup*.

Distribution. Thailand and throughout Malesia. In Borneo, known from Sabah (e.g., *Kokawa & Hotta 2303*, *SAN 22227*, *SAN 65191*, *SAN 96345*, and *SAN 133326*), Sarawak (e.g., *S 12298*, *S 20260*, *S 38989*, and *S 54089*), and Kalimantan (e.g., *Burley et al. 2349*, *Church et al. 446*, *Kostermans 13760*, and *Mahyar et al. 1325*).

Ecology. Common in lowland mixed dipterocarp and limestone hill forests, to 500 m altitude.

Notes. Although cauliflorous specimens dominate, flowers and fruits may also be borne on the twigs and branches. The species is easily recognised by the obovate membranaceous leaves and the strong tendency towards cauliflory. The minuteness of the male flower buds and the small 1–4-seeded fruits with thick velvety reflexed calyx lobes, are highly distinctive. In Sintang, Kalimantan, there are trees in which the female inflorescences and fruit stalks are exceptionally long: 1–1.5 cm (*Church et al. 392* and *Mahyar et al. 1325*).

11. *Diospyros clementium* Bakh.

(J. Clemens and M.S. Clemens, American husband-and-wife team who collected plants in Borneo in the early half of the 20th Century)

Gard. Bull. S. S. 7 (1933) 167, *l.c.* (1937) 104; Anderson *l.c.* 168. **Type:** *Clemens 20098*, Borneo, Sarawak, G. Pueh (holotype BO; isotype SAR).

Tree to 9 m tall. **Twigs** bearing 0.2 cm long spreading hairs. **Leaves** membranaceous, hairy below, *drying olive-green or brown; oblong, parallel-sided, 1.5–4 × 0.5–1 cm*, base rounded, margin ciliate, apex acute; midrib sunken above, groove filled with hairs, hairy below; lateral veins faint, 10–20 pairs, closely spaced, inarching and joining to form intramarginal vein-loops at some distance from leaf margin; *intercostal venation invisible*; petiole 0.1–0.2 cm long. **Male inflorescences** and **male flowers** unknown. **Female inflorescences** consisting of a solitary flower on a *c. 0.2 cm* stalk. **Female flowers** with calyx divided almost to base into 4 (imbricate?) triangular lobes, each lobe *c. 0.2 × 0.1 cm*; corolla unknown; ovary covered with long bristly hairs. **Fruits** solitary, bristly hairy, on *c. 0.2 cm* long stalks, ellipsoid, *c. 0.8 × 0.6 cm* (immature), symmetric. **Fruit calyx** non-acrescent; lobes *c. 0.2 × 0.1 cm*.

Distribution. Endemic to Borneo and known from Sarawak (e.g., *Clemens 20098*, *Ding Hou 566*, *S 24924*, *S 25124*, and *Sinclair & Kadim 10293*), Brunei (e.g., *Tan et al. 511*), and Kalimantan (e.g., *Church et al. 3264*).

Ecology. In lowland and hill mixed dipterocarp forests, to 700 m.

Notes. Sterile specimens are superficially close to small-leaved forms of *D. confertiflora*, but may be distinguished by the spreading hairs on the twigs.

12. *Diospyros confertiflora* (Hiern) Bakh.

(Latin, *confertiflorus* = with crowded flowers)

Gard. Bull. S. S. 7 (1933) 162, *l.c.* (1937) 82; Ng *l.c.* (1978) 65; Anderson *l.c.* 168; Turner *l.c.* 197; Coode *et al. (eds.) l.c.* 88; Argent *et al. (eds.) l.c.* 179. **Basionym:** *Maba confertiflora* Hiern *l.c.* 136, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607. **Type:** *Motley 205*, Borneo, Sabah, Labuan (K).

Tree to 20 m tall. **Twigs** glabrous or bearing short (less than 0.1 cm) hairs, *tending to dry black*. **Leaves** membranaceous to chartaceous, glabrous, or bearing short (less than 0.1 cm long) hairs,

tending to dry black above and sometimes on both sides; lanceolate or oblong, parallel-sided except where the blade tapered to base and apex, $2.5\text{--}9 \times 1\text{--}5$ cm, base cuneate to rounded, apex acuminate; midrib sunken above but groove sometimes filled with small hairs; lateral veins prominulous, c. 6 pairs, arching and diminishing toward leaf margin; intercostal venation invisible; petiole 0.2–0.5 cm long. **Male inflorescences** 0.1–0.4 cm long, each bearing 3–12 tiny flowers. **Male flowers** with calyx c. 0.1 cm long, divided into 3 triangular valvate lobes; corolla ellipsoid to oblong in bud, 0.2–0.4 cm long. **Female inflorescences** 0.2–0.3 cm long, each bearing 1–3 flowers. **Female flowers** with calyx divided into 3 imbricate lobes. **Fruits** solitary, on 0.2–0.3 cm long stalks, ovoid but markedly asymmetric, with one side more strongly curved than the other, so that the pointed apex is shifted off-centre, to 2.2×1.3 cm, smooth and glabrous. **Fruit calyx** leafy coriaceous; lobes c. 0.5×0.5 cm, completely reflexed backwards.

Vernacular name. Sarawak—*kayu malam pinang* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (common, e.g., *SAN 41327*, *SAN 103355*, *SAN 127091*, and *SAN 132102*), Sarawak (e.g., *S 13351*, *S 24143*, *S 30042*, *S 44718*, and *S 73355*), Brunei (e.g., *BRUN 15030*), and Kalimantan (e.g., *Ambriansyah 2025*, *van Balgooy 5491*, *Kostermans 6628*, and *Kostermans 13046*).

Ecology. In lowland mixed dipterocarp, swamp and *kerangas* forests.

Notes. *D. confertiflora* superficially resembles *D. kurzii*, *D. ferruginescens* and *D. venosa*, but can be distinguished by the asymmetric fruits with consistently 3-lobed calyx, the invisible intercostal venation and the membranaceous parallel-sided leaves. A small leafed form in Sabah (*SAN 68434*, *SAN 118725* and *SAN 128816*) closely resembles *D. clementium* in the vegetative state but does not bear long spreading hairs on the twigs.

13. *Diospyros cordata* (Hiern) Bakh.

(Latin, *cordatus* = heart-shaped; alluding the leaf base)

Gard. Bull. S. S. 7 (1933) 167, *l.c.* (1937) 165, *l.c.* (1955) plate 31. **Basionym:** *Maba cordata* Hiern *l.c.* 141, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607. **Type:** *Beccari PB 1837*, Borneo, Sarawak (K, photo).

Treelet to 1.5 m tall. **Twigs** covered with spreading hairs of 0.2–0.3 cm long. **Leaves** chartaceous, glabrous except for midrib, drying yellowish; narrowly oblong and parallel-sided to oblong-obovate; $14\text{--}20 \times 3.5\text{--}4.5$ cm, base cordate, margin not undulate, apex acuminate; midrib sunken above; lateral veins prominent below, 10–15 pairs, often inarching and joining to form intramarginal vein-loops near leaf margin; intercostal venation prominulous below, reticulate; petiole c. 0.3 cm long, densely hairy. **Male flowers** solitary, subsessile; calyx divided into 4 imbricate lobes; corolla salverform, c. 1.5 cm long. **Female inflorescences, flowers and fruits** unknown.

Distribution. Endemic to Borneo and known from Sarawak by two collections (*Beccari PB 1837* and *S 45582*).

Notes. *D. cordata* was, until this revision, known only by the type specimen, which is illustrated in Bakhuizen's Plate 31. I was able to match the illustration with *S 45582*, which represents only

the second collection of this very rare species. The main diagnostic features are the oblong to oblong-obovate leaves with cordate base, the spreading hairs on the twigs and the yellowish tinge of the dry leaves. *D. everettii* comes close in leaf shape but the leaves drying black on the upper surface, and the twigs are appressed hairy.

14. *Diospyros coriacea* Hiern

Fig. 1C.

(Latin, *coriaceus* = leathery; the leaves)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 259; Merrill *l.c.* (1921) 484; Bakhuizen *l.c.* (1938) 346; Masamune *l.c.* 601; Ng *l.c.* (1978) 67; Turner *l.c.* 197. **Type:** *Beccari PB 3455*, Borneo, Sarawak (holotype K).

Tree to 15 m tall. **Twigs** subrugose, drying blackish. **Leaves** chartaceous, glabrous and not subglaucous below; narrowly oblong-elliptic, 6–15 × 2.3–4.3 cm, base cuneate to rounded, margin not undulate, apex acuminate; midrib sunken above; lateral veins 5–10 pairs, prominent below, inarching and joining to form intramarginal vein-loops at some distance from leaf margin; intercostal venation prominulous below, reticulate; petiole 0.6–1 cm long. **Male inflorescences** 1–1.5 cm long, each bearing 3–7 flowers. **Male flowers** with calyx ellipsoid and truncate, mouth fringed by 4–5 small valvate teeth, c. 0.3 × 0.2 cm (very young bud). **Female inflorescences and flowers** unknown. **Fruits** solitary, sessile, glabrous, globose, to 3.5 cm diameter, smooth, symmetric. **Fruit calyx** divided into 4 valvate, leafy coriaceous lobes; lobes prominently veined, erect and clasping fruit, 1–1.5 × 1.5–1.75 cm, with plicate sides.

Distribution. Singapore and Borneo. In Borneo, known from Sarawak (e.g., *Beccari PB 1422* and *Beccari PB 3455*) and Kalimantan (e.g., *Hallier 1259*, *Hallier 1284*, *Hallier 1318*, *Hallier 2187*, *Jaheri 1893*, *Main 1914*, *Polak 1907*, and *Polak 1914*).

Notes. *D. coriacea* differs from *D. britanno-borneensis* by its sessile fruits with erect, leafy, veined and plicate calyx lobes, and the tendency of the lateral veins to form intramarginal vein-loops.

15. *Diospyros crockerensis* Ng

Fig. 3A–E.

(of the Crocker Range, Sabah)

Gard. Bull. Sing. 53 (2001) 295. **Type:** *Dewol & Karim SAN 78389*, Borneo, Sabah, Crocker Range (holotype SAN; isotype SING).

Tree to 11 m tall. **Twigs** densely velvety. **Leaves** chartaceous, densely hairy and not subglaucous below; elliptic, 7–17 × 2.5–8.3 cm, base cuneate, margin not undulate, apex acuminate; midrib sunken above, groove covered with short hairs; lateral veins prominent below, 6–9 pairs, arching and diminishing toward leaf margin; intercostal venation prominulous below, laxly scalariform; petiole c. 0.5 cm long, densely velvety. **Male inflorescences** 2–4.5 cm long, each bearing 3–9 flowers at distal ends. **Male flowers** with calyx divided deeply into 4 narrowly oblong imbricate lobes; corolla salverform, to c. 0.8 cm long. **Female inflorescences** 0.8–2.8 cm long, each terminating in about 3 flowers. **Female flowers** with calyx divided deeply into

4 imbricate lobes. **Fruits** usually solitary, on 0.8–2.8 cm long stalks, oblong-ovoid, to c. 3.5×1.5 cm, with apex gradually tapered to a sharp point, velvety, with thin woody, smooth wall. **Fruit calyx** non-acrescent; lobes c. 0.2×0.1 cm.

Distribution. Endemic to Borneo and known from Sabah (e.g., *SAN 78389*, *SAN 11589*, and *SAN 130109*) and Sarawak (e.g., *S 25273*).

Ecology. In hill mixed dipterocarp forest.

16. *Diospyros curranii* Merr.

(H.M. Curran, 1875–?, forest officer of the Bureau of Forestry, Manila, the Philippines)

Philip. J. Sci. Bot. 4 (1909) 306; Bakhuizen *l.c.* (1937) 196. **Type:** *Elmer 12090*, the Philippines, Sibuyan, Capiz Prov., Mt. Giting-Giting (L). **Synonym:** *D. curraniopsis* Bakh. *l.c.* (1933) 168, *l.c.* (1938) 198, Anderson *l.c.* 168, Argent *et al. l.c.* 180.

var. **curranii**

Tree to 30 m tall. **Twigs** drying greyish or brownish or blackish. **Leaves** chartaceous, glabrous, often drying with a yellowish tinge below; elliptic, oblong-elliptic or obovate; $6.5\text{--}21 \times 2.5\text{--}7$ cm, base cuneate to rounded, margin not undulate, apex acuminate; midrib sunken above; lateral veins prominent below, 4–10 pairs, often inarching and joining to form intramarginal vein-loops near leaf margin; intercostal venation prominulous below, finely reticulate; petiole 0.5–1 cm long. **Male inflorescences** 0.5–1.5 cm long, each bearing many tiny crowded flowers. **Male flowers** with calyx divided halfway into 4–5 valvate triangular lobes; corolla globose or ellipsoid in bud, 0.1–0.2 cm long. **Female inflorescences** 0.3–1 cm long, sometimes arising on short leafless shoots to 2 cm long, each bearing 1–3 flowers. **Female flowers** with calyx divided into 4–5 valvate plicate-auriculate leafy coriaceous lobes. **Fruits** usually solitary, on 0.3–1 cm long stalks, globose, 1.5–2.5 cm diameter, symmetric, smooth, often puckered when dried, velvety when young. **Fruit calyx** accrescent, distinctly veined, forming a plate with plicate reflexed margins, of the same diameter as the fruit or smaller.

Distribution. Borneo and the Philippines. In Borneo, known from Sabah (common, e.g., *Elmer 21529*, *SAN 15223*, *SAN 54448*, *SAN 109185*, and *SAN 141554*), Sarawak (e.g., *S 22845*, *S 36779*, *S 48655*, *S 51580*, and *S 67580*) and Kalimantan (e.g., *bb. 10753*, *Endert 4883*, *Kostermans 21374*, and *Sidiyasa 536*).

Ecology. Common in lowland and hill mixed dipterocarp forests, to 900 m elevation.

Notes. In Kalimantan, another variety (var. *kalimantanensis* Ng) occurs (e.g., *Mogea 3569*, *Mogea 3585*, *Mogea 3621*, and *Veldkamp 8148*). This variety differs from the typical one in the fruit calyx being stretched out instead of reflexed, and much enlarged, so that the calyx forms a 5-lobed funnel with the fruit in the centre. However, the male flowers and leaves in this population have not diverged from the rest of the species.

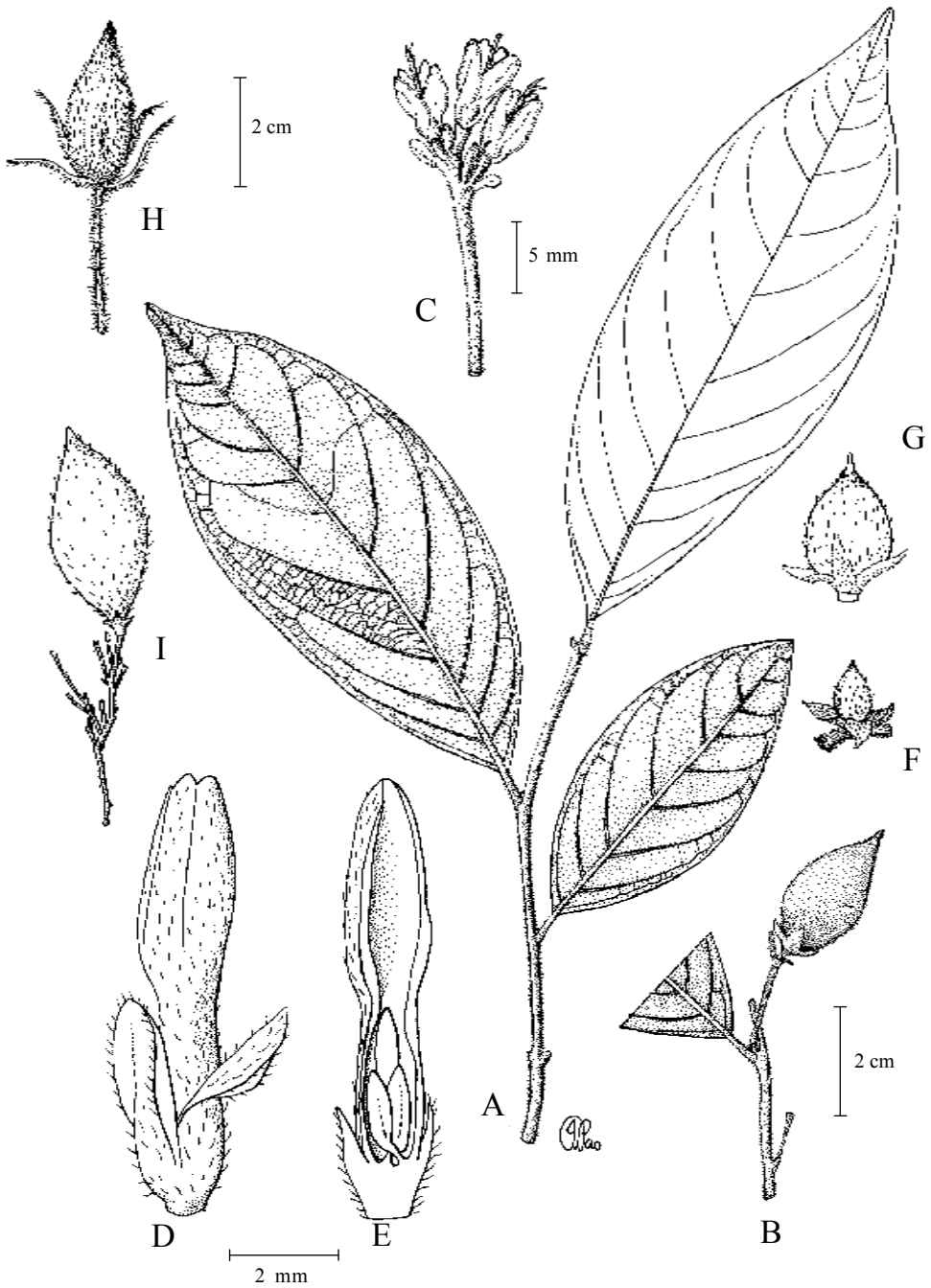


Fig. 3. *Diospyros crockerensis* (A–E); *D. eriantha* (F); *D. euphlebia* (G); *D. ferox* (H); *D. fusiformis* (I). A, leafy twig; B, fruiting leafy twig; C, female flowers after shedding of corollas; D, male flower bud; E, male flower bud in longitudinal section; F–I, fruits. (A–C from SAN 78389, D–E from S 25273, F from SAN 26695, G from SAN 51537, H from SAN 30746, I from SAN 73678.)

17. *Diospyros daemona* Bakh.

Fig. 5G.

(Latin, *daemon* = demon; alluding to the presumably poisonous fruits)

Gard. Bull. S. S. 7 (1933) 169, *l.c.* (1937) 140; Ng *l.c.* (1978) 67; Turner *l.c.* 197. **Type:** *Henderson SFN 25030*, Peninsular Malaysia, Pahang (holotype SING; isotypes FHO, KEP).

Tree to 20 m tall. **Twigs** velvety in young parts, becoming glabrous with age, drying greyish. **Leaves** membranaceous to chartaceous, tending to crinkle along veins on drying, *not subglaucescent and velvety on midrib and lateral veins below; elliptic, elliptic-obovate or elliptic-oblong, (7.5–)11–21 × (3–)4–10.5 cm, base rounded or subcordate to broadly cuneate, margin not undulate, apex acute to shortly acuminate; midrib sunken to prominent above; lateral veins prominent below, 6–13 pairs, arching and diminishing toward leaf margin; intercostal venation prominent below, laxly scalariform; petiole 0.4–1 cm long. Male inflorescences* 1–3 cm long, raceme-like, each bearing 3–10 flowers. **Male flowers** with *calyx 4-lobed, lobes imbricate; corolla salverform, to c. 1 cm long. Female inflorescences* 1–3.5 cm long, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 4 small imbricate rounded lobes. Fruits* 1–5, on 1–3.5 cm long stout stalks, globose or depressed-globose, to 6 cm diameter, symmetric, thick-walled, velvety when young, *maturing smooth and glabrous, drying black. Fruit calyx not accrescent; lobes rounded, c. 0.5 × 0.5 cm, dwarfed by the fruit.*

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (common, e.g., *SAN 46291*, *SAN 54321*, *SAN 72158*, *SAN 85013*, and *SAN 107989*), Sarawak (e.g., *S 13774*, *S 34191*, *S 34773*, and *Jacobs 5183*) and Kalimantan (e.g., *bb. 12051*, *bb. 14750*, *Hallier 384*, *Kostermans 10514*, *Kostermans 21029*, and *Kostermans 21181*).

Notes. The specimens from Peninsular Malaysia tend to be more hairy on the leaf under surface than those from Borneo, and to dry black on the upper surface. The Kalimantan specimens *bb. 12051* and *bb. 14750* were confused with *D. beccarii* (= a synonym of *D. sumatrana*) by Bakhuizen (*l.c.* (1936–41) 239), who inferred that the fruits would be poisonous, because in his system of classification, *D. daemona* came close to *D. insidiosa* (of Peninsular Malaysia and Sumatra), which was reported to have poisoned several people in Aceh who ate the fruits.

18. *Diospyros densa* Bakh.

(Latin, *densus* = dense; alluding to its dense foliage)

Gard. Bull. S. S. 7 (1933) 169, *l.c.* (1937) 120; Anderson *l.c.* 168; Argent *et al.* (eds.) *l.c.* 180. **Type:** *bb. 11018*, Borneo, Kalimantan (holotype BO).

Tree to 50 m tall, with large buttresses and black outer bark. **Twigs** appressed hairy when young, becoming glabrous with age, rugose, drying white. **Leaves** chartaceous to coriaceous, glabrous, *drying brownish or dull greenish above, not subglaucescent below; elliptic to obovate, 3–8.5 × 1–3 cm, base cuneate to rounded, margin not undulate, apex acuminate; midrib sunken above; lateral veins prominent below, 4–8 pairs, inarching and joining to form intramarginal vein-loops near leaf margin; intercostal venation faint, laxly reticulate; petiole 0.2–0.3 cm long. Male inflorescences* 0.5–1.5 cm long, each bearing usually solitary flower. **Male flowers** with *calyx divided almost to base into 4 long narrow imbricate glabrous lobes of c. 0.4 × 0.1 cm. Female inflorescences* 0.5–3.3 cm long, each bearing usually solitary flower. **Female flowers** with *calyx divided into 4 glabrous, long, narrowly pointed lobes to 2 cm long. Fruits* solitary, on slender

0.5–3.3 cm long stalks, globose, to *c.* 2.2 cm diameter, symmetric, thin-walled (often crushed in herbaria), *smooth*, glabrous. **Fruit calyx** *not accrescent*; lobes narrowly triangular, to 2 cm long and 0.2 cm wide at base, variably erect, spreading or reflexed.

Distribution. Endemic to Borneo. Known from Sabah (common, e.g., *SAN 19245*, *SAN 44191*, *SAN 61702*, *SAN 97105*, and *SAN 139653*), Sarawak (e.g., *S 24373*), Kalimantan (e.g., *bb. 11018*, *bb. 26233* and *Kostermans 9098*), and Brunei (e.g., *BRUN 17767*).

Ecology. In lowland mixed dipterocarp forest.

Notes. *D. densa* can be distinguished by its larger calyx lobes from *D. graciliflora*.

19. *Diospyros dictyoneura* Hiern

Fig. 1D.

(Greek, *dictyon* = net, *neuron* = sinew, nerve; having net-like venation)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 192; Merrill *l.c.* (1921) 484; Bakhuizen *l.c.* (1938) 257; Masamune *l.c.* 601; Ng *l.c.* (1978) 68; Anderson *l.c.* 168; Turner *l.c.* 197; Coode *et al.* (eds.) *l.c.* 88; Argent *et al.* (eds.) *l.c.* 180; Beaman *et al.* *l.c.* 227. **Syntypes:** *Beccari PB 2542* and *Beccari PB 2615*, Borneo (all at K).

Tree to 30 m tall. Shoots growing in intermittent flushes. **Twigs** glabrous, rugose. **Leaves** *membranaceous to chartaceous*, glabrous, *not subglaucous below*; *ovate, elliptic, oblong-elliptic, or obovate*, *c.* 5.5 × 3.5 cm (proximal leaves) to *c.* 22 × 10 cm (distal leaves of a flush), *base subcordate, rounded or cuneate, margin not undulate, apex acuminate*; *midrib sunken above, wrinkled below on drying*; *lateral veins 4–12 pairs, prominent below, arching and diminishing toward leaf margin*; *intercostal venation prominulous below, densely and finely reticulate*; *petiole 0.5–1.3 cm long, characteristically coarsely wrinkled on drying*. **Inflorescences** borne on basal nodes of new flushes. **Male inflorescences** to *c.* 3 cm long, each bearing many flowers. **Male flowers** with *calyx divided into 4 or 5 valvate triangular lobes*; corolla salverform, *c.* 1 cm long. **Female inflorescences** 1.5–4 cm long, each bearing usually solitary flower. **Female flowers** with *calyx divided into 5 valvate lobes*. **Fruits** solitary, on 1.5–4 cm long stalks, ellipsoid, to *c.* 4.5 × 3.5 cm, symmetric, hairy, *not ribbed*. **Fruit calyx** *accrescent*; lobes to *c.* 2 × 2 cm or larger, *leafy, prominently veined, coriaceous, erect, margins dilated and plicate*.

Distribution. Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SANA 1349*, *SAN 36752* and *SAN 39879*), Sarawak (e.g., *Pennington 8007*, *S 15705*, *S 23936*, *S 48415*, and *S 69767*) and Brunei (e.g., *Ashton 7868*, *Chin et al. 460*, *S 7868*, and *SAN 17466*).

Ecology. In lowland mixed dipterocarp forest.

20. *Diospyros diepenhorstii* Miq.

(H. Diepenhorst, 1811–1860?, a Dutch district officer and botanist in Sumatra)

Fl. Ind. Bat. Suppl. (1860) 250 & 583; Bakhuizen *l.c.* (1937) 142; Ng *l.c.* (1978) 68; Anderson *l.c.* 168; Turner *l.c.* 197; Argent *et al.* (eds.) *l.c.* 180; Beaman *et al.* *l.c.* 227. **Type:** *Diepenhorst HB 2176*, W Sumatra, Priaman (L, U).

Tree to 30 m tall. **Twigs** brownish to blackish, glabrous, *rugose*. **Leaves** chartaceous to coriaceous, glabrous, *not subglaucescous below*; *oblong*, 13–50 × 4.5–14 cm, *base rounded to subcordate*, apex acute to acuminate; midrib sunken above; *lateral veins* prominent below, 8–15 pairs, *arching and diminishing toward leaf margin*; *intercostal venation prominent below*, *laxly reticulate*; petiole 0.7–2.3 cm long. **Inflorescences** borne on tree trunk and larger branches. **Male inflorescences** c. 2 cm long, each bearing many flowers. **Male flowers** with calyx divided into 5, 6 or 7 imbricate lobes. **Female inflorescences** c. 4 cm long, each bearing several clustered flowers. **Female flowers** with calyx divided about halfway into 6 imbricate lobes. **Fruits** in clusters, each terminating a 4 cm long stalk, obovoid to oblong-ellipsoid, to c. 10 × 6 cm, symmetric, glabrous, *vertically ribbed*, ripening soft and yellow, edible. **Fruit calyx** slightly accrescent, *forming a shallow cup with 6 shallow lobes* of c. 0.5 × 1.3 cm.

Vernacular name. Sabah—*kayu malam* (preferred name).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo, known from Sabah (common, e.g., *SAN 16407*, *SAN 25060*, *SAN 38831*, *SAN 97662*, and *SAN 140525*), Sarawak (e.g., *S 4323*, *S 13800*, *S 32605*, *S 49005*, and *S 13840*) and Kalimantan (e.g., *Jarvie & Ruskandi 5350*, *Kostermans 10437* and *Kostermans 13840*).

Ecology. In lowland and hill mixed dipterocarp to lower montane forests, to 1800 m altitude.

Notes. The large oblong leaves with subcordate to rounded bases, lax reticulations and the large fruits with 6-lobed calyx, are diagnostic.

21. *Diospyros discocalyx* Merr.

(Latin, with disc-shaped fruit calyx)

PEB (1929) 245; Bakhuizen *l.c.* (1938) 316; Masamune *l.c.* 601. **Type:** *Elmer 21898*, Borneo, Sabah, Tawau (L, SING).

Tree to 50 m tall, c. 1 m diameter, unbuttressed or with small symmetrical buttresses to c. 1 × 1 m. **Bark** black; inner bark bright yellow. **Sapwood** white. **Twigs** tuberculate-lenticellate, *rugose*, glabrous. **Leaves** membranaceous to chartaceous, not bullate, *not subglaucescous beneath*, glabrous; *elliptic to obovate*, 8–20 × 3.5–8 cm, *base attenuate*, apex acuminate; midrib *sunken above*; *lateral veins prominulous on both sides*, 5–10(–12) pairs, *curving steeply upwards and forming multiple loops in the apical half of leaf*; *intercostal venation prominulous below*, *vaguely reticulate*; petiole 0.5–1.3 cm long, upper limit imprecise because of the attenuate leaf base. **Male inflorescences** 1–2 cm long, each bearing 3 or more flowers. **Male flowers** with calyx in the form of a narrow cup, c. 0.6 × 0.4 cm, truncate or shallowly 4-lobed; corolla 1–1.5 cm long, oblong-conic in bud. **Female inflorescences** c. 1.5 cm long, each bearing 1–3 flowers. **Female flowers** with *calyx* truncate or globose, with a hole at the top through which protrudes the corolla. **Fruits** solitary, on 0.6–1 cm long stalks, initially ovoid, eventually become woody and *globose*, to c. 7.5 cm diameter, *smooth*, glabrous, symmetric. **Fruit calyx** accrescent, *initially cup-shaped and covering the basal half of fruit, later expanded into a 4–5 cm diameter woody dish*.

Distribution. Endemic to Borneo and known from Sabah (common, e.g., *SAN 16093*, *SAN 26044*, *SAN 44880*, *SAN 82093*, and *SAN 129558*) and Kalimantan (e.g., *Kostermans 5107*).

Ecology. In lowland mixed dipterocarp forest, but once recorded at 1600 m altitude (*SAN 59664*).

Notes. This is probably the biggest *Diospyros* in Borneo. It is easily distinguished by its attenuate leaf base and the lateral veins anastomosing and forming multiple loops in the apical half of the leaf. The male flowers may be mistaken for those of *D. korthalsiana* because of the similar calyx.

22. *Diospyros elliptifolia* Merr.

Fig. 1E.

(Latin, *elliptifolius* = with elliptic leaves)

Philip. J. Sci. 30 (1926) 421, *l.c.* (1929) 247; Fischer *l.c.* 247; Bakhuizen *l.c.* (1938) 232; Masamune *l.c.* 602; Anderson *l.c.* 168; Coode *et al.* (eds.) *l.c.* 88 (including *D. cf. elliptifolia*); Argent *et al.* (eds.) *l.c.* 182; Ng *l.c.* (2001) 309. **Type:** *Ramos & Edano 44020*, the Philippines, Sulu Archipelago, Tawi-tawi (SING). **Synonyms:** *D. elliptifolia* forma *kinabaluensis* Bakh. *l.c.* (1938) 233; *D. kinabaluensis* (Bakh.) Kosterm. *l.c.* 460, Beaman *et al.* *l.c.* 228.

Tree to 18 m tall. **Twigs** not tending to dry black. **Leaves** chartaceous, glabrous, *not subglaucous below*; obovate, elliptic or oblong, 8–17(–32) × 4–9.5(–12) cm, base attenuate, apex shortly acuminate; midrib grooved above, with prominently raised rims, especially toward base, and often conspicuously black against a light greenish brown leaf under surface; lateral veins prominent below, 5–10 pairs, arching and diminishing toward leaf margin; intercostal venation prominulous on both sides, reticulate, or sometimes invisible; petiole very short, 0.2–0.5 cm long, leaf almost sessile because of the attenuate base. **Male inflorescences** c. 0.3 cm long, each bearing up to 3 flowers. **Male flowers** with calyx divided into 4 or 5 valvate triangular lobes; corolla c. 0.7 cm long, urceolate. **Female inflorescences** 0.1–0.5 cm long, each bearing usually solitary flower. **Female flowers** with calyx deeply divided into 4–5 leafy valvate lobes of 0.7–1 × 0.5–1.5 cm. **Fruits** solitary, sessile, globose, 1.5–3 cm diameter, often with a pointed apical protuberance, drying shining black, smooth, finely hairy, symmetric. **Fruit calyx** not or slightly accrescent; lobes leafy coriaceous, veined, erect, to c. 1.5 × 1.5 cm, sides expanded and slightly plicate.

Distribution. Sumatra, Borneo and the Philippines. In Borneo, known from Sabah (very common, e.g., *Pereira 459*, *RSNB 4175*, *SAN 22905*, *SAN 90411*, and *SAN 14069*), Sarawak (e.g., *Haviland 1740*, *S 3942*, *S 41875*, *S 53917*, and *S 65446*), Brunei (e.g., *BRUN 909*, *Dransfield 7029*, *Forman 1139*, *Sands 5864*, and *Simpson 2146*), and Kalimantan (e.g., *Burley et al. 710*, *Endert 3582*, *Kostermans 5038*, and *Meijer 2331*).

Ecology. In lowland and hill mixed dipterocarp forests, to 800 m altitude.

Notes. Diagnostic features are the almost sessile leaves, with attenuate base, and the midrib above appearing as a groove with raised rims, the shiny black sessile fruits and the leafy, veined calyx lobes. The leaves vary greatly in size but I cannot find any justification for Kosterman's elevation of forma *kinabaluensis* to the status of a separate species. In fact I cannot sustain it

even as a form. *D. eucalyptifolia* is similar except for its willow-like or eucalypt-like narrow, slightly curved leaves.

23. *Diospyros eriantha* Champ. ex Benth.

Fig. 3F.

(Greek, *erion* = wool, *anthos* = flower; with the flowers covered with woolly hairs)

In Hooker's J. Bot. 4 (1852) 302; Merrill *l.c.* (1921) 484; Bakhuizen *l.c.* (1938) 182; Masamune *l.c.* 602. **Type:** *Cunningham s.n.*, Hong Kong (holotype K).

Tree to 7 m tall. **Twigs** hairy when young, becoming glabrous with age. **Leaves** chartaceous, hairy on midrib and lateral veins below, tending to dry black above; 6–9.5 × 2.5–4 cm, base cuneate to slightly attenuate, apex acuminate; midrib raised above and hairy; lateral veins prominent below, 4–6 pairs, arching and diminishing toward leaf margin; intercostal venation faint on both sides, scalariform, spaced 0.1–0.2 cm apart; petiole 0.2–0.3 cm long. **Male and female inflorescences and flowers** unknown. **Fruits** solitary, sessile, ellipsoid, c. 1 × 0.5 cm, symmetric, sparsely hairy, with pointed apex, shiny black. **Fruit calyx** not accrescent, 4-lobed; lobes hairy, leafy coriaceous, triangular-ovate, erect, c. 0.7 × 0.4 cm, covering the base of fruit.

Distribution. S China, Indo-China, Sumatra, Java, Borneo, and the Philippines. Rare in Borneo and known from Sabah (e.g., *Wood 2525* and *SAN 26695*) and Kalimantan (according to Bakhuizen). Bakhuizen also cited a specimen from Peninsular Malaysia (*FMS 10445*) but this has been excluded from the species (Ng, *l.c.* (1978) 94).

24. *Diospyros eucalyptifolia* Bakh.

(Latin, with leaves resembling those of *Eucalyptus*)

Gard. Bull. S. S. 7 (1933) 172; Bakhuizen *l.c.* (1938) 232; Masamune *l.c.* 602. **Type:** *Amdjah 255*, Borneo, Kalimantan, Sedalir (holotype BO; isotype L).

Treelet to 5 m tall. **Leaves** chartaceous to coriaceous, not subglaucescent below, glabrous, sessile; narrowly oblong-elliptic, willow-like, tapered gradually to apex and base, 6–15(–25) × 1.5–3(–4.5) cm, base attenuate, apex long-acuminate and often slightly curved; midrib sunken into a groove above, with raised rims especially toward base; lateral veins prominent below, c. 5 pairs, arching and diminishing toward leaf margin; intercostal venation prominent, laxly reticulate; petiole 0.2–0.3(–0.5) cm long. **Male and female inflorescences and flowers** unknown. **Fruits** solitary, sessile, on 0.2–0.7 cm long stalks, globose or ovoid, to c. 2 cm diameter, shiny black, with an acuminate beak or apical point, smooth, glabrous, symmetric. **Fruit calyx** not accrescent, divided almost to base into (3–)4 valvate lobes; lobes leafy coriaceous, erect, c. 1.5 × 1.5 cm.

Distribution. Endemic to Borneo and known from Sabah (e.g., *SAN 129568*), Sarawak (e.g., *S 38037* and *S 49738*) and Kalimantan (e.g., *Amdjah 255*, type).

Ecology. In lowland and hill mixed dipterocarp forests, to 900 m altitude. The Sabah specimen was growing on the banks of a rocky river.

Notes. The narrow leaves resemble those of *D. lanceifolia* var. *saliciformis* and the riverine form of *D. andamanica*. *D. eucalyptifolia* may, when flowers become available, prove to be merely a narrow-leafed form of *D. elliptifolia*.

25. *Diospyros euphlebia* Merr.

Fig. 3G.

(Greek, *eu-* = well-developed, *phlebos* = vein; referring to the well-veined leaves)

PEB (1929) 241; Bakhuizen *l.c.* (1937) 168; Masamune *l.c.* 602; Anderson *l.c.* 168; Coode *et al.* (eds.) *l.c.* 88. **Type:** *Elmer 20756*, Borneo, Sabah, Tawau (BO, L, SING).

Tree to 13 m tall. **Twigs** thick, *usually with rough corky bark*, hairy in young parts, becoming glabrous with age. **Leaves** membranaceous to chartaceous, glabrous or hairy below, bullate between veins, tending to dry black above, *not subglaucous below*; *oblong-obovate*, 20–40 × 6–13 cm, *base rounded, subcordate or cordate*, apex acute to shortly acuminate; midrib sunken above; *lateral veins* sunken above, prominent below, 7–11 pairs, *tending to inarching and joining to form intramarginal vein-loops near leaf margin*; *intercostal venation sunken above, prominent below, laxly reticulate*; petiole 0.5–1.2 cm long (leaf almost sessile in relation to its size). **Male inflorescences** and **flowers** unknown. **Female inflorescences** 0.1–0.2 cm long, each bearing 1–15 crowded flowers, arising from axils of extant leaves and sometimes on large leafless branches. **Female flowers** with calyx divided halfway into 5 imbricate triangular lobes; corolla salverform, *c.* 1 cm long. **Fruits** usually solitary, sessile, ovoid, with a pronounced beak or point, to *c.* 3.5 × 2 cm, thin-walled, covered with bristly hairs especially when young, symmetric. **Fruit calyx** not accrescent; *lobes c.* 0.2 × 0.2 cm.

Distribution. Endemic to Borneo and known from Sabah (common, e.g., *Kokawa & Hotta 2307*, *Ridsdale 1940*, *SAN 52007*, *SAN 85137*, and *SAN 136152*), Sarawak (e.g., *S 13981* and *S 16040*), Brunei (e.g., *Coode 7905*), and E Kalimantan (e.g., *Ambri M 1573*).

Notes. The corky bark, the large sessile oblong-obovate leaves with cordate/subcordate base which dry black above, the sunken midrib, lateral and intercostal veins, the lax reticulations, and the sessile flowers and fruits make this species easy to recognise. However, *SAN 107635* does not have corky twigs. *D. muricata* comes close but has smaller leaves and more slender, non-corky twigs.

26. *Diospyros evena* Bakh.

Fig. 6D.

(Latin, *evenus* = without veins; referring to invisible veins of the leaf)

Gard. Bull. S. S. 7 (1933) 163, *l.c.* (1937) 93; Masamune *l.c.* 602; Anderson *l.c.* 168; Coode *et al.* (eds.) *l.c.* 88; Argent *et al.* (eds.) *l.c.* 182. **Syntypes:** *Haviland & Hose 3348*, Borneo, Sarawak (SAR); *bb. 7264*, *bb. 7789* and *bb. 12643*, Borneo, Kalimantan (all at BO). **Synonym:** *Maba motleyi* Hiern *l.c.* 483, *p.p.*, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607.

Tree to 25 m tall. **Twigs** *drying consistently black*, hairy in young parts, becoming glabrous with age. **Leaves** *coriaceous*, glabrous, *drying consistently black on both sides*; *obovate or oblong-elliptic*, 3.5–8(–12) × 1.5–3.5(–4.5) cm, *base sequentially subcordate, rounded and cuneate on a flush, apex acute, rounded or retuse* (rarely acuminate); midrib sunken above; lateral veins

invisible; *intercostal venation invisible*; petiole 0.3–0.5 cm long. **Male inflorescences** 0.1–0.2 cm long, each bearing solitary flower. **Male flowers** with calyx divided into 4 imbricate rounded lobes; corolla salverform, *c.* 0.8 cm long. **Female inflorescences** and **flowers** unknown. **Fruits** solitary, on *c.* 0.3 cm long stalks, oblong, *c.* 2.3 × 1.3 cm, without acuminate beak at top, woody, smooth, glabrous, symmetric. **Fruit calyx** not accrescent, divided into 4 rounded imbricate lobes, each lobe *c.* 0.2 × 0.3 cm.

Vernacular name. Sarawak—*merpinang daun kecil* (preferred name).

Distribution. Sumatra and Borneo. In Borneo, known from Sabah (common, e.g., *FRI 41333*, *Kokawa & Hotta 2669*, *SAN 22293*, *SAN 84289*, and *SAN 140539*), Sarawak (common, e.g., *S 4953*, *S 5044*, *S 12887*, *S 30162*, and *S 44295*), Brunei (e.g., *BRUN 549*, *BRUN 700*, *S 5552*, *S 5855*, and *Sinclair & Kadim 10498*), and Kalimantan (e.g., *bb. 12643*, *Buwalda 7835*, and *Kostermans 9276*).

Ecology. Locally very common in freshwater swamp forests, especially in Sarawak.

Notes. Closely related to *D. maingayi* and *D. puncticulosa*, which also have leaves drying black and have virtually invisible intercostal venation.

27. *Diospyros everettii* Merr.

(H.D. Everett, 1880–1908, a forest officer at the Philippines Bureau of Forestry)

Philip. J. Bot. 4 (1909) 307; Bakhuizen *l.c.* (1937) 167; Masamune *l.c.* 602. **Type:** *Everett 7261*, the Philippines (*n.v.*).

Tree to 15 m tall. **Twigs** appressed hairy. **Leaves** chartaceous, glabrous, *not subglaucous below*; oblong to oblong-obovate, 13–19 × 3–5 cm, base subcordate, margin not undulate, apex acute to acuminate; midrib sunken above; lateral veins prominent below, 6–11 pairs, somewhat inarching and joining to form intramarginal vein-loops at a distance from leaf margin; intercostal venation prominulous below, reticulate to vaguely scalariform; petiole 0.3–0.8 cm long. **Male inflorescences** 0.3–0.5 cm long, each bearing about 6 flowers. **Male flowers** with calyx divided deeply into 4 oblong imbricate lobes; corolla salverform, *c.* 0.8 cm long. **Female inflorescences** and **flowers** unknown. **Fruits** *c.* 6, on a 0.3–1 cm long stalk, globose, *c.* 1 cm diameter (immature), densely velvety, puckered when dry. **Fruit calyx** not accrescent, divided into 4 rounded imbricate lobes of *c.* 0.3 × 0.3 cm.

Distribution. Borneo and the Philippines. In Borneo, known from Sabah (e.g., *Fraser 203*, *fide Bakhuizen*) and Kalimantan (e.g., *Amdjah 787*, *Amdjah 861*, *Kostermans 5303*, *Kostermans 8682*, and *Meijer 2367*).

Notes. The above description is based on the Kalimantan specimens. *D. everettii* differs from *D. muricata* in the midrib sunken instead of prominent above.

28. *Diospyros ferox* Bakh.

(Latin, *ferox* = fierce-looking; alluding the rusty bristles on the twigs, lower leaf surface, inflorescences, and fruits)

Fig. 3H.

Gard. Bull. S. S. 7 (1933) 170; Bakhuizen *l.c.* (1937) 162; Masamune *l.c.* 603; Coode *et al.* (eds.) *l.c.* 88.
Type: *Native Collector 137*, Borneo, Sarawak (holotype BO; isotype L).

Tree to 10 m tall, rarely to 20 m. **Twigs** densely covered with spreading rusty hairs. **Leaves** chartaceous, softly densely rusty hairy below, tending to dry black above; oblong to oblong-ovate, somewhat parallel-sided, 3.5–12 × 1–3.6 cm, base rounded to subcordate, margin not undulate, apex acuminate; midrib sunken above and the groove filled with spreading rusty hairs; lateral veins prominulous below, 6–13 pairs, faintly inarching and joining to form intramarginal vein-loops near leaf margin; intercostal venation invisible above, prominulous below, reticulate; petiole 0.1–0.2 cm long. **Male inflorescences** and **flowers** unknown. **Female inflorescences** rusty hairy, slender, 0.4–3 cm long, each bearing 1–3 flowers. **Female flowers** with calyx divided into 4 filiform valvate lobes, densely covered with spreading rusty hairs. **Fruits** often solitary, oblong-ovoid, beaked and *c.* 3 × 1.2 cm or globose and *c.* 2 cm diameter, rusty hairy, not ribbed, thin-walled, symmetric. **Fruit calyx** not accrescent; lobes filiform, *c.* 1.5 × 0.1 cm, covered with spreading rusty hairs.

Distribution. Endemic to Borneo and known from Sabah (common, e.g., *SAN 30736*, *SAN 46643*, *SAN 52233*, *SAN 93955*, and *SAN 101128*), Sarawak (e.g., *S 18043*, *S 42215*, *S 62113*, and *FRI 38978*), Brunei (e.g., *Sinclair 10509*), and Kalimantan (e.g., *Shea 27147*).

Ecology. In peat swamp, lowland and hill mixed dipterocarp forests, to 900 m altitude.

Notes. The spreading rusty hairs on twigs, leaves, fruits and calyces, and the filiform calyx lobes are highly diagnostic. There are forms with globose fruits (Sarawak) and forms with beaked fruits (Sabah, e.g., *SAN 39107*).

29. *Diospyros ferrea* (Willd.) Bakh.

(Latin, *ferreus* = pertaining to iron; probably alluding the hard wood)

Gard. Bull. S. S. 7 (1933) 162, *l.c.* (1937) 50; Ng *l.c.* (1978) 71; Turner *l.c.* 197. **Basionym:** *Ehretia ferrea* Willd., *Phytogr.* 1 (1794) 4. **Type:** unknown. **Synonyms:** *Pisonia buxifolia* Rottb., *Nov. Act. Hafn.* 2 (1783) 536; *Maba buxifolia* (Rottb.) Juss., *Ann. Mus. Hist. Nat.* 5 (1804) 418, Merrill *l.c.* (1929) 240, Masamune *l.c.* 606.

Treelet to 5 m tall. **Leaves** chartaceous, glabrous, not subglaucous below; obovate, 4–8.5 × 2–4 cm, base cuneate, margin not undulate, apex rounded, retuse or acute; midrib sunken to shallowly depressed above; lateral veins prominulous below, 4–5 pairs, inarching and anastomosing to form intramarginal vein-loops at a distance from leaf margin, leaving space for more loops to form closer to leaf margins; intercostal venation prominulous on both sides, reticulate; petiole 0.2–0.3 cm long. **Male inflorescences** 0.1–0.2 cm long, each bearing 3 tiny flowers. **Male flowers** with calyx divided halfway into 3 triangular valvate lobes. **Female inflorescences** 0.1–0.2 cm long, each bearing usually solitary flower. **Female flowers** with calyx divided halfway into 3 valvate lobes. **Fruits** solitary, on 0.1–0.2 cm long stalks, globose, *c.* 0.8 cm diameter, glabrous, smooth, symmetric. **Fruit calyx** accrescent, forming a shallow three-pointed dish or cup of about the same diameter as fruit.

Distribution. A very widespread species, from West Africa to India, Burma, Thailand, Indo-China and throughout Malesia to Australia and the South Pacific Islands. In Borneo, known

from Sabah (e.g., *Elmer 21096*, *Keith 7389*, *FMS 41507*, *SAN 76115*, and *SAN 135372*), on coasts and small islands, and Sarawak (once only, *S 31976*) on summit of a limestone hill at G. Subu in Miri district.

30. *Diospyros ferruginescens* Bakh.

(Latin, *ferruginescens* = becoming rusty-red; referring to the indumentum)

Bull. Jard. Bot. Buitenz. 3, 15 (1941) 409; Anderson *l.c.* 168; Coode *et al.* (eds.) *l.c.* 88. **Syntypes:** *bb. 26182*, *bb. 29294*, *bb. 29305*, and *bb. 29375*, Borneo, Kalimantan, Nunukan (BO, L).

Tree 20–36 m tall. **Twigs** and buds densely velvety or rusty hairy, tending to dry black. **Leaves** membranaceous to chartaceous, glabrous to *densely rusty hairy and not subglauous below*, tending to dry black above; *oblong-elliptic, oblong and parallel-sided, or elliptic, 4–15 × 1.5–5.5 cm, base cuneate, margin not undulate, apex acuminate; midrib sunken above, groove often filled with hairs, prominent and velvety hairy below; lateral veins prominulous to prominent below, 6–10 pairs, inarching strongly at margins or diminishing toward leaf margin; intercostal venation very faint to prominulous below, reticulate and often stretched parallel to lateral veins; petiole 0.5–0.7 cm long. Male inflorescences* 0.2–0.7 cm long, each bearing (1–)3–9 flowers. **Male flowers** with *calyx divided one third to one fourth down into 4–5 valvate triangular lobes or teeth; corolla salverform, 0.5–0.7 × 0.2 cm. Female inflorescences* 0.1–0.3 cm long, each usually bearing solitary flower. **Female flowers** with *calyx divided halfway into 4–5 valvate triangular lobes. Fruits* solitary, on 0.1–0.3 cm long stalks, *globose to nearly so, 1.5–2.5 cm diameter, symmetric, not ribbed, woody, densely velvety rusty hairy. Fruit calyx* accrescent, *divided deeply into 4–5 triangular valvate lobes; lobes coriaceous, erect or spreading, 0.5 × 0.3–0.4 cm, forming a 4–5-pointed star.*

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

Ecology. In lowland and hill mixed dipterocarp and lower montane forests, to 1500 m altitude.

Key to varieties

Leaves with lateral veins prominulous below, diminishing towards leaf margin; usually glabrous.....

var. *ferruginescens*

In Borneo, known from Sabah (e.g., *SAN 13128*, *SAN 36880*, *SAN 44513*, *SAN 80199*, and *SAN 133272*), Sarawak (common, e.g., *Asah 5305*, *Chew CWL 1170*, *S 10320*, *S 14499*, and *S 61701*), Brunei (e.g., *BRUN 592*, *BRUN 15456*, *Dransfield JD 7267*, and *SAN 17128*), and Kalimantan (e.g., *bb. 26182* and *Kostermans 8607*). In lowland and hill mixed dipterocarp to lower montane forests, to 1500 m altitude.

Leaves with lateral veins prominent below, strongly inarching near leaf margin; usually densely rusty hairy below.....

var. *rufotomentosa* Ng

(Latin, *rufus* = reddish, *tomentosus* = thickly and evenly covered with hairs; the lower leaf surface)

Gard. Bull. Sing. 53 (2001) 305. Type: *Maikin et al. SAN 132942*, Borneo, Sabah, Lumaku FR (holotype SAN).

Tree to 20 m tall.

In Borneo, known from Sabah (e.g., *SAN 55535*, *SAN 66013*, *SAN 102122*, *SAN 113977*, *SAN 132942*, and *SAN 139235*) and Kalimantan (e.g., *Kostermans 8602*, *Kostermans 8778* and *Kostermans 10755*). In lowland and hill mixed dipterocarp forests, to 700 m altitude.

31. *Diospyros foxworthyi* Bakh.

Fig. 2D.

(F.W. Foxworthy, 1877–1950, American botanist and forest research officer at Kepong)

Gard. Bull. S. S. 7 (1933) 171, *l.c.* (1938) 293; Ng *l.c.* (1978) 71; Turner *l.c.* 197; Ng *l.c.* (2001) 309. **Type:** *Foxworthy FMS 10447*, Peninsular Malaysia, Perak (KEP). **Synonyms:** *D. levigata* Bakh. *l.c.* (1933) 175, *l.c.* (1938) 294, Masamune *l.c.* 604, Argent *et al.* (eds.) *l.c.* 185; *D. cylindrocarpa* Kosterm. *l.c.* 456, Beaman *et al.* *l.c.* 227.

Tree to 20 m tall. **Leaves** chartaceous to coriaceous, *glabrous*; oblong-elliptic, 10–35 × 3.5–12 cm, base cuneate to rounded, *apex long-acuminate to caudate*; midrib sunken above; *lateral veins* sunken or flush above, prominent below, (6–)10–15 pairs, mostly *joining strongly at margin to form an intramarginal vein close to leaf margin*; *intercostal venation flush to prominulous above, prominent below, reticulate*; petiole 0.8–1.5 cm long. **Male inflorescences** 1–4.5 cm long, slender, each bearing 3–15 flowers. **Male flowers** with calyx divided halfway into 4 valvate triangular lobes; corolla salverform, *c.* 0.6 cm long. **Female inflorescences** 1–3.5 cm long, each bearing 1–several flowers. **Female flowers** with calyx divided into 4 valvate triangular lobes of *c.* 0.5 × 0.6 cm. **Fruits** in clusters of 1–5, on stout 1–3.5 cm long stalks, velvety and globose when young, maturing glabrous, oblong, to 5 × 4.5 cm, symmetric, on drying tending to shrink into as many longitudinal furrows as there are seeds (maximum of 8 seeds). **Fruit calyx** slightly accrescent, forming a shallow woody 4-pointed plate of 1.5–3 cm diameter; lobes with erect tips and slightly dilated and reflexed sides.

Distribution. Peninsular Malaysia and Borneo. In Borneo, known from Sabah (common, e.g., *SAN 16505*, *SAN 40665*, *SAN 75770*, *SAN 100196*, and *SAN 141584*), Sarawak (common, e.g., *Hotta 6121*, *Jacobs 3947*, *S 15910*, *S 36229*, and *S 63711*) and Kalimantan (e.g., *bb. 32302*, *Burley et al. 3145*, *Jacobs 5220*, and *Kostermans 21178*).

Ecology. In lowland mixed dipterocarp forest.

Notes. The intramarginal veins of the Bornean specimens are nearly always strongly developed, while that of the Peninsular Malaysian specimens are weakly developed. There are, however, intermediate specimens (e.g., *SAN 55682* and *SAN 92760*) which justify treating all the specimens under one species.

32. *Diospyros frutescens* Blume

(Latin, *frutescens* = shrubby; the growth habit)

Bijdr. Fl. Ned. Ind. (1825) 668; Bakhuizen *l.c.* (1938) 192; Ng *l.c.* (1978) 73; Anderson *l.c.* 168; Turner *l.c.* 197; Beaman *et al.* *l.c.* 227. **Type:** *Blume s.n.*, Java (holotype L). **Synonym:** *D. atra* Merr. *l.c.* (1929) 242, Masamune *l.c.* 601.

Tree to 18 m tall. **Twigs** puberulous when young, becoming glabrous with age, sparsely lenticellate, drying blackish. **Leaves** membranaceous, slightly bullate between veins, glabrous, not subglaucescent below; elliptic, 13–25(–35) × 4.5–10(–13.5) cm, base rounded to cuneate, margin not undulate, apex acute to acuminate; midrib sunken above; lateral veins sunken above, prominent below, 6–11 pairs, faintly inarching and joining to form intramarginal vein-loops near leaf margin; intercostal venation prominulous below, laxly reticulate; petiole 0.8–1.3 cm long. **Male inflorescences** laxly branched, 1–2 cm long, each bearing 3–10 or more flowers. **Male flowers** with calyx deeply divided into 4 narrowly triangular valvate lobes; corolla ovoid in bud, to c. 0.5 cm long. **Female inflorescences** c. 0.8 cm long, each bearing 3–10 flowers. **Female flowers** with calyx divided into 4 plicate-auriculate valvate lobes. **Fruits** in clusters of 1–3, on stalks of c. 0.8 cm long, globose, to c. 2 cm diameter, symmetric, smooth, glabrous, often puckered on drying. **Fruit calyx** accrescent; lobes leafy coriaceous and auriculate, c. 0.8 × 0.8 cm.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, and Sulawesi. In Borneo, known from Sabah (common, e.g., SAN 30075, SAN 56230, SAN 88179, SAN 96478, and SAN 134543), Sarawak (e.g., Fuchs 21209, S 41969 and S 53446), Brunei, and Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, to 800 m altitude.

Notes. A specimen, Fuchs 21209, from Sarawak has exceptionally large leaves, up to 35 × 13.5 cm. SAN 133318 has an exceptionally small fruit calyx only c. 0.5 cm across. *D. tuberculata* has similar but asymmetric fruits. There is also some resemblance to *D. piscicarpa* but in *D. piscicarpa* the leaves are not bullate, the lateral veins prominulous (not sunken) above, and the fruits are larger, up to 5 cm diameter.

33. *Diospyros fusiformis* Kosterm.

Fig. 3I.

(Latin, *fusiformis* = spindle-shaped; alluding the shape of fruit)

Blumea 23 (1977) 457. **Type:** SAN 21228, Borneo, Sabah, Sepilok FR (holotype L; isotype SAN).

Tree to 15 m tall. **Leaves** chartaceous, glabrous, not subglaucescent below; ovate or elliptic, 4–11.5(–13) × 1.5–4(–6) cm, base cuneate, margin not undulate, apex acuminate; midrib shallowly impressed above; lateral veins prominulous on both sides, 4–6 pairs, arching and diminishing toward leaf margin; intercostal venation faint, laxly reticulate; petiole 0.3–0.6 cm long. **Male inflorescence** consisting of 1–10 or more small flowers, sometimes umbel-like, each flower borne on a characteristically slender threadlike 0.5–1 cm long pedicel, arising from a slender 1–6.5 cm long peduncle. **Male flowers** with calyx divided halfway into 4 valvate triangular lobes; corolla salverform, c. 0.8 cm long. **Female inflorescences** resembling the males. **Female flowers** with calyx divided halfway into 4 valvate triangular lobes. **Fruits** 1 or more on 1–6.5 cm long stalks, ovoid to spindle-shaped, with prominent beak, to c. 4 × 1.7 cm, symmetric, not ribbed, covered sparsely with long bristly appressed hairs when young. **Fruit calyx** not accrescent; lobes 4, triangular-ovate, c. 1 × 1 cm.

Distribution. Endemic to Borneo. Known from Sabah (locally common at Sepilok FR in Sandakan district and Gunong Silam VJR in Lahad Datu district, e.g., SAN 21244, SAN 48699,

SAN 52388, SAN 76255, and SAN 141526), Sarawak (once only, *S 42858* from Limbang), and Brunei (e.g., *Davies L 349, Davies L 645 and K 800*).

Ecology. In lowland and hill mixed dipterocarp forests, to 600 m altitude.

34. *Diospyros graciliflora* Hiern

Fig. 6E.

(Latin, *gracilis* = slender, *florum* = flower; referring to the slender inflorescence)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 191; Merrill *l.c.* (1921) 484; Bakhuizen *l.c.* (1937) 119; Masamune *l.c.* 603; Anderson *l.c.* 168. **Type:** *Beccari PB 1560*, Borneo (K, photo).

Tree to 10 m tall. **Twigs** slender, appressed hairy, *not tending to dry black*. **Leaves** membranaceous, glabrous, *drying shining above, dull and not glaucous beneath; elliptic or rhombic, 1.6–6.5 × 0.7–2.9 cm*, base cuneate (where leaves are elliptic) to acuminate (where leaves are rhombic), *apex acuminate to caudate*; midrib, sunken above, groove filled with hairs; lateral veins prominulous below, *3–4 pairs*, faintly arching and diminishing toward leaf margin; *intercostal venation invisible*; petiole 0.1–0.3 cm long. **Male inflorescences** slender, *0.7–2.5 cm long*, each bearing 1–4 flowers. **Male flowers** with calyx divided into 4 small *c. 0.1 × 0.1 cm* imbricate ovate lobes; corolla salverform, *0.7–1.3 cm long*. **Female inflorescences** filiform, *0.7–2.5 cm long*, each bearing solitary flower. **Female flowers** with calyx divided into 4 small imbricate ovate or rounded lobes. **Fruits** solitary, *on slender 0.7–2.5 cm long stalks, globose, c. 1.5 cm diameter, thin-walled* (brittle and easily crushed on herbarium specimens), sparsely hairy, smooth, symmetrical. **Fruit calyx** not accrescent, with 4 ovate or rounded lobes of *c. 0.2 × 0.2 cm*.

Distribution. Endemic to Borneo and confined to Sarawak (e.g., *S 16741, S 27527, S 35773, S 36810, S 44264, S 45433, S 48368, S 52711, S 53439, S 53445, and S 53914*).

Ecology. In lowland mixed dipterocarp forest.

Notes. *D. graciliflora* is distinguished by the solitary flowers (and fruits) on filiform 0.7–2.5 cm long unbranched stalks, and the small round thin-walled fruits. The leaves vary from elliptic to rhombic. The small rhombic specimens are indistinguishable from *D. squamaefolia* by their leaves, but differ by the length of their stalks: 0.7–2.5 cm in *D. graciliflora*, 0.1–0.2 cm in *D. squamaefolia*. The two species are also geographically separated, one in Sarawak and the other in Sabah. It differs from *D. densa* by its much smaller calyx lobes.

35. *Diospyros hallieri* Bakh.

Fig. 2E.

(J.G. Hallier, 1868–1932, a German botanist)

Gard. Bull. S. S. 7 (1933) 172, *l.c.* (1938) 338; Masamune *l.c.* 603; Anderson *l.c.* 169; Beaman *et al. l.c.* 228. **Type:** *Hallier f. 2854*, Borneo, Kalimantan, Liang Gagang (holotype BO; isotype L).

Tree to 30 m tall. **Twigs** thick, reddish brown hairy when young, becoming glabrous with age, *rugose, warty-lenticellate*. **Leaves** chartaceous, glabrous, *not subglaucous below; oblong-elliptic to oblong-obovate, 15–30(–38) × 5–11 cm, base cuneate to slightly attenuate, margin*

not undulate, apex acuminate; midrib sunken above; lateral veins prominent below, 8–15 pairs, diminishing toward leaf margin; intercostal venation very fine and scalariform-reticulate, with the veins spaced c. 0.2 cm apart; petiole c. 1 cm long. **Male inflorescences** c. 1 cm long, each bearing about 10 flowers crowded at its extremity. **Male flowers** with calyx divided into 4–5 valvate triangular lobes; corolla salverform, c. 1 cm long. **Female inflorescences** 0.5–1.5 cm long, each bearing 3–6 flowers. **Female flowers** with calyx divided into 4–5 valvate triangular lobes. **Fruits** usually solitary, on 0.5–1.5 cm long stalks, depressed ovoid-globose, c. 4 × 5 cm, woody, apex depressed, glabrous, shallowly ribbed, symmetric. **Fruit calyx** accrescent, rugose-woody, faintly veined, more or less flattened into a 4–5 pointed star-shaped plate of c. 3 cm diameter, sometimes (but not always) with a woody pedestal under the plate, formed by the thickening of the calyx tube.

Distribution. Endemic to Borneo and known from Sabah (common, e.g., SAN 21569, SAN 36421, SAN 59078, SAN 84992, and SAN 103486), Sarawak (e.g., S 16502) and Kalimantan (e.g., Endert 2588, Endert 2629, Kostermans 4833, Kostermans 5898, and Kostermans 13262).

Ecology. In lowland mixed dipterocarp forest.

Notes. The species is easily identified by its large oblong leaves with fine and closely spaced scalariform-reticulate intercostal venation. The leaves may resemble those of *D. perfida* but in *D. perfida*, the midrib tends to dry black; there is no such tendency in *D. hallieri*.

36. *Diospyros havilandii* Bakh.

Fig. 6F.

(G.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Gard. Bull. S. S. 7 (1933) 172, *l.c.* (1937) 114; Masamune *l.c.* 603; Anderson *l.c.* 169. **Type:** *Haviland 2315*, Borneo, Sarawak, Kuching (holotype BO; isotypes L, SAR, SING).

Tree to 13 m tall. **Twigs** initially reddish brown tomentellous, later glabrous, drying whitish. **Leaves** coriaceous, glabrous, glaucous below, with tendency to blacken above; elliptic, 4–9 × 1.6–4 cm, base cuneate to slightly attenuate, apex acute to shortly acuminate; midrib sunken above; lateral veins faintly visible, 5–7 pairs, diminishing toward leaf margin; intercostal venation invisible; petiole c. 0.5 cm long. **Male inflorescences** slender, c. 1.4 cm long, each bearing 1–5 flowers. **Male flowers** with calyx divided almost to base into 4 small ovate imbricate lobes; corolla salverform, c. 1 cm long. **Female inflorescences** 0.2–0.8 cm long, each usually bearing solitary flower. **Female flowers** with calyx divided almost to base into 4 imbricate ovate lobes. **Fruits** solitary, ellipsoid or globose, to c. 1.6 cm diameter, without pointed apical protuberance, with thin brittle wall, smooth, glabrous, symmetric, on drying not shining black. **Fruit calyx** not accrescent, remaining small, c. 0.2 × 0.2 cm.

Distribution. Endemic to Borneo and confined to Sarawak (e.g., S 1825, S 2671, S 8068, S 20871, and S 27803).

Ecology. In peat swamp forest.

Notes. This species is distinguished by its small leaves which are glaucous below, tending to

blacken above, with almost invisible lateral veins and intercostal venation. In the past, specimens have been misplaced in the Euphorbiaceae, under *Glochidion* J.R. & G.Forst. and *Breynia* J.R. & G.Forst.

37. *Diospyros keningauensis* Ng
(of Keningau, Sabah)

Fig. 4A–J.

Gard. Bull. Sing. 53 (2001) 297. **Type:** *Leopold & Saikeh SAN 74495*, Borneo, Sabah (holotype SING; isotypes KEP, SAN).

Tree to 40 m tall. **Leaves** chartaceous, *glabrous to sparsely appressed hairy below*, drying characteristically wrinkled; narrowly elliptic to ovate, 3.5–13 × 1.5–4 cm, *base cuneate to rounded*, apex acuminate; midrib prominulous above, appressed hairy when young; *lateral veins prominent below*, 5–8 pairs, *diminishing toward leaf margin*; *intercostal venation prominulous below*, *densely scalariform*; petiole 0.5–1 cm long. **Male inflorescences** 0.5–1.5 cm long, sometimes clustered in 2 or more to each node, each bearing 3–5 flowers. **Male flowers** with calyx divided into 4 valvate lobes; corolla salverform, *c.* 1.4 cm long. **Female inflorescences** 0.5–1 cm long, each usually bearing solitary flower. **Female flowers** with calyx divided into 4(–5) valvate lobes. **Fruits** solitary, *on 0.5–1 cm long stalks*, *globose*, *to c. 4.5 cm diameter*, irregularly wrinkled on drying, thick-walled, symmetric, densely hairy when young. **Fruit calyx** not accrescent; lobes about 0.5 × 0.5 cm.

Distribution. Endemic to Borneo and confined to Sabah (e.g., *Carr SFN 27136*, *SAN 26704*, *SAN 33783*, *SAN 71930*, and *SAN 74495*).

Ecology. In lower montane forest at 1300–1500 m altitude, in the vicinity of Mt. Kinabalu (Keningau, Ranau).

38. *Diospyros korthalsiana* Hiern
(P.W. Korthals, 1807–1892, a Dutch botanist)

Fig. 5H.

Trans. Camb. Phil. Soc. 12, 2 (1873) 168; Merrill *l.c.* (1921) 484; Fischer *l.c.* 294; Bakhuizen *l.c.* (1938) 356; Masamune *l.c.* 604; Anderson *l.c.* 169; Coode *et al.* (eds.) *l.c.* 89; Argent *et al.* (eds.) *l.c.* 183; Ng *l.c.* (2001) 309; Beaman *et al.* *l.c.* 228. **Type:** *Korthals s.n.*, Borneo, Kalimantan (holotype L; isotype BO). **Synonyms:** *Maba myrmecocalyx* Hiern *l.c.* 139, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607; *D. myrmecocalyx* (Hiern) Bakh. *l.c.* (1933) 178, *l.c.* (1938) 359, *l.c.* (1955) plate 87; *D. bangueyensis* Merr. *l.c.* (1929) 247, Masamune *l.c.* 601.

Tree to 20 m tall. **Twigs** tending to dry whitish. **Leaves** chartaceous to coriaceous, glabrous, *tending to dry black on both sides*; *elliptic*, 5.5–13.5(–17) × 2.5–6(–9) cm, *base broadly cuneate* or slightly attenuate, *margin not undulate*, apex acuminate; midrib sunken above; *lateral veins prominulous below*, 5–6 pairs, *diminishing toward leaf margin*; *intercostal venation prominulous on both sides*, *reticulate*, *with reticulation stretched parallel to the lateral veins* (sometimes invisible); petiole 0.4–1 cm long, *drying black*. **Male inflorescences** 0.8–2.2 cm long, each bearing 1–7 flowers. **Male flowers** with *calyx a deep parallel-sided cup of 0.6–0.9 cm long*, *with 5 valvate teeth around rim*; corolla salverform, 1–1.5 cm long. **Female inflorescences** and

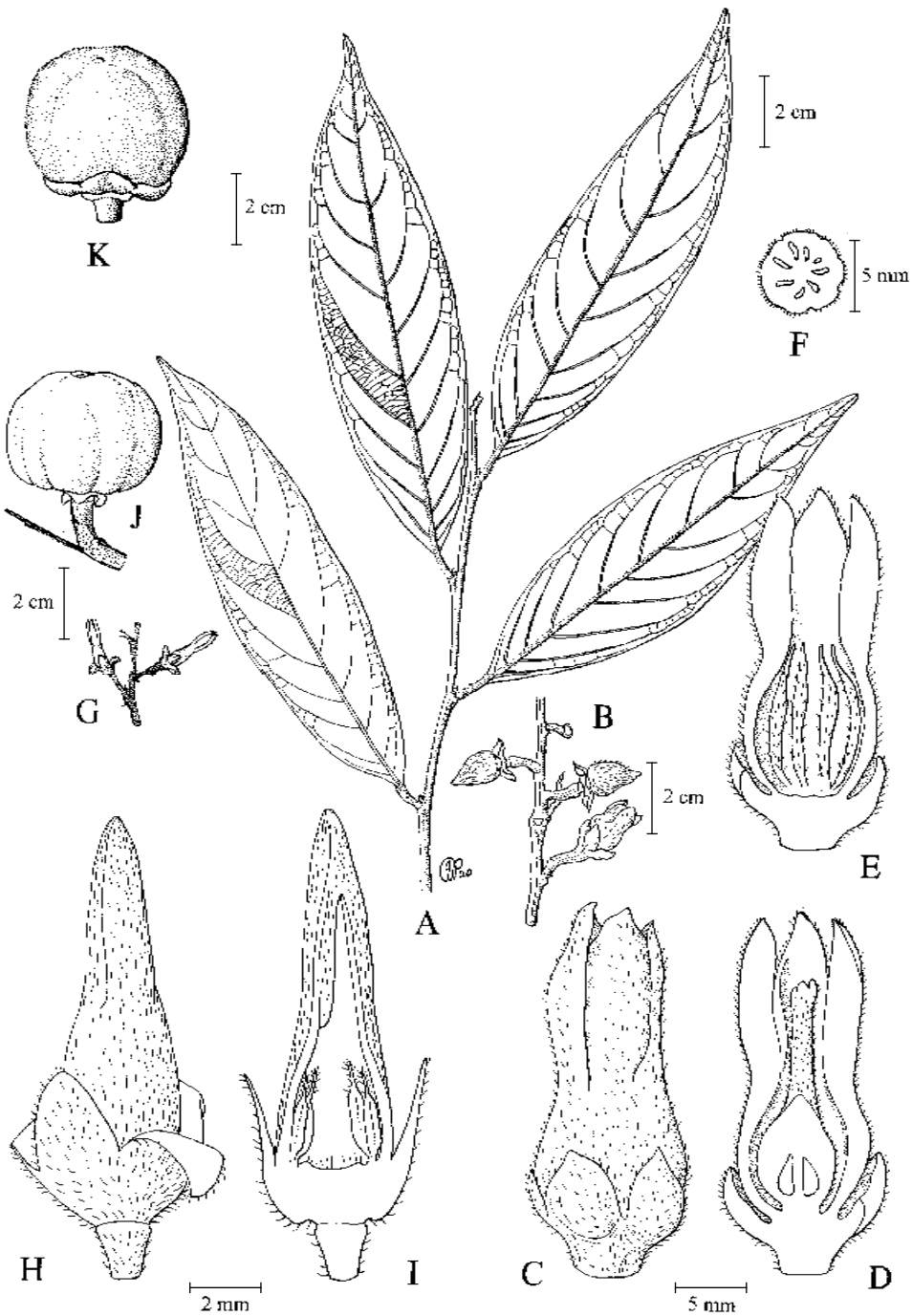


Fig. 4. *Diospyros keningauensis* (A–J); *D. areolata* (K). A, leafy twig; B, female inflorescence; C, female flower; D, female flower in longitudinal section; E, as D but after removal of ovary to show staminodes; F, ovary in transverse section; G, male inflorescence; H, male flower bud; I, male flower bud in longitudinal section; J–K, fruits. (A–F from SAN 26704, G–I from SFN 27136, J from SAN 74495, K from Code 9644.)

flowers unknown. **Fruits** solitary, on 0.2–0.6 cm long stalk, velvety when young, maturing glabrous, oblong and c. 4×3.5 cm or depressed ovoid and c. 4×4.5 cm, symmetric, thick-walled, with pimply surface, not ribbed, drying black. **Fruit calyx** accrescent, divided into 4–5 triangular valvate lobes, initially cup-shaped, then becoming a shallow rugose-woody dish, c. 5.5 cm diameter; lobes stretched until the original lobing is almost obscured, faintly veined.

Distribution. Borneo and the Philippines. In Borneo, known from Sabah (e.g., Chew *et al.* 243, SAN 72250, SAN 77627, SAN 82245, and SAN 107012), Sarawak (e.g., S 18942, S 24910, S 29102, S 29141, S 39180, S 45263, and S 61787), Brunei (e.g., Atkins 507), and Kalimantan (e.g., Kostermans 6934).

Ecology. In lowland and hill mixed dipterocarp forests, to 1000 m altitude.

Notes. Bakhuizen divided this species into three varieties: var. *macrocarpa* (Korth.) Bakh. (which should properly be called var. *korthalsiana*) in Peninsular Malaysia, Borneo and Sulawesi; var. *mirandae* (Merr.) Bakh. in the Philippines; and var. *kinabaluensis* Bakh. in Sabah. In this treatment, no varieties are recognised. The sole specimen of this species from Peninsular Malaysia cited by Bakhuizen was *Henderson 23013*, but this was assigned by Bakhuizen a few pages later to *D. retrofracta* Bakh. The combination of black petiole and whitish twigs is quite striking. Male flowers may be mistaken for those of *D. discocalyx* because of the similar calyx.

39. *Diospyros kurzii* Hiern

(W.S. Kurz, 1834–1878, Curator of the herbarium at Calcutta, India)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 162; Bakhuizen *l.c.* (1937) 173; Ng *l.c.* (1978) 76; Turner *l.c.* 198; Argent *et al.* (eds.) *l.c.* 162. **Type:** Kurz *s.n.*, Andamans (K).

Tree to 20 m, occasionally to 30 m tall. **Twigs** tending to dry black. **Leaves** membranaceous to chartaceous, drying wrinkled along lateral and intercostal veins, glabrous, tending to dry black on both sides; elliptic, 6–16 \times 3–4.8 cm, base mostly slightly attenuate, sometimes cuneate, margin not undulate, apex acuminate; midrib sunken above; lateral veins prominulous to prominent below, 5–8 pairs, arching and diminishing toward leaf margin; intercostal venation fine and faint, laxly reticulate; petiole 0.2–0.4 cm long. **Male inflorescences** 0.2–0.5 cm long, each bearing many small clustered flowers. **Male flowers** with calyx small, divided into 4 valvate triangular lobes; corolla ovoid in bud, c. 0.3 cm long. **Female inflorescences** c. 0.5 cm long, each bearing a few flowers. **Female flowers** with calyx divided practically to base into 4 rounded valvate lobes. **Fruits** 1–4 per cluster, on c. 0.5 cm long stalks, ellipsoid, c. 1.2×0.9 cm, symmetric, not ribbed, woody, glabrous. **Fruit calyx** not or slightly accrescent, divided virtually to base into 4 leafy-coriaceous lobes that are reflexed backwards, each lobe about 0.5×0.4 cm.

Distribution. Andamans, Thailand, Peninsular Malaysia, Borneo, the Philippines, and Maluku. In Borneo, known only from Sabah (e.g., Nootboom 1005, SAN 127582, SAN 30660, SAN 74397, and SAN 88380).

Ecology. In lowland forests.

Notes. The Bornean specimens differ from those of Peninsular Malaysia in the fruits being glabrous instead of velvety. *D. kurzii* can be confused with *D. venosa*. In fruiting specimens of *D. venosa*, the calyx tube forms a distinct cup below the reflexed lobes, but such a cup is absent in *D. kurzii* because the lobes are divided to the base. The calyx in *D. kurzii* is always 4-lobed whereas that in *D. venosa* is often 3-lobed.

40. Diospyros lanceifolia Roxb.

(Latin, *lanceifolius* = with lance-shaped leaves)

Hort. Beng. (1814) 93, Fl. Ind., ed. Carey 2 (1832) 537; Bakhuizen *l.c.* (1938) 273; Anderson *l.c.* 169; Argent *et al.* (eds.) *l.c.* 183; Ng *l.c.* (1978) 76; Turner *l.c.* 198; Beaman *et al.* *l.c.* 228. **Type:** unknown.

Tree to 27 m tall. **Twigs** more or less reddish brown hairy when young, becoming glabrous with age, *drying blackish or dark brown*. **Leaves** chartaceous to coriaceous, glabrous or sparsely or densely appressed hairy below, *drying yellowish brown*, plane or bullate between veins; narrow willow-like, elliptic, ovate, lanceolate, oblong-elliptic, or oblong-lanceolate, 5.5–35 × 1–14 cm, base long-tapered, cuneate or rounded, with or without a pair of pit-glands, margin not undulate, apex long-tapered, acute or acuminate; midrib sunken above; lateral veins 5–24 pairs, prominulous to prominent below, diminishing toward leaf margin or inarching and forming pronounced intramarginal veins; intercostal venation invisible or visible on one or both sides of leaf, reticulate, laxly scalariform to reticulo-scalariform; petiole 0.6–2.4 cm long. **Male inflorescences** 0.2–0.5 cm long, each bearing 3–10 crowded flowers. **Male flowers** with calyx divided into 4 valvate triangular lobes; corolla salverform, 0.6–1.2 cm long. **Female inflorescences** 0.1–0.3(–0.6) cm long, each bearing 1–7 flowers. **Female flowers** with calyx divided into 4 valvate triangular lobes. **Fruits** 1–3, subsessile or on stalks up to 0.6 cm long, globose, 1–2.5 cm diameter, woody, symmetric, not ribbed, velvety hairy when young, glabrous with age. **Fruit calyx** slightly accrescent, woody, smooth, with the tubular portion forming a cup to fit the base of fruit; lobes 0.5–1 × 0.4–1 cm, with erect or reflexed margins, veins faint or invisible.

Distribution. India, Sumatra, Peninsular Malaysia, Borneo, and the Philippines.

Ecology. In lowland forests.

Notes. A highly variable species in which the extremes differ greatly from each other but are linked by intermediate forms. Five varieties are recognised in Sabah and Sarawak.

Key to varieties

1. Leaves glabrous or only scantily hairy below.....2
 - Leaves hairy below.....4
2. Leaves narrow, willow-like.....
 - var. **saliciformis** Ng
 - (Latin, *saliciformis* = shaped like the willow, *Salix*)
 - Gard. Bull. Sing. 53 (2001) 307. Type: *Coode 7826*, Borneo, Brunei (holotype KEP; isotype SING).

Tree to 20 m tall. Leaves chartaceous, *glabrous, narrowed, willow-like*, 5.5–11.5 × 1–3.2 cm, base gradually tapered and attenuate, without pit-glands, apex gradually tapered; lateral veins prominulous to almost invisible, 5–7 pairs; intercostal veins practically invisible below; petiole 0.3–0.5 cm long. Male and female inflorescences and flowers unknown. Fruits solitary, subsessile on 0.1–0.2 cm long stalks, to c. 1.5 cm diameter. Fruit calyx a 4 pointed star with the lobes up to 0.6 × 0.4 cm.

Endemic to Borneo and known from Sarawak (e.g., *Chew CWL 1170* and *S 49201*) and Brunei (e.g., *Coode 7826*). The leaves of *D. lanceifolia* var. *saliciformis* are superficially similar to those of *D. eucalyptifolia* and the narrow-leafed forms of *D. andamanica* and *D. ferruginescens*.

Leaves broader, lanceolate, oblong-elliptic, elliptic or ovate.....3

3. Leaf base cuneate.....

var. **lanceifolia**

Synonym: *D. lanceifolia* forma *typica* Bakh. *l.c.* (1938) 276.

Tree to 20 m tall. Leaves chartaceous, *glabrous to scantily hairy below; lanceolate to oblong-lanceolate*, rarely *elliptic*, 8–17 × 2.5–5.5 cm, *base cuneate*, apex acuminate; lateral veins prominulous to prominent below, 6–9 pairs; intercostal venation invisible to prominulous below, vaguely scalariform to vaguely reticulate; petiole 0.6–1.5 cm long. Female inflorescences c. 0.1 cm long, each bearing 1–3 flowers. Fruits mostly solitary, subsessile, on c. 0.1 cm stalks, to c. 1.3 cm diameter. Fruit calyx with lobes c. 0.5 × 0.5 cm.

India, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo, known from Sabah (e.g., *SAN 61442*, *SAN 77588*, *SAN 93823*, and *SAN 99625*), Sarawak (e.g., *S 13428*, *S 37680* and *S 42109*), Brunei (e.g., *SAN 13137*), and Kalimantan (e.g., *Anderson 14* and *Mahyar et al. 1297*). In lowland and hill mixed dipterocarp forests, to 700 m altitude.

Leaf base rounded.....

var. **renageorgei** Ng

(Rena George, 1956–1994, former officer-in-charge of the Semengoh Botanical Research Centre, Sarawak)

Gard. Bull. Sing. 53 (2001) 306. Type: *Rena George S 43068*, Borneo, Sarawak, Limbang (holotype KEP).

Tree to 21 m tall. Leaves chartaceous, *glabrous*, usually shiny on upper surface and sometimes also on lower surface, slightly bullate between veins; *elliptic to ovate*, 6–19.5 × 4–8.5 cm, *base rounded*, slightly attenuate, and often bearing a pair of pit-glands, apex acuminate; lateral veins sunken above, prominent below, 6–12 pairs; intercostal venation sunken above, prominulous below, reticulo-scalariform; petiole 0.8–1.5 cm long. Female inflorescences up to 0.6 cm long, each bearing 1–5 flowers. Fruits about 3, on 0.3–0.6 cm long stalks, c. 1.3 cm diameter. Fruit calyx with lobes to 1 × 1 cm.

Endemic to Borneo and known from Sabah (e.g., *SAN 99668*), Sarawak (e.g., *S 17862*, *S 17897*, *S 42254*, *S 43068*, and *S 47134*) and Brunei (e.g., *Coode 7050*). In lowland mixed dipterocarp forest.

4. Lateral veins inarching near leaf margin but the inarches not prominent enough to rate as an intramarginal veins.....

var. **consanguinea** (Merr.) Masamune

(Latin, *consanguineus* = akin; a species closely resembling *D. maritima*)

EPB (1942) 604. Basionym: *D. consanguinea* Merr. *l.c.* (1929) 244, Coode *et al.* (eds.) *l.c.* 88. Type: *Elmer 20626*, Borneo, Sabah, Tawau (SING). Synonym: *D. lanceifolia* forma *consanguinea* (Merr.) Bakh. *l.c.* (1938) 276.

Tree to 20 m tall. Leaves chartaceous to coriaceous, *hairy below*; oblong-elliptic to lanceolate, 8–15(–22) × 2.5–6(–8) cm, base cuneate to rounded, apex acuminate; *lateral veins c. 10 pairs*; sunken above, *inarching near margin but not forming distinct intramarginal veins*, prominent below, intercostal venation sunken above, prominent below, vaguely scalariform; petiole 0.8–1.2 cm long. Female inflorescences 0.1–0.3 cm long, each bearing 1–3 flowers. Fruits mostly solitary, on 0.1–0.3 cm long stalks, to *c.* 1.5 cm diameter. Fruit calyx lobes about 0.5 × 0.5 cm.

Sumatra and Borneo. In Borneo, known from Sabah (common, e.g., *Elmer 20626*, *SAN 34133*, *SAN 40126*, *SAN 55848*, *SAN 96393*, and *SAN 116669*), Sarawak (e.g., *S 32328*, *S 32332*, *S 37491*, and *S 38311*), Brunei (e.g., *Dransfield JD 7412* and *Wong WKM 264*), and Kalimantan (e.g., *Kostermans 10685* and *McDonald & Ismail 3472*).

The type is actually less hairy than the majority of specimens subsequently collected, so it forms a bridge between the glabrous var. *lanceifolia* and hairy var. *consanguinea*. Kostermans (1977) has proposed to restore var. *consanguinea* to species status because of the strong intramarginal vein development in some specimens. However, the type specimen itself does not have strong intramarginal vein development. In the present account, the specimens with strong intramarginal veins are placed under a separate variety, var. *iliaspaiei*, as described below.

Lateral veins linked up on each side by a prominent intramarginal vein.....

var. **iliaspaiei** Ng

(Ilias Paie, 1936–1986, plant collector of the Sarawak Forestry Department)

Gard. Bull. Sing. 53 (2001) 305. Type: *Ilias S 50180*, Borneo, Sarawak (holotype SAR).

Tree to 27 m tall. Twigs densely rusty hairy. Leaves coriaceous, *densely rusty hairy below*, bullate between veins; oblong-lanceolate, 13.5–35 × 3.5–14 cm, base cuneate to rounded, sometimes bearing a pair of pit-glands, apex acuminate to acute; *lateral veins* prominent below, sunken above, 15–24 pairs, *inarching and joining near leaf margin to form a prominent intramarginal vein*; intercostal venation prominent below, sunken above, reticulo-scalariform; petiole 1–2.4 cm long. Female inflorescences 0.2–0.5 cm long, each bearing *c.* 3 flowers. Fruits 1–3, on 0.2–0.5 cm long stalks, globose, to *c.* 2 cm diameter, shiny black. Fruit calyx with lobes *c.* 1 × 0.8 cm.

Endemic to Borneo and confined to Sarawak (e.g., *S 24803*, *S 39109*, *S 41224*, *S 50180*, and *Zainuddin 5671*). In lowland mixed dipterocarp forest.

41. **Diospyros lateralis** Hiern

Fig. 5I.

(Latin, *lateralis* = lateral; alluding the lateral position of the inflorescences on the stem)

Trans. Camb. Phil. Soc. 12, 2 (1873) 167; Merrill *l.c.* (1921) 485; Bakhuizen *l.c.* (1938) 352; Masamune *l.c.* 604; Ng *l.c.* (2001) 310. **Type:** *Beccari PB 1600*, Borneo, Sarawak (K). **Synonym:** *D. crassipes* Bakh. *l.c.* (1933) 167, *l.c.* (1938) 290.

Tree to 17 m tall. **Twigs** *glabrous*. **Leaves** chartaceous, *glabrous*; oblong-elliptic, 9.5–12 × 3.2–4.6 cm, *base cuneate*, apex acuminate; midrib sunken above; *lateral veins* prominent below, 4–6 pairs, *arching and diminishing toward leaf margin*; *intercostal venation prominulous, closely*

scalariform and running at right angles to midrib; petiole 0.2–0.8 cm long. **Male inflorescence** 0.5–1 cm long, each bearing *c.* 3 flowers. **Male flowers** with calyx deeply cup-shaped, divided at top into 5 small triangular teeth. **Female inflorescences** and **flowers** unknown. **Fruits** *solitary, subsessile (stalks 0.1–0.2 cm long), globose to depressed ovoid, to c. 2.6 cm diameter*, when dry vertically ribbed according to the number of seeds contained within, woody. **Fruit calyx** accrescent, rugose, woody, forming a shallow cup with 5 teeth around the rim.

Distribution. Thailand, Sumatra and Borneo. In Borneo, known from Sarawak only; a rare tree represented by its type (*Beccari PB 1600*) and two other specimens (*Beccari PB 2041*, type of *D. crassipes*, and *S 5367*).

Ecology. In lowland mixed dipterocarp forest.

42. *Diospyros lunduensis* Ng (of Lundu, Sarawak)

Fig. 5A–F.

Gard. Bull. Sing. 53 (2001) 299. **Type:** *Othman S 49996*, Borneo, Sarawak, Lundu, G. Pueh (holotype KEP; isotype SAR).

Tree to 25 m tall. **Twigs** covered with short appressed hairs. **Leaves** coriaceous, glabrous, tending to dry black above, *not subglaucous below; elliptic to oblong-elliptic, 5.6–14 × 2.8–6 cm, base rounded to subcordate, margin not undulate, apex shortly acuminate or acute; midrib sunken above; lateral veins prominent below, 5–7 pairs, arching and diminishing toward leaf margin; intercostal venation prominent below, laxly reticulate; petiole 0.5–0.8 cm long.* **Male inflorescences** and **flowers** unknown. **Female inflorescences** 0.2–0.4 cm long, each bearing usually solitary flower. **Female flowers** with *calyx deeply divided into 4 rounded imbricate hairy lobes*, sometimes notched at apex. **Fruits** solitary, on 0.2–0.4 cm long stalks, globose, *to c. 2 cm diameter, glabrous to sparsely appressed hairy, not ribbed*, smooth, symmetric. **Fruit calyx** *not accrescent; lobes to 0.6 × 0.6 cm, spreading to reflexed.*

Distribution. Endemic to Borneo and known from Sarawak (e.g., *S 25482*, *S 49996*, and *S 59692*) and Brunei (e.g., *BRUN 18266* and *Ogata et al. OG-B 507*).

43. *Diospyros macrophylla* Blume (Greek, *makro* = large, *phullon* = leaf; large-leafed)

Fig. 2F.

Bijdr. Fl. Ned. Ind. (1825) 670; Bakhuizen *l.c.* (1938) 342; Argent *et al.* (eds.) *l.c.* 184. **Type:** *Blume s.n.*, Java, G. Parang (holotype L). **Synonyms:** *D. suluensis* Merr. *l.c.* (1926) 422, *l.c.* (1929) 240, Masamune *l.c.* 606; *D. pachycalyx* Merr. *l.c.* (1929) 246, Masamune *l.c.* 605.

Tree to 30 m tall. **Twigs** velvety in young parts, becoming glabrous with age. **Leaves** chartaceous, *not bullate between veins, finely velvety on midrib and lateral veins below to almost glabrous, tending to dry black above or on both sides; elliptic or oblong-elliptic, 8–18 × 3–7 cm, base cuneate to rounded, margin not undulate, apex acuminate; midrib sunken above; lateral veins prominent below, 7–13 pairs, diminishing toward leaf margin; intercostal venation very fine*

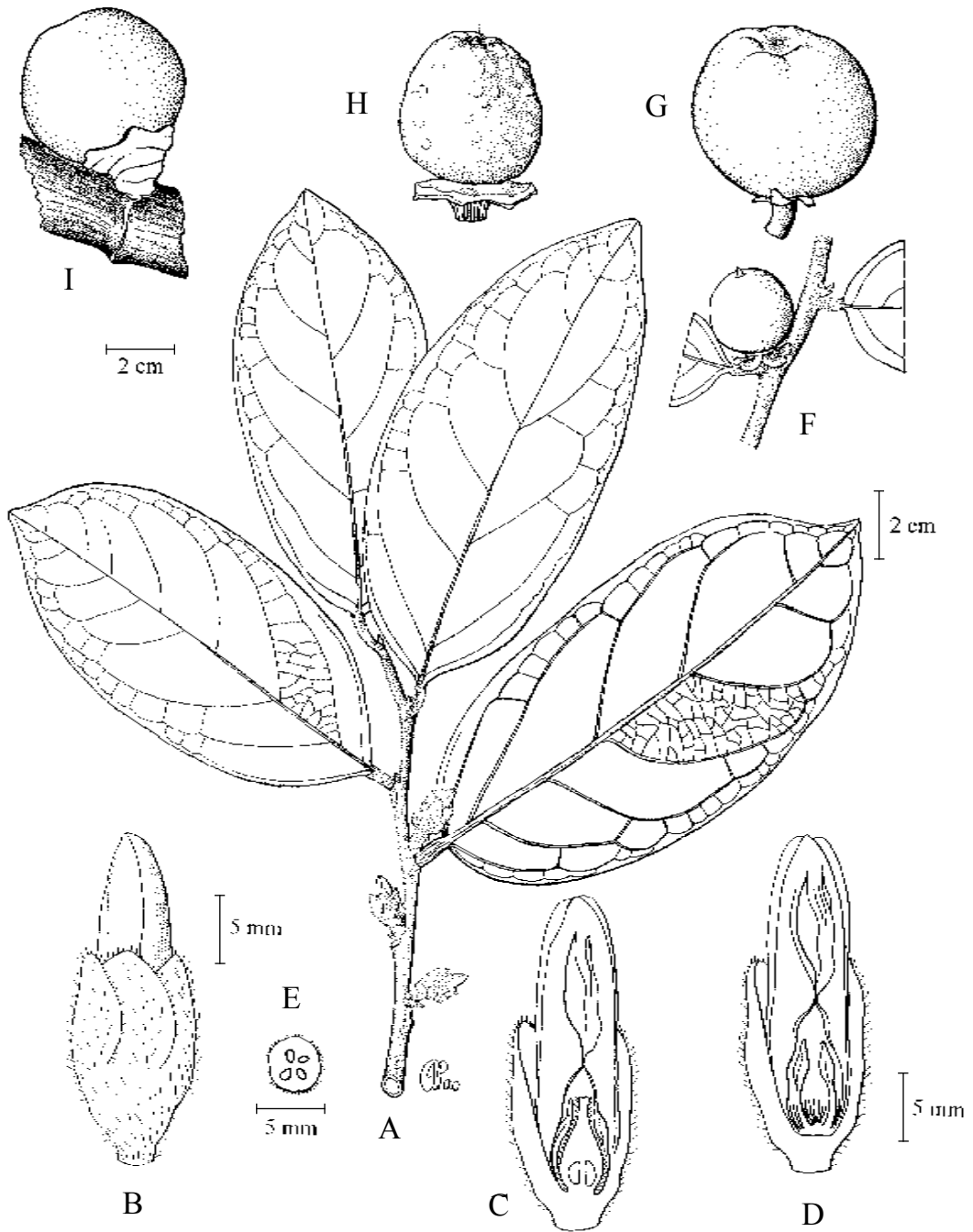


Fig. 5. *Diospyros lunduensis* (A–F); *D. daemona* (G); *D. korthalsiana* (H); *D. lateralis* (I). A, flowering leafy twig; B, female flower bud; C, female flower bud in longitudinal section; D, as C but with ovary removed to show staminodes; E, ovary in transverse section; F–I, fruits. (A–E from S 25482, F from S 49996, G from SAN 85013, H from SAN 43100, I from S 5367.)

and prominulous below, scalariform as well as reticulate; petiole 0.3–0.5 cm long. **Male inflorescences** 0.5–2 cm long, each bearing 3–20 flowers. **Male flowers** with calyx tubular, divided at top into 4–5 small teeth; corolla salverform, to c. 0.8 cm long. **Female inflorescences** 0.5–4 cm long, each bearing 1–5 flowers. **Female flowers** with calyx divided deeply into 4–5 plicate-triangular valvate lobes; pedicels sometimes conspicuously black-hairy. **Fruits** 1–4, on stout stalks of 0.5–4 cm long, velvety when young, maturing glabrous, globose to oblong, to c. 6.5 × 5.5 cm, not ribbed, smooth or sometimes shallowly longitudinally puckered; pulp edible. **Fruit calyx** accrescent, stretched into a 4–5 sided woody plate with narrow reflexed margins, either 3–4 cm diameter and not extending beyond the periphery of the fruit, or massively enlarged to 8 cm diameter and extending beyond the periphery of the fruit, veins very faint or invisible.

Distribution. Sumatra, Java, Borneo, Sulawesi, and the Philippines. In Borneo, known from Sabah (very common; e.g., *SAN 17712*, *SAN 34272*, *SAN 57664*, *SAN 75156*, and *SAN 109328*), Sarawak (e.g., *S 31532*, *S 31739*, *S 32171*, and *S 39352*) and Kalimantan (e.g., *Burley & Lee 279*, *Kostermans 4840*, *Kostermans 6927*, and *Kostermans 9537*).

Ecology. In lowland and hill mixed dipterocarp forest, to 1000 m altitude.

Notes. *D. macrophylla* is very variable in the degree of hairiness of the leaves (finely velvety below to glabrous), the size of the fruiting calyx (4–8 cm diameter) and the form of the female inflorescence. Male inflorescences may be mistaken for those of *D. pilosanthera*.

44. *Diospyros maingayi* (Hiern) Bakh.

(A.C. Maingay, 1836–1869, British physician and botanist, sometime jail-warden in Malacca, Peninsular Malaysia)

Gard. Bull. S. S. 7 (1933) 164, *l.c.* (1937) 94; Ng *l.c.* (1978) 77; Anderson *l.c.* 169; Turner *l.c.* 198; Argent *et al.* (eds.) *l.c.* 184. **Basionym:** *Maba maingayi* Hiern *l.c.* 138, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607. **Type:** *Maingay 976*, Peninsular Malaysia, Malacca (holotype K). **Synonym:** *Maba motleyi* Hiern *l.c.* 139, *p.p.*, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607.

Tree to 30 m tall or more. **Twigs** drying black. **Leaves** coriaceous, glabrous to velvety below, drying consistently black on both sides; elliptic, 8–20 × 5–11 cm, base rounded or broadly cuneate, apex rounded, retuse or shortly acuminate; midrib sunken above; lateral veins prominulous, 5–9 pairs, faintly inarching and joining to form intramarginal vein-loops near leaf margin; *intercostal venation invisible*; petiole 1.5–2 cm long. **Male inflorescences** 0.5–1.2 cm long, often in axillary clusters of up to 4 per node, each bearing a solitary flower. **Male flowers** with calyx divided into 4–5 semi-circular lobes. **Female inflorescences** 1–1.5 cm long, each bearing 2–4 flowers. **Female flowers** resembling male except more bulging at base. **Fruits** in clusters of 2–4, on 1–1.5 cm long stalks, oblong-ellipsoid, to c. 5 × 3.5 cm, drying woody, smooth and glabrous. **Fruit calyx** not accrescent; lobes spreading, rounded, c. 0.5 × 0.4 cm.

Vernacular name. Sarawak—*merpinang daun besar* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN 57592*, *SAN 80001*, *SAN 80005*, *SAN 80006*, and *SAN 80028*), Sarawak (common, e.g.,

Carroll 229, Hewitt 1039, KEP 79320, S 12421, S 29384, and S 40434), Brunei (e.g., *Sinclair & Kassim 10505*), and Kalimantan (e.g., *bb. 26094, Kostermans 4197, Kostermans 6077, Kostermans 7736, Kostermans 10072, and Kostermans 10365*).

Ecology. Mostly in peat swamp forest, but also in non-swampy lowland forests.

Notes. Close to *D. evena* and *D. puncticulosa* in the way the leaves and twigs drying black, the imbricate non-acrescent fruit calyx and the almost invisible intercostal venation, but the leaves and fruits are larger.

45. *Diospyros maritima* Blume

(Latin, *maritimus* = growing by the sea)

Bijdr. Fl. Ned. Ind. (1825) 669; Fischer *l.c.* 294; Bakhuizen *l.c.* (1938) 265; Masamune *l.c.* 604. **Type:** *Blume s.n., Java (n.v.)*.

Tree to 15 m tall. **Leaves** chartaceous, glabrous, *not subglaucous below; oblong-elliptic to elliptic, 7–21 × 3–7 cm, base cuneate to rounded, margin somewhat undulate, apex acute to rounded; midrib sunken above; lateral veins prominulous, 6–10 pairs, arching and diminishing toward leaf margin; intercostal venation faint on both sides, laxly reticulate; petiole 0.8–1 cm long. Male inflorescences* 0.1–0.2 cm long, each bearing to 10 flowers. **Male flowers** with calyx divided in the upper quarter into 4 small valvate triangular lobes; corolla salverform, *c.* 0.7 cm long. **Female inflorescences and flowers** unknown. **Fruits** solitary, subsessile, globose, *to c.* 1.7 cm diameter, *not ribbed*, thinly woody, velvety when young, smooth and symmetric. **Fruit calyx accrescent, forming a 4-pointed cup.**

Distribution. Sumatra, Java, Borneo, the Philippines, Sulawesi, Maluku, and New Guinea. In Borneo, known from Sabah (locally common on Pulau Balambangan, Pulau Tiga and Pulau Mengalon, e.g., *SAN 26599, SAN 84740, SAN 103157, SAN 126022, and SAN 127152*) and Brunei (*Wong & Kamariah 4*).

Ecology. In coastal forests.

Notes. The flowers and fruits remind those of *D. lanceifolia* but the leaves are characteristically elliptic, with rounded to acute apices (unusual in a genus in which most species have acuminate apices), and usually undulate leaf margin.

46. *Diospyros mindanaensis* Merr.

(of Mindanao, the Philippines)

Philip. J. Sci. 4 (1909) 309; Bakhuizen *l.c.* (1938) 349; Anderson *l.c.* 169; Coode *et al.* (eds.) *l.c.* 89 (including *D. aff. mindanaensis* and *D. mindanaensis vel aff.*); Ng *l.c.* (2001) 310; Beaman *et al.* *l.c.* 228. **Syntypes:** *Whitford FB 9019 and Hutchinson FB 4811, the Philippines (n.v.)*. **Synonym:** *D. endertii* Bakh. *l.c.* (1933) 169, *l.c.* (1938) 365, Masamune *l.c.* 602.

Tree to 27 m tall. **Twigs** glabrous, sparsely lenticellate, rugose, drying blackish. **Leaves** chartaceous to coriaceous, *not bullate between veins, glabrous, upper surface dull, lower surface*

not subglaucous; oblong, 8.5–37 × 3.5–10 cm, base cuneate, rounded or subcordate, margin not undulate, apex acuminate; midrib variably sunken, flat or prominent above; lateral veins prominent below, 5–14 pairs, diminishing toward leaf margin; intercostal venation prominulous above and below, reticulate; petiole 0.7–3 cm long. **Male inflorescences** 1.3–3.5 cm long, each bearing 3 or more flowers, sometimes appearing as a large pseudo-panicle formed by the suppression of leaves on the flower-bearing shoots. **Male flowers** with calyx cup-shaped, with the opening truncate or shallowly 4–5 toothed; corolla urceolate. **Female inflorescences** 0.3–3.5 cm long, each bearing 1–3 flowers. **Female flowers** with calyx divided into 4–5 valvate lobes, sharply reflexed at a position halfway up the tube, reflexed part spreading horizontally or bent backwards. **Fruits** usually solitary, on 0.3–3.5 cm long stalks, globose, depressed globose or ovoid-globose, to c. 7.5 cm diameter, symmetric, not ribbed, woody thick-walled, glabrous. **Fruit calyx** 1.5–2.5 × 3–5 cm, erect to reflexed, with the base of calyx tube greatly thickened or not, not distinctly cup-shaped; lobes greatly expanded or not, coriaceous to hard and brittle, veins very faint or invisible.

Distribution. Borneo and the Philippines. In Borneo, known from Sabah (common, e.g., Clemens 30359, Kokawa & Hotta 1492, SAN 24548, SAN 70209, and SAN 132635), Sarawak (common, e.g., Jacobs 5097, S 13184, S 37510, S 39094, and S 47320), Brunei (e.g., Dransfield JD 7277, Hotta 12812, S 10959, and Simpson 2454), and Kalimantan (e.g., Burley 2704, Burley et al. 2491, Endert 4017, and Partomihardjo 1142).

Notes. This species is distinguished by its large oblong leaves and large fruits. The form of the fruit calyx is extremely variable. In general, the calyx is reflexed sharply from a position about halfway up the calyx tube. The lobes themselves may or may not be bent back in the opposite direction. Also, the basal (non-reflexed) part of the calyx tube may be greatly thickened or not. These variations are not correlated with any differences in leaf morphology. Male specimens are few in comparison with female specimens, but the male specimens are consistent and provide no basis for recognition of more than one species. It is not even possible to divide the species into varieties. *D. rigida* differs in having longer, more rigid leaves, which dry with a yellowish tinge on the underside, and its intercostal venation is finer.

47. *Diospyros muricata* Bakh.

Fig. 6G.

(Latin, *muricatus* = rough with short hard points; alluding the bristly hairy fruits)

Gard. Bull. S. S. 7 (1933) 177; Bakhuizen l.c. (1937) 164; Masamune l.c. 604; Anderson l.c. 169. **Syntypes:** Jaheri 644, Borneo, Kalimantan (BO) and Haviland & Hose 3483, Borneo, Sarawak (SAR).

Tree to 11 m tall. **Twigs** covered with short appressed hairs. **Leaves** chartaceous, glabrous or hairy on veins, tending to dry black above, not subglaucous below; obovate or elliptic, 11–21 × 3.5–7.5 cm, base cordate to rounded, margin not undulate, apex acuminate; midrib prominent above; lateral veins prominent below, 6–10 pairs, arching and diminishing toward leaf margin; intercostal venation prominulous below, reticulate to laxly scalariform; petiole c. 0.5 cm long. **Male inflorescences** 0.1–0.5 cm long, each bearing 3–7 closely clustered flowers. **Male flowers** with calyx divided deeply into 4 imbricate ovate lobes; corolla salverform, c. 1 cm long. **Female inflorescences** 0.1–0.3 cm long, each bearing about 3 flowers. **Female flowers** with calyx divided

into 4 imbricate rounded lobes. **Fruits** 1–3, subsessile on 0.1–0.3 cm long stalks, ovoid, to c. 2 cm diameter, covered with bristly, appressed or somewhat spreading hairs, not ribbed, faintly wrinkled, symmetric. **Fruit calyx** not accrescent; lobes c. 0.3×0.2 cm.

Distribution. Endemic to Borneo and known from Sabah (e.g., *SAN 34099*, *SAN 93111* and *SAN 120973*), Sarawak (e.g., *Haviland & Hose 3483* and *S 16438*), Brunei (e.g., *Dransfield JD 6874*), and Kalimantan (e.g., *Jaheri 644*).

Ecology. In lowland mixed dipterocarp forest, to 330 m altitude.

Notes. The leaves with subcordate to rounded base, tending to dry black above, and the bristly hairs on the fruits are diagnostic. The midrib, lateral and intercostal veins raised instead of sunken above distinguishes *D. muricata* from *D. everettii*.

48. *Diospyros neurosepala* Bakh.

Fig. 1F.

(Greek, *neuron* = sinew or nerve, *sepalum* = sepal; alluding the prominently veined fruit calyx)

Gard. Bull. S. S. 7 (1933) 178, *l.c.* (1938) 181; Masamune *l.c.* 604; Anderson *l.c.* 169. **Type:** *Beccari PB 541*, Borneo, Sarawak (K, photo).

Tree to 13 m tall. **Leaves** chartaceous, *glabrous*, more or less bullate between veins, drying with a yellow tinge; elliptic to oblong-elliptic, $8\text{--}22 \times 2.5\text{--}6$ cm, base rounded to cuneate, apex acuminate; midrib sunken above; *lateral veins* 5–8 pairs, *sunken above*, prominent below, *inarching and joining to form intramarginal vein at one third of the distance from leaf margin to midrib*; *intercostal venation sunken above, prominent below, laxly reticulate*; petiole 0.7–1.5 cm long. **Male inflorescences** c. 2 cm long, each bearing about 6 flowers. **Female inflorescences and flowers** unknown. **Fruits** solitary, on 0.8–1.3 cm long bracteate stalks, globose, to c. 4.5 cm diameter, *glabrous*, symmetric, drying smooth to somewhat puckered. **Fruit calyx** *divided into 4 valvate leafy coriaceous, prominently veined, erect spreading lobes of c. 2.5×2.5 cm.*

Distribution. Endemic to Borneo and known from Sarawak (e.g., *S 13370*, *S 13393*, *S 17036*, *S 34326*, *S 35736*, and *Sinclair & Kassim 10226*) and Kalimantan (e.g., *Church et al. 1654*).

Notes. This species stands out by the midrib, lateral and intercostal veins sunken above, the inarching of the lateral veins at a wide distance from the leaf margins, and the leafy, veined fruit calyx lobes.

49. *Diospyros oligantha* Merr.

Fig. 6H.

(Greek, *oligos* = few, *anthos* = flower; the few-flowered inflorescence)

PEB (1929) 243; Bakhuizen *l.c.* (1937) 118; Masamune *l.c.* 604. **Type:** *Elmer 21419*, Borneo, Sabah, Tawau (BO, L, SING).

Tree to 30 m tall. **Twigs** glabrous to densely hairy. **Leaves** chartaceous, glabrous to densely hairy and *not subglaucous below*; obovate, elliptic or ovate, 4–18 × 2–7 cm, base cuneate, rarely rounded, margin not undulate, apex acuminate; midrib sunken above, forming a groove that is often filled with hairs; lateral veins prominent below, 4–6 pairs, diminishing toward leaf margin; intercostal venation prominulous below, weakly scalariform to reticulate; petiole 0.3–0.9 cm long. **Male inflorescences** 0.1–0.8 cm long, each bearing 3–10 flowers. **Male flowers** with calyx divided into 4 imbricate rounded lobes; corolla 0.5–0.8 cm long, salverform. **Female inflorescences** 0.1–1 cm long, each bearing 3–5 flowers. **Female flowers** with calyx divided into 4 imbricate rounded lobes. **Fruits** 1–5, on stalks of 0.1–0.5 cm long (rarely up to 1 cm long, in which case the individual pedicels do not exceed 0.5 cm), globose, to c. 1.9 cm diameter, not ribbed, symmetric, glabrous to sparsely appressed hairy, puckered on drying. **Fruit calyx** not accrescent; lobes c. 0.2 × 0.2 cm.

Distribution. Endemic to Borneo and known from Sabah (common, e.g., *Elmer 20592*, *FMS 36824*, *SAN 25001*, *SAN 97125*, and *SAN 109820*), Sarawak (e.g., *S 0895*, *S 16622* and *S 23893*) and Brunei (e.g., *FMS 48207*).

Notes. Until this revision, *D. oligantha* was only a name attached to the type specimens, of which there were no duplicates in Sabah. It turns out to be a very common species in Sabah, bearing a close resemblance to *D. clavigera* of Peninsular Malaysia. It differs from *D. simaloerensis* in the fruits sparsely appressed hairy or glabrous instead of densely velvety, and the pedicels less than 0.5 cm long. It differs from *D. fusiformis* by its shorter inflorescences and globose fruits. Its fruits resemble those of *D. subrhomboidea*.

50. *Diospyros parabuxifolia* Ng (Greek, *para* = near/similar to; near to *D. buxifolia*)

Fig. 6A–B.

Gard. Bull. Sing. 53 (2001) 301. **Type:** *Ilias S 33017*, Borneo, Sarawak, Lawas, Bt. Batanga (holotype KEP; isotype SAR).

Tree to 15 m tall. **Twigs** on drying not consistently black. **Leaves** chartaceous, glabrous, *not glaucous below*, on drying not consistently black; obovate, 1.5–2 × 0.8–1.5 cm, base cuneate to attenuate, apex rounded, acute or shortly acuminate; midrib sunken to raised above; lateral veins invisible; intercostal venation invisible; petiole 0.1–0.2 cm long. **Male and female inflorescences and flowers** unknown. **Fruits** solitary, on elongated 1.5–2 cm long stalks, ellipsoid, c. 2 × 1 cm, symmetric, thin-walled, puckered on drying, almost glabrous. **Fruit calyx** not accrescent, divided deeply into 4 imbricate rounded lobes c. 0.2 × 0.2 cm.

Distribution. Endemic to Borneo and confined to Sarawak (e.g., *S 33017* and *S 60062*).

Ecology. In lower montane forest at 1000–1500 m altitude.

Notes. This species differs from *D. buxifolia* mainly by its elongated fruit stalk. From *D. graciliflora*, which also has an elongated fruit stalk, it differs in the fruit ellipsoid instead of globose. Also the fruit stalk in *D. graciliflora* is much more slender.

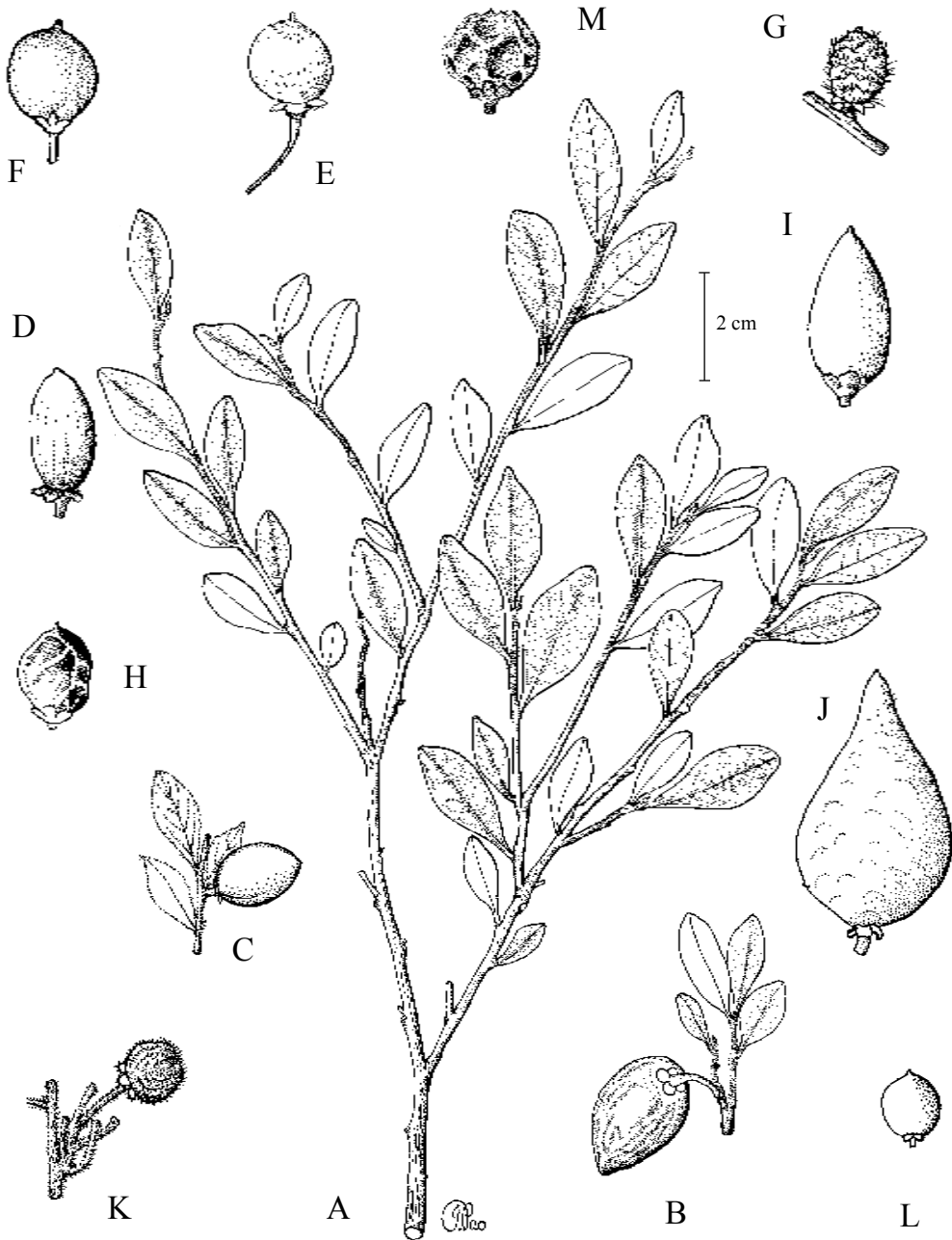


Fig. 6. *Diospyros parabuxifolia* (A–B); *D. buxifolia* (C); *D. evena* (D); *D. graciliflora* (E); *D. havilandii* (F); *D. muricata* (G); *D. oligantha* (H); *D. plectosepala* (I); *D. puncticulosa* (J); *D. simaloerensis* (K); *D. squamaefolia* (L); *D. subrhomboidea* (M). A, leafy twig; B–C, fruiting leafy twigs; D–M, fruits. (A–B from S 33017, C from SAN 94300, D from SAN 84289, E from S 27527, F from S 27803, G from SAN 93111, H from SAN 61533, I from S 44205, J from S 48377, K from S 23775, L from SAN 93630, M from S 41141.)

51. *Diospyros pendula* Hasselt ex Hassk.

(Latin, *pendulus* = pendent; referring to the inflorescence)

Pl. Jav. Rar. Descr. (1848) 468; Bakhuizen *l.c.* (1938) 295; Masamune *l.c.* 605; Ng *l.c.* (1978) 80; Anderson *l.c.* 170; Turner *l.c.* 199; Coode *et al.* (eds.) *l.c.* 89; Beaman *et al.* *l.c.* 229. **Type:** unknown. **Synonym:** *D. fuliginea* Hiern *l.c.* 184, Merrill *l.c.* (1921) 484, Masamune *l.c.* 603.

Tree to 20 m tall. **Twigs** *glabrous, on drying not black*. **Leaves** chartaceous to coriaceous, *glabrous*, smooth on both sides, *drying pale brown on both sides; oblong, oblong-elliptic, or oblong-obovate, 7–25 × 2.5–8 cm*, base cuneate to rounded, apex acute to acuminate; midrib sunken above; *lateral veins* prominulous below, *7–9 pairs*, diminishing toward leaf margin; *intercostal venation invisible on both sides*; petiole 0.7–1.3 cm long. **Male inflorescences** slender, 0.3–4 cm long, each bearing 3 or more flowers. **Male flowers** with calyx divided into 4 valvate lobes, but in the young buds appearing globose or ellipsoid with a small opening at top; corolla salverform, *c.* 1 cm long. **Female inflorescences** stout, 0.3–2.5 cm long, each bearing usually 1, rarely 3 flowers. **Female flowers** with calyx divided halfway into 4 triangular valvate lobes. **Fruits** usually solitary (rarely up to 3), on stalks of 0.3–2.5 cm long, ovoid to depressed globose, to *c.* 3 × 3.5 cm, woody, glabrous, symmetric, with pimply surface when dry. **Fruit calyx** slightly accrescent, more-or-less flattened into a 4-pointed woody star to *c.* 2 cm diameter.

Distribution. Myanmar, Thailand, Peninsular Malaysia, Borneo, and Java. In Borneo, known from Sabah (common, e.g., *SAN 32170, SAN 41346, SAN 75975, SAN 78422, and SAN 127019*), Sarawak (e.g., *Hansen 840, Jacobs 5449, S 33140, S 40769, and S 43884*), Brunei (e.g., *SAN 17405*), and Kalimantan (e.g., *Church & Mahyar 1868, Kessler et al. 860 and Kostermans 13849*).

Ecology. In lowland mixed dipterocarp forest.

52. *Diospyros penibukanensis* Bakh.

(of Penibukan, Sabah)

Bull. Jard. Bot. Buitenz. 3, 15 (1937) 124; Beaman *et al.* *l.c.* 229. **Type:** *Clemens 50214*, Borneo, Sabah, Penibukan (BO).

Tree to 25 m tall. **Twigs** *covered with dense spreading hairs or with velvety appressed hairs*. **Leaves** chartaceous, *under surface densely hairy all over or glabrous except on veins, not subglaucous below; elliptic, obovate or oblong-obovate, 11–38 × 4–15 cm*, base subcordate, rarely rounded, margin not undulate, apex acute to acuminate; midrib sunken above, covered with dense spreading or velvety appressed hairs below; *lateral veins prominent below, 5–24 pairs, arching and diminishing toward leaf margin; intercostal venation prominent to prominulous below, densely or laxly scalariform; petiole 0.5–1.5 cm long*. **Male inflorescences** *c.* 0.5 cm long, each bearing to 10 crowded flowers. **Male flowers** with *calyx divided into 4 imbricate triangular lobes*. **Female inflorescences** *c.* 0.5 cm long, each bearing to 10 flowers. **Female flowers** with *calyx divided into 4 imbricate ovate to semi-circular lobes*. **Fruits** in clusters of 1–3, *on c.* 0.5 cm long stalks, globose, 2–2.5 cm diameter, *not ribbed*, densely velvety, woody,

smooth, symmetric. **Fruit calyx** *not accrescent*; lobes coriaceous, rounded or broadly ovate, $0.2-0.6 \times 0.3-0.8$ cm.

Distribution. Endemic to Borneo (Sabah and Sarawak).

Ecology. In lowland and hill mixed dipterocarp forests, including heath forest.

Key to varieties

Twigs densely covered with spreading hairs. Leaf under surface densely pubescent all over with spreading hairs; intercostal venation densely scalariform.....

var. **penibukanensis**

Tree up to 20 m tall. Leaves obovate, $12-20 \times 5-7.5$ cm, base subcordate, apex acute to acuminate; lateral veins 9-13 pairs; petiole *c.* 0.5 cm long. Fruits up to 2 cm diameter. Fruit calyx lobes *c.* 0.2×0.3 cm.

Endemic to Borneo and confined to Sabah (e.g., *Clemens 50214*, *SAN 31935*, *SAN 64837*, and *SAN 69324*).

Twigs velvety with appressed hairs. Leaves glabrous except for the velvety veins; intercostal venation laxly scalariform.....

var. **scalarinervis** Ng

(Latin, *scalaris* = ladder-like, *nervus* = vein; referring to the ladder-like intercostal venation)

Gard. Bull. Sing. 53 (2001) 308. Type: *S 56607*, Borneo, Sarawak (holotype KEP; isotype SAR).

Tree up to 10 m, rarely to 25 m tall. Leaves elliptic, broadly obovate to oblong-obovate, $11-38 \times 4-15$ cm, base subcordate, rarely rounded, apex acute to acuminate; lateral veins 5-24 pairs; petiole 0.8-1.5 cm long. Fruits to 2.5 cm diameter. Fruit calyx lobes $0.4-0.6 \times 0.5-0.8$ cm.

Endemic to Borneo and confined to Sarawak (e.g., *S 13586*, *S 13681*, *S 13702*, *S 18639*, *S 34482*, *S 34935*, *S 34962*, *S 35271*, *S 41850*, *S 49997*, and *S 56607*).

53. **Diospyros perfida** Bakh.

(Latin, *perfidus* = unsafe/unreliable; alluding the allegedly poisonous fruits)

Gard. Bull. S. S. 7 (1933) 181, *l.c.* (1938) 340; Argent *et al.* (eds.) *l.c.* 185. **Syntypes:** *bb. 2327*, *bb. 13221* and *Endert 2705*, Borneo, Kalimantan (all at BO).

Tree to 25 m tall. **Leaves** membranaceous, glabrous, *tending to dry black on both sides*; oblong-elliptic, $(7.5-12-25 \times (2-)4.5-10$ cm, base cuneate to slightly attenuate, margin not undulate, apex acuminate; midrib sunken above, prominent below, drying black; lateral veins prominent below, 8-11 pairs, arching and diminishing toward leaf margin; intercostal venation prominulous below, laxly scalariform; petiole *c.* 1 cm long. **Male inflorescences** 0.5-0.8 cm long, each bearing 3 crowded flowers. **Male flowers** with calyx divided into 4 imbricate rounded lobes; corolla salverform, *c.* 0.7 cm long. **Female inflorescences** *c.* 0.3 cm long, each bearing 1-3 flowers. **Female flowers** with calyx divided into 4 imbricate ovate lobes. **Fruits** usually solitary, on *c.* 0.5 cm long stalks, depressed globose, *to c.* 5 cm diameter, not ridged, symmetric, woody, finely velvety when young, becoming smooth and glabrous with age. **Fruit calyx** *accrescent*, rugose,

woody, initially cup-shaped with 4–5 valvate rounded lobes tightly clasping the lower three-quarters of the fruit, then half as the fruit enlarges and finally forming a shallow tray when the fruit is fully grown; during the process of enlargement, the calyx lobes are stretched so that they look valvate in fruit; veins very faint or invisible.

Distribution. Endemic to Borneo and known from Sabah (common, e.g., *SAN 29982*, *SAN 39906*, *SAN 58222*, *SAN 95530*, and *SAN 133947*) and Kalimantan (e.g., *Kostermans 5446*, *Kostermans 5927*, *Kostermans 6774*, *Kostermans 6915*, and *Kostermans 6993*).

Ecology. Common in lowland mixed dipterocarp forest.

Notes. The oblong leaves with scalariform intercostal venation resemble those of *D. hallieri* but differ in the tendency of the midrib to blacken on drying. In Bakhuizen's revision, the local name of *D. perfida* in SE Borneo is recorded as *toeba api* (fiery tuba) which suggests that it is a potent fish poison.

54. *Diospyros pilosanthera* Blanco

(Latin, *pilosantherus* = with pilose or hairy anthers)

Fl. Filip. ed. 1 (1837) 304; Merrill, *Spec. Blanc.* (1918) 302; Turner *l.c.* 199; Ng *l.c.* (2001) 310; Beaman *et al. l.c.* 229. **Neotype:** Merrill *Spec. Blanc.* 820, the Philippines, Luzon, Batangas Prov. (*n.v.*). **Synonyms:** *D. polyalthioides* Korth. ex Hiern *l.c.* 198, Merrill *l.c.* (1921) 485, Bakhuizen *l.c.* (1938) 241, Masamune *l.c.* 605; *D. polyalthioides* var. *polyalthioides* (Korth. ex Hiern) Ng *l.c.* (1977) 237; *D. plicata* Merr. *l.c.* (1914) 336, *l.c.* (1929) 240, Masamune *l.c.* 605; *D. cubica* Bakh. *l.c.* (1933) 168, *l.c.* (1938) 253, *l.c.* (1955) plate 56; *D. helferi* auct. non C.B. Clarke: Masamune *l.c.* 603.

Tree to 35 m tall. **Twigs** slender to stout, reddish brown pubescent when young, glabrous when older, drying whitish, greyish or blackish. **Leaves** chartaceous to coriaceous, *not bullate between veins*, glabrous to velvety below, *tending to dry black on upper or both sides*; elliptic, oblong, oblong-elliptic or oblong-obovate, 5–30 × 2.5–12 cm, base cuneate, rounded, subcordate to slightly attenuate, margin not undulate, apex acuminate; midrib sunken above, glabrous below; lateral veins faint to prominent below, 5–20 pairs, inarching faintly to form multiple anastomosing loops near leaf margin; intercostal venation faint to prominent below, reticulate to vaguely scalariform; petiole 0.5–1.5 cm long. **Male inflorescences** c. 1 cm long, each bearing 5–12 clustered flowers. **Male flowers** with calyx divided one quarter to halfway into 4–5 triangular valvate lobes; corolla slender, salverform, to c. 0.7 × 0.2 cm. **Female inflorescences** 0.1–0.5 cm long, each bearing 1–5 flowers. **Female flowers** with calyx divided into 4–5 valvate lobes which range from small and simple to large and plicate. **Fruits** in clusters of 1–3, subsessile on 0.1–0.5 cm long stalks, globose to ovoid, 1.8–3.5 cm diameter, symmetric, not ribbed, woody, smooth to faintly vertically lobed, densely velvety when young, maturing velvety or glabrous. **Fruit calyx** not, slightly, or greatly accrescent; lobes spreading or reflexed, small and not exceeding the fruit in diameter to greatly enlarged and thrown into many folds covering the whole fruit; veins very faint to invisible.

Distribution. Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, and Maluku.

Ecology. In lowland, hill to lower montane forests, to 1600 m altitude.

Notes. This species is very variable in the development of its fruit calyx. At one extreme, the fruit calyx may be only slightly accrescent and of smaller diameter than the fruit, but at the other extreme it may be much enlarged and at the same time, thrown into many waves or folds which almost completely cover the fruit. The calyx may also be only slightly wavy or not wavy at all, and erect, clasping the base of the fruit, or reflexed backwards away from the fruit. All these forms are linked by intermediates. The leaves are also very variable in size and degree of hairiness, and the intercostal venation varies from faint to prominent below. In general, the leaves vary independently of the fruits, as a result of which any subdivision based on fruits alone would leave sterile and male specimens un-namable. Subdivision based on leaves alone is also untenable. Out of this complex, only one entity stands out somewhat. This is var. *elmeri* in which large many-folded calyx lobes is combined with leaves often (but not always) velvety below, with intercostal venation prominent below. The remainder make up, by default, the highly variable var. *pilosanthera*. A better subdivision cannot be attempted without examining the species throughout its range, which covers the whole of SE Asia. The reduction of *D. cubica* is based on examination of a photograph from Kew of the type (*Beccari PB 830*, Sarawak).

Key to varieties

Fruit calyx greatly accrescent, lobes thrown into many folds. Leaves more or less velvety below; lateral and intercostal veins prominent below, intercostal venation laxly reticulate to vaguely scalariform.....

var. **elmeri** (Merr.) Ng Fig. 1G.

(A.D.E. Elmer, 1870–1942, American botanist and plant collector in Borneo and the Philippines)

Malay. For. 40 (1977) 238, *l.c.* (2001) 310. Basionym: *D. elmeri* Merr. *l.c.* (1929) 243, Bakhuizen *l.c.* (1938) 249, Masamune *l.c.* 602. Type: *Elmer 20070*, Borneo, Sabah (BO, K, L, SING). Synonym: *D. nidus-avis* Kosterm. *l.c.* 464.

Tree to 15 m tall. Leaves chartaceous, *often velvety below*, tending to dry black above; elliptic to oblong-elliptic, 7.5–18(–30) × 2.7–7.2(–11) cm, base cuneate, rounded, subcordate or slightly attenuate, apex acute to acuminate; *lateral veins prominent below*, 7–11(–20) pairs; *intercostal veins prominent below*, *laxly reticulate to vaguely scalariform*. Female flowers with plicate calyx lobes. Fruits subsessile, globose, to c. 1.8 cm diameter, densely velvety. *Fruit calyx greatly accrescent, coriaceous and very plicate (wavy)*, covering much of the fruit.

Endemic to Borneo and known from Sabah (e.g., *Boden-Kloss 18688*, *FMS 38648*, *SAN 21362*, *SAN 75954*, and *SAN 77815*), Sarawak (e.g., *S 22842*, *S 32181* and *S 47153*), Brunei (e.g., *Dransfield 7025* and *Hotta 12735*), and Kalimantan (e.g., *Church & Mahyar 1596*, *Kostermans 5588* and *Kostermans 5911*). In lowland mixed dipterocarp forests.

Fruit calyx highly variable, of smaller diameter than the fruit or slightly to greatly enlarged, with the lobes spreading, reflexed or thrown into many folds. Leaves usually glabrous; lateral and intercostal veins usually faint below, with the reticulations stretched parallel to the lateral veins.....

var. **pilosanthera**

Tree to 35 m tall. Leaves chartaceous to coriaceous, *glabrous to velvety below*, tending to dry black on upper side or both sides; elliptic to oblong, oblong-elliptic, or oblong-obovate, 5–30 × 2.5–12 cm, base cuneate, rounded or slightly attenuate, apex acuminate; *lateral*

veins faint to prominent below, 5–17 pairs; intercostal venation faint to prominent below, reticulate, with reticulations stretched parallel to lateral veins; shorter veins between lateral veins well-developed. Fruits on 0.1–0.5 cm long stalks, globose to ovoid, to 2(–3.5) cm diameter.

Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi and Maluku. In Borneo, known from Sabah (common, e.g., *FMS 41340*, *SAN A 3449*, *SAN 24303*, *SAN 34709*, *SAN 100413*, and *SAN 122557*), Sarawak (common, e.g., *Clemens 22189*, *Fuchs 21274*, *S 13958*, *S 32880*, *S 40726*, and *S 58275*), Brunei (e.g., *BRUN 17429*, *BRUN 17823*, *BRUN 18714*, *BRUN 18927*, and *BRUN 19054*) and Kalimantan (e.g., *Argent et al. 93157*, *van Balgooy 5599*, *bb. 28320*, *Kostermans 5340*, and *Kostermans 13289*). In lowland mixed dipterocarp, peat swamp, coastal, hill to lower montane forests, to 1600 m altitude.

55. *Diospyros piscicarpa* Ridl.

Fig. 1H.

(Latin, *piscis* = fish, *carpus* = fruit; alluding the use of the fruit to poison fish)

J. Bot. 63 (1925) 51; Bakhuizen *l.c.* (1938) 259; Anderson *l.c.* 170; Beaman *et al. l.c.* 229. **Type:** *Beccari PB 1957*, Borneo, Sarawak (K, photo).

Tree to 27 m tall. **Twigs** somewhat stout, smooth, young ones tomentose, older ones glabrous, drying whitish with blackish dots. **Leaves** chartaceous, not bullate between veins, glabrous, drying somewhat shiny on upper surface, not subglaucous below; elliptic, 10–20 × 3.5–8.5 cm, base cuneate to rounded or slightly attenuate, margin not undulate, apex acuminate; midrib sunken above, groove extended into the channelled petiole; lateral veins prominulous above, prominent below, 6–12 pairs, inarching and joining to form intramarginal vein-loops near leaf margin; intercostal veins prominulous below, reticulate; petiole 0.8–1.8 cm long, tending to dry blacker than stem, not wrinkled. **Male inflorescence** a 1–3 flowered cyme, 0.5–1 cm long, cymes often arising from raceme-like short reproductive shoots 3–5 cm long. **Male flowers** with tubular, almost truncate (shallowly 4-lobed) calyx; corolla c. 1.2 cm long. **Female inflorescences and flowers** unknown. **Fruits** 1–3, on stalks of 0.5–2 cm long, ellipsoid to globose, to c. 5 cm diameter, not ribbed, smooth, shiny and woody, glabrous, symmetric. **Fruit calyx** accrescent, divided into 4 valvate plicate lobes; lobes prominently veined, leafy coriaceous, c. 2 × 2 cm, clasping fruit base.

Distribution. Endemic to Borneo and known from Sabah (e.g., *Berhaman et al. AB 89*, *SAN 83139*, *SAN 107397*, *SAN 132031*, and *SFN 26280*), Sarawak (e.g., *Chin 2694*, *Hewitt 868*, *S 30421*, *S 36530*, and *S 39568*) and Kalimantan (e.g., *Burley et al. 2855*, *Burley et al. 2863* and *Burley et al. 2869*).

Ecology. In lowland mixed dipterocarp forest, to 700 m altitude.

Use. The fruits are used to stun fish, hence the local names *tuba*, *buah tuba*, *tuba api*, or *tuba kalingan*.

Notes. Easily confused with *D. frutescens* but the fruits much larger and the leaves non-bullate, with lateral veins prominulous (not sunken) above. The petiole tends to dry black in contrast to the lighter coloured stem to which it is attached.

56. *Diospyros plectosepala* Hiern

Fig. 6I.

(Greek, *plectos* = twisted, *sepalum* = sepal; alluding the twisted sepals)

Trans. Camb. Phil. Soc. 12, 2 (1873) 201; Merrill *l.c.* (1921) 485; Bakhuizen *l.c.* (1937) 106; Masamune *l.c.* 605; Ng *l.c.* (2001) 310. **Type:** *Beccari PB 3225*, Borneo, Sarawak (K). **Synonyms:** *D. poiensis* Bakh. *l.c.* (1933) 181, *l.c.* (1937) 111, Masamune *l.c.* 605, Anderson *l.c.* 170; *D. setosa* Bakh. *l.c.* (1933) 184, *l.c.* (1937) 118, *l.c.* (1955) Plate 12, Masamune *l.c.* 606.

Tree to 8 m tall. **Leaves** membranaceous to chartaceous, glabrous, *not subglaucous below*; *elliptic* or *ovate*, 5–13 × 2–5.5 cm, *base cuneate*, *margin not undulate*, *apex acuminate*; *midrib sunken above*; *lateral veins prominulous below*, 4–7 pairs, *arching and diminishing toward leaf margin*; *intercostal venation very faint*, *laxly reticulate*; *petiole 0.4–0.9 cm long*. **Male inflorescences** 0.1–0.2 cm long, each bearing 1 or a few flowers. **Male flowers** with *calyx divided to base into 4–5 imbricate rounded lobes*; corolla salverform. **Female inflorescences** 0.1–0.2 cm long, each bearing solitary flower. **Female flowers** with *calyx divided into 4–5 rounded imbricate lobes*. **Fruits** solitary, on 0.1–0.2 cm stalks, *oblong-ellipsoid*, 2.5–3 × 1–2 cm, *not ribbed*, symmetric, sparsely appressed hairy, thin-walled, drying brittle and easily crushed. **Fruit calyx non-acrescent**, *lobes about 0.3 × 0.3 cm*.

Distribution. Endemic to Borneo and known in Sarawak by four collections apart from its type (*Clemens 20304*, type of *D. poiensis*; *Haviland 2324*, type of *D. setosa*; *S 42287* and *S 44025*).

Ecology. A rare species in lowland to lower montane forests, to 1500 m altitude.

Notes. The ellipsoid subsessile fruits distinguish this from other species. A Sabah specimen (*SAN 125886*) differs in having densely appressed-hairy ovoid fruits with a prolonged beak but otherwise matches this species.

57. *Diospyros puncticulosa* Bakh.

Fig. 6J.

(Latin, *puncticulosus* = minutely dotted; alluding the fruits)

Gard. Bull. S. S. 7 (1933) 164, *l.c.* (1937) 91; Anderson *l.c.* 170; Argent *et al.* (eds.) *l.c.* 186. **Type:** *Beccari PB 1948*, Borneo, Sarawak (K, photo). **Synonym:** *Maba beccarii* Hiern *l.c.* 140, Merrill *l.c.* (1921) 483, Masamune *l.c.* 606.

Tree to 30 m tall. **Twigs drying consistently black**. **Leaves** chartaceous to coriaceous, glabrous, *drying black on both sides*; *elliptic* to *ovate*, 3.5–10 × 1.2–4 cm, *base broadly cuneate to rounded*, *apex acuminate*; *midrib sunken or flat above*; *lateral veins invisible*; *intercostal venation invisible*; *petiole c. 0.3 cm long*. **Male and female inflorescences and flowers** unknown. **Fruits** solitary, on 0.2–0.3 cm long stalks, ovoid, to *c. 6 × 3 cm*, with acuminate beak, symmetric, woody, with smooth to pimply surface, glabrous. **Fruit calyx** not accrescent, divided into 4 imbricate rounded lobes; *lobes c. 0.2 × 0.3 cm*.

Distribution. Endemic to Borneo and known from Sabah (e.g., *SAN 138851* and *SAN 44504*), Sarawak (e.g., *FMS 7158*, *S 36248*, *S 45453*, *S 48377*, *S 51497*, and *S 59883*), Brunei (e.g., *S 10662*), and Kalimantan (e.g., *Kostermans 10216*).

Ecology. In lowland mixed dipterocarp forest, to 400 m altitude.

Notes. Close to *D. evena* in the small leaves, invisible intercostal venation, the way in which the leaves and twigs drying black, and the imbricate non-acrescent fruit calyx, but the leaves of *D. evena* are generally obovate, with rounded, retuse or acute (rarely acuminate) apex. Close also to *D. maingayi* but differs by its smaller leaves.

Upon reduction of *Maba* to *Diospyros*, this species was given a new name by Bakhuizen because the name *D. beccarii* had already been used for another species.

58. *Diospyros pyrrocarpa* Miq.

(Greek, *pyrrhos* = fiery red or yellow, *karpos* = fruits)

Fl. Ind. Bat., Suppl. (1860) 250; Bakhuizen *l.c.* (1938) 305; Ng *l.c.* (1978) 83; Anderson *l.c.* 170; Turner *l.c.* 199. **Type:** *Diepenhorst HB 2351*, Sumatra, Priaman (holotype U, *n.v.*). **Synonym:** *D. asterocalyx* Hiern *l.c.* 193, Merrill *l.c.* (1921) 484, Masamune *l.c.* 601.

Tree to 23 m tall. **Twigs** pubescent when young, glabrous when older, drying greyish to brownish. **Leaves** chartaceous, glabrous, *not bullate between veins, drying with a yellowish tinge below; oblong-elliptic to oblong-obovate, 15–30 × 5–9 cm, base cuneate to slightly attenuate, margin not undulate, apex acuminate; midrib sunken above; lateral veins prominent below, 8–12 pairs, arching and diminishing toward leaf margin; intercostal venation prominulous above, prominent below, laxly reticulate; petiole 1–2.3 cm long.* **Male inflorescences** *c.* 0.5 cm long, each bearing 1–3 flowers. **Male flowers** with *calyx divided into 4 triangular valvate lobes*; corolla salverform. **Female inflorescences** 0.5–1 cm long, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 4 valvate, velvety, spreading to slightly plicate lobes of c. 1 × 0.5 cm.* **Fruits** 1–3, on 0.5–1 cm long stalks, globose to ovoid-ellipsoid, *to c. 5 cm diameter, not ribbed, symmetric, densely velvety, deeply wrinkled and conspicuously puckered when dried.* **Fruit calyx** *accrescent, divided almost to base; lobes at first spreading, then reflexed completely so that the 4 triangular enlarged woody lobes point downwards (i.e. away from the apex); veins faint or invisible.*

Distribution. India (Assam), Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo, known from Sabah (common, e.g., *FMS 41174*, *Pennington 7886*, *SAN 16531*, *SAN 39470*, and *SAN 97052*), Sarawak (e.g., *Clemens 15198*, *Clemens 20122* and *S 32663*) and Kalimantan (e.g., *Kostermans 5912* and *Kostermans 13766*).

Ecology. In lowland mixed dipterocarp forest.

59. *Diospyros ridleyi* Bakh.

Fig. 2G.

(H.N. Ridley, 1855–1956, sometime Director of the Botanic Gardens Singapore)

Gard. Bull. S. S. 7 (1933) 183, *l.c.* (1938) 354; Ng *l.c.* (1978) 84; Turner *l.c.* 199; Ng *l.c.* (2001) 310. **Type:** *Ridley s.n.* (= *Herb. Sing. No. 40455*), Peninsular Malaysia, Johore (holotype SING). **Synonym:**

D. dajakensis Bakh. *l.c.* (1933) 168, *l.c.* (1938) 321; *D. bantamensis* auct. non Bakh.: Coode *et al.* (eds.) *l.c.* 87.

Tree to 30 m tall. **Twigs** rather stout, sparsely lenticellate, rugose and prominently cracked, reddish-brown appressed pubescent when young, glabrous when older. **Leaves** coriaceous, *not bullate between veins, glabrous; upper surface dull, lower surface shining, not subglaucous*, on drying without yellowish tinge; *broadly elliptic to ovate, 8–24 × 4–11 cm, base rounded, broadly cuneate or almost subcordate, margin not undulate, apex shortly acuminate; midrib more or less sunken above* (sometime only shallowly depressed or not sunken); *lateral veins prominent below, 6–8 pairs, arching and with a tendency to form intramarginal vein-loops near leaf margin; intercostal venation prominulous on both sides, finely reticulate above, laxly reticulate below; petiole 0.6–1.5 cm long*. **Male inflorescences** *c.* 0.5 cm long, each bearing about 3 flowers. **Male flowers** with *calyx narrowly tubular, 0.7 cm long, divided halfway into 4–5 triangular valvate lobes*; corolla salverform, *c.* 1 cm long in bud. **Female inflorescences** 0.2–1 cm long, each bearing solitary flower. **Female flowers** with *calyx divided into 4–5 valvate leafy coriaceous lobes, c. 0.8 × 0.9 cm, with undulate margins*. **Fruits** solitary, on 0.2–1 cm long stalks, globose to ovoid, *to c. 5 cm diameter, not ribbed, symmetric, with thick woody smooth to pimpled walls, glabrous or velvety*. **Fruit calyx** *accrescent, expanded into a more-or-less flattened 4–5-pointed woody plate, with edges of the lobes stretched until no longer evident, or persisting as a reflexed narrow fringe; veins very faint or invisible*.

Distribution. Andamans, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *Chew & Corner 4917, SAN 27460, SAN 30226, SAN 62184, and SAN 84128*), Sarawak (e.g., *Ding Hou 347, S 15824, S 24137, S 27187, and S 28024*), Brunei (e.g., *BRUN 267, BRUN 550, BRUN 603, BRUN 835, and BRUN 16951*), and Kalimantan (e.g., *bb. 10490, bb. 15872, bb. 15877, and Kostermans 10322*).

Ecology. Mainly in lowland mixed dipterocarp forest, but once found at 1600 m altitude (*Chew & Corner 22536, Sabah*).

Notes. The medium-sized elliptic, coriaceous, glabrous leaves, lateral veins tending to form vein-loops near the leaf margins, and the reticulation of intercostal venation (fine on upper surface, lax on lower surface) are quite distinctive, as also the form of the fruit calyx. From *D. areolata*, this species can be quickly distinguished by the dull (not shiny) leaf upper surface.

60. *Diospyros rigida* Hiern

Fig. 11.

(Latin, *rigidus* = stiff or rigid; alluding the stiffly leathery leaves)

Trans. Cambr. Phil. Soc. 12, 2 (1873) 257; Merrill *l.c.* (1921) 485; Bakhuizen *l.c.* (1938) 367; Masamune *l.c.* 605; Ng *l.c.* (1978) 84; Anderson *l.c.* 170; Turner *l.c.* 199; Coode *et al.* (eds.) *l.c.* 89. **Type:** *Beccari PB 2285*, Borneo, Sarawak (K). **Synonym:** *D. subrigida* Hochr., Bull. Inst. Bot. Buitenz. 19 (1904) 24, Merrill *l.c.* (1921) 485, Masamune *l.c.* 606.

Tree to 26 m tall. **Twigs** thick, greyish black, appressed tomentose, becoming glabrous with age, *rugose*. **Leaves** *coriaceous*, glabrous, *drying subglaucous with yellowish tinge below; oblong, 15–45 × 6.5–14 cm, base rounded to subcordate, margin not undulate, apex acute to slightly acuminate; midrib sunken, shallowly depressed or prominent above; lateral veins prominent*

below, 10–20 pairs, arching and diminishing toward leaf margin; intercostal venation prominent below, finely reticulate; petiole 1.5–3 cm long. **Male and female inflorescences and flowers** unknown. **Fruits** 1–3, on 1.5–2 cm long stalks, globose, to c. 4.5 cm diameter, not ribbed, symmetric, smooth, glabrous, with woody wall. **Fruit calyx** accrescent, divided into 4 leafy coriaceous, valvate, prominently veined lobes; lobes c. 3 × 2 cm, plicate, erect, clasping the base of fruit.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN* 66872), Sarawak (e.g., *Beccari PB* 2285, *Pennington* 7963, *S* 17836, and *S* 19724), Brunei (e.g., *Coode* 6785 and *Wong WKM* 1291) and Kalimantan (e.g., *Afriastini* 1182).

Ecology. In lowland mixed dipterocarp forest.

61. *Diospyros rufa* King & Gamble

(Latin, *rufus* = reddish; referring to the indumentum of young twigs)

J. As. Soc. Beng. 74, 2 (1906) 228; Bakhuizen *l.c.* (1938) 292; Ng *l.c.* (1978) 84; Turner *l.c.* 199; Ng *l.c.* (2001) 310. **Syntypes:** *King's Collector* 3330, *King's Collector* 5409 and *King's Collector* 6712, Peninsular Malaysia, Perak (all at SING). **Synonym:** *D. swingleri* Kosterm. *l.c.* 172, Coode *et al.* (eds.) *l.c.* 90.

Tree to 30 m tall. **Twigs** somewhat stout, rugose or striate, drying brownish, reddish tomentose when young, glabrous when older. **Leaves** coriaceous, not bullate between veins, not tending to dry black, not subglaucous below, glabrous; elliptic, 12–21 × 5.5–11 cm, base broadly cuneate, margin not undulate, apex acuminate; midrib variably sunken to shallowly depressed above; lateral veins prominent below, 7–10 pairs, inarching and joining to form intramarginal vein-loops near leaf margin; intercostal venation prominulous below, laxly reticulate; petiole 1–1.7 cm long. **Male inflorescences** to 1 cm long, each bearing 3–10 flowers. **Male flowers** with calyx divided halfway or three-quarter way into 4 triangular valvate lobes; corolla salverform, 0.6–1 cm long. **Female inflorescences** to 1 cm long, each bearing many clustered flowers. **Female flowers** with calyx velvety, divided halfway into 4 triangular valvate lobes. **Fruits** in clusters of 1–3 or more, on c. 1 cm long stalks, borne on thick (0.7–2 cm thick) branches, ellipsoid-globose, c. 3.5 cm diameter, not ribbed, symmetric, glabrous, shallowly puckered when dry. **Fruit calyx** only slightly accrescent; lobes c. 0.5 × 0.5 cm, flattened against the base of fruit; veins very faint or invisible.

Distribution. Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN* 67168), Sarawak (e.g., *S* 26941, *S* 27760, *S* 35981, *S* 49901, and *S* 56608), Brunei (e.g., *BRUN* 24, *BRUN* 266, and *FMS* 30432) and Kalimantan (e.g., *Veldkamp* 8539).

Ecology. In lowland mixed dipterocarp forest.

62. *Diospyros siamang* Bakh.

(after its Sumatran name—*siamang*)

Fig. 2H.

Gard. Bull. S. S. 7 (1933) 184, *l.c.* (1938) 261; Ng *l.c.* (1978) 86; Anderson *l.c.* 170; Turner *l.c.* 199; Argent *et al.* (eds.) *l.c.* 186. **Type:** *Boschpr. F.* 198, Sumatra, Palembang, Banjuasin, Bajung Lintjir (L).

Small tree. **Leaves** chartaceous, glabrous, shiny above, *subglaucous below*, somewhat concave, as a result of which the base and apex of flattened specimens are usually forced to fold, one side over the other; *elliptic to elliptic-oblong*, 10.5–21 × 4.5–9.5 cm, base rounded, apex acute to slightly acuminate; midrib sunken above; *lateral veins* prominent below, 6–9 pairs, *arching and diminishing toward leaf margin*; *intercostal venation prominulous below, laxly reticulate*; petiole c. 1 cm long. **Male inflorescences** c. 1 cm long, each bearing several flowers. **Male flowers** with calyx divided into 4–5 valvate lobes; corolla salverform. **Female inflorescences** and **flowers** unknown. **Fruits** 1–5, on 1–1.5 cm long stalks, urn-shaped (with an expanded rim around a sunken apex), to c. 3.8 × 3 cm, symmetric, woody, velvety. **Fruit calyx** divided into 4 valvate lobes, accrescent, woody, erect, clasping the base of fruit; margins of lobes auriculate-plicate.

Vernacular name. Sarawak—*kayu malam balih* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sarawak (e.g., *S 468*, *S 487*, *S 2656*, and *S 8048*) and Kalimantan (*bb. 32400* and *Buwalda 7841*).

Ecology. Common in peat swamp forest.

63. *Diospyros simaloerensis* Bakh.
(of Simaloer island, Sumatra)

Fig. 6K.

Gard. Bull. S. S. 7 (1933) 185, *l.c.* (1937) 128; Ng *l.c.* (2001) 311. **Syntypes:** *Achmad 580*, *Achmad 1343* and *Achmad 1391*, Sumatra, Simaloer (all at BO). **Synonym:** *D. paraoesi* Bakh. *l.c.* (1933) 180, *l.c.* (1937) 108.

Tree to 30 m tall. **Twigs** slender, densely short-tomentose when young, glabrescent, drying greyish, rugulous, prominently cracked. **Leaves** chartaceous, *not subglaucous* and usually glabrous but sometimes (e.g., *S 23628*) densely hairy *below*; *elliptic, ovate or obovate*, 4–10 × 1.5–5 cm, base *cuneate* to rounded, *margin not undulate*, apex *acuminate*; midrib *sunken above to form a groove filled with hairs*; *lateral veins prominent below*, 4–5 pairs, *inarching and joining to form intramarginal vein-loops near leaf margin*; *intercostal venation faint, vaguely reticulate*; petiole 0.3–0.8 cm long. **Male and female inflorescences** slender, to 3 cm long, each bearing 1–5 flowers. **Flowers** with *calyx divided into 4 rounded imbricate lobes*. **Fruits** in clusters of 1–5, each on 0.5–2 cm long stalk, *globose*, to c. 1.5 cm diameter, *not ribbed*, symmetric, *densely velvety*, thin-walled and deeply wrinkled/puckered on drying. **Fruit calyx** *not accrescent*; lobes c. 0.3 × 0.2 cm.

Distribution. Sumatra and Borneo. In Borneo, known from Sabah (e.g., *SAN 16766*, *SAN 70321* and *SAN 99860*), Sarawak (e.g., *S 15376*, *S 23775*, *S 23811*, and *S 43353*) and Kalimantan (e.g., *bb. 10162*, type of *D. paraoesi*).

Ecology. In lowland mixed dipterocarp forest, to 600 m altitude.

Notes. The Sumatran population differs from the Bornean population in the fruits and inflorescences more or less glabrous instead of velvety. The Bornean *D. simaloerensis* is distinguished from *D. singaporensis* by its velvety-hairy puckered (instead of glabrous shiny

black smooth) fruits. It is distinguished from *D. subrhomboidea* and *D. oligantha* by its 0.5–2 cm fruit stalk, with individual pedicels at least 0.5 cm long (instead of shorter stalks and shorter pedicels).

64. *Diospyros singaporensis* Bakh.
(of Singapore)

Gard. Bull. S. S. 7 (1933) 185, *l.c.* (1937) 110; Ng *l.c.* (1978) 86; Turner *l.c.* 199. **Type:** *Md. Nur 14*, “Cult. Bot. Gard.” Singapore (holotype SING).

Tree to 28 m tall. **Twigs** *not tending to dry black*. **Leaves** chartaceous, glabrous, *drying reddish brown or blackish above, reddish brown below; elliptic, 2.8–11 × 1.4–4 cm*, base rounded to cuneate, *apex acuminate*; midrib prominulous to sunken above; *lateral veins faintly visible below, 3–5 pairs*, arching and diminishing toward leaf margin; *intercostal venation invisible*; petiole 0.2–0.5 cm long. **Male inflorescences** 0.1–0.3 cm long, each bearing *c.* 3 flowers. **Male flowers** with calyx divided into 4 imbricate lobes; corolla salverform. **Female inflorescences** 0.5–1.3 cm long, each bearing solitary flower. **Female flowers** with calyx divided into 4 rounded imbricate lobes. **Fruits** solitary, *on 0.5–1.3 cm long stalks, globose, 2.5–3.5 cm diameter*, symmetric, glabrous, smooth, shiny black, *thick-walled* (not easily crushed when dried). **Fruit calyx** not accrescent; lobes measuring *c.* 0.3 × 0.3 cm.

Distribution. Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN 27205*, *SAN 29378*, *SAN 62398*, and *SAN 110420*) and Sarawak (e.g., *S 35145*).

Ecology. In lowland mixed dipterocarp forest.

Notes. This species is distinguished by the combination of small leaves and glabrous, smooth, shiny black globose fruits. The fruits do not wrinkle or pucker on drying.

65. *Diospyros squamaefolia* Kosterm.

Fig. 6L.

(Latin, *squamus* = scale, *folium* = leaf; alluding the shape of the leaves, which resemble fish scales)

Blumea 23 (1977) 470. **Type:** *Wood SAN 15475*, Borneo, Sabah, Sandakan district, Sepilok FR (holotype L; isotypes A, K, KEP, SING).

Treelet to 5 m tall. **Twigs** *on drying not consistently black*. **Leaves** chartaceous, glabrous, *on drying not consistently black, not glaucous below; rhombic (with the upper and lower halves narrowed abruptly into an attenuate base and acuminate apex), 1.3–2.5 × 0.6–1.6 cm*; midrib very slender, sunken above and filled with minute hairs; lateral veins practically invisible; *intercostal venation invisible*; petiole 0.1–0.2 cm long. **Male and female inflorescences** 0.1–0.2 cm long, each bearing *subsessile solitary flower*. **Male and female flowers** with calyx divided into 4 imbricate rounded lobes; *corolla salverform, to c. 0.8 cm long*. **Fruits** solitary, *subsessile*, on 0.1–0.2 cm long stalks, *globose, to c. 1.5 cm diameter*, symmetric, glabrous, smooth and thin-walled. **Fruit calyx** non-acrescent; lobes *c.* 0.1 × 0.2 cm.

Distribution. Endemic to Borneo and known only from Sabah (e.g., *Ridsdale 1934, SAN 19156, SAN 41428, SAN 93630, and SAN 108746*).

Ecology. Common in lowland mixed dipterocarp forest.

Notes. The rhombic leaves of *D. squamaefolia* are indistinguishable from the rhombic form of *D. graciliflora*, but the flowers and fruits differ in being sessile. Also, *D. squamaefolia* is restricted to Sabah and *D. graciliflora* to Sarawak.

66. *Diospyros styraciformis* King & Gamble

Fig. 2I.

(Latin, *-formis* = with a shape/form of; alluding the fruits which resemble those of *Styrax*, Styracaceae)

J. As. Soc. Beng. 74, 2 (1906) 216; Bakhuizen *l.c.* (1938) 287; Ng *l.c.* (1978) 87; Turner *l.c.* 199; Ng *l.c.* (2001) 311. **Syntypes:** *Maingay 969*, Peninsular Malaysia, Malacca (K) and *Ridley 3787*, Singapore (SING). **Synonyms:** *D. sarawakana* Bakh. *l.c.* (1933) 184, *l.c.* (1938) 288, Masamune *l.c.* 605, Anderson *l.c.* 170, Coode *et al.* (eds.) *l.c.* 89; *D. styraciformis* var. *sarawakana* (Bakh.) Ng *l.c.* (1977) 241; *D. clavipes* Bakh. *l.c.* (1933) 166, *l.c.* (1938) 289, Anderson *l.c.* 168.

Tree to 20 m tall. **Leaves** chartaceous to coriaceous, glabrous, *not bullate between veins, not subglaucous below; elliptic, oblong-elliptic or ovate, 7.5–15(–18) × 2.5–7(–10) cm, base cuneate, rarely rounded or subcordate, often bearing a pair of pit-glands, margin not undulate, apex acuminate; midrib sunken above; lateral veins sunken above, prominent below, 5–9 pairs with basal pairs mostly diverging at an angle of 30–45° from midrib, arching and diminishing toward leaf margin; intercostal venation prominulous below, vaguely scalariform; petiole 0.5–1.5 cm long. Male inflorescences* c. 0.5 cm long, each bearing several flowers. **Male flowers** with *calyx divided into 4 valvate triangular lobes; corolla salverform, c. 1 cm long. Female inflorescences* 1–2 cm long, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 4 valvate triangular lobes. Fruits in clusters of 1–3 on branchlets of 0.5–2 cm thick, on stalks 1–2 cm long, depressed globose, to c. 3.5 cm diameter, often slightly sunken at apex, symmetric, velvety, woody, not ribbed. Fruit calyx accrescent, forming a cup fitting basal third or quarter of the fruit; lobes 4, erect or more commonly dilated and forming a narrow reflexed or erect fringe around mouth of the cup; veins very faint or invisible.*

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN 109461*), Sarawak (common, e.g., *Haviland 2316, S 19335, S 38328, and S 64627*), Brunei (e.g., *BRUN 5042 and Niga 88*), and Kalimantan (e.g., *Teijsmann 11397*, type of *D. clavipes*).

Ecology. In lowland mixed dipterocarp forest and limestone hill forest, to 950 m altitude.

Use. The fruits are used to stupefy fish.

Notes. In Borneo, the fruit calyx usually has the margin dilated and reflexed whereas in Peninsular Malaysia, the margin is usually non-dilated and erect. *D. styraciformis* differs from *D. lanceifolia* mainly in the fruit stalk which is 1–2 cm long (instead of 0.1–0.6 cm) and the persistently velvety fruits.

67. *Diospyros subrhomboidea* King & Gamble

Fig. 6M.

(Latin, *sub-* = somewhat, *rhomboideus* = almost rhombic; alluding the leaf shape)

J. As. Soc. Bengal 74, 2 (1906) 209; Bakhuizen *l.c.* (1937) 101; Ng *l.c.* (1978) 97; Turner *l.c.* 200; Ng *l.c.* (2001) 311. **Type:** *King's Collector 7302*, Peninsular Malaysia, Perak, Larut (SING). **Synonyms:** *D. confusa* Bakh. *l.c.* (1933) 167, *l.c.* (1937) 106, Ng *l.c.* (1978) 67; *D. jaherii* Bakh. *l.c.* (1933) 173, *l.c.* (1937) 105, Masamune *l.c.* 604; *D. kajangensis* Bakh. *l.c.* (1937) 109.

Tree to 20 m tall. **Twigs** hairy when young, becoming glabrous with age. **Leaves** chartaceous to membranaceous, glabrous or hairy on midrib below, with scattered pit-glands on lower surface, tending to dry paler below, darker above, *not subglaucous below; ovate, elliptic or obovate, 3.5–14 × 1.5–5.4 cm, base cuneate, margin not undulate, apex acuminate; midrib sunken above, appressed hairy below; lateral veins prominent, 3–8 pairs, arching and diminishing toward leaf margin; intercostal venation prominulous, reticulate; petiole 0.2–0.5 cm long. **Male inflorescences** 0.1–0.2 cm long, each bearing solitary terminal flower. **Male flowers** with *calyx divided into 4 imbricate rounded lobes*; corolla salverform, to c. 1.2 cm long. **Female inflorescences** 0.1–0.3 cm long, each bearing usually solitary flower, sometimes arising on leafless short shoots to 4 cm long, which resemble racemes. **Female flowers** with *calyx divided into 4 imbricate lobes.* **Fruits** solitary, on 0.1–0.3 cm long stalks, *globose*, to c. 1.5 cm diameter, *not ribbed*, symmetric, *densely appressed hairy* (thinly hairy to glabrous on mature fruits), thin-walled and wrinkled-puckered when dried. **Fruit calyx** *not accrescent; lobes c. 0.2 × 0.2 cm.**

Distribution. Sumatra, Singapore, Java, and Borneo. In Borneo, known from Sabah (common, e.g., *SAN 16773, SAN 37052, SAN 77693, SAN 94314, and SAN 100190*), Sarawak (common, e.g., *S 21746, S 23008, S 41137, S 43881, and S 43909*), Brunei (e.g., *Dransfield 6895*), and Kalimantan (e.g., *Jaheri 128 and Mogeia 4185*).

Ecology. In lowland and hill mixed dipterocarp forests, to 700 m altitude.

Notes. The smallish elliptic leaves with scattered pit-glands on the under surface and the small round puckered fruits are characteristic of this quite common species, which used to be difficult to understand because Bakhuizen had split it into four species based on very vague differences. The fruits resemble those of *D. oligantha*.

68. *Diospyros subtruncata* Scheff. ex Hochr.(Latin, *sub-* = somewhat, *truncatus* = truncate; alluding the calyx)

Plant. Bogor. Exsicc. (1904) 15; Bakhuizen *l.c.* (1938) 310; Anderson *l.c.* 170. **Syntypes:** *Teijsmann 962 and Teijsmann 5646*, “Cult. Hort. Bot.” Bogor (all at BO).

Tree to 22 m tall. **Leaves** chartaceous, somewhat bullate between veins, glabrous, *not subglaucous below; oblong-elliptic to oblong-ovate, 21–26 × 6.5–8.5 cm, base cuneate to rounded, margin not undulate, apex acuminate; midrib sunken above; lateral veins c. 12 pairs, arching and diminishing toward leaf margin, sunken above, prominent below; intercostal venation prominulous above, prominent below, laxly scalariform; petiole 1–1.3 cm long. **Male inflorescences** c. 1 cm long, each bearing about 3 flowers. **Male flowers** with *calyx a deep barrel-shaped cup, not divided into lobes*, covering most of corolla; corolla about 1 cm long,*

in bud protruding slightly above calyx. **Female inflorescences** and **flowers** unknown. **Fruits** solitary or a few per axil, on stout 0.6–1 cm long stalks, obovoid, to *c.* 3 × 2.8 cm, *not ribbed*, symmetric, with thick woody walls, densely velvety. **Fruit calyx** a truncate cup, split and flattened into a broken plate *c.* 1.8 cm diameter.

Distribution. Sumatra and Borneo. In Borneo, rare in Sarawak and represented by two collections (*S* 22248 and *S* 22529).

Ecology. In lowland mixed dipterocarp forest, to 400 m altitude.

69. *Diospyros sulcata* Kosterm.

(Latin, *sulcatus* = grooved; alluding the midrib)

Blumea 23 (1977) 471. **Type:** *Meijer SAN 39320*, Borneo, Sabah, Sandakan district, Tawai Plateau (holotype L; isotype SAN).

Tree to 27 m tall. **Leaves** chartaceous to coriaceous, glabrous, *not bullate between veins, not subglaucous below; oblong-elliptic to oblong, 10–23 × 3–7.5 cm, base cuneate to rounded, margin not undulate, apex acuminate to acute; midrib sunken above; lateral veins barely visible, 8–13 pairs, arching and diminishing toward leaf margin; intercostal venation faint, laxly reticulate; petiole 1–1.5 cm long. **Male inflorescences** and **flowers** unknown. **Female inflorescences** *c.* 0.3 cm long, each bearing 3 or more condensed flowers. **Female flowers** with *calyx divided into 5 valvate erect lobes; sides of each lobe bent back against each other. **Fruits** solitary, subsessile, ovoid or globose, to *c.* 4 cm diameter, *not ribbed*, symmetric, apex slightly depressed, drying black and grooved vertically between seeds. **Fruit calyx** *accrescent, divided deeply into 5 coriaceous valvate lobes of c. 1 cm long; lobes curved upwards following curvature of fruit base, with two sides of each lobe bent backwards to almost touch each other; veins very faint or invisible.***

Distribution. Endemic to Borneo and known from Sabah (e.g., *SAN 29320* and *SAN 41891*) and Sarawak (e.g., *S 19389* and *S 33928*).

Ecology. In hill, lower montane and upper montane forests, at 850–2100 m altitude.

Notes. The shape of the calyx in fruit is very distinctive and reminiscent of *D. brainiana*, which is easily differentiated by the presence of intramaginal vein-loops on the leaves.

70. *Diospyros sumatrana* Miq.

(of Sumatra)

Pl. Jungh. (1851–55) 203; Merrill *l.c.* (1921) 485; Bakhuizen *l.c.* (1938) 184; Masamune *l.c.* 606; Ng *l.c.* (1977) 242, *l.c.* (1978) 87; Anderson *l.c.* 170; Turner *l.c.* 200; Coode *et al.* (eds.) *l.c.* 90; Argent *et al.* (eds.) *l.c.* 187; Ng *l.c.* (2001) 311. **Type:** *Junghuhu s.n.*, Sumatra, Angkola (holotype U, *n.v.*). **Synonyms:** *D. monticola* Kosterm. *l.c.* 463, Beaman *et al.* *l.c.* 229; *D. beccarii* Hiern *l.c.* 204, Merrill *l.c.* (1921) 484, Bakhuizen *l.c.* (1938) 239, Masamune *l.c.* 601, Coode *et al.* (eds.) *l.c.* 167.

Tree to 30 m tall. **Twigs** hairy when young, becoming glabrous with age. **Leaves** chartaceous,

finely hairy below to glabrous, tending to darken above on drying, *not subglaucescent below*; *elliptic, ovate, oblong or obovate, 3.5–16(–17) × 1.3–7 cm, base cuneate, margin not undulate, apex acuminate; midrib sunken to prominent above; lateral veins prominent below, 5–9 pairs, arching and diminishing toward leaf margin or sometimes linked near leaf margin to form an intramarginal vein-loops; intercostal venation prominulous below, vaguely scalariform to vaguely reticulate; petiole 0.2–0.7 cm long. Male inflorescences c. 0.2 cm long, each bearing about 3 subsessile flowers. Male flowers with calyx divided into 4 triangular valvate leafy lobes; corolla salverform, c. 1 cm long. Female inflorescences c. 0.2–0.5 cm long, each bearing 1–3 subsessile flowers. Female flowers with calyx divided into 4 broadly ovate valvate leafy lobes. Fruits usually solitary, subsessile (stalks 0.2–0.5 cm long), ellipsoid or oblong, to c. 2.5 × 1.2 cm, mostly symmetric, sometimes asymmetrically curved, glabrous, smooth or shallowly lobed. Fruit calyx slightly accrescent; lobes leafy, erect or spreading, to c. 0.6 × 0.5 cm.*

Vernacular name. Sarawak—*entam* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, known from Sabah (common, e.g., *Clemens 32541, Pereira JTP 469, SAN 16697, SAN 95613, and SAN 113910*), Sarawak (common, e.g., *Frodin 2118, Jacobs 5331, S 22388, S 23354, and S 53577*), Brunei (e.g., *Coode 7335, Johns 7381, Sands 5338, and Wong WKM 1232*), and Kalimantan (e.g., *Burley 710, Church & Mahyar 1538, Church 448, Kostermans 7253, and Sidiyasa 703*).

Ecology. In lowland mixed dipterocarp forest, to 800 m altitude.

Notes. The leaf size and other leaf features are very variable. Bakhuizen divided the species into two varieties: var. *decipiens* with small leaves, caudate-acuminate apices and curved lateral veins, and var. *flavicans* with large leaves, short obtuse-acuminate apices and ascending lateral veins. However, there are many intermediates, which completely blur the distinction. The species is best characterised by its small subsessile ellipsoid to oblong (never globose) fruits and leafy 4-lobed fruit calyx. In Borneo, it may be confused with *D. elliptifolia* and *D. tuberculata*. The former differs in that the midrib above appears as a bordered groove, especially towards the base, and the leaf is almost subsessile. The latter has flowering and fruiting peduncles 0.5–1 cm long, fruits larger and asymmetric, with one side more curved than the other; female calyx larger and more plicate. *D. monticola* is merely a glabrous montane form with small, elliptic, somewhat coriaceous leaves. *D. beccarioides* differs in its longer leaves (16–30 cm long), somewhat more prominent intramarginal veins, larger (2.5 cm diameter) globose fruits, and accrescent calyx lobes to 2 × 1.5 cm.

71. *Diospyros toposia* Ham.

(from its Indian name—*toposi*)

Trans. Linn. Soc. 15, 2 (1827) 115; Merrill *l.c.* (1921) 485; Bakhuizen *l.c.* (1938) 298; Masamune *l.c.* 606; Ng *l.c.* (1978) 89; Turner *l.c.* 200. **Type:** *Wallich 4122E*, India, Gongachora (K-W). **Synonym:** *D. foveo-reticulata* Merr. *l.c.* (1909) 308, *l.c.* (1929) 247, Masamune *l.c.* 603.

Tree to 13 m tall. **Twigs** slender, short-tomentose, glabrescent, sparsely lenticellate, drying yellowish or blackish, rugose, prominently cracked. **Leaves** chartaceous to coriaceous,

glabrous, *plane* or *bullate* (puckered) *between veins*, *drying with a yellowish tinge*; *oblong to oblong-elliptic*, 13–34 × 3.5–11 cm, *base cuneate to rounded*, *margin not undulate*, *apex short-acuminate*; *midrib, lateral veins and intercostal veins plane or sunken above, prominent below*; *lateral veins 7–16 pairs, arching and joining to form intramarginal vein-loops near leaf margin*; *intercostal venation reticulate, veins of the fourth or fifth order are present in the form of very fine reticulations of closer than 0.1 cm mesh, prominulous on both surfaces*; *petiole 1–1.5 cm long*. **Male inflorescences** *c.* 0.3 cm long, each bearing 3–5 flowers, often borne on specialised reproductive short shoots of 3–6 cm long. **Male flowers** with *calyx globose or ovoid, divided at top into 3–4 valvate triangular teeth*. **Female flowers** with *calyx divided almost to base into 3–4 valvate triangular lobes*. **Fruits** usually solitary, on 0.5–1 cm long stalks (often appearing sessile), ellipsoid, ovoid, or globose, *to c.* 5 × 5 cm, symmetric, velvety when young, becoming glabrous with age, *smooth or puckered*. **Fruit calyx** *accrescent, woody, velvety, rim reflexed backwards or spreading; veins very faint or invisible*.

Distribution. India, Sri Lanka, Thailand, Indo-China, Peninsular Malaysia, Borneo, and the Philippines.

Key to varieties

Leaf blade *plane* between veins; lateral and intercostal veins flat above.....

var. **toposia**

Distribution as the species. In Borneo rare, known by two collections from Sabah (e.g., *Keith 36*) and Kalimantan (e.g., *Ninieck 607*).

Leaf blade *bullate* between veins; lateral and intercostal veins sunken above.....

var. **toposioides** (King & Gamble) Phengklai

(Greek, *-oides* = resembling; resembling *D. toposia*)

Thai For. Bull. 11 (1978) 36; Argent *et al.* (eds.) *l.c.* 187. Basionym: *D. toposioides* King & Gamble *l.c.* 223, Merrill *l.c.* (1929) 240, Bakhuizen *l.c.* (1938) 301, Masamune *l.c.* 606, Ng *l.c.* (1978) 89, Anderson *l.c.* 170, Turner *l.c.* 200, Coode *et al.* (eds.) *l.c.* 290, Beaman *et al.* *l.c.* 230. Syntypes: *Ridley 10302*, Peninsular Malaysia, Perak, Lumut (SING) and *King's Collector 4106*, Peninsular Malaysia, Perak, Larut (SING).

Peninsular Malaysia and Borneo. In Borneo, known from Sabah (common, e.g., *Chew et al. 1166*, *FMS 44682*, *SAN 16142*, *SAN 77182*, and *SAN 100319*), Sarawak (common, e.g., *Hansen 1030*, *S 21314*, *S 3598*, *S 52385*, and *S 53961*), Brunei (e.g., *Atkins 509*, *BRUN 15044* and *Dransfield 6681*), and Kalimantan (e.g., *bb. 29023*, *Kostermans 8951* and *Veldkamp 8230*). In lowland and hill mixed dipterocarp forest, to 600 m altitude.

The bullate condition of the leaves and the very fine pattern of reticulations distinguishes this variety from *D. pyrrhocarpa*.

72. *Diospyros tuberculata* Bakh.

Fig. 1J.

(Latin, *tuberculatus* = covered with tubercles or warts; possibly referring to the fruit)

Gard. Bull. S. S. 7 (1933) 187, *l.c.* (1938) 191; Masamune *l.c.* 606; Anderson *l.c.* 170; Beaman *et al.* *l.c.* 230. **Syntypes:** *Castro & Melegrito 1409*, Borneo, Sabah (K, photo) and *Amdjah 498*, Borneo, Kalimantan, Sebuk (n.v.).

Tree to 15 m tall. **Leaves** membranaceous, not subglaucous and glabrous to velvety below, often drying crinkled along intercostal veins; elliptic, 7–18 × 3–7.5 cm, base cuneate, margin not undulate, apex acuminate; midrib sunken above; veins often black against a pale leaf under surface; lateral veins prominent below, 6–7 pairs, arching and diminishing toward leaf margin; intercostal venation prominulous below, vaguely scalariform; petiole 0.5–1.2 cm long. **Male inflorescences** slender, 1–2 cm long, each bearing 5 or more flowers. **Male flowers** with calyx deeply divided into 4 valvate triangular tiny lobes, each lobe c. 0.1 × 0.1 cm; corolla 0.2–0.4 cm long, ovoid to ellipsoid in bud. **Female inflorescences** 0.5–1.5 cm long, each bearing solitary flower, peduncles often in clusters of 2–5. **Female flowers** with calyx divided deeply into 4 leafy broad valvate lobes with plicate margins. **Fruits** solitary, on 0.5–1 cm long stalks, ovoid to globose, to c. 2 cm diameter, often asymmetric because of one side longer and more curved than the other, velvety, becoming glabrous and smooth, somewhat puckered on drying. **Fruit calyx** accrescent; lobes leafy coriaceous, erect to spreading, margins undulate.

Distribution. Endemic to Borneo and known from Sabah (very common, e.g., SAN 26333, SAN 31470, SAN 35349, SAN 76338, SAN 93942, and SAN 111747) and Kalimantan (e.g., Amdjah 498).

Ecology. In lowland mixed dipterocarp forest.

Notes. *D. tuberculata* resembles *D. sumatrana* in the broad leafy valvate calyx lobes of the female flowers and fruits, but the peduncles are longer, 0.5–1 cm, the fruits larger and asymmetric, with one side more curved than the other, the calyx lobes larger and more plicate, and the male flowers much smaller (lobes small and not leafy). Also, the leaves are thinner and the vein reticulation more obvious.

73. *Diospyros ulo* Merr.

(after the Philippine vernacular name—*ulo*)

Philip. J. Sci. Bot. 11 (1916) 30; Bakhuizen *l.c.* (1938) 312; Argent *et al.* (eds.) *l.c.* 187; Beaman *et al. l.c.* 231. **Type:** Barros 23243, the Philippines, Luzon, Cagayan Prov. (*n.v.*)

Tree to 22 m tall. **Leaves** coriaceous, glabrous (rarely velvety hairy below), not subglaucous below; elliptic, ovate or obovate, 10–20 × 5–10 cm, base cuneate to rounded, margin not undulate, apex acuminate; midrib sunken above; lateral veins prominent below, 5–8 pairs, arching and diminishing toward leaf margin; intercostal venation prominulous below, laxly reticulate; petiole 0.6–1.2 cm long. **Male inflorescences** to 2.5 cm long, each bearing 3 or more flowers. **Male flowers** with calyx cup-shaped with mouth truncate or bearing 4 small teeth. **Female inflorescences** 0.2–1.5 cm long, each bearing 3 or more flowers. **Female flowers** with calyx truncate, cup-shaped. **Fruits** in clusters of 1–4, on 0.2–1.5 cm long stalks, obovoid or globose, to c. 5 cm diameter, not ribbed, symmetric, woody and thick-walled, densely velvety, becoming glabrous. **Fruit calyx** slightly accrescent, forming a shallow truncate cup or plate of 1.5–2 cm diameter, or irregularly torn and reflexed.

Distribution. Borneo and the Philippines. In Borneo, known from Sabah (e.g., SANA 127, SAN 15544, SAN 38206, SAN 43333, SAN 95131, and SAN 100576), Sarawak (e.g., S 32664) and

Kalimantan (e.g., *Kostermans 5751*, *Kostermans 6943*, *Kostermans 13552*, and *Kostermans 13884*).

Ecology. In lowland mixed dipterocarp forest.

Notes. The truncate calyx is distinctive. Specimen *SAN 95131* is exceptional in the leaves velvety hairy below.

74. *Diospyros venosa* Wall. ex A.DC.

(Latin, *venosus* = conspicuously veined; referring to the leaf)

Prod. Syst. Nat. 8 (1844) 233; Ng *l.c.* (1977) 246, *l.c.* (1978) 93; Turner *l.c.* 200; Coode *et al.* (eds.) *l.c.* 90; Ng *l.c.* (2001) 311; Beaman *et al.* *l.c.* 231. **Type:** *Wallich 4126*, Penang (K-W). **Synonyms:** *D. rotundiflora* Hiern *l.c.* 163, Merrill *l.c.* (1921) 485 (*spalme* “*rotundifolia*”), Masamune *l.c.* 605; *Rhipidostigma teysmanni* Hassk., *Retzia* 1 (1855) 106; *Maba teysmanni* (Hassk.) Hiern *l.c.* 137, Merrill *l.c.* (1921) 484; *Maba hermaphroditica* Zoll., Syst. Verzeich. 14 (1857) 155 & 158; *D. hermaphroditica* (Zoll.) Bakh. *l.c.* (1933) 162, *l.c.* (1937) 84, Anderson *l.c.* 169; *Maba merguensis* Hiern, *l.c.* 134, Merrill *l.c.* (1921) 483, Masamune *l.c.* 607; *Maba venosa* (Wall. ex A.DC.) King & Gamble *l.c.* 203; *D. bintuluensis* Kosterm. *l.c.* 453.

Tree to 20 m tall. **Twigs** velvety to glabrous. **Leaves** chartaceous to coriaceous, glabrous or densely velvety below, *drying dark brown to almost black; elliptic, oblong-elliptic to oblong-ovate, 5–20 × 1.8–9 cm, base broadly cuneate to rounded, margin not undulate, apex acuminate; midrib sunken above; lateral veins prominulous to prominent below, 4–11 pairs, arching and diminishing toward leaf margin; intercostal venation laxly reticulate; petiole 0.5–1.3 cm long.* **Male inflorescences** 0.6–3.6 cm long, sometimes arising on special leafless twigs to 3 cm long, each bearing 1–25 minute globose flowers, sometimes many inflorescences crowded together to resemble witches brooms. **Male flowers** with *calyx divided into 3(–4) valvate lobes; corolla globose to ovoid in bud.* **Female inflorescences** 0.5–1.5 cm long, each bearing 6–many crowded flowers. **Female flowers** with *calyx divided two-thirds down into 3(–4) valvate slightly plicate triangular lobes, the basal third forming a cup or not.* **Fruits** in clusters of 1–3 or more, on 0.5–1.5 cm long stalks, ellipsoid to depressed globose, *2–2.5 × 1.5–1.8 cm, not ribbed, symmetric, smooth, shiny, black, glabrous. Fruit calyx not or slightly accrescent, forming a cup around the base of fruit; lobes leafy coriaceous, to c. 0.9 × 0.5 cm, reflexed backwards.*

Distribution. Myanmar to Vietnam, Sumatra, Peninsular Malaysia, Java, and Borneo.

Ecology. In lowland mixed dipterocarp forest.

Notes. *D. venosa* can be confused with *D. kurzii* and *D. confertiflora*. In fruiting specimens, *D. venosa* differs from *D. kurzii* by its fruit calyx with the base forming a distinct cup below the reflexed lobes (such a cup is absent in *D. kurzii* because the lobes are divided to the base). *D. confertiflora* can be distinguished from *D. venosa* by its asymmetric fruits with consistently 3-lobed calyx, the nearly invisible venation and the membranaceous parallel-sided leaves.

Key to varieties

Lower leaf surface glabrous, or hairy only on midrib and lateral veins below.....

var. **venosa**

Distribution as the species. In Borneo, found in Sabah (e.g., *FMS 38604*, *SAN 44586*, *SAN 76248*, *SAN 125512*, and *SAN 132919*), Sarawak (common, e.g., *Clemens 20636*, *Chew CWL 518*, *S 12723*, *S 15912*, and *S 38881*), and Brunei (e.g., *S 4146*). In lowland mixed dipterocarp forest.

Lower leaf surface densely velvety.....

var. **olivacea** (King & Gamble) Ng

(Latin, *olivaceus* = olive-green; alluding the colour of drying leaves)

Malay. For. 40 (1977) 247; Turner *l.c.* 200; Ng *l.c.* (2001) 311. Basionym: *Maba olivacea* King & Gamble in Williams, Bull. Herb. Boiss. 2, 5 (1905) 227. Type: *King's Collector 7877*, Peninsular Malaysia, Perak (K, SING). Synonyms: *D. hermaphroditica* (Zoll.) Bakh. var. *olivacea* (King & Gamble) Bakh. *l.c.* (1937) 85; *D. olivacea* (King & Gamble) Kosterm. *l.c.* 465.

Peninsular Malaysia and Borneo. In Borneo, known from Sabah (e.g., *SAN 49536*, *SAN 53860* and *SAN 83892*) and Sarawak (e.g., *S 38590*, *S 39237*, *S 42462*, *S 42562*, and *S 59689*). In lowland mixed dipterocarp forest.

75. Diospyros wallichii King & Gamble

Fig. 2J.

(N. Wallich, 1786–1854, Danish botanist at Calcutta, India)

In Williams, Bull. Herb. Boiss. 2, 5 (1905) 429; Bakhuizen *l.c.* (1938) 262; Ng *l.c.* (1978) 93; Anderson *l.c.* 171; Turner *l.c.* 200; Coode *et al.* (eds.) *l.c.* 90; Argent *et al.* (eds.) *l.c.* 188; Ng *l.c.* (2001) 311. **Type:** *Curtis 2594*, Peninsular Malaysia, Kedah, Langkawi (SING). **Synonym:** *D. pulchrinervia* Kosterm. *l.c.* 460.

Tree to 20 m tall. **Twigs** rusty appressed hairy when young, becoming glabrous with age. **Leaves** chartaceous, glabrous to rusty-hairy below, *plane* or *bullate between veins*, *not subglaucous below*; *oblong-elliptic*, rarely *lanceolate*, (14–)20–43 × 5.5–18 cm, *base subcordate* to *rounded* or *broadly cuneate*, sometimes bearing a pair of pit-glands, *apex acuminate*; *midrib sunken* (sometimes *prominulous*) *above*; *lateral veins more-or-less sunken* (sometimes *prominulous*) *above*, *prominent below*, (10–)11–30 pairs, *diminishing toward leaf margin*; *intercostal venation vaguely scalariform*; *petiole 0.7–1.5 cm long*. **Male inflorescences** slender, 1–2 cm long, each bearing to 9 flowers. **Male flowers** with *calyx divided into 4 valvate triangular lobes*; corolla salverform, *c.* 1 cm long. **Female inflorescences** 0.7–2.5 cm long, each bearing 1–3 flowers. **Female flowers** with *calyx divided into 4 valvate lobes*. **Fruits** in clusters of 1 or more, on 0.5–2 cm long stalk, *globose*, *to c. 2.5 cm diameter*, *not ribbed*, *symmetric*, often with small pointed tip in the centre of a depressed apex, *densely rusty velvety*. **Fruit calyx** *accrescent*, *woody*, *densely rusty velvety*; *lobes short*, *erect but the sides often dilated and reflexed*.

Distribution. Myanmar, Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, known from Sabah (e.g., *SAN 25227*, *SAN 30856*, *SAN 83521*, *SAN 87816*, and *SAN 93812*), Sarawak (common, e.g., *S 16721*, *S 23318*, *S 33915*, *S 49198*, and *S 54756*), Brunei (e.g., *BRUN 448*, *BRUN 15145*, *SAN 17399*, *SAN 17407*, and *Wong WKM 228*), and Kalimantan (e.g., *Kostermans 9785*, *Kostermans 9951* and *Kostermans 21583*).

Ecology. In lowland and hill mixed dipterocarp forests, to 700 m altitude, and on limestone hills.

Notes. In other parts of its range, the spaces between the calyx lobes of the fruits are filled with a proliferated callus tissue, but such tissue is absent or only present in slight amount in the Bornean specimens. *D. pulchrinervia* is merely a specimen with extremely bullate leaves.

EXCLUDED SPECIES

Diospyros sororia Bakh. *l.c.* (1936–41) 125. **Type:** *Sitam 00046*, Borneo, Sarawak = *Ilex borneensis* Loes. (*cf. Ng, Blumea 18 (1970) 412*).

LECYTHIDACEAE

Michelle A. Pinard

Department of Agriculture and Forestry, University of Aberdeen,
Aberdeen, United Kingdom

King, J. As. Soc. Beng. 70, 2 (1901) 134 (under Myrtaceae); Merrill, EB (1921) 418; Ridley, FMP 1 (1922) 756 (under Myrtaceae); Knuth, Pflanzenreich 105 (1939) 1; Masamune, EPB (1942) 513; Backer & Bakhuizen *f.*, FJ 1 (1964) 351; Payson, Blumea 15 (1967) 157; Whitmore, TFM 2 (1972) 257; Anderson, CLTS (1980) 230; Cockburn, TS 2 (1980) 44; Corner, WSTM 3rd. edition 1 (1988) 386; Ng, MFFSS (1991) 415; Kessler & Sidiyasa, TBSA-EK (1994) 159; Turner, Gard. Bull. Sing. 47 (1995) 286; Chantaranonthai, Kew Bull. 50 (1995) 677, *ibid.* 695; Coode *et al.* (eds.), CLBD (1996) 158; Argent *et al.* (eds.), MNDR-CK 1 (1997) 332; Beaman *et al.*, PMK 4 (2001) 419.

Trees. **Leaves** spirally arranged, simple, usually without stipules (infrequently with minute, caducous stipules), clustered or scattered at branch ends, penninerved. **Flowers** solitary or in spikes or racemes, axillary or terminal, radially (all Bornean species) or bilaterally symmetrical, 4–8-merous, bisexual; calyx 4–8-lobed, free or fused to corolla; corolla usually present, 4–6-lobed, less frequently absent; stamens numerous, filaments fused at base into a staminal tube, the tube radially symmetrical (all Bornean species) or prolonged on one side into a strap-like structure with arches over the summit of the ovary, in some apetalous species the outermost stamens modified into a petaloid corona; anthers basifixed, dehiscing along a longitudinal suture; intrastaminal disc present or absent; ovary inferior to half-inferior; ovules anatropous to apotropous, placentation axial. **Fruits** fibrous berries, dry drupes, or woody circumscissile capsules with one to many seeds. **Seeds** with or without cotyledons, with leathery seed coats; endosperm scanty or absent; germination hypogeal for species without cotyledons, epigeal for species with cotyledons.

Distribution. About 25 genera and 400 species, with pantropical distribution. The family is generally subdivided into four subfamilies, with members of the subfam. Planchonioideae (6 genera, 55 species) ranging from Africa to Australia; subfam. Foetidioideae (1 genus, 5 species) from Madagascar to Peninsular Malaysia; subfam. Napoleoniaeideae (3 genera, 12 species) from West Africa to S America; and subfam. Lecythidoideae (10 genera, *c.* 212 species) confined to C and S America. In Sabah and Sarawak, the family is represented by 2 genera with 23 species, all belonging to the subfam. Planchonioideae.

Ecology. In Borneo, common in lowland mixed dipterocarp forests. Many species are found in wet habitats (e.g., swamp, littoral and alluvial forests) and some species occur in well-drained forests.

Uses. Trees have large showy flowers which make them valuable as ornamentals. The timber of some species is used locally for construction. The roots, bark, leaves, fruits and seeds of some species are used in traditional medicine. Bark of some species is used as fish poison.

Taxonomy. Traditionally, the Lecythidaceae was aligned with the Myrtaceae, probably owing to its alternate leaves with minute stipules, myrtalian chemical characteristics (i.e., triterpene, saponins and ellagic acid), and numerous stamens. However, a lack of internal phloem and vestured pits while possessing centrifugal development of the stamens, showy imbricate petals, and various embryological features suggest the family is affiliated with the Theales, specifically Theaceae, Ochnaceae, Scytopetalaceae, Ebenaceae, and Styracaceae.

Although the genera in the family have been aggregated and segregated in various ways in the past, one family with four subfamilies is currently recognised. The subfamilies are distinguished by pollen type (syntri-colpate, tri-colpate or tri-colporate), the orientation of the cortical bundles, and the presence or absence of the followings: crystal chains in the secondary xylem, petals, and a corona of staminal origin. As circumscribed, the Lecythidaceae is paraphyletic; the subfam. Planchonioideae and subfam. Lecythidoideae make a monophyletic group with *Gustavia* L. and *Grias* L. of the New World Lecythidoideae being the link between the New and Old World Lecythidaceae.

Key to genera

Leaves generally whorled, tufted or clustered at ends of twigs; base mostly cuneate, non-decurrent; midrib usually prominent on both sides. Petioles thickened at insertion. Inflorescences terminal, axillary, or borne on leafless older branches, generally pendulous and long (more than 20 cm long), rarely erect and short, mostly many-flowered. Ovules pendent, 2–6(–13) per locule, inserted at the apical part of placentation axis. Fruits one-seeded (4–6-seeded in *B. hallieri*); embryo solid, spindle-shaped, without cotyledons

..... **1. Barringtonia**

Leaves generally well-spaced along twigs; base attenuate, decurrent, often extending down along the entire length of petiole; midrib prominent beneath, flattened above. Petioles not thickened at insertion. Inflorescences terminal, generally short (less than 15 cm long), mostly erect and few-flowered. Ovules, horizontal, numerous per locule, inserted along the entire length of placentation axis. Fruits (1–)3–15(or more)-seeded; embryo coiled, with folded foliaceous cotyledons.....

2. Planchonia

1. BARRINGTONIA J.R. & G.Forst.

(D. Barrington, 1727?–1800, an English naturalist)

Char. Gen (1776) 75; King, J. As. Soc. Beng. 70, 2 (1901) 134; Ridley, FMP 1 (1922) 756; Burgess, TBS (1966) 340; Backer & Bakhuizen *f.*, FJ 1 (1964) 352; Burkill, EPMP 1 (1966) 306; Payens, Blumea 15 (1967) 175; Whitmore, TFM 2 (1972) 260; Anderson, CLTS (1980) 230; Cockburn, TS 2 (1980) 44; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 190; Ng, MFFSS (1991) 417; Kessler & Sidiyasa, TBSA-EK (1994) 159; Chantaranonthai, Kew Bull. 50 (1995) 677 & 695; Coode *et al.* (eds.), CLBD (1996) 158; Argent *et al.* (eds.), MNDR-CK 1 (1997) 332; Beaman *et al.*, PMK 4 (2001) 419. **Synonyms:** *Butonica* Lam., Enc. Méth. Bot. 1, 2 (1785) 521; *Stravadium* Juss., Gen. Pl. (1789) 326; *Michelia auct. non L.*: Kuntze, Rev. Gen. Pl. I (1891) 240; *Careya* sect. *Barringtoniopsis* Nied. in K. Schumann, Notizbl. Bot. Gart. Berl. 2 (1898) 137.

Trees or shrubs with a wide range of growth forms, generally without buttresses. Shoots with episodic growth, young twigs with prominent leaf scars. **Stipules** distinct at base of young leaves, cauducous. **Leaves** mostly whorled, tufted or clustered at ends of twigs, rarely also persistent proximally; base cuneate, non-decurrent; midrib tends to be prominent on both sides of leaf; petiole generally thickened at insertion. **Inflorescences** axillary, terminal, or borne on leafless older branches or stems, many-flowered spikes or racemes, unbranched and mostly pendulous and long, rarely erect and short; bracts often early caducous. **Flowers:** hypanthium funnel-shaped, tetragonal, or subglobular, often extending into a pedicel, articulated at base near rachis; sepals generally chartaceous, either connate or free in bud; petals 3–5, imbricate, convex, adnate to staminal tube at base; stamens numerous, longer than petals, in 3–8 whorls, inner whorl(s) reduced to sterile filaments; filaments fused at base into a tube; anthers basifixed, 2-loculed, latrorse; intrastaminal disk a thin or thick undulating ring around the base of style; ovary inferior, 2–4-loculed, style usually as long as stamens, persistent; stigma knob-like or lobed; ovules attached apically and axially, pendent, anatropous to apotropous, 2–6(–13) per locule, usually only one developed into seed in each fruit (except for *B. hallieri*, where 4–6 ovules developed into seeds). **Fruits** drupaceous, in cross-section angled, winged or rounded; pericarp usually fleshy-leathery outside and woody or fibrous inside; calyx persistent. **Seeds** 1 (exceptionally 4–6 in *B. hallieri*) per fruit, large; testa brown, membranaceous; embryo solid, spindle shaped, without cotyledons; germination hypogeal.

Vernacular names. Sabah—*putat* (Malay), *tampalang* (Dusun). Sarawak—*karut*, *langkong* (Iban).

Distribution. In tropical and subtropical regions of E Africa, Madagascar, Asia, Malesia, Australia and the Pacific Islands. In Sabah and Sarawak, 20 species are recorded.

Ecology. In Borneo, the genus is common in lowland and hill mixed dipterocarp forests, swamp forest, mangroves and along the coast in the littoral zone, at altitudes to 2000 m. The fruits of some species are bouyant and perhaps are dispersed by water, while those of many other species have a fleshy mesocarp and probably are dispersed by mammals.

Uses. Most species of *Barringtonia* have saponins in its various tissues, the highest concentration being found in seeds though bark, wood and roots are used as a source of saponin. The saponins are frequently used as fish poisons, as a tanning agent, or medicinally for poulticing. Young leaves of some species are eaten raw. Timber is generally not used as it is not durable.

Taxonomy. The genus has been variously subdivided, most recently (Payens *l.c.*) into two sympatric sections, *i.e.* sect. *Barringtonia* and sect. *Stravadium*, based on the structure of the calyx in bud, whether lobes are connate or free. Based on morphological and embryological characters, *Barringtonia* appears to be one of the least derived genera within the subfam. Planchonioideae.

Key to *Barringtonia* species

1. Coastal plants, in littoral or mangrove forests or on tidal riverbanks near the limit of saline influence.....2
- Inland plants, in swamp forest, riverine forest, lowland or hill mixed dipterocarp forest.....4

2. Leaves subcoriaceous, margin entire; lateral veins 6–10 pairs. Fruits ovoid, angular, sharply tapering towards apex, without wings.....**3. B. asiatica**
 Leaves chartaceous, margin serrate-crenulate or minutely denticulate; lateral veins 10–20 pairs. Fruits conical, ovoid or with distinct wings.....3
3. Leaf base auriculate or emarginate, apex rounded or emarginate, rarely acute. Hypanthium cylindrical, with 8 wing-like appendages at base. Fruits conical with 8 distinct wings.....**4. B. conoidea**
 Leaf base cuneate, apex acute or acuminate. Hypanthium long, funnel-shaped, often extending into a pseudopedicel. Fruits ovoid, subtetragonous, slightly winged when young.....**15. B. racemosa** (in part)
4. Lateral veins 35–45 pairs. Petiole 9–20 cm long.....**7. B. hallieri**
 Lateral veins less than 35 pairs, or if more than 35 pairs, then petiole less than 9 cm long.....5
5. Twigs stout, with a diameter of more than 10 mm.....6
 Twigs slender, with a diameter of less than 10 mm.....9
6. Twigs and inflorescence rachises distinctly winged.....
**6. B. gigantostachya** (var. **megistophylla**)
 Twigs and inflorescence rachises not distinctly winged.....7
7. Leaf margin almost entire, revolute.....**19. B. sarcostachys**
 Leaf margin serrate-crenulate to minutely denticulate.....8
8. Leaves in two or more whorls at ends of twigs, obovate-lanceolate or linear-lanceolate. Inflorescence rachis glabrous.....**11. B. macrocarpa**
 Leaves not tufted or clustered at ends of twigs, obovate-oblong or obovate-lanceolate. Inflorescence rachis covered with tawny powdery granules.....**5. B. curranii** (in part)
9. Leaves coriaceous or subcoriaceous.....10
 Leaves chartaceous.....16
10. Inflorescence a spike.....11
 Inflorescence a raceme.....14
11. Inflorescences borne on leafless older twigs.....12
 Inflorescence terminal.....13
12. Spike rachis 5–6 mm diameter increasing to 15 mm; hypanthium with distinct grooves but not winged on edges.....**13. B. pendula** (in part)
 Spike rachis 3–7 mm diameter; hypanthium with distinctly winged edges.....**20. B. scortechinii** (in part)
13. Leaves drying grey-green above, yellowish brown beneath.....**2. B. ashtonii** (in part)
 Leaves drying concolourous.....**16. B. reticulata**

14. Petiole rugose, thick, and slightly winged.....**17. B. revoluta**
 Petiole otherwise..... 15
15. Leaves oblong to obovate-lanceolate; petiole 2–5 cm long.....**10. B. longispala**
 Leaves elliptic, narrow elliptic to obovate; petiole 0.6–1.2 cm long.....
**18. B. sarawakensis** (in part)
16. Inflorescence a spike.....17
 Inflorescence a raceme.....25
17. Spikes erect.....**9. B. lanceolata**
 Spikes pendulous..... 18
18. Lateral veins 15 pairs or more. Inflorescence rachis 5 mm or more in diameter at base...
19
 Lateral veins less than 15 pairs, if more than 15 pairs, the inflorescence rachis is less
 than 5 mm in diameter at base.....22
19. Inflorescence rachis glabrous.....20
 Inflorescence rachis covered with tawny powdery granules.....21
20. Leaf margin shallowly serrate-crenulate, not revolute. Hypanthium tetragonous, hard,
 4–6 mm long, glabrous.....**12. B. macrostachya**
 Leaf margin entire or serrate-crenulate towards apex, often revolute. Hypanthium
 subterete to tetragonous, with 4 distinct grooves on corners, 6–12 × 5–8 mm,
 ferruginous pubescent.....**13. B. pendula** (in part)
21. Spikes terminal.....**5. B. curranii** (in part)
 Spikes borne on leafless older twigs.....**13. B. pendula** (in part)
22. Calyx lobes free in bud.....**20. B. scortechinii** (in part)
 Calyx lobes connate in bud.....23
23. Lateral veins less than 15 pairs. Flower buds *c.* 5 × 5 mm or smaller.....
**2. B. ashtonii** (in part)
 Lateral veins more than 15 pairs, or if less than 15 pairs, flower buds larger than 5
 × 5 mm.....24
24. Hypanthium tetragonous, sharply angled or winged.....**14. B. pterita** (in part)
 Hypanthium funnel-shaped without angles or wings.....**15. B. racemosa** (in part)
25. Twigs flaky or ridged. Bracts at base of inflorescence (cataphylls) persistent.....
**1. B. acutangula** (subsp. **acutangula**)
 Twigs not obviously flaky or ridged. Bracts at base of inflorescence (cataphylls)
 caducous.....26
26. Leaf margin serrate-crenulate.....27
 Leaf margin entire to finely crenulate.....**18. B. sarawakensis** (in part)

27. Hypanthium tetragonous, sharply angled or winged.....**14. B. pterita** (in part)
 Hypanthium funnel-shaped or tubular, often extending into a pseudopedicel...28
28. Flower buds often mucronate; calyx lobes connate in bud.....**15. B. racemosa** (in part)
 Flower buds not mucronate; calyx lobes free in bud.....**8. B. havilandii**

1. Barringtonia acutangula (L.) Gaertn.

(Latin, *acutangularis* = sharp-angled; the fruit)

Fruct. Sem. Pl. 2 (1791) 97, t. 101; Payens *l.c.* 226; Anderson *l.c.* 230; Corner, WSTM 3rd. edition 1 (1988) 353; Whitmore, Tantra & Sutisna *l.c.* 191; Turner, Gard. Bull. Sing. 47 (1995) 287; Chantaranothai *l.c.* 680; Coode *et al.* (eds.) *l.c.* 158; Argent *et al.* (eds.) *l.c.* 333. **Basionym:** *Eugenia acutangula* L., Fl. Zeyl. (1748) 85, no. 190, Sp. Pl. (1753) 471. **Lectotype** (Payens, 1967); *Herb. Hermann 190*, "Ceylon" (hololectotype BM). **Synonyms:** *Stravadium acutangulum* (L.) J.St.-Hil., Exp. Fam. 2 (1805) 24, *excl. syn.*; *Michelia acutangula* (L.) Kuntze, Rev. Gen. Pl. 1 (1891) 240; *Huttum acutangulum* (L.) Britten, J. Bot. 39 (1901) 67; *B. spicata* Blume, Bijdr. Fl. Ned. Ind. (1826) 1099; *S. spicatum* (Blume) Blume in DC., Prod. 3 (1828) 289; *M. spicata* (Blume) Kuntze *l.c.* 241; *B. micrantha* Gagn., Not. Syst. 3 (1914) 385; *B. pedicellata* Ridl. *l.c.* (1922) 759; *B. martensii* Knuth, Pflanzenreich 105 (1939) 46, Masamune, EPB (1942) 514. (For complete synonyms see Payen *l.c.* 226).

Distribution. Afghanistan, Pakistan, India, Bangladesh, Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi, Timor, New Guinea, and N Australia. In Sabah, known from Sandakan district (e.g., *SAN 24755* and *SAN 85356*) and in Sarawak from Miri district (e.g., *S 39158* and *S 44803*). Also occurs in Brunei (e.g., *Niga NN 12*, *Kirkup 355* and *Wong WKM 621*) and E Kalimantan.

subsp. **acutangula**

Tree to 15(-25) m tall, 7-20 cm diameter. **Bark** grey or brown, fissured. **Twigs slender**, 3-5 mm diameter, usually flaky or ridged, usually glabrous. **Leaves chartaceous**, glabrous or hairy beneath; elliptic or obovate-oblong, (5-)6-16(-31) × 2-6(-9.5) cm, margin finely serrate-crenulate, apex obtuse, acute, or acuminate; *lateral veins* (7-)10-12(-20) pairs; *petiole* 0.4-1(-1.5) cm long. *Cataphylls* (bracts at the base of inflorescence) triangular, 1.5-6 × 1-3.5 mm, *persistent*. **Inflorescences racemose**, terminal, pendulous, main rachis 20-45(-78) cm long, 1-2 mm diameter at base, glabrous, slightly fissured; bracts elliptic-lanceolate, 1-5 × 0.75-2 mm. **Flowers:** buds c. 5 × 5 mm; hypanthium tubular, tetragonous, glabrous, extending into pedicels (1-)3-17 mm long, to 1 mm diameter; calyx lobes free in bud, semicircular, 2-3.5 × 1.5-3 mm, chartaceous, obtuse; petals 6-10(-12) × 4-7 mm, elliptic, obtuse, convex; staminal tube 1-4.5 mm high; stamens in 3 whorls; disk c. 0.5 mm high; ovary 2(-3-4)-loculed, 4(-5)-gonous, style 10-20 mm long, ovules 2-4(-5) per locule. **Fruits** angled or ovoid or subglobose, 2-6 × 1-3 cm, 4-winged when young, apex truncate, base emarginate or tapering; pericarp 3-6 mm thick. **Seeds** ovoid, grooved, 1-4 cm long.

Vernacular names. Sabah—*tampalang* (Dusun). Sarawak—*langkong* (Iban), *putat* (Malay). Brunei—*jempalang* (Dusun), *langkong* (Iban), *putat* (Malay).

Distribution. As the species.

Ecology. In lowland mixed dipterocarp forest.

Uses. The bark is used as a fish poison; the leaves, bark and fruit are used in traditional medicine.

Notes. Payens (*l.c.*) reduced many binomials to two subspecies of *B. acutangula*, one with pedicellate flowers and angled fruits (subsp. *acutangula*) and one with sessile flowers and globular to slightly winged fruits (subsp. *spicata* (Blume) Payens). Disagreement over the reduction exists (e.g., Corner *l.c.*) but palynological data supports designation as one species only (Payens *l.c.*). The variability in the hypanthium or calyx tube found in this widely distributed species argues against subspecies distinctions. However, it appears that the Bornean population belongs to subsp. *acutangula* and are small, single-stemmed trees tending to occur in lowland mixed dipterocarp forest. The Peninsular Malaysian population, on the other hand, represents subsp. *spicata*, tending to be multiple-stemmed, and are more often found near rivers, in swamp and mangrove forests.

2. *Barringtonia ashtonii* Payens

(P.S. Ashton, former Forest Botanist at the Forestry Departments of Brunei and Sarawak; Charles Bullard Professor of Forestry, Harvard University, U.S.A.)

Blumea 15 (1967) 218; Anderson *l.c.* 230; Cockburn *l.c.* 47; Whitmore, Tantra & Sutisna *l.c.* 191. **Type:** *Kostermans 5289*, Borneo, Kalimantan (holotype L; isotype BO).

Tree to 17 m tall, 10–45 cm diameter. **Bark** brown, scaly and dippled; inner bark brown. **Sapwood** whitish yellow. **Twigs** slender, 2–5 mm diameter. **Leaves** clustered at ends of twigs, subcoriaceous to chartaceous, glabrous, drying grey-green above, yellowish brown beneath; elliptic, ovate, or oblong, (8–)10–15(–21) × (3–)4–6(–9) cm, base cuneate, decurrent, margin entire to crenulate, apex acuminate or cuspidate; lateral veins 7–12 pairs; petiole 1–3(–4.5) cm long, 1–2 mm diameter. Cataphylls triangular, 5–7 × 3–4 mm. **Inflorescences** spicate, terminal, pendulous, main rachis (15–)30–77 cm long, 0.5–3 mm diameter at base, glabrous or sparsely covered with powdery granules, many-flowered; bracts linear-lanceolate, 10–12 × 1.5–2 mm. **Flowers:** buds 4–5 × 4–5 mm; hypanthium tetragonous with 4 ribs, 3–4 mm long, 1–1.5 mm wide, glabrous; calyx lobes connate in bud, rupturing into 2–3 equal, ovate, mucronate lobes, 6–8 × 4–6 mm; petals 4, 11–13 × 6–8 mm, obtuse or rounded; stamens in 3–4 whorls, staminal tube 1–2 mm high; disk thick, 0.5–2 mm high; ovary 3(–4)-loculed, style filiform, 22–28 mm long, ovules 1–2 per locule. **Fruits** ovoid, 4.5–5 × 2–3 cm, tapering towards apex and base, rugose, 4-ribbed; pericarp 1.5–2 mm thick. **Seeds** ovoid, c. 2.7 cm long.

Vernacular name. Sabah—*tampalang* (Dusun).

Distribution. Endemic to Borneo. In Sabah, recorded from Tawau, Sandakan and Lahad Datu districts (e.g., *SAN A 3988*, *SAN 30658*, *SAN 53023*, *SAN 71658*, *SAN 79863*, *SAN 82130*, *SAN 94885*, and *Stevens 422*), and in Sarawak from Miri district (e.g., *S 27027*). Also occurs in Kalimantan (e.g., *Kostermans 5289* and *Kostermans 13352*).

Ecology. Along rivers in inland lowland mixed dipterocarp forest.

3. *Barringtonia asiatica* (L.) Kurz (of Asia)

Rep. Pegu (1875) App. A, lxxv, App. B, 52 *in clavi*; Merrill, EB (1921) 418; Burkill *l.c.* 304; Payens *l.c.* 184; Whitmore *l.c.* 258; Anderson *l.c.* 230; Cockburn *l.c.* 45; Corner *l.c.* 391; Whitmore, Tantra & Sutisna *l.c.* 191; Turner *l.c.* 288; Chantaranonthai *l.c.* 682; Coode *et al.* (eds.) *l.c.* 158; Argent *et al.* (eds.) *l.c.* 333. **Basionym:** *Mammea asiatica* L., Sp. Pl. (1753) 512. **Type:** *Osbeck s.n.*, "Prinsen Is., off W Java" (holotype LINN; isotype S). **Synonyms:** *B. speciosa* J.R. & G.Forst. *l.c.* 76, Merrill *l.c.* (1921) 418; *Commersona speciosa* (J.R. & G.Forst.) Salisbury, Prod. (1796) 355; *Agasta asiatica* (L.) Miers, Trans. Linn. Soc. Bot. 1 (1875) 61; *Butonica asiatica* (L.) J.St.-Hil. *l.c.* 166; *Huttum speciosum* (J.R. & G.Forst.) Britten *l.c.* 67. (For complete synonymy see Payens *l.c.* 185).

Tree with spreading branches, 7–20(–30) m tall, 25–100 cm diameter; bole often crooked, sometimes buttressed. **Bark** brown or grey, grooved and fissured, covered with diamond-shaped lenticels. **Sapwood** white to pale yellow; heartwood not distinct from sapwood. **Twigs** stout, 6–10 mm diameter, with large leaf scars. **Leaves** clustered at ends of twigs, *subcoriaceous*, glabrous; obovate or obovate-oblong, (15–)20–38(–52) × (7–)10–18(–21) cm, *margin entire*, apex emarginate to mucronate; *lateral veins 6–10 pairs*; petiole *c.* 0.5 cm long. Cataphylls 13–30 × 7–10 mm. **Inflorescences** racemose, terminal, rarely lateral near top of branches, erect, main rachis 2–15(–20) cm long, 8–10 mm diameter at base, glabrous, few–many-flowered; bracts sessile, ovate, 8–15(–20) × 4–10(–15) mm. **Flowers:** buds 20–40 × 20–40 mm; hypanthium tetragonous or slightly winged to subglobular, glabrous, 5–9 mm long, extending into pedicels 4–6(–9) cm long; calyx lobes connate in bud, rupturing into 2 persistent unequal segments, 3–4 × 2–3 cm; petals 55–85 × 25–45 mm, elliptic, convex; stamens in 6 whorls, staminal tube 1.5–6 mm high; disk thick, glabrous, *c.* 1 mm high; ovary 4(–5)-loculed, style 9–13.5 cm long, ovules 4(–5) per locule. **Fruits** *ovoid*, 8.5–11 × 8.5–10 cm, *angular, sharply tapering towards apex*, tetragonous to emarginate at base, *without wings*; pericarp with thin, shiny exocarp and thick, spongy mesocarp. **Seeds** oblong, 4–5 cm long.

Vernacular name. Sabah and Sarawak—*putat laut* (Malay).

Distribution. From Madagascar to Sri Lanka, throughout Malesia, N Australia to the Pacific Islands. In Sabah, recorded from Sandakan district (Kuala Penyu; e.g., *SAN 86142*, *SAN 114975* and *SAN 115264*), and in Sarawak from Kuching district (e.g., *S 17828*). Also occurs in Brunei (e.g., *Zainal FD. M.M.S. 30360* and *van Niel 3973*) and Kalimantan.

Ecology. A littoral or strand species with water-dispersed fruits.

Uses. Fruits are pulped and thrown into streams as a fish poison. Bark, leaves, and fruit are used in the treatment of backache and sores joints. The tree is apparently of little value for its timber.

4. *Barringtonia conoidea* Griff. (Latin, *conoideus* = almost conical; the fruit)

Not. Pl. As. 4 (1854) 656; King *l.c.* 136; Merrill *l.c.* (1921) 419; Ridley *l.c.* (1922) 757; Burkill *l.c.* 305; Payens *l.c.* 189; Whitmore *l.c.* 258; Anderson *l.c.* 230; Corner *l.c.* 391; Whitmore, Tantra & Sutisna *l.c.*

191; Turner *l.c.* 288; Coode *et al.* (eds.) *l.c.* 158. **Type:** *Griffith Kew Distr. No. 2423*, “Malaya” (holotype K; isotype P).

Small tree or shrub, 3–15 m tall, 10–15 cm diameter. **Twigs** 4–10 mm diameter. **Leaves** chartaceous, glabrous; broadly obovate-oblong, 12–28 × (4–)7–10 cm, *base auriculate* or *emarginate*, *margin serrate-crenulate*, revolute when dry, *apex rounded*, *emarginate* or *rarely acute*; *lateral veins 10–15 pairs*, prominent beneath; petiole 0.1–0.4(–0.7) cm long, slightly winged. Cataphylls triangular-lanceolate, 5–10 × 3–4.5 mm. **Inflorescences** racemose, terminal or borne on leafless older twigs, pendulous, main rachis (2–)5–10(–60) cm long, *c.* 2 mm diameter at base, fissured, puberulous; bracts triangular, acute, *c.* 5 × 2 mm, caducous. **Flower:** buds 4–8 × 5–8 mm; *hypanthium cylindrical*, with 8 wing-like appendages at base, *c.* 3 mm long, glabrous or covered with powdery granules; pedicel 5–10 mm long, *c.* 1 mm diameter, growing to 20 mm long with fruit maturation; articulation at rachis or slightly up the flower stalk; calyx lobes connate in bud, rupturing into 2 equal ovate segments, 8–13 × 7–10 mm, subsistent; petals *c.* 16 × 8 mm, elliptic, obtuse, convex; stamens in 5(–6) whorls, staminal tube *c.* 3 mm high; disk 0.7–2 mm high, thin; ovary 4-loculed, style 25–33 mm long, ovules 1–3 per locule. **Fruits** conical, 3–5 × 2.5–3.5 cm, with 8 distinct wings, wings 1.2–1.7 × 0.6–1.3 cm, base and apex gradually tapered; pericarp *c.* 4 mm thick. **Seeds** ovoid, *c.* 3 cm long, fissured, apex pointed, base rounded.

Vernacular name. Sarawak—*putat sungai* (Malay).

Distribution. Myanmar, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, known from Sarawak (Bintulu; e.g., *S 18586*), Brunei (Belait; e.g., *BRUN 5073* and *BRUN 5382*) and Kalimantan.

Ecology. In mangrove forest at the limit of saline influence; along the tidal zones of rivers behind the *Nypa*-zone. Generally rare although it can be locally common, often growing in thickets with *Gluta velutina* Blume (Anacardiaceae).

5. *Barringtonia curranii* Merr.

(H.Mc. Curran, 1875–?, forest officer of the Bureau of Forestry, Manila, the Philippines)

Philip. J. Sci. 1 (1906) Suppl. 211; Merrill *l.c.* (1921) 419; Masamune *l.c.* 513; Payens *l.c.* 255; Anderson *l.c.* 230; Cockburn *l.c.* 46; Whitmore, Tantra & Sutisna *l.c.* 191; Kessler & Sidiyasa *l.c.* 160; Beaman *et al. l.c.* 419. **Type:** *Curran 3596*, the Philippines, Palawan (isotype K). **Synonym:** *B. rhodochlamys* Airy Shaw, Kew Bull. (1950) 137.

Small to medium-sized tree with straight stem, (2–)13–25 m tall, 10–40 cm diameter. **Bark** grey, greyish green or dark brown, pitted, smooth or flaky; inner bark fibrous, yellow. **Sapwood** yellow or white. **Twigs** slender or stout, (5–)10–18 mm diameter, not distinctly winged. **Leaves** not tufted or clustered at ends of twigs, chartaceous, usually glabrous but sometimes hairy beneath; *obovate-lanceolate* or *obovate-oblong*, 24–70(–90) × 9–13(–21) cm, base cuneate to decurrent, *margin serrate-crenulate*, apex acuminate or obtuse; *lateral veins (15–)18–26(–30) pairs*; *petiole 0.5–1(–2.5) cm long*, 7–10 mm thick. Cataphylls triangular, lanceolate, 7–20 × 4 mm. **Inflorescences** *spicate*, terminal, pendulous, *rachis 40–100(–110) cm long*, (5–)10–15 mm diameter at base, covered with tawny powdery granules, not distinctly winged, many-flowered. **Flowers:** buds 7–12 × 7–12 mm; *hypanthium tetragonous*, 6–8 × 4–7 mm, thickened at base, covered with tawny powdery granules, calyx lobes free in bud, ovate-orbicular, covered with

reddish brown powdery granules outside, 4–7 × 4–11 mm, fimbriate; petals 27–35 × 12–20 mm, elliptic, obtuse, convex; stamens in 5(–6) whorls, staminal tube *c.* 4–5 mm high; disk annular, undulating, grooved, 1–1.5 mm high; ovary 4-loculed, style filiform, 4–7 cm long, ovules 4–7 per locule. **Fruits** ovoid, 7–11 × 4–7.5 cm, subtetragonous or terete, tapering at both ends, covered with reddish brown powdery granules; pericarp 5–10 mm thick. **Seeds** ovoid, fissured, 4–5 cm long.

Distribution. Borneo and the Philippines (Palawan). In Sabah and Sarawak, common (e.g., *RSNB 86*, *SAN 20436*, *SAN 34592*, *SAN 49914*, *SAN 68248*, *SAN 78744*, and *SAN 118982*). Also occurs in Brunei and Kalimantan.

Ecology. In mixed dipterocarp and lower montane forests from sea level to 1700 m altitude.

6. *Barringtonia gigantostachya* Koord. & Valetton

(Greek, *giganto-* = very large, *stachys* = spike; referring to the inflorescence)

Bull. Inst. Bot. Buitenz. 2 (1899) 9. **Lectotype** (Payens, 1967): *Koorders 5403*, Java (hololectotype L).

Distribution. Borneo and Java.

var. **megistophylla** (Merr.) Payens

(Greek, *megisto-* = very large, *phullon* = leaf)

Blumea 15 (1967) 206; Cockburn *l.c.* 45; Whitmore, Tantra & Sutisna *l.c.* 191; Coode *et al.* (eds.) *l.c.* 158; Argent *et al.* (eds.) *l.c.* 333. **Basionym:** *B. megistophylla* Merr., PEB (1929) 213, Knuth *l.c.* 22. **Type:** *Elmer 21823*, Borneo, Sabah, Tawau (holotype lost; isotypes BM, BO, BRI, K, L, P, SING, U).

Small tree, 10–15 m tall, 20–40 cm diameter; bole often crooked or irregular. **Bark** smooth, superficially fissured; inner bark *c.* 10 mm thick, greyish white. **Sapwood** yellow. **Twigs stout, 15–20 mm diameter, distinctly winged**, wings 3–5 mm wide. **Leaves** chartaceous or subcoriaceous, glabrous; obovate-lanceolate, rarely obovate-oblong, (30–)40–75(–106) × (9–)11–19(–24) cm, base decurrent, margin crenulate, apex cuspidate or obtuse; *lateral veins* (22–)25–30(–40) *pairs*; *petiole* 0.5–1(–2) cm long, 8–10 mm diameter. Cataphylls lanceolate or triangular, 15–90 × 5–15 mm. **Inflorescences** spicate, terminal, pendulous, *rachis* 60–125 cm long, 7–20 mm diameter at base, *fissured, distinctly winged* with the wings in pairs beneath flowers, 15–45 × 5 mm; bracts, narrow-triangular, serrate, 3–20 × 2–8 mm. **Flowers:** buds 8–15 mm; hypanthium subglobose to tetragonous, 4–10 mm long, glabrous; calyx lobes connate in bud with apical pore, rupturing into 3–4(–5) unequal lobes, 5–15 × 6–15 mm; petals 20–35 × 15–20 mm, fleshy, elliptic, obtuse, convex; stamens in 5–6 whorls, staminal tube 4–10 mm high; disk annular, undulating, grooved, 1–2 mm high; ovary 4-loculed, style 40–50 mm long, ovules 4–7 per locule. **Fruits** ovoid, 8.5–10 × 3–4.5 cm, tapering at both ends, glabrous; pericarp 3–5 mm thick. **Seeds** ovoid, distinctly fissured, *c.* 5 cm long.

Distribution. This variety is known only from Sabah (Kinabatangan, Kota Belud, Lahad Datu, Sandakan, and Tawau districts; e.g., *SAN 15379*, *SAN 59116*, *SAN 83166*, *SAN 112076*, and *SAN 118982*) and Kalimantan (e.g., *Kostermans 5585* and *Kostermans 13301*). The other known variety, *B. gigantostachya* var. *gigantostachya*, occurs in C Java.

Ecology. In mixed dipterocarp forest, uncommon.

Notes. This variety differs from var. *gigantostachya* by having winged rachis, with the wings inserted in pairs underneath each flower. The two varieties do not overlap in distribution.

7. *Barringtonia hallieri* Knuth

(J.G. Hallier, 1868–1932, a German botanist)

Pflanzenreich 105 (1939) 34; Masamune *l.c.* 513; Payens *l.c.* 240; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 191. **Type:** *Hallier 3067*, Borneo, Kalimantan, W Kutai (holotype L).

Small tree to 5 m tall, 6 cm diameter. **Twigs** stout, 8–20 mm diameter. **Leaves** tufted towards ends of branches but also extending down the twigs, subcoriaceous to chartaceous, glabrous; lanceolate or obovate-lanceolate, 28–68 × 5.5–19 cm, base occasionally decurrent, margin entire to finely serrate-crenulate, apex caudate or narrowly acute; *lateral veins 35–45 pairs*; *petiole 9–20 cm long, c.* 3 mm diameter, swollen at base. **Inflorescences** racemose, terminal, pendulous, rachis *c.* 75 cm long, 4–6 mm diameter at base, accrescent to 12 mm, glabrous, slightly fissured. **Flowers:** buds 12–15 mm long; hypanthium campanulate, slightly 4-gonous, 8–10 mm long; pedicel 2–6 cm long, 2–3 mm diameter, articulation at the peduncle, glabrous; calyx lobes free in bud, lobes broadly triangular *c.* 8 × 8 mm, chartaceous, fimbriate; petals 25–30 × 15–20 mm, elliptic; stamens in 4 whorls, staminal tube *c.* 2 mm high; disk a thin (fleshy, triangular) ring, *c.* 1.5 mm high; ovary 4-loculed, style *c.* 30 mm long, ovules 11–13 per locule, septa incomplete. **Fruits** oblong to musiform, 11–14 × 2.8–3.5 cm, apex truncate, base narrowly tapering; pericarp *c.* 3 mm thick, fissured; mesocarp with many small fibers. **Seeds** 6, arranged one above another in a crooked or *zig-zag* column, irregularly shaped, ovoid with concavities where other seeds fit closely together, 2.5–3.5 × 1.8–2.4 cm.

Distribution. Endemic to Borneo. Known from Sarawak (Rejang, Kapit, and Kuching; e.g., *Haviland 2936, S 18245* and *S 40236*) and Kalimantan (e.g., *Hallier 3067*).

Ecology. Inland riverine and mixed dipterocarp forests, at altitudes to 900 m.

Notes. This species is very unusual for *Barringtonia* in that it possesses many ovules (more than 30) per ovary, and has more than one seed in each fruit. It is reminiscent of species of *Abdulmajidia* Whitmore, a genus within the family described by Whitmore (Kew Bull. 29 (1974) 207) from Peninsular Malaysia, in seed number and position of the ovules in the locules. However, the species has 4-locular ovary and a long, pendulous inflorescence, typical for *Barringtonia* species. Further work is needed to explore the relationship between this species and those of *Abdulmajidia*.

8. *Barringtonia havilandii* Ridl.

(G.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Kew Bull. (1938) 284; Knuth *l.c.* 34; Masamune *l.c.* 513; Payens *l.c.* 242; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 191; Coode *et al.* (eds.) *l.c.* 158. **Type:** *Haviland 2935*, Borneo, Sarawak (holotype SING; isotypes K, SAR). **Synonym:** *B. baramensis* Knuth *l.c.* 33.

Tree. **Twigs** slender, 4–9 mm diameter, not flaky or ridged. **Leaves** tufted at ends of twigs, chartaceous, glabrous; elliptic, obovate-oblong, rarely obovate-lanceolate, 24–37 × 8–11 cm, base cuneate, attenuate or decurrent, margin serrate-crenulate; apex acuminate; lateral veins 16–25(–32) pairs; petiole 1–8.5(–11.5) cm long, 2.5–4.5 mm diameter at base. **Cataphylls** triangular, c. 23 × 6 mm, caducous. **Inflorescences** racemose, terminal or lateral, pendulous, rachis initially hairy, soon becoming glabrous, 40–110 cm long, 1.5–3 mm diameter at base, slightly fissured, covered with powdery granules; bracts triangular, c. 3.5 × 0.5 mm. **Flowers:** buds c. 8 mm long, not mucronate; hypanthium tubular, often extending into a pseudopedicel, trigonous or subtetragonous, 3–7 mm long, covered with powdery granules; pedicel thin, 5–20 mm long; calyx lobes 3–4, free in bud, semicircular, 3–6 × 3–5 mm; petals 9–14 × 6–10 mm, elliptic, convex; stamens in 3–4 whorls, staminal tube 1–3 mm high; disk thin, 0.5–0.8 mm high; ovary 3(–4)-loculed, style c. 2–3 cm long, ovules 2–5 per locule. **Fruits** unknown.

Distribution. Endemic to Borneo. Known from Sarawak (Kuching and Kapit districts; e.g., Haviland 2935 and Haviland 2937), Brunei (e.g., Johns 7441) and Kalimantan.

Ecology. In inland riverine forest.

9. *Barringtonia lanceolata* (Ridl.) Payson

Fig. 1.

(Latin, *lanceolatus* = broadest at the middle, tapering to each end; referring to the leaf)

Blumea 15 (1967) 250; Anderson *l.c.* 231; Cockburn *l.c.* 47; Whitmore, Tantra & Sutisna *l.c.* 191; Coode *et al.* (eds.) *l.c.* 159; Argent *et al.* (eds.) *l.c.* 333; Beaman *et al.* *l.c.* 419. **Basionym:** *Careya lanceolata* Ridl. *l.c.* (1938) 285. **Type:** Haviland 2933, Borneo, Sarawak (holotype K; isotype SAR). **Synonyms:** *Planchonia lanceolata* (Ridl.) Knuth *l.c.* 54; *B. pseudoglomerata* P.Chantaranothai, Kew Bull. 50 (1995) 697. Type: Othman, Jugah & Anyie S 31858, Borneo, Sarawak, Ulu Sg. Tutoh (holotype L; isotypes A, K, SAN, SAR, SING), *syn. nov.*

Tree, 8–30 m tall, 10–33(–60) cm diameter, with short buttresses. **Bark** smooth, dippled or slightly flaky, hard, brown, grey or reddish brown with grey patches; inner bark brown or pink. **Sapwood** yellow or white. **Twigs** slender, 1.5–5 mm diameter. **Leaves** chartaceous, glabrous, often distinctly grey above when dry, yellow-ochre below; obovate-oblong to oblong, 9–17(–25) × 3–7(–9) cm, margin entire or serrate-crenulate, apex acute or acuminate, rarely emarginate; lateral veins 8–11 pairs; petiole (1–)3–5(–8) cm long, 1–2 mm diameter. **Inflorescences** spicate, erect, borne on leafless older twigs; rachis 5–25(–100) cm long, 5–8 mm diameter at base, glabrous; bracts lanceolate, 3–7 mm × 1–3 mm, apex rounded. **Flowers:** buds c. 10 mm diameter; hypanthium subtetragonous, 5–12 × 4–9 mm, glabrous; calyx lobes free in bud, suborbicular, 3–6 × 5–9 mm; petals 4, 23–30 × 10–16 mm, elliptic, convex; stamens in 4(–5) whorls, staminal tube 3–4 mm; disk 0.5–1 mm high; ovary 4-loculed, style 45–50(–60) mm long, ovules 3–6 per locule. **Fruits** ovoid or fusiform, (6–)6.5–8.5(–10.5) × (2.5–)3–5(–7) cm, apex truncate, base tapering; pericarp 6–15 mm thick; mesocarp with thick anastomosing fibers. **Seeds** ovoid or spindle-shaped, 5 ribbed, 3–4.5 cm long.

Vernacular names. Brunei—*jempalang*, *jempalang apoi* (Dusun), *langkong* (Iban), *putat* (Malay).

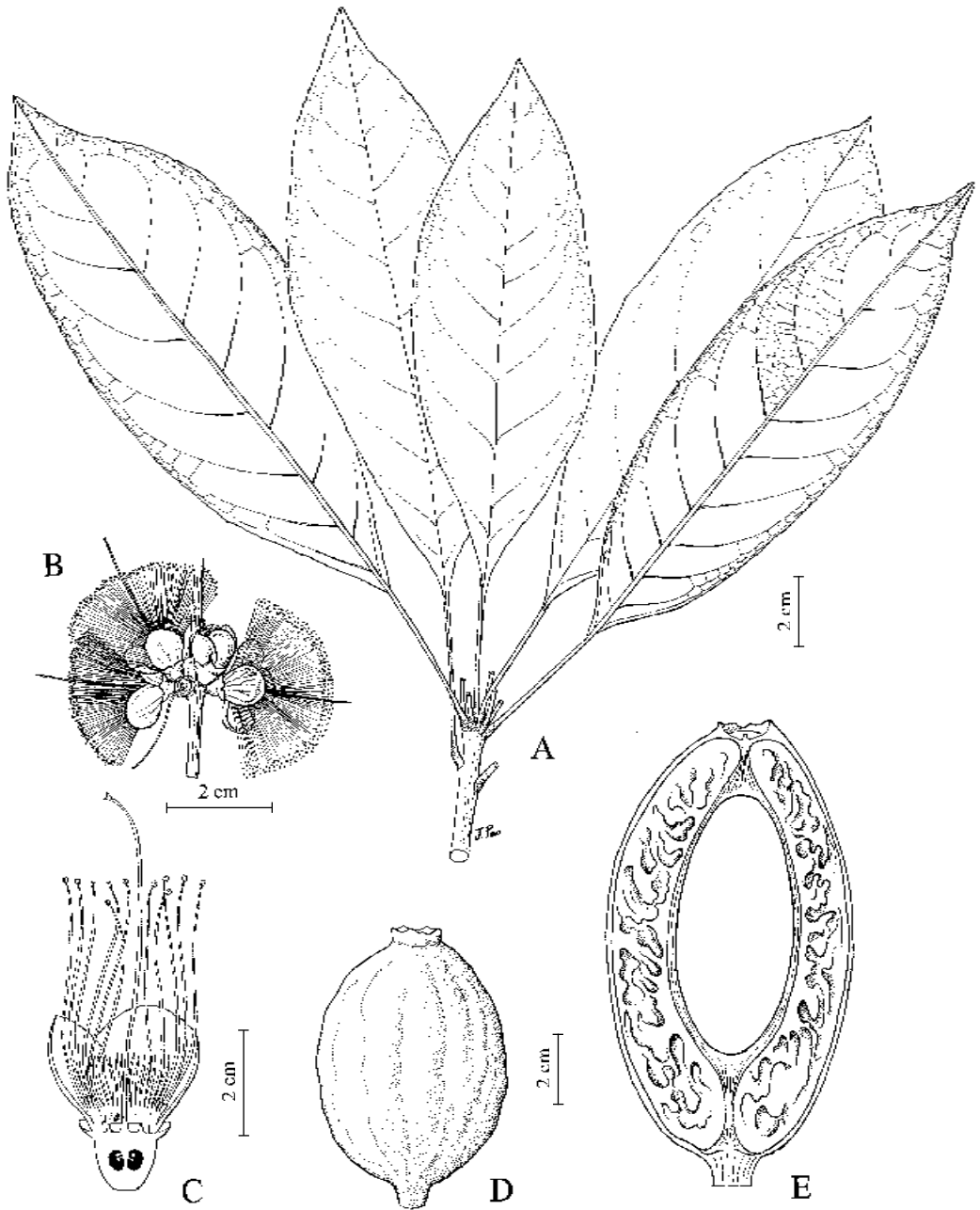


Fig. 1. *Barringtonia lanceolata*. A, leafy twig; B, part of inflorescence showing two fully open flowers; C, longitudinal section of flowers; D, fruit; E, longitudinal section of a mature fruit showing woody pericarp and a single solid seed/embryo at the centre. (A–C from *SAN 17288*, D from *SAN 94948*, E from *SAN 116597*.)

Distribution. Endemic to Borneo. Known from Sabah (Keningau, Lahad Datu, Sandakan, and Tawau districts; e.g., *SAN 15381*, *SAN 24437*, *SAN 49146*, *SAN 73757*, and *SAN 120958*), Sarawak (Miri, Marudi, Kuching, Serian, and Bintulu districts; e.g., *S 13309*, *S 18193*, *S 33594*, *S 33728*, and *S 34348*), Brunei (e.g., *BRUN 255*, *Dransfield JD 6679* and *Wong WKM 1405*), and Kalimantan (e.g., *Kostermans 21695*).

Ecology. In lowland and hill mixed dipterocarp to lower montane forests, at altitudes to 1700 m.

Uses. In Sabah, the bark is sometimes used as a fish poison.

10. *Barringtonia longisepala* Payens

(Latin, *longus* = long, *sepalum* = sepal; in reference to the extended hypanthium)

Blumea 15 (1967) 191; Anderson *l.c.* 231; Cockburn *l.c.* 46; Whitmore, Tantra & Sutisna *l.c.* 192. **Type:** *Sam SAN 26364*, Borneo, Sabah, Sandakan (holotype L; isotypes K, SAN).

Tree to 21 m tall, 35 cm diameter. **Bark** fissured, dark grey or greyish brown, with distinct lenticels. **Sapwood** white. **Twigs** slender, 4–8 mm diameter. **Leaves** coriaceous, glabrous, glossy above; oblong to obovate-lanceolate, (10–)15–20(–23) × (3–)4–7(–8) cm, base cuneate to decurrent, margin entire, apex acuminate, acute or rounded; lateral veins (9)11–15(–18) pairs, prominent on both sides; petiole 2–5 cm long, not winged or rugose. Cataphylls *c.* 6 × 1.5 mm. **Inflorescences** racemose, terminal, rachis 25–86 cm long, 3–4 mm diameter at base, increasing to 6–8 mm, yellowish puberulous, slightly fissured; bracts lanceolate, 5–11 × 1–3 mm. **Flowers:** buds 12–20 mm long; hypanthium tetragonous, tubular, 7–10 mm long, puberulous, extending into a stout pedicel of 5–15 mm long, 2–4 mm diameter, puberulous; calyx lobes connate in bud, sometimes with apical pore when young, rupturing into 3–4 equal segments, 10–18 × 10–20 mm increasing to 25–33 × 10–20 mm; petals 4, 35–45 × 20–25 mm, obovate to elliptic, convex; stamens in 6(–7) whorls, staminal tube 2–3 mm; disk 1–1.5 mm high; ovary 4-loculed, style 40–55 mm long, increasing to 65 mm, ovules 3–5 per locule. **Fruits** oblong, 13–14 × 5–5.5 cm, slightly tetragonous; pericarp 5–11 mm thick; exocarp rugose; mesocarp spongy with dispersed large and small fibres. **Seeds** ovoid, deeply fissured, *c.* 7 cm long.

Vernacular name. Sabah—*tampalang* (Dusun).

Distribution. Endemic to Borneo. Known from Sabah (Beaufort, Sandakan, and Sipitang districts; e.g., *SAN 26364* and *SAN 41781*), Sarawak (Miri district; e.g., *S 37001*) and Brunei (e.g., *S 5558*).

Ecology. In primary and secondary inland forests on sandstone hills; also recorded in mixed peat swamp forest.

11. *Barringtonia macrocarpa* Hassk.

(Greek, *makro* = large, *karpon* = fruit; relating to the large fruit)

Flora 25, 2 (1842) Beibl. 36; Payens *l.c.* 237; Whitmore *l.c.* 259; Whitmore, Tantra & Sutisna *l.c.* 192; Turner *l.c.* 288. **Type** (Payens, 1967): *Description by Hasskarl*. **Synonyms:** *Megadendron macrocarpum*

(Hassk.) Miers *l.c.* 109, *t.* 15; *Michelia macrocarpa* (Hassk.) Kuntze *l.c.* 241; *Stravadium insigne* Blume in Van Houtte, Fl. Serr. 7 (1851) 21, 24, *t.* 654; *B. insignis* Miq., Fl. Ind. Bat. 1, 1 (1855) 488, Backer & Bakhuizen *f. l.c.* 353; *Michelia insignis* (Miq.) Kuntze *l.c.* 240; *B. acutangula auct. non* (L.) Gaertn.: Blume *l.c.* (1826) 1097. (For complete synonymy see Payens *l.c.* 237).

Shrub or small to medium-sized tree, 1.5–13(–30) m tall, 5–16(–24) cm diameter. **Twigs** stout, (5–)7–15 mm diameter, not winged. **Leaves** in two or more whorls at ends of twigs, subcoriaceous to chartaceous, glabrous; obovate-lanceolate or linear-lanceolate, 29–60(–70) × 4–6.5(–18) cm, base narrowly cuneate to decurrent, margin finely serrate-crenulate, especially towards apex, apex acuminate, cuspidate or obtuse; lateral veins (16–)22–34 pairs; petiole 1.5–2 cm long. **Inflorescences** racemose, terminal, pendulous, rachis (26–) 40–75(–112) cm long, 2–7 mm diameter at base, glabrous, not winged; bracts densely tufted at the base of peduncle, lanceolate-triangular, 5–7.5 × 2–30 mm. **Flowers:** buds 5–12 mm long; hypanthium, 3–4-gonous or globular (vase-shaped), 7–11 mm long, glabrous, extending into pedicel of 15–30 mm long, glabrous, articulation at peduncle; calyx lobes free in bud, unequal, broadly ovate, 3–5 × 3–5 mm, persistent; petals 17–28 × 7–15 mm, elliptic, obtuse, convex; stamens in 3–4 whorls, staminal tube 0.5–5 mm high; disk a grooved small ring, to 1 mm high; ovary 3-loculed, style 35–42 mm long, ovules 2–5 per locule. **Fruits** 3–4-gonous, 6–12.5 × 1–3 cm, 3–4-winged, narrowly tapering towards base, apex truncate, glabrous; pericarp c. 2.5 mm thick. **Seeds** ovoid, fissured.

Distribution. Vietnam, Myanmar, Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. In Borneo, known from Sabah (e.g., *Keith FD. F.M.S. 44691* and *SAN 48814*), Sarawak (Bt. Raya, Pelagus; e.g., *S 17768*) and Kalimantan.

Ecology. Inland riverine and swamp forests, at low elevations.

12. *Barringtonia macrostachya* (Jack) Kurz

(Greek, *makro* = large, long, great, *stachys* = spike; referring to the inflorescence)

Rep. Pegu (1875) App. A, lxvi, App. B 52 in *clavi*; Merrill *l.c.* (1921) 419; Burkill *l.c.* 305; Payens *l.c.* 244; Whitmore *l.c.* 260.; Anderson *l.c.* 231; Cockburn *l.c.* 46; Corner *l.c.* 392; Whitmore, Tantra & Sutisna *l.c.* 192; Turner *l.c.* 288; Coode *et al.* (eds.) *l.c.* 159; Argent *et al.* (eds.) *l.c.* 337. **Basionym:** *Careya macrostachya* Jack, Mal. Misc. 1 (1821) 47. **Type** (Payens, 1967): *Jack's description*. **Synonyms:** *Doxomma macrostachyum* (Jack) Miers *l.c.* 104; *Michelia macrostachya* (Jack) Kuntze *l.c.* 241; *Doxomma sumatrana auct. non* (Miq.) Miers: Miers *l.c.* 103; *B. sumatrana auct. non* Miq.: Ridley *l.c.* (1922) 758, Burkill *l.c.* 307.

Shrub or small to medium-sized tree, 4–20(–30) m tall, 3–35(–95) cm diameter. **Bark** smooth or scaly, brown, greenish yellow or greyish brown or brown with grey mottling; inner bark thin, soft, fibrous. **Sapwood** pale yellow. **Twigs** slender, 5–10 mm diameter. **Leaves** chartaceous, glabrous; obovate-oblong to oblong, (10–)15–25(–45) × (4–)6–8(–10) cm, margin shallowly serrate-crenulate, not revolute, apex cuspidate or caudate; lateral veins (10–)14–18(–21) pairs; petiole 2.5–10(–17) cm long, thick at base. Cataphylls triangular, 4.5–7 × 1–2 mm, glabrous. **Inflorescences** spicate, terminal or borne on leafless older twigs, pendulous, rachis (10–)19–45(–75) cm long, 3–6 mm diameter at base, increasing to 10 mm, glabrous; bracts triangular, lanceolate, 5–11 × 1.5–3 mm. **Flowers:** buds 7–9 × 7–9 mm; hypanthium tetragonous, hard, 4–6 mm long, glabrous; calyx lobes free in bud, suborbicular, glabrous, convex, chartaceous, 3–5 × 4–6 mm; petals 4, 20–23 × 15 mm, elliptic to suborbicular; stamens in 4(–5) whorls, staminal

tube 1.5–3 mm high; disk thin, grooved, 0.5–1.5 mm high; ovary 4-loculed, style 40–45 mm long, ovules 2–4 per locule. **Fruits** obovoid, 5.5–9 × 2–4 cm, tetragonous, apex truncate, base emarginate; pericarp 3–10 mm thick. **Seeds** ovoid, 3–4.5 cm long.

Vernacular names. Sabah—*tampalang* (Dusun Kinabatangan). Sarawak—*karuk* (Iban).

Distribution. China (S Yunnan), Vietnam, Myanmar, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, N Sulawesi, Maluku, and several other islands in the region. In Borneo, known from Sabah (all districts; e.g., *SAN 26291*, *SAN 53601*, *SAN 67305*, *SAN 80657*, and *SAN 122817*), Sarawak (e.g., *S 33806*, *S 42026* and *S 46748*), Brunei, and Kalimantan.

Ecology. In hill mixed dipterocarp forest along rivers or in swampy areas, on sandy or loamy soils, at altitudes to 1300 m. The fruits are presumably dispersed by animals (primarily small rodents).

Uses. Pulped root is used in the treatment of ringworm and sore eyes. Leaves are also used medicinally in the treatment for stomach aches. Bark is used as a fish poison.

13. *Barringtonia pendula* (Griff.) Kurz

(Latin, *pendulus* = dangling; referring to the inflorescence)

J. As. Soc. Beng. 46, 2 (1877) 71; Payens *l.c.* 248; Whitmore *l.c.* 261; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 192; Kessler & Sidiyasa *l.c.* 160; Turner *l.c.* 288; Argent *et al.* (eds.) *l.c.* 337. **Basionym:** *Careya pendula* Griff. *l.c.* 661. **Type:** *Griffith s.n.*, Myanmar, Mergui (isotype W, *n.v.*). **Synonyms:** *Doxomma pendula* (Griff.) Miers *l.c.* 99; *B. musiformis* King *l.c.* 139, Ridley *l.c.* (1922) 758, Knuth *l.c.* 30, Corner *l.c.* 355. (For complete synonymy see Payens *l.c.* 248).

Tree, 15–33(–47) m tall, 20–80(–90) cm diameter; bole slightly ribbed at base. **Bark** reddish brown, mottled with vertical cracks and thin flakes; inner bark fibrous. **Sapwood** light brown. **Twigs** slender, 3–10 mm diameter. **Leaves** subcoriaceous to chartaceous, sometimes glaucous beneath; obovate-lanceolate or obovate-oblong, (11–)16–25(–36) × (4–)5–7(–9) cm, base long-cuneate, *margin entire* or *serrate-crenulate towards apex, often revolute*, apex acuminate; *lateral veins 8–15(–18) pairs*, prominent beneath but not above; *petiole (1.5–) 3–4(–6) cm long*. **Inflorescences** *spicate, borne on leafless older twigs, pendulous; rachis (2–)3.2–4.1(–11) cm long, 5–6 mm diameter at base, increasing to 15 mm, fissured, glabrous or covered with powdery granules; bracts triangular c. 7 × 4 mm*. **Flowers:** buds 10–20 mm long; *hypanthium 6–12 mm long, subterete or tetragonous, with 4 distinct grooves or ribs on the corners, 6–12 × 5–8 mm, reddish brown pubescent*; calyx lobes free in bud, suborbicular, 12–18 mm, chartaceous, slightly reddish brown pubescent; petals 20–38 × 15–18 mm, elliptic-rounded, fimbriate; stamens in 4(–6) whorls, staminal tube 3–8 mm high; disk 1.5–2 mm high; ovary (3–)4-loculed, style 45–60 mm long, ovules 3–6 per locule. **Fruits** ovoid or musiform (banana-shaped), (6–)8–12.5(–15) × (1.5–)2–3.5 cm, covered with powdery granules, fissured and warty, very hard, apex and base truncate; pericarp 4–6 mm thick; mesocarp hard, filled with fine fibers. **Seeds** unknown.

Vernacular name. Sarawak—*langkong* (Iban).

Distribution. China, Myanmar, Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, known from Sabah (Kinabatangan, Pensiangan, and Tawau districts; e.g., *SAN 31093*, *SAN 31362*, *SAN 133554*, and *SAN 37136*), Sarawak (Kuching and Ulu Sinrok; e.g., *S 14615*, *S 15646* and *S 18113*) and Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, at altitudes to 1200 m.

14. *Barringtonia pterita* Merr.

(Greek, *pteron* = wing; referring to the winged fruit)

Philip. J. Sci. Bot. 9 (1914) 322; Payens *l.c.* 210. **Type:** *Ramos BS 15121*, the Philippines, Luzon (isotypes K, US).

Tree or shrub, 7–10 m tall, 10–12 cm diameter. **Bark** black. **Sapwood** pale yellow. **Twigs** slender, 5–8(–10) mm diameter, not flaky or ridged. **Leaves** chartaceous, glabrous; obovate-lanceolate or linear-lanceolate, rarely obovate-oblong, (13–)17–40(–52) × 3–9 cm, base cuneate, margin serrate-crenulate towards apex, apex cuspidate or acuminate; lateral veins (15–)20–25(–28) pairs; petiole 0.5–1 cm long. **Cataphylls** caducous. **Inflorescences** racemose or spicate, pendulous, terminal or borne on leafless older twigs; rachis 58–71(–144) cm long, 2–3 mm diameter at base, accrescent to c. 5 mm, glabrous, slightly fissured; bracts triangular, 2.5–5 × 1–2 mm, serrate. **Flowers:** buds c. 10 mm long; hypanthium tetragonous, sharply angled or winged, c. 5 × 3–5 mm, glabrous or covered with powdery granules; pedicel to 12 mm long, often tetragonous or winged apically; calyx lobes connate in bud, disrupting into 2(–3) unequal segments, lobes convex, 9–10 × 6–11 mm, chartaceous; petals 15–20 × 7–10 mm, elliptic, convex; stamens in 3 whorls, staminal tube 1.5–3 mm high; disk small ring, c. 0.5 mm high; ovary (3–)4-loculed, tetragonous, style c. 35 mm long, ovules 3–5 per locule. **Fruits** 4–6 × 1–2.5 cm, distinctly winged, tetragonous, glabrous, apex truncate, tapering towards base, wings 4–7 mm wide; pericarp c. 3 mm thick. **Seeds** ovoid, deeply fissured, 2.5–3.5 cm long.

Distribution. Borneo and the Philippines. In Borneo, occurs only in Sabah (Kinabatangan and Sandakan districts; e.g., *SAN 22629*, *SAN 46186*, *SAN 90808*, and *SAN 117965*).

Ecology. On banks of rivers and creeks, on ridges, and in swamp forest, from sea level to 170 m altitude.

15. *Barringtonia racemosa* (L.) Spreng.

Fig. 2.

(Latin, *racemosus* = raceme-like; the inflorescence)

Syst. Veg. 3 (1826) 127; Merrill *l.c.* (1921) 419; Ridley *l.c.* (1922) 757; Burkill *l.c.* 305; Payens *l.c.* 192; Whitmore *l.c.* 259; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 192; Turner *l.c.* 288; Coode *et al.* (eds.) *l.c.* 159; Argent *et al.* (eds.) *l.c.* 337. **Basionym:** *Eugenia racemosa* L. *l.c.* (1753) 471. **Syntypes:** *Herb. Hermann 212, 213* and *339* (all at BM). **Synonyms:** *Stravadium racemosum* (L.) Sweet, Hort. Brit. edition 1 (1826) 159; *B. elongata* Korth., Ned. Kruidk. Arch. 1 (1846) 206; *B. timorensis* Blume *l.c.* (1851) 23; *Butonica racemosa* (L.) Miers *l.c.* 66; *Michelia racemosa* (L.) Kuntze *l.c.* 240; *M. timorensis* (Blume) Miers *l.c.* 241; *Huttum racemosum* (L.) Britten *l.c.* 67.



Fig. 2. *Barringtonia racemosa*. A, flowering leafy twig; B, longitudinal section of fully open flower; C, immature fruit. (A–B from SAN 80585, C from SAN 126092.)

Shrub to medium-sized tree, 2–20(–27) m tall, 10–50 cm diameter; bole erect or crooked, occasionally many-stemmed, swollen at base; buttresses with surface roots. **Bark** yellowish grey, smooth or fissured. **Sapwood** white, soft. **Twigs** slender, 3–6 mm diameter, not obviously flaky or ridged. **Leaves** chartaceous, glabrous; obovate-oblong or obovate-lanceolate, 14–36(–42) × 4–14(–16) cm, base cuneate, margin serrate-crenulate, apex acute or acuminate; lateral veins (10–)13–18(–20) pairs, more prominent beneath than above; petiole 0.2–1(–1.5) cm long, 2.5–4 mm diameter, slightly winged. **Cataphylls** triangular, 5–11 × 2–8 mm, caducous. **Inflorescences** racemose or spicate, pendulous, mostly terminal, sometimes borne on leafless older twigs; rachis 20–70(–100) cm long, 2–3 mm diameter, glabrous or puberulent; bracts triangular, 5–6 × 1.5–2 mm. **Flowers:** buds 6–9 × 6–10 mm at base, often mucronate; hypanthium (4–)6–12 mm long, funnel-shaped, without angles or wings, often extending into a pseudopedicel of 2–20 mm long, covered with powdery granules or glabrous; calyx lobes connate in bud, rupturing into 2–4(–5) equal or unequal elliptic lobes, 7–15 × 5–13 mm; petals 4, 15–25 × 5–15 mm, elliptic obtuse, convex; stamens in (5–)6 whorls, staminal tube 3.5–6 mm high; disk thick, grooved; ovary (2–)3–4-loculed, style (2–)3–5.5 cm long; ovules 2–3 per locule. **Fruits** ovoid, 5–7(–9) × 2–4(–5.5) cm, subtetragonous, slightly winged when young, apex truncate, tapering at base; pericarp 3–12 mm thick, fleshy; exocarp with dispersed fibers. **Seeds** ovoid, 2–4 cm long, subtetragonous, tapering towards apex, flat at base.

Vernacular names. Sabah—*putat ayer*, *putat sungai* (Kadazan), *utak-utak* (Tidong). Sarawak—*putat rambai* (Malay).

Distribution. E and S Africa, Madagascar, the Seychelles Islands, India, Sri Lanka, Myanmar, Thailand, throughout SE Asia and the Pacific Islands to N Australia. In Borneo, known from Sabah (Beaufort, Kudat, Sandakan, and Sipitang districts; e.g., *SAN 80585*, *SAN 102919*, *SAN 103275*, *SAN 126092*, and *SAN 126937*), Sarawak (Kuching district; e.g., *S 41871*), Brunei (e.g., *van Niel 4163* and *van Niel 4190*), and Kalimantan.

Ecology. In forests on tidal riverbanks just beyond saline influence.

Uses. The wood of this species is used for fuel and construction in some areas, though it is rarely used in Borneo. Leaves or leaves mixed with bark or roots, are used medicinally as a poultice for itching skin and chicken pox. Seeds are also used as a poultice for ophthalmia and taken internally for colic. Bark is used as a tanning agent.

16. *Barringtonia reticulata* (Blume) Miq.

(Latin, *reticulatus* = like a network; in reference to the leaf venation)

Fl. Ind. Bat. 1, 1 (1855) 490; Merrill *l.c.* (1921) 419; Masamune *l.c.* 514; Payens *l.c.* 252; Anderson *l.c.* 231; Corner *l.c.* 392; Whitmore *l.c.* 260; Whitmore, Tantra & Sustisna *l.c.* 192; Kessler & Sidiyasa *l.c.* 159; Turner *l.c.* 288; Coode *et al.* (eds.) *l.c.* 159; Argent *et al.* (eds.) *l.c.* 337. **Basionym:** *Stravadium reticulatum* Blume *l.c.* (1851) 24. **Type:** *Korthals s.n.* (= *RHL Sheet Nos. 898204205–898204207*), Borneo, Kalimantan (holotype L; isotype U). **Synonyms:** *B. sumatrana* Miq., Fl. Ind. Bat. Suppl. (1862) 315; *B. gitingensis* Elmer, Leaf. Philip. Bot. 8 (1915) 2730.

Shrub or small tree, 2–10 m tall, 3–20 cm diameter, with drooping or straggling branches. **Bark** deeply fissured, roughly cracked, grey. **Twigs** slender, c. 4 mm diameter. **Leaves** coriaceous,

glabrous, *drying concolourous*; elliptic, (11–)14–18(–22) × (3–)5–7(–8) cm, base decurrent, margin entire to slightly serrate-crenulate and revolute, apex acute or obtuse; *lateral veins 9–18 pairs*; *petiole* winged, 2.5–6 cm long, 2–3 mm diameter. Cataphylls triangular, 3–6 × 1–2.5 mm. **Inflorescences** *spicate, terminal*, pendulous; rachis 30–65 cm long, 2 mm diameter at base, slightly fissured, glabrous; bracts triangular, *c.* 5 × 1 mm. **Flowers:** buds 8–10 × 4 mm; hypanthium funnel-shaped, tetragonous with acute edges, 4–6 × 4–5 mm, glabrous; calyx lobes free in bud, equal, convex, coriaceous, suborbicular, 4.5–6 × 4–6 mm, persistent; petals 17–20 × 6–9 mm, elliptic, obtuse, convex; stamens in 4 whorls, staminal tube 2–3 mm high; disk annular, *c.* 0.5 mm high; ovary 4-loculed, style 40–60 cm long; ovules 2–4 per locule. **Fruits** tetragonous, 3.5–5 × 1–2 cm, sharply 4-angled with the sides depressed at base, truncate at apex and base; pericarp mostly shiny, 1–2 mm thick on sides, 4–5 mm thick on corners. **Seeds** ovoid, trigonous, *c.* 2 cm long, deeply fissured, tapering at both ends.

Vernacular name. Sarawak—*putat paya* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Borneo, the Philippines, and SE Sulawesi. In Borneo, occurs in Sarawak (Kuching and Bintulu districts; e.g., *S 12051*, *S 14481* and *S 17100*) and Brunei (e.g., *van Niel 3937* and *S 2225*).

Ecology. In *kerangas* forest.

17. *Barringtonia revoluta* Merr.

(Latin, *revolutus* = rolled back from edge; referring to the leaf margin)

Philip. J. Sci. 1 (1906) Suppl. 211; Knuth *l.c.* 36; Payens *l.c.* 199; Anderson *l.c.* 231; Cockburn *l.c.* 46; Whitmore *l.c.* 259; Whitmore, Tantra & Sutisna *l.c.* 192; Turner *l.c.* 288; Coode *et al.* (eds.) *l.c.* 159. **Type:** *Curran 3507*, the Philippines, Palawan (holotype PNH†; isotypes K, L). **Synonym:** *B. flagellata* Liitjeh. & Ooststr., *Blumea* 3 (1938) 95.

Tree 5–20(–33) m tall, 25–50 cm diameter; bole sometimes crooked or sprawling. **Bark** pale brown, crumbling, rough or smooth, mottled with green and brown; inner bark hard, redbrown to cream coloured. **Sapwood** hard, yellow. **Twigs** *slender*, 3–7 mm diameter. **Leaves** *subcoriaceous*, glabrous; obovate-lanceolate, 11–22(–34) × 3–6(–13) cm, margin serrate-crenulate and distinctly revolute; *lateral veins 14–16 pairs*, prominent beneath; intercostal venation equally distinct on both sides; *petiole 1–9(–11) cm long, rugose, thick, slightly winged*. Cataphylls caducous. **Inflorescences** *racemose*, terminal or borne on leafless older twigs, pendulous; rachis 70–80 cm long, 1–2 mm diameter at base, glabrous; bracts triangular, *c.* 1 × 0.5 mm. **Flowers:** buds 5–10 × 5–10 mm; hypanthium trigonous, obpyramidal with acute edges, 3–5 × 2.5–4 mm, glabrous; pedicel 5–20 mm long, very thin; calyx lobes connate in bud, rupturing into (2–)3(–4) segments, convex, elliptic or suborbicular, 9–12 × 6–10 mm, persistent and slightly accrescent, chartaceous; petals 17–20 × 10–13 mm, elliptic, obtuse, convex; stamens in 4 whorls, staminal tube *c.* 1.5 mm high; disk thin, outside grooved, 0.25–0.5 mm high; ovary 3(–4)-loculed, style 35–45 mm long; ovules (2–)3–4 per locule. **Fruits** sharply 3–4-gonous, 4.5–6 × 1.2–1.8 cm, apex truncate, base cuneate, distinctly pedicelled, sides depressed towards base; pericarp thin, *c.* 0.5–1 mm thick at sides. **Seeds** ovoid, trigonous, *c.* 3 cm long.

Vernacular names. Sarawak—*karut* (Iban). Brunei—*putat samba* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and the Philippines (Palawan). In Borneo, occurs in Sabah (Beaufort and Papar districts; e.g., *SAN 80630*, *SAN 102973*, *SAN 111453*, *SAN 115559* and *SAN 127098*), Sarawak (e.g., *S 4936*) and Brunei (e.g., *BRUN 929*, *BRUN 5162*, *Sands 5633*, and *Wong WKM 2051*).

Ecology. In primary lowland mixed dipterocarp forest on sandy-clay soils, seasonal swamp forest on riverbanks, and *kerangas* forest, at altitudes to 200 m.

18. *Barringtonia sarawakensis* P.Chantaranothai (of Sarawak)

Kew Bull. 50 (1995) 700. **Type:** *Soepadmo & Chai S 28183*, Borneo, Sarawak, Kapit district, Bt. Raya (holotype L; isotypes A, BO, K, SAN, SAR, SING).

Tree, 10–30 m tall, to 30 cm diameter; bole slightly fluted below. **Bark** light chocolate brown to reddish brown, flaky and slightly pock-marked, thin. **Sapwood** yellow. **Twigs** slender, 2–4 mm diameter, not obviously flaky or ridged. **Leaves** subcoriaceous to chartaceous, glabrous; elliptic, narrow elliptic to obovate, 6–13 × 3.5–5 cm, base cuneate to slightly decurrent, margin entire, sometimes revolute, apex acuminate to cuspidate or emarginate or acute; lateral veins 7–12 pairs, prominent beneath; petiole 0.6–1.2 cm long, not winged or rugose. **Cataphylls** caducous. **Inflorescences** racemose, terminal or axillary; rachis 1.5–4 cm long, up to 2 mm diameter at base, glabrous, few-flowered; bracts caducous. **Flowers:** buds to 5 mm diameter; hypanthium funnel-shaped, c. 10 mm long, extending into narrow pedicel of 30–50 mm long, c. 1 mm diameter at base, articulation at point of attachment to rachis; calyx lobes connate in bud, mucronate, rupturing into 2–3 persistent lobes, 12–14 × 9–11 mm, oblong-lanceolate; petals c. 6 × 8 mm, ovate, rimmed with ciliate teeth; ovary 2-loculed, style 40–45 mm long; ovules 4–7 per locule. **Immature fruits** green, ovoid-oblong, 3–4 × 2 cm, sharply tapering towards base, apex truncate; pericarp c. 2 mm thick.

Vernacular names. Sarawak—*karut putat* (Iban), *pelenuim* (Kenyah).

Distribution. Endemic to Borneo and confined to Sarawak (Kuching, Bintulu, Kapit, and Baram districts; e.g., *S 28183*, *S 34827*, *S 36808*, *S 43412*, and *S 44507*).

Ecology. Hill mixed dipterocarp forests, at altitudes to 1000 m.

Notes. Morphologically, the species is very similar to *B. filirachis* Payens but is found in an entirely different habitat from the swampy lowland forest where *B. filirachis* is found in Johore, Peninsular Malaysia. The spirally arranged leaves along the branches, decurrent leaf base, terminal few-flowered racemose inflorescences, and 4–7 ovules per locule inserted along the central axile strongly suggest that the species may belong to *Planchonia* (Editors).

19. *Barringtonia sarcostachys* (Blume) Miq.

Fig. 3.

(Greek, *sarco* = fleshy, *stachys* = relating to spike; referring to the fleshy inflorescence rachis)

Fl. Ind. Bat. 1, 1 (1855) 490; Knuth *l.c.* 34; Payens *l.c.* 216; Cockburn *l.c.* 47; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 192; Coode *et al.* (eds.) *l.c.* 159. **Basionym:** *Stravadium sarcostachys* Blume *l.c.* (1851) 24. **Type:** *Praetorius s.n.* (= RHL Sheet Nos. 898294176–898294181), Sumatra (holotype L; isotype BO). **Synonyms:** *Doxomma sarcostachys* (Blume) Miers *l.c.* 102; *Barringtonia dolichobotrys* Merr., J. Str. Br. R. As. Soc. 77 (1917) 204, *l.c.* (1921) 419, Knuth *l.c.* 22; *B. dolichophylla* Merr. *l.c.* (1917) 205; *B. anacardifolia* Ridl. *l.c.* (1938) 284; *B. sarcostachys* (Blume) Miq. forma *dolichophylla* (Merr.) Payens *l.c.* 218.

Small to large tree, 8–40 m tall, 5–50 cm diameter. **Bark** cracked, fissured, brown, reddish brown, grey, greenish brown, or blackish mottled; inner bark pink or white. **Sapwood** yellow or white. **Twigs** stout, 8–15 mm diameter, not distinctly winged. **Leaves** subcoriaceous, glabrous; obovate, elliptic, lanceolate, or linear-lanceolate, 2–100 × 4.5–15 cm, base cuneate or decurrent, margin almost entire, revolute, apex rounded or acuminate; lateral veins (10–)14–50 pairs; petiole 1–13 cm long. Cataphylls triangular, 6–14 × 2–5 mm. **Inflorescences** spicate, terminal, pendulous; rachis (24–)42–130(–180) cm long, 4 mm diameter at base, accrescent to 10–15 mm, glabrous, shiny brown, woody, not distinctly winged; bracts sublanceolate-triangular, 4–11 × 2–4 mm. **Flowers:** buds *c.* 15 mm diameter, hypanthium subtetragonous with rounded edges, *c.* 10 × 7 mm, accrescent, glabrous; calyx lobes connate in bud, rupturing into 2–5 unequal segments, segments convex, suborbicular, 14–18 × 12–16 mm, coriaceous, obtuse or acute; petals coriaceous; stamens in 4–6 whorls, staminal tube 4–5 mm high; disk annular, 1.5–2 mm high; ovary 4-loculed, style 40–75 mm long; ovules 4–6 per locule. **Fruits** ovoid to subglobular, 5–11 × 3.5–7.5 cm, rarely pear-shaped, with truncate base; pericarp 4–10 mm thick; exocarp hard. **Seeds** ovoid-subglobular, 3.5–6.5 cm long, deeply fissured.

Vernacular names. Sabah—*tampalang* (preferred name). Sarawak—*langkong* (Iban), *putat* (Malay), *tubai langkong* (Iban).

Distribution. Sumatra and Borneo. In Borneo, occurs in Sabah (Labuk Sugut, Pensiangan, and Sandakan districts; e.g., *RSNB 2610*, *SAN 23737*, *SAN 29969*, *SAN 82122*, *SAN 100764*, and *SAN 131744*), Sarawak (Kuching, Serian and Nyabau FR; e.g., *S 13040*, *S 15894*, *S 16668*, *S 26996*, and *S 31992*), Brunei (e.g., *S 7842* and *Wong WKM 1121*), and Kalimantan.

Ecology. In lowland mixed dipterocarp forest, at altitudes to 300 m.

Uses. Bark is used as fish poison. The tree is sometimes planted as an ornamental.

Notes. Payens (*l.c.*) recognised two forms, distinguishable only by leaf characters. As flower structure appears identical, the forms are not recognised here.

20. *Barringtonia scortechinii* King

(Reverend Scortechini, 1845–1886, sometime a Roman Catholic missionary and government botanist at Taiping, Perak)

J. As. Soc. Beng. 70, 2 (1901) 138; Ridley *l.c.* (1922) 757; Burkill *l.c.* 306; Knuth *l.c.* 30; Payens *l.c.* 233; Whitmore *l.c.* 260; Corner *l.c.* 393; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 192; Turner *l.c.*



Fig. 3. *Barringtonia sarcostachys*. A, leafy twig; B, longitudinal section of mature fruit; C, portion of young infructescence; D, longitudinal section of young fruit showing two developing ovules/seeds; E, longitudinal section of flower bud. (A–B from *Stevens et al.* 419, C–D from *SAN 108903*, E from *SAN A 3527*.)

288. **Lectotype** (Payens, 1967): *King's Collector 3854*, Peninsular Malaysia, Perak (hololectotype K; isolectotypes BM, P).

Small to large tree, 7–20(–40) m tall, 10–20(–40) cm diameter; buttresses up to 2 m tall; crown round with spreading branches. **Bark** scaly, peeling off in flakes, longitudinally fissured, brown or red; inner bark white or yellow, *c.* 20 mm thick. **Sapwood** yellow. **Twigs** slender, 2.5–4 mm diameter. **Leaves** subcoriaceous or chartaceous, glabrous; obovate or elliptic, 8–17(–21) × 5–7.5 cm, margin serrate-crenulate, revolute, apex acuminate; lateral veins 7–10 pairs, curving upwards rather sharply; petiole (0.5–)1.5–5 cm long, 1–2 mm diameter. **Inflorescences** spicate, mostly borne on leafless older twigs, rarely terminal, pendulous; rachis (13–)20–55(–70) cm long, 3–7 mm diameter at base, accrescent, often fissured, glabrous or slightly pubescent; bracts triangular, *c.* 0.5 × 0.5 mm. **Flowers:** buds 3–5 mm diameter; hypanthium tetragonous, with distinctly winged edges, often covered with powdery granules, pubescent, 5–9 × 3–6 mm; calyx lobes free in bud, thin, convex, 12–18 × 7–10 mm; petals 12–18 × 7–10 mm, elliptic, convex, thin, fimbriate; stamens in 4–5 whorls, staminal tube 3–4 mm high; disk a thick, distinct ring 1–2 mm high; ovary 3–4-loculed, style *c.* 4 cm long; ovules 3–4(–6) per locule. **Fruits** tetragonous with distinct wings on edges which are gradually disappearing as the fruit grows and matures, at maturity ovoid with 8 ridges, 10–12 × 3–5 cm, fissured, rugose, dull, covered with powdery granules; pericarp 4–8 mm thick. **Seeds** ovoid, 5–6 cm long.

Vernacular name. Sabah—*tempalang* (Kadazan).

Distribution. Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, occurs in Sabah (Mt. Kinabalu, Sandakan, and Tawau; e.g., *SAN 16504*, *SAN 24981*, *SAN 31362*, *SAN 61162*, *SAN 75753*, and *SAN 134866*), Sarawak (e.g., *S 52754*), Brunei (e.g., *S 5826*), and Kalimantan.

Ecology. In primary and secondary mixed dipterocarp forests, at altitudes to 1400 m.

Uses. Fruit may be used to add flavour to foods.

2. PLANCHONIA Blume

(J.E. Planchon, 1823–1888, a French botanist)

In Van Houtte, Fl. Serr. 7 (1851) 24; King, J. As. Soc. Beng. 70, 2 (1901) 241; Merrill, EB (1921) 143; Ridley, FMP 1 (1922) 759; Backer & Bakhuizen *f.*, FJ 1 (1964) 252; Kuswata, Bull. Bot. Surv. India 7 (1965) 162; Burkill, EPMP 2 (1966) 1796; Whitmore, TFM 2 (1972) 264; Cockburn, TS 2 (1980) 49; Anderson, CLTS (1980) 231; Whitmore, Tantra, & Sutisna, CLK 2, 1 (1990) 193; Ng, MFFSS (1991) 417; Kessler & Sidiyasa, TBSA-EK (1994) 160; Argent *et al.* (eds.), MNDR-CK 1 (1997) 340.

Trees or rarely shrubs, often with large buttresses. **Stipules** absent or rudimentary, caducous. **Leaves** spirally arranged, generally well-spaced along twigs, glabrous; base attenuate, slightly decurrent to decurrent, often extending down along the entire length of petiole, margin crenulate-serrate to entire, apex often acuminate, obtuse, sometimes emarginate; midrib prominent beneath, flattened above; petiole not thickened at insertion. **Inflorescences** terminal, spikes

or racemes (flowers sometimes solitary), *generally short, erect and few-flowered*; bracts and bracteoles subsistent. **Flowers** radially symmetrical; buds globular, tribracteate; hypanthium a turbinate or campanulate tube; calyx lobes imbricate in bud with gibbose margin between lobes, persistent; petals 4, free, imbricate in bud, adnate to the staminal tube at base, caducous; stamens numerous, longer than petals, in whorls with innermost one sterile, filaments fused at base, fusiform, anthers basifixed; intrastaminal disk present, epigynous; ovary turbinate, inferior, adnate to calyx tube, 3–4-loculed, style persistent; *ovules* anatropous, *numerous, horizontally inserted down the length of central placenta*, biseriate or irregular. **Fruits** fibrous berries, *3–15-seeded*, without pulp, 1–4-loculed; pericarp fibrous; endocarp coriaceous. **Seeds** ovoid, smooth or angular; endosperm absent; *embryo coiled, with folded and crumpled foliaceous cotyledons*; germination epigeal.

Vernacular name. Sabah—*putat paya* (Malay).

Distribution. Eight species ranging from the Andaman Islands to N Australia, including Malesia and the Solomon Islands. Three of the eight species occur in Borneo, and two occur in Peninsular Malaysia.

Uses. Timber is used locally for temporary construction, not durable.

Taxonomy. The horizontal ovules characteristic of *Planchonia* suggest this genus is more closely related to *Careya* Roxb. than to *Barringtonia* J.R. & G.Forst. and *Chydenanthus* Miers. The genus differs from all others in the subfam. Planchonioideae in that its embryo consists of a spirally coiled radicle with foliaceous cotyledons.

Key to *Planchonia* species

1. Leaves coriaceous, margin entire to finely serrate-crenulate; intercostal venation obscure. Flowers in spikes to 8 cm long; calyx lobes not persistent on fruit.....**2. P. grandis**
Leaves chartaceous, margin coarsely serrate-crenulate; intercostal venation distinct. Flowers solitary or in racemes to 13.5 cm long (rarely longer); calyx lobes persistent on fruit.....2
2. Leaves oblanceolate, base undulating and decurrent. Fruits globose, with basal stalk of 2–3 mm long.....**1. P. brevistipitata**
Leaves obovate to ovate, base slightly decurrent. Fruit ovoid to ellipsoid, without basal stalk.....**3. P. valida**

1. *Planchonia brevistipitata* Kuswata

Fig. 4.

(Latin, *brevi* = short, *stipitatus* = provided with a stipe or little stalk; referring to flower and fruit)

Bull. Bot. Surv. India 7 (1965) 179, Reinwardtia 11 (1998) 191; Whitmore, Tantra & Sutisna *l.c.* 193; Argent *et al.* (eds.) *l.c.* 340. **Type:** *Amdjah* 256, Borneo, Kalimantan, Berau, Sedalir (holotype BO; isotype L). **Synonym:** *Barringtonia belagaensis* P.Chantaranothai, Kew Bull. 50 (1995) 695.

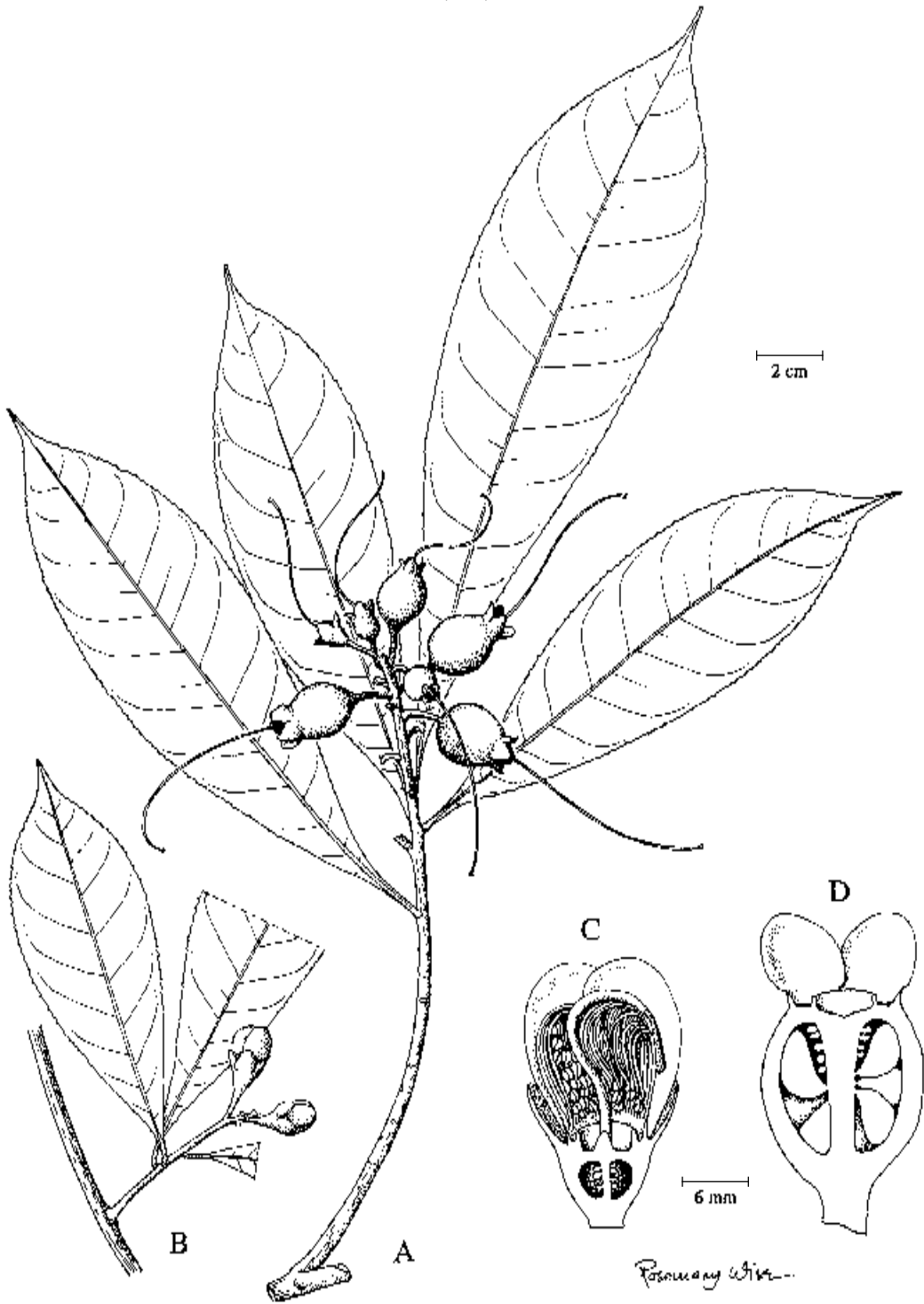


Fig. 4. *Planchonia brevistipitata*. A, fruiting (young) leafy twig; B, flowering leafy twig; C, longitudinal section of flower bud; D, longitudinal section of developing young fruit showing many developing ovules/seeds. (A and D from SAN 64340, B–C from S 43541.)

Small tree to 15 m tall. **Twigs** slender, *c.* 5 mm diameter, greyish brown, finely grooved, set with conspicuous leaf scars. **Bark** greyish to brown, smooth to flaky; inner bark light brown to reddish grey. **Sapwood** pale brown. **Stipules** lacking. **Leaves** chartaceous, glabrous; *oblanceolate*, 8–25 × 2–6 cm, *base undulating and decurrent, margin coarsely serrate-crenulate*, apex acuminate, acumen to 2 cm long; midrib strongly prominent beneath, prominulous above; lateral veins (8–)12–18(–20) pairs, prominent beneath, prominulous above; *intercostal venation* densely reticulate, *distinct beneath*, faint above; petiole slightly winged, 0.5–1 cm long. **Inflorescences** racemose, few–many-flowered; *rachis to 13.5 cm long, c.* 3 mm diameter, angular, glabrous. **Flowers:** hypanthium 6–10 mm long, funnel-shaped, slightly tetragonal; pedicel 3–10 mm long, 1–2 mm diameter; calyx lobes 4, connate at base, orbicular, *c.* 9 × 7 mm; petals 4, orbicular; stamens in 5–6 whorls; ovary 4-loculed, style *c.* 7 cm long, stigma lobed. **Fruits** globose, 2–3 × 1.5–2 cm, slightly ribbed at base, *with slender stalk of 2–3 mm long*, 4–11-seeded; *calyx* and style *persistent*. **Seeds** irregularly elongate-ovoid, 3-angular, 7–9 × 3–5 mm; seed coat silvery brown, coriaceous.

Vernacular name. Sabah and Sarawak—*putat paya* (Malay).

Distribution. Endemic to Borneo, and known from Sabah (Beaufort, Kinabatangan, Kudat, Lamag, Lahad Datu, and Tenom districts; e.g., *SAN 25982, SAN 64340, SAN 84810, SAN 107297*, and *SAN 128015*), Sarawak (Baram district; e.g., *Chew CWL 1071, Chin 2887, S 41360*, and *S 43451*) and Kalimantan (e.g., *Amdjah 256*).

Ecology. Common in riverine and lowland mixed dipterocarp forests on sandy, rocky soils.

2. *Planchonia grandis* Ridl.

(Latin, *grandis* = large, great, tall, lofty; referring to the habit)

J. Str. Br. Roy. As. Soc. 61 (1912) 9, *l.c.* (1922) 760; Kuswata *l.c.* (1965) 185; Burkill *l.c.* 1797; Whitmore *l.c.* 264; Whitmore, Tantra & Sutisna *l.c.* 193; Turner *l.c.* 289. **Type:** *Ridley 6423*, Singapore (holotype K; isotypes BO, CAL, SING).

Tree to 33 m tall, 1 m diameter; bole sometimes fluted, often with buttresses. **Bark** reddish brown, grey, or black, vertically grooved, becoming scaly; inner bark soft and spongy, pink to reddish orange, fibrous, sticky. **Twigs** smooth to striate, *c.* 4 mm diameter, set with distinct leaf scars. **Leaves** coriaceous, lower surface dull, upper surface glossy; obovate to elliptic, 5–17 × 4–9 cm, base slightly decurrent, *margin entire to finely serrate-crenulate*, apex acuminate or cuspidate to broadly rounded; lateral veins obscure, 9–10(–15) pairs; *intercostal venation obscure*; petiole *c.* 1 cm long, wing much narrower on lower part, almost invisible, drying dark reddish-brown. **Inflorescences** spicate; *spike to 8 cm long*; rachis 5–8 mm diameter, glabrous; bracts ovate-oblong, to 15 × 7 mm. **Flowers:** hypanthium turbinate, not ribbed, *c.* 10 mm long; calyx lobes coriaceous, semi-orbicular; petals chartaceous, greenish white, *c.* 30 × 15 mm; staminal tube red; free filaments to 30 mm long, white; style up to 45 mm long. **Fruits** globose, *c.* 4 cm diameter, 3–more-seeded, fleshy, astringent, bitter; *calyx lobes non-persistent*. **Seeds** longitudinally compressed, not angular, *c.* 1.5 cm long; seed coat coriaceous, brown.

Vernacular name. Sabah—*putat* (Malay).

Distribution. Sumatra, Peninsular Malaysia, and Borneo. In Borneo, occurs in Sabah (Kudat, Labuk Sugut and Sipitang districts; e.g., *SAN 48513*, *SAN 50312*, *SAN 76112*, *SAN 86760*, and *SAN 96881*) and Kalimantan (e.g., *bb. 11536*, *bb. 15280*, *bb. 26036*, *bb. 27001*, and *bb. 34272*).

Ecology. Primary lowland mixed dipterocarp forest and forest bordering mangroves.

3. *Planchonia valida* (Blume) Blume

(Latin, *validus* = strong, robust-growing; referring to the tree)

In Van Houtte, Fl. Serr. 7 (1851) 24; Ridley *l.c.* (1922) 760; Cockburn *l.c.* 49; Kuswata *l.c.* (1965) 168; Burgess, TBS (1966) 342; Anderson *l.c.* 231; Whitmore, Tantra & Sutisna *l.c.* 193. **Basionym:** *Pirigara valida* Blume, Bijdr. Fl. Ned. Ind. (1826) 1096. **Type:** *Blume 233*, Java (holotype L). **Synonyms:** *P. alata* Blume *l.c.* (1851) 25; *P. sumatrana* Blume *l.c.* (1851) 25; *P. littoralis* Blume *l.c.* (1851) 25; *P. sundaica* Miq., Fl. Ind. Bat. 1, 1 (1855) 493; *P. undulata* Teijsm. & Binn., Nat. Tijdschr. Ned. Ind. 29 (1866) 256; *P. elliptica* Miers, Trans. Linn. Soc. London 2, 1 (1875) 93, Merrill *l.c.* 143; *P. forbesii* Knuth, Pflanzenreich 105 (1939) 54.

Large tree to 50 m tall, 2 m diameter; bole straight; buttresses to 4 m tall. **Twigs** angular, with distinct leaf scars and scattered lenticels. **Bark** grey-brown, 2–6 mm thick, scaling off in small irregular pieces; inner bark 10–15 mm thick, inner white. **Sapwood** greyish white to pale yellow, distinct from heartwood which is dark red with coloured bands. **Stipules** early caducous, subulate, *c.* 0.4 × 0.1 mm. **Leaves** chartaceous, glossy, turning red before falling, glabrous; *ovate* to *obovate*, (3–)6–25(–35) × (2.5–)4.5–13 cm, *base slightly decurrent, margin coarsely serrate-crenulate*; apex acuminate, acumen to 15 mm long; lateral veins distinct, irregular; *intercostal venation distinct*, densely reticulate with the veinlets ending in a mucro near or at the tip of the tooth of the crenulation. **Inflorescences** racemose; *rachis to 13.5 cm long* (rarely to 30 cm), generally many-flowered, puberulous to glabrous, 2–5(–7) mm diameter; pedicel 2–10 mm long, 2–5 mm diameter; bracts oblong to semi-orbicular, 7.5–10(–15) × 5 mm. **Flowers:** hypanthium campanulate, ribbed, puberulous to glabrous; calyx lobes coriaceous, pale green, *ovate*, 7–10 × 4–8 mm; petals membranaceous, green, reflexed, *obovate-oblong*; staminal tube *c.* 10 mm long, pink to red at base, yellow to white distally; disk *c.* 1 mm high; style slender, 30–60 mm long. **Fruits** *ovoid to ellipsoid*, 3–4 × 1.5–2.5 cm, 1–15-seeded, covered with powdery granules, *without basal stalk*; pericarp to 7 mm thick, fibrous; *calyx lobes persistent*. **Seeds** ovoid, 3–4-angular; seed coat pale brown, coriaceous.

Vernacular names. Sabah—*putat paya* (Malay), *selangan kangkong* (Kadazan).

Distribution. Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, Bali, Lombok, and Timor. In Borneo, occurs in Sabah (all districts; e.g., *SAN 15271*, *SAN 19584*, *SAN 21773*, and *SAN 27260*) and Kalimantan (e.g., *bb. 11706*, *bb. 15207*, *bb. 26251*, *Kostermans 5000*, and *Kostermans 6763*).

Ecology. Common in seasonally flooded forest and in lowland and hill mixed dipterocarp forests, at altitudes to 1000 m.

Uses. Timber of medium density but not strong or durable, warps severely, used locally for various purposes. Young leaves and red shoots can be eaten as a vegetable, raw or steamed.

OLEACEAE

Ruth Kiew

Singapore Botanic Gardens,
Singapore

King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 254; Merrill, EB (1921) 488; Ridley, FMP 2 (1923) 310; Masamune, EPB (1942) 610; Backer & Bakhuizen *f.*, FJ 2 (1965) 212; Anderson, CLTS (1980) 284; Corner, WSTM 3rd. edition 2 (1988) 601; Kiew, TFM 4 (1989) 285; Coode *et al.* (eds.), CLBD (1996) 247; Argent *et al.* (eds.), MNDF-CK 2 (1997) 487.

Trees, shrubs or climbers, evergreen, glabrous or pubescent. **Stipules** absent. **Leaves** opposite (rarely alternate), simple, trifoliate or pinnate, margin entire (sometimes toothed). **Inflorescences** basically cymose but often appearing racemose, paniculate or spicate (rarely flowers solitary), axillary, terminal, rarely ramiflorous. **Flowers** bisexual, sometimes polygamous or unisexual, radially symmetrical; calyx usually small or campanulate and undivided or divided into 4–(5–15) lobes or teeth; corolla gamopetalous with a long or short tube, or divided to base or petals joined in pairs at base, (2–)4(–12)-lobed, lobes imbricate or valvate-induplicate; stamens 2 (rarely 3 or 4), alternating with petals, epipetalous or inserted at base of corolla tube, filaments short or sometimes long, anthers oblong, dorsifixed, 2-loculed, dehiscing longitudinally, connective sometimes apiculate; disc absent; ovary superior, 2-loculed, styles usually short, rarely long, stigma capitate to shortly bifid; ovules 2 per locule, rarely 1 or 4–8, basally, laterally or apically attached, anatropous, rarely amphitropous. **Fruits** drupaceous (in *Chionanthus* and *Olea*), capsules (in *Schrebera*), or 2-lobed berries (in *Jasminum*). **Seeds** 1–4, erect or pendulous; testa thin (rarely fleshy); endosperm fleshy, horny, oily or absent; embryo straight, cotyledons in albuminous seeds thin, oblong-ovate, in exalbuminous seeds thick and fleshy; radicle short, rarely long.

Distribution. About 25 genera and 600 species worldwide in tropical, subtropical and temperate regions but mostly in the Old World. In Sabah and Sarawak, 6 genera and 47 (including three incompletely known) species are recorded.

Ecology. Apart from mangrove forest, species are found in all forest types from the lowlands to the summit of mountains but most species are uncommon, although a few are widespread.

Uses. A few exotic species of *Jasminum* are cultivated, especially *J. sambac* (L.) W.Ait. for its heavily scented flowers. Species of *Chionanthus*, *Ligustrum*, *Olea*, and *Schrebera* are trees but most are small, some are shrubby and none is either common or large enough to be a timber tree.

Key to genera

1. Climbing plants or scandent shrubs.....2
 Trees or shrubs.....4

2. Leaves trifoliolate or unifoliolate (i.e. the stalk is jointed indicating the blade represents a terminal leaflet). Corolla tube narrow, at least 6 mm long, with (4–)6 or more spreading lobes. Fruits bilobed.....
 - Jasminum** L.
 (Latinised Persian plant name—*jasmin*)
 Sp. Pl. 1 (1753) 7; King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 255; Ridley, FMP 2 (1923) 310; Backer & Bakhuizen *f.*, FJ 2 (1965) 216; Kiew, Sandakania 4 (1994) 75, *ibid.* 5 (1994) 1; Coode *et al.* (eds.), CLBD (1996) 248.
 Mostly tropical and Old World, about 450 species. In Borneo, 12 species, of which 10 occur in Sabah and Sarawak.
Climbers or *scandent shrubs*, glabrous or pubescent. *Leaves unifoliolate* or *trifoliolate*. Inflorescences terminal or axillary, cymose or paniculate (rarely flowers solitary). Flowers bisexual and *heterostylous*; calyx joined at base with long or short lobes 4–10 mm long; *corolla tube narrow, at least 6 mm long*, white sometimes tinged rosy purple, *lobes 4 to many*, imbricate in bud; stamens with short filaments, inserted within corolla tube; ovary with long or short styles. *Fruits strongly bilobed* and 2-seeded, endosperm absent. Usually in lowlands on forest margins, along rivers, in disturbed forest, on hill tops to 1900 m altitude.
 - Leaves simple. Corolla tube short with 4 lobes. Fruits not bilobed.....3

3. Twigs quadrangular. Leaves with 3 longitudinal veins.....
 - Myxopyrum** Blume
 (Greek, *muxa* = mucus or slime, *puros* = wheat or fruit; referring to the mucilaginous fruit)
 Bijdr. Fl. Ned. Ind. (1826) 683; King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 272; Ridley, FMP 2 (1923) 320; Backer & Bakhuizen *f.*, FJ 2 (1965) 215; Kiew, Blumea 29 (1984) 499; Coode *et al.* (eds.), CLBD (1996) 248.
 Four species from India, Indo-China and China (Hainan), throughout Malesia to New Britain. In Sabah and Sarawak two species, *M. nervosum* Blume subsp. *coriaceum* (Blume) Kiew and *M. pierrei* Gagnep.
Twining climbers or *scandent shrubs*. *Twigs acutely quadrangular*. *Leaves simple*, narrowly lanceolate or ovate or cordate, *triplinerved*, margin entire or toothed towards apex. Inflorescences terminal and axillary, cymose panicles. Flowers sessile, small, bisexual; calyx shortly tubular, lobes 4, short and acute; *corolla tube and lobes short*, lobes valvate in bud; stamens subsessile with anthers contained within corolla tube; ovary with subsessile stigma. Fruits globose, *not bilobed*, with 1 or 2 endospermic seeds.
 - Leaves terete. Leaves with pinnate venation.....
 - 1. Chionanthus** (in part; **C. macrobotrys**)

4. Leaves pinnate. Flowers to 20 mm long; corolla lobes (4–)6–8. Fruits woody 2-valved capsules with winged seeds.....**4. Schrebera**

- Leaves simple. Flowers to 8 mm long; corolla lobes 4. Fruit fleshy and drupaceous; seeds not winged.....5
5. Inflorescences terminal; style 1–2 mm long.....**2. Ligustrum**
 Inflorescences usually axillary, sometimes ramiflorous; style very short, stigma sessile or subsessile.....6
6. Leaves entire or serrate. Flowers polygamous; flower buds rounded, corolla tube equal to or slightly longer than lobes.....**3. Olea**
 Leaves always entire. Flowers bisexual (except in *C. polygamus*); flower buds pointed (except in *C. balgooyiana* and *C. ramiflorus*); corolla divided to base into 4 lobes joined in pairs, rarely with corolla tube and then shorter than the lobes.....
 **1. Chionanthus** (in part)

1. CHIONANTHUS L.

(Greek, *chion* = snow, *anthos* = flower, referring to white flower)

mok (Iban)

Sp. Pl. 1 (1753) 8; Stearn, Ann. Missouri Bot. Gard. 63 (1976) 355; Kiew, Malay. For. 42 (1979) 259, *ibid.* 43 (1980) 362, *ibid.* 44 (1981) 143, TFM 4 (1989) 286; Corner, WSTM 3rd. edition 2 (1988) 601; Coode *et al.* (eds.), CLBD (1996) 247; Argent *et al.* (eds.), MNDT-CK 2 (1997) 487. **Synonym:** *Linociera* Sw. in Schreber, Gen. 2 (1791) 784, Ridley, FMP 2 (1923) 316, Anderson, CLTS (1980) 284.

Trees or *shrubs*, rarely scandent climbers. **Leaves** simple with entire margin, pinnately veined, surface appearing glabrous but minutely punctate from sunken lepidote trichomes. **Inflorescences** axillary, rarely ramiflorous or terminal, much branched panicle, racemose or short and spicate; bracts scarious sometimes foliaceous, usually caducous. **Flowers** to 8 mm long, bisexual (rarely polygamous, *C. macrobotrys* and *C. polygamus*), white or yellow, fragrant; buds pointed (except in *C. balgooyiana* and *C. ramiflorus*); calyx shallowly 4-lobed, persistent, pubescent or glabrous; corolla 4-lobed, lobes usually free to base and joined in pairs, rarely with distinct tube and then lobes longer than the tube, induplicate (rarely valvate), frequently twisting at anthesis; stamens attached at the base where the corolla lobes are joined in pairs, subsessile or filament very short and anthers hardly exposed in open flower, anthers oblong, connective sometimes apiculate; ovary ovoid, c. 2 mm long, style very short, stigma slightly bilobed, sessile. **Fruits** drupaceous, smooth, ridged or pimply; epicarp fleshy, mesocarp and endocarp either drying thin and brittle, thick and leathery or woody. **Seeds** not winged, usually albuminous, if exalbuminous then cotyledons thick and fleshy.

Distribution. About 100 species, largely tropical with species in all continents. The two temperate species, which are cultivated as ornamentals, are deciduous and have large flowers with petals c. 2 cm long. Thirty (including three incompletely known) species are found in Sabah and Sarawak.

Ecology. As for family.

Key to *Chionanthus* species

1. Leaf base cordate.....**4. *C. cordulatus***
 Leaf base not cordate.....2

2. Twigs quadrangular in cross-section. Fruit ridged and curved.....**6. *C. curvicarpus***
 Twigs round in cross-section. Fruit not curved, rarely superficially 4-ridged or longitudinally ridged or verrucose or rugose.....3

3. Petiole drying brown or fawn.....4
 Petiole drying black.....7

4. Leaf apex cuspidate; lateral veins 5–8 pairs; petiole 0.5–1 cm long.....5
 Leaf apex rounded to acuminate; lateral veins 8–15 pairs; petiole 1.5–3 cm long...6

5. Shrub to 2 m tall. Leaf 20–28 cm long, drying fawn to midbrown. Fruit ovoid, *c.* 0.4 cm long.....
C. longipetalus (Merr.) Kiew
 (Latin, *longi-* = long, *petalus* = petal; with long petals)
 Malay. For. 43 (1980) 379, *p.p.*, *l.c.* (1981) 152, *p.p.* Basionym: *Linociera longipetala* Merr., PEB (1929) 249, Masamune, EPB (1942) 612. Type: *Elmer 20455*, Borneo, Sabah, Tawau (holotype K; isotype L).
Shrub 1–2 m tall. Twigs round in cross-section, drying pale brown, nodes slightly flattened, minutely lenticellate, glabrous. Leaves subcoriaceous, glabrous, drying fawn or midbrown, with lateral veins darker than leaf blade beneath; lanceolate to broadly lanceolate 20–28 × 8–11 cm, base cuneate to rounded, margin slightly recurved, apex cuspidate, acumen 1–1.5 cm long; midrib slightly raised above, prominent beneath; lateral veins 6–8 pairs, plane above and prominent beneath, marginal vein c. 3 mm from margin; petiole 0.5–1 cm long, thickened, drying fawn. Inflorescences axillary, solitary, racemose with 2–3 pairs of widely spaced flowers, 0.6–1 cm long; peduncle c. 2 mm long, glabrous; bracts scarious, c. 1 mm long, minutely pubescent, persistent. Flowers bisexual, white; pedicel 0.5–1 mm long; buds pointed; calyx c. 0.5 mm long, deeply divided, lobes acute, glabrous; corolla 7–12 mm long, divided almost to the base, lobes narrowly linear, sometimes twisted at anthesis; stamens inserted on the corolla tube by thick filaments of 0.5–1 mm long, anthers oblong-ovate, 1–1.5 mm long; ovary oblong-ovoid, c. 2 mm long, glabrous, stigma narrowly notched. Fruits (immature) ovoid, c. 0.4 × 0.3 cm, not curved or ridged.
 Endemic to Borneo. In Sabah, only known from the type collection in Tawau and *SAN 90114* from Tingkayu in Kunak district. Also known in E Kalimantan (e.g., *Endert 2788*, *Endert 3039*, *Kostermans s.n.*, *Kostermans 10460*). In lowland mixed dipterocarp forest, to 150 m altitude.
 Tree 3–17 m. Leaf 10–17 cm long, drying pale grey-green. Fruit globose, *c.* 1.8 cm long.....**25. *C. spicatus***

6. Twigs stout. Leaf larger, 23–38 × 7–13 cm; lateral veins obscure beneath. Inflorescence ramiflorous. Fruit ovoid, smooth, *c.* 2.5 × 2 cm.....**3. *C. callophyllus***
 Twigs slender. Leaf smaller, 17–28 × 6–10 cm; lateral veins conspicuous beneath. Fruit ellipsoid, superficially 4-ridged, *c.* 3 × 1.5 cm.....**2. *C. callophylloides***

7. Leaf thickly coriaceous.....8
 Leaf coriaceous, subcoriaceous or chartaceous.....13
8. Petiole to 0.7 cm long. Inflorescence racemose, *c.* 0.5 cm long.....**15. C. palustris**
 Petiole 1 cm or longer. Inflorescence paniculate, 1–11 cm long.....9
9. Leaf obovate to oblong-lanceolate, base strongly tapering.....10
 Leaf lanceolate to broadly elliptic, base cuneate or rounded.....11
10. Lower leaf surface rugose, lateral veins obscure beneath. Fruit ellipsoid, 3.5–4.5 cm long.....**7. C. evenius**
 Lower leaf surface smooth, lateral veins prominent beneath. Fruit globose, 2–2.5 cm diameter... ..**8. C. globosus**
11. Leaf to 14 × 6 cm. Flowers in tight clusters, densely brown hairy. Fruit ovoid, *c.* 2.5 cm long.....**18. C. polycephalus**
 Leaf 14–30 × 5.5–13 cm. Flowers spaced, sparsely pubescent. Fruit globose, 1.5–1.8 cm diameter.....12
12. Lateral veins 7–8 pairs, plane and obscure on upper surface.....**11. C. leopoldi**
 Lateral veins 8–14 pairs, deeply impressed on upper surface....**14. C. pachyphyllus**
13. Inflorescence (or infructescence) racemose.....14
 Inflorescence (or infructescence) paniculate.....18
14. Leaf surface conspicuously glossy, slightly bullate (drying wrinkled) above.....
**12. C. lucens** (in part)
 Leaf surface dull and plane above.....15
15. Intercostal veins forming a conspicuous network on lower leaf surface.....
**10. C. kinabaluensis**
 Intercostal veins obscure.....16
16. Leaf apex bluntly rounded into the acumen. Fruit *c.* 2.5 cm long.....**9. C. havilandii**
 Leaf apex cuspidate. Fruit to 1.2 cm long.....17
17. Leaf oblong-ovate, base rounded to cuneate; lateral veins obscure beneath. Fruit smooth.....**5. C. crispus**
 Leaf lanceolate, base tapered; lateral veins prominent beneath. Fruit rugose.....
**23. C. rugosus**
18. Leaf obovate.....19
 Leaf lanceolate, broadly elliptic or oblong.....21
19. Intercostal veins prominent in dry leaf. Flower buds rounded. Fruit *c.* 2 cm long, with thin pericarp.....**22. C. ramiflorus** (in part)
 Intercostal veins obscure. Flower buds pointed. Fruit 4.5–6 cm long, with thick pericarp20

20. Petiole 1.5–3 cm long. Peduncle less than half the length of inflorescence. Fruit smooth....
 **13. C. macrocarpus**
 Petiole 2.5–5.5 cm long. Peduncle more than half the length of inflorescence. Fruit deeply
 ridged..... **20. C. porcatus**
21. Leaf coriaceous. Flowers polygamous.....22
 Leaf chartaceous to subcoriaceous. Flowers bisexual.....23
22. Tree 12–30 m tall. Calyx grey hairy. Fruit pear-shaped, *c.* 1.2 cm long.....
 **19. C. polygamus**
 Scandent, sometimes shrubby plants. Calyx not grey hairy. Fruit not pear-shaped...
C. macrobotrys (Merr.) Kiew
 (Greek, *makro* = large, *botrys* = bunch; referring to the inflorescence)
 J. Arn. Arb. 64 (1983) 620. Basionym: *Linociera macrobotrys* Merr., Philip. J. Sci. Bot. 13
 (1918) 117. Type: *Foxworthy 367*, Borneo, Sarawak, G. Pueh (holotype A). Synonyms: *Linociera*
scandens Merr., Philip. J. Sci. 37 (1928) 189, *syn. nov.* Type: *Ramos & Edano BS 45740*, the
 Philippines, Luzon, Mt. Alzapan (holotype A); *Myxopyrum enerve* van Steenis, Blumea 15 (1967)
 152; *Chionanthus enerve* (van Steenis) Kiew, J. Arn. Arb. 64 (1983) 622, *syn. nov.* Type: *Asah*
S 22740, Borneo, Sarawak, Mt. Dulit (holotype L; isotypes A, K).
Twigs round in cross-section, greyish brown. Leaves coriaceous, glabrous, punctate
beneath; lanceolate to slightly ovate, 4–12.5 × 1.5–6.5 cm, base rounded to truncate,
margin entire and recurved, apex acute to acuminate; midrib impressed above; lateral
veins 4–8 pairs, obscure on both surfaces; petiole drying black. Inflorescences axillary,
sometimes terminal, paniculate with up to fourth-order branching, 3–15 cm long.
Flowers polygamous; buds rounded. Fruits ovoid, c. 0.7 × 0.6 cm, not curved or
ridged.
 Borneo and the Philippines. In Borneo, recorded from Sabah (e.g., *Carr 27662A, Carr*
27905, Clemens 30910, Clemens 40704A, Clemens 50128, and RSNB 4499), Sarawak
 (e.g., *Argent & Jermy 1015, S 33831, S 33950, S 44617, and S 50866*), Brunei (e.g.,
Coode 7433 and Wong WKM 730), and Kalimantan (e.g., *Hallier 688, Hallier 709* and
Kostermans 13083B). In montane forest at 1100–2500 m altitude; once collected from
 limestone habitat (G. Api, Sarawak).
23. Panicle with second or third order branching.....24
 Panicle with first order branching.....25
24. Leaf drying chestnut-brown; petiole 0.5–1.5 cm long. Flower buds pointed; flowers
 crowded at tips of inflorescence branches. Fruit wall (pericarp) pimply (verrucose) and
 thick..... **17. C. pluriflorus**
 Leaf drying greenish brown; petiole 1.5–3 cm long. Flower buds rounded; flowers
 spaced. Pericarp smooth and thin..... **22. C. ramiflorus** (in part)
25. Leaf glossy above, slightly bullate (drying wrinkled) above..... **2. C. lucens** (in part)
 Leaf dull and plane above.....26
26. Leaf widest in the lower half; apex strongly cuspidate. Fruit *c.* 0.9 cm long, minutely
 rugose..... **1. C. balgooyiana**
 Leaf widest at the middle; apex acute, acuminate to cuspidate. Fruit 1.5–2.3 cm long,
 smooth.....27

27. Leaf drying dark chestnut-brown; lateral veins conspicuously darker than leaf blade beneath..... **16. C. plurifloroides**
 Leaf drying greenish grey or greenish brown; lateral veins concolorous or slightly darker than leaf blade beneath.....28
28. Leaf narrowly lanceolate, 14–21.5 × 3.5–6 cm. Panicles 7–13 cm long. Fruit globose..... **25. C. sabahensis**
 Leaf broadly elliptic to lanceolate, 6–15 × 2.5–5.5 cm. Panicles 1.5–5 cm long. Fruit ovoid..... **21. C. pubicalyx**

1. *Chionanthus balgooyiana* Kiew

Fig. 1.

(Max M.J. van Balgooy, botanist and plant geographer, National Herbarium of the Netherlands, Leiden Branch, the Netherlands)

TFSS 4, App. (2002) 351. **Type:** *Martin S 38039*, Borneo, Sarawak, G. Mulu (holotype SAR; isotypes K, KEP, SAN, SING).

Tree to 20 m tall and 35 cm diameter; bole with low buttresses *c.* 20 cm tall. **Bark** greyish green or dark brown, flaky. **Twigs** slender, *round in cross-section*, drying greyish white, flattened at nodes when young, lenticellate, glabrous. **Leaves** *subcoriaceous, dull and plane above*, drying greyish green, very sparsely pubescent; *narrowly lanceolate*, 7–8.5 × 2–3.5 cm, *widest in the lower half, base cuneate*, margin recurved, *apex strongly cuspidate*, acumen 0.75–1.5 cm long; midrib raised above, plane beneath; lateral veins 4–6 pairs, plane and obscure on both surfaces, marginal vein absent; *petiole* 0.5–1 cm long, not thickened, *drying black*. **Inflorescences** axillary, solitary, *panicle with first order branching*, (0.5–)1–2.75 cm long, branch *c.* 3 mm long with 2–4 spaced pairs of flowers; peduncle 2–4 mm long, glabrous; bracts scarious, *c.* 1 mm long, glabrous, persistent. **Flowers** *bisexual*, white or greenish white; buds rounded; pedicel 1–3 mm long; calyx *c.* 1.5 mm long, divided more than halfway, lobes acute, glabrous; corolla 2–3.5 mm long, divided almost to base, lobes narrowly linear, involute, apex cucullate, straight at anthesis; stamens almost sessile, epipetalous, anthers rotund, *c.* 0.5 mm long, without apiculum; ovary conical, *c.* 1.25 mm long, glabrous, stigma bilobed. **Infructescences** *c.* 1.25 cm long, slightly thickened. **Fruits** (?immature) ovoid, *c.* 0.9 × 0.6 cm, *not curved, minutely rugose*, apex rounded, base tapered; stalk *c.* 3 mm long, slightly thickened. **Seeds** unknown.

Distribution. Endemic to Borneo, known in Sarawak only from Bt. Senyandang in the Second Division (e.g., *S 44254*), Dulit Range in the Fourth Division (e.g., *Richards 1706, Richards 1773, S 34896*, and *S 46777*) and G. Mulu (the type).

Ecology. In hill to lower montane forest on steep slopes, at 650–1400 m altitude.

2. *Chionanthus callophylloides* Kiew

(Greek, *-oides* = like; referring to its resemblance to *C. callophyllus*)

TFSS 4, App. (2002) 351. **Type:** *Saikeh SAN 79917*, Borneo, Sabah, Sandakan district, Sepilok FR (holotype SAN; isotype SING).

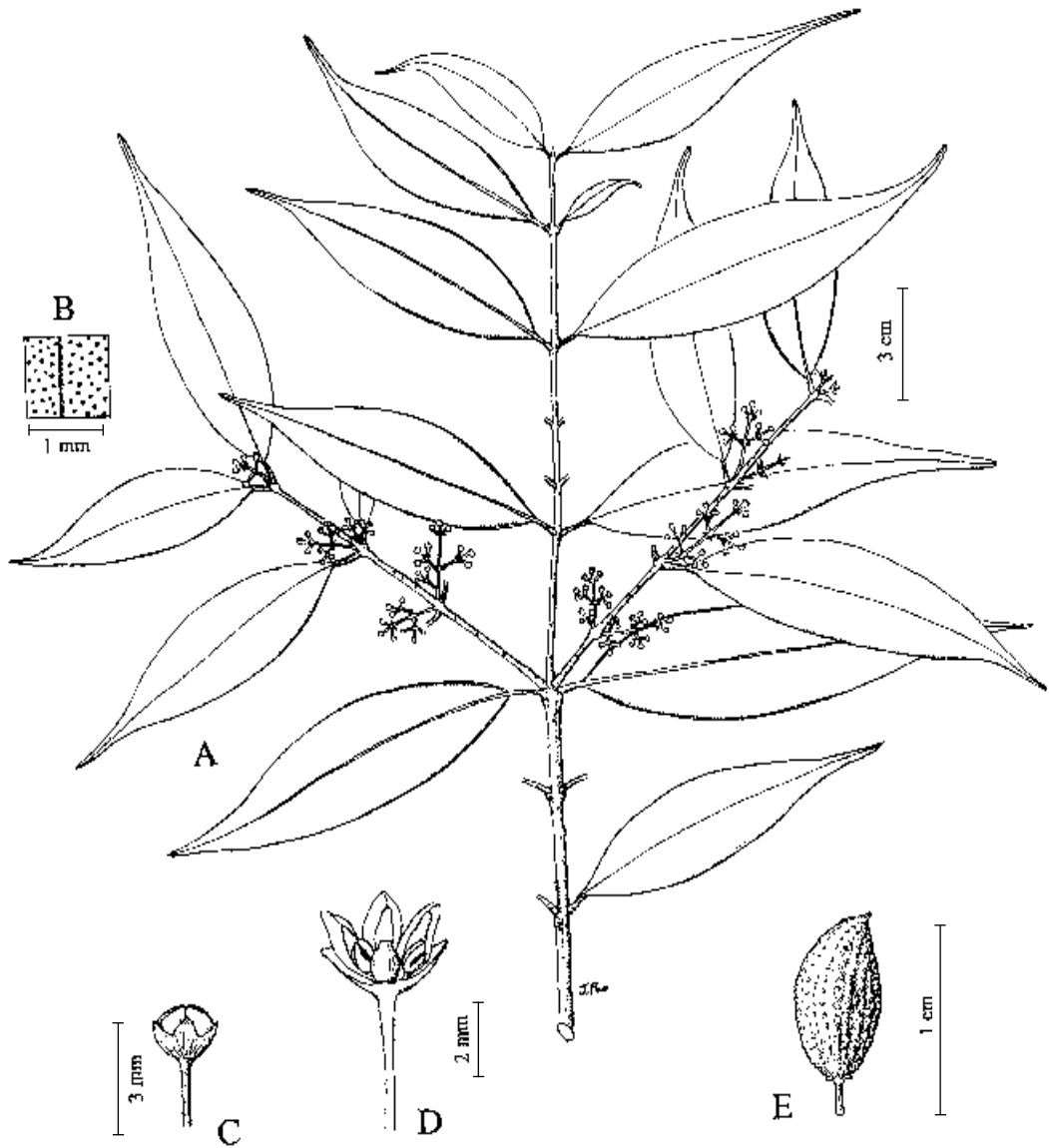


Fig. 1. *Chionanthus balgooyiana*. A, flowering leafy twig; B, detail of upper leaf surface; C, flower bud; D, open flower with one calyx lobe and one corolla lobe removed; E, young fruit. (A–D from S 34896, E from S 38039.)

Tree to 13 m and 25 cm diameter. **Bark** brown, minutely fissured; inner bark yellowish pink. **Sapwood** pinkish. **Twigs** slender, round in cross-section, glabrous, older twigs drying pale grey, nodes flattened, lenticels conspicuous in young green twigs, disappearing with age, leaf scars large, horseshoe-shaped. **Leaves** subcoriaceous, glabrous, drying grey-green above and fawn beneath; narrowly obovate, $(17.5\text{--}27(-28) \times (6\text{--})8(-10)$ cm, base tapered, margin slightly recurved, apex acuminate, acumen 1–2 cm long; midrib impressed above, prominent beneath; lateral veins 9–11(–15) pairs, impressed or plane above, conspicuous beneath, marginal vein conspicuous and 2–3 mm from margin; petiole 1.75–2.5 cm long, thickened, deeply grooved above, drying brown. **Inflorescences** c. 1 cm long, glabrous. **Flowers** unknown. **Infructescences** (young) racemose panicle, solitary, axillary, 2–3 cm long, lowest branch c. 1.5 cm long, upper branch c. 0.5 cm long; peduncle 2–5 mm long; bracts scarious. **Fruits** ellipsoid, c. 3×1.5 cm, not curved, superficially 4-ridged, apex acute or rounded, base truncate, immature fruits blue green, drying with white bloom; stalk thickened; pericarp rough, c. 1.5 mm thick but not woody when dry. **Seeds** endospermous.

Distribution. Endemic to Borneo. In Sabah, known from Lahad Datu, Pitas, Ranau, Sandakan, and Tenom districts (e.g., SAN 12142, SAN 35605, SAN 72028, SAN 92435, SAN 120061, and SAN 132640). In Sarawak, recorded from Ulu Sg. Berar, G. Mulu (e.g., S 39633).

Ecology. Lowland mixed dipterocarp forest, often in flat swampy (fresh water) lands, at c. 20 m altitude.

3. *Chionanthus callophyllus* Blume (Greek, *calos* = beautiful; *phullon* = leaf)

Mus. Bot. Lugd. Bat. 1 (1850) 319; Kiew, Gard. Bull. Sing. 37 (1984) 210, l.c. (1989) 287. **Lectotype** (Kiew, 1984): *Korthals s.n.* (= RHL Sheet No. 908158933), Borneo, without locality (hololectotype L). **Synonyms:** *Linociera paludosa* King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 268, Merrill, EB (1921) 489, Ridley l.c. (1923) 316, Masamune l.c. 612; *Olea platycarpa* King & Gamble l.c. 271; *C. platycarpus* (King & Gamble) Kiew, Malay. For. 42 (1979) 272, l.c. (1981) 149.

Tree or shrub, 3–30 m tall, to 30 cm diameter. **Bark** rough or scaly, white, grey or brown; inner bark orange-brown to red. **Sapwood** white or yellow. **Twigs** stout, round in cross-section, drying white, nodes flattened with large horseshoe-shaped leaf scars, glabrous, lenticellate. **Leaves** clustered at ends of twigs, slightly subcoriaceous, glabrous, drying grey or pale brown; obovate to oblong-lanceolate, $23\text{--}38 \times 7\text{--}13$ cm, base tapered or cuneate, margin slightly recurved, apex rounded to shortly acuminate; midrib plane above; lateral veins 8–13 pairs, impressed above, obscure beneath, marginal vein 3–5 mm from margin; petiole 1.5–3 cm long, stout, drying reddish brown. **Inflorescences** ramiflorous, occasionally axillary, fascicled, paniculate with first order branching, 2–2.5 cm long, glabrous, lowest branch 3–6 mm long; peduncle 3–5 mm long; bracts scarious, ovate-acute, c. 4 mm long, glabrous, persistent. **Flowers** sessile, bisexual, pale green or white, sometimes tinged purple or creamy yellow with a brown centre; buds pointed; calyx c. 2.5 mm long, divided c. halfway, lobes acute, glabrous, margin sometimes ciliate; corolla c. 5 mm long, divided almost to base, lobes narrowly linear, twisted at anthesis; stamens with broad filament c. 0.5 mm long, attached at base of corolla, anthers oblong, c. 0.5 mm long; ovary globose, c. 1 mm long, glabrous, stigma bilobed. **Infructescences** 1.5–3.5 cm long, thickened. **Fruits** ovoid, up to 2.5×2 cm, smooth, not curved, base flattened, apex acute; pericarp purple,

drying with white bloom, *c.* 1 mm thick, leathery; stalk 3–10 mm long. **Seeds** albuminous.

Distribution. Thailand, Sumatra, Peninsular Malaysia, and Borneo (Sabah and Kalimantan). In Sabah, not common, collected several times from Sandakan district and once from Tenom district (e.g., *SAN 35605*, *SAN 72028* and *SAN 79917*).

Ecology. Lowland mixed dipterocarp and swamp forests, commonly on hill slopes, at altitudes to 500 m.

4. *Chionanthus cordulatus* Koorders

(Latin, *cordulatus* = shallowly heart-shaped at base; referring to the leaf blade)

Meded's Lands Plant. 19 (1898) 527 & 638. **Type:** *Koorders 19592*, Sulawesi, Minahasa, Manado (BO, L).

Small tree or shrub to 15 m tall and 30 cm diameter; once recorded as a climber (*Carr SFN 26728*). **Bark** greenish; inner bark pink-yellow. **Sapwood** yellowish. **Twigs** moderately slender, round in cross-section, drying white, nodes slightly flattened, lenticellate, glabrous. **Leaves** chartaceous, glabrous, drying green-brown to light chestnut-brown; slightly obovate to ovate, (16–)22(–36) × (6–)8(–13) cm, *base cordate*, margin not recurved, apex acuminate or sometimes acute, acumen to 1.5 cm long; midrib and lateral veins plane above, prominent beneath; lateral veins (9–)12(–17) pairs, marginal vein 2–3 mm from margin; petiole (0.4–)0.8(–1.5) cm long, thickened, drying white. **Inflorescences** ramiflorous or axillary, 3 or more fascicled together, racemose with 3–6 pairs of flowers or racemose panicle, 1–4 cm long, lowest branch to 1 cm long; flowers well spaced, pubescent; peduncle 3–5 mm long; bracts scarious, acute, 2–3 × 1.5 mm, densely pubescent, persistent. **Flowers** bisexual, white or yellowish green; buds pointed; pedicel 1–2 mm long; calyx *c.* 0.5 mm long, divided *c.* halfway, lobes acute, minutely pubescent; corolla 6–8 mm long, divided almost to base, lobes narrowly linear, straight or twisted at anthesis; stamens sessile, anther oblong, *c.* 0.7 mm long; ovary globose, *c.* 1 mm diameter, glabrous, stigma capitate. **Infructescences** thickened. **Fruits** ovoid, *c.* 2.75 × 2.25 cm, apex rounded; pericarp greyish green, rough with brown warts, *c.* 2 mm thick, leathery; stalk *c.* 5 mm long and 2 mm thick. **Seeds** albuminous.

Distribution. Borneo (Sabah and E Kalimantan), NE Sulawesi and N Maluku. In Sabah, known from Keningau, Ranau, Tambunan, and Tenom districts (e.g., *SAN 114151*, *SAN 116582*, *SAN 120257*, *SAN 122437*, and *SFN 26728*). In Kalimantan, recorded from Berau (e.g., *Kostermans 21416*).

Ecology. Lowland forest usually by rivers but also from hillsides, at altitudes to 930 m.

5. *Chionanthus crispus* Kiew

(Latin, *crispus* = curled; alluding the strongly twisted petals at anthesis)

Malay. For. 44 (1981) 153; Coode *et al.* (eds.) *l.c.* 247. **Type:** *Ahmad SAN 47649*, Borneo, Sabah, Lahad Datu district, Tabawan Is. (holotype SAN; isotypes KEP, L).

Tree to 30 m tall and 60 cm diameter; flowering at 3 m tall; bole shortly buttressed or fluted. **Bark** grey, smooth or lenticellate; inner bark orange. **Sapwood** ochre. **Twigs** slender, *round in cross-section*, drying white, nodes flattened, glabrous, lenticels inconspicuous. **Leaves** *coriaceous*, glabrous, *drying dull and plane above*, grey-green or sometimes brownish green beneath; *oblong-ovate*, occasionally rotund, 7–13 × 2.5–5.5 cm, *base rounded or cuneate*, margin slightly recurved, *apex cuspidate*, acumen 1–2 cm long; midrib plane or slightly impressed above, slightly prominent beneath; *lateral veins* 6–9 pairs, *plane and obscure on both surfaces*, marginal vein 1–2 mm from margin; *intercostal venation obscure*; *petiole* 0.5–0.7 cm long, not thickened, *drying black*, densely pubescent. **Inflorescences** axillary and solitary, *racemose* with 3–4 spaced pairs of opposite flowers, 0.5–1.5 cm long; peduncle *c.* 1 mm long, ferruginous; bracts scarious, *c.* 2 mm long, pubescent, persistent. **Flowers** bisexual, white or purple; buds pointed; sessile or with pedicel to 1 mm long; calyx *c.* 2 mm long, divided almost to base, lobes acute, pubescent, margin ciliate; corolla 5–6 mm long, divided almost to base, lobes narrowly linear, strongly twisted and recurved at anthesis; stamens subsessile, attached at base of corolla, anthers oblong; ovary ovoid, *c.* 1 mm long, glabrous, stigma bilobed. **Fruits** (?immature) ovoid, 1–1.2 × 0.8 cm, *smooth, not curved*, apex rounded; pericarp drying thin and brittle. **Seeds** unknown.

Distribution. Endemic to Borneo (Sabah and Brunei only). In Sabah, known from islands in the south (Tabawan, Timbun Mata and Pababag Is.; e.g., *SAN 63917* and *SAN 68539*) and inland from ultrabasic soils at Lahad Datu district (Bt. Silam; e.g., *SAN 57285*), Ranau district (Bt. Hampuan; e.g., *SAN 56566* and *SAN 64136*) as well as from Sandakan district (Bt. Senilakan; e.g., *SAN 51240* and *SAN 53214*). In Brunei, recorded from Tutong district (e.g., *Coode 6854*).

Ecology. Primary forest, usually on sandy or ultrabasic soils, at altitudes to 850 m.

6. *Chionanthus curvicarpus* Kiew

(Latin, *curvi-* = curved, Greek, *karpos* = fruit; with curved fruits)

Gard. Bull. Sing. 37 (1984) 211; Coode *et al.* (eds.) *l.c.* 247; Argent *et al.* (eds.) *l.c.* 487. **Type:** *Aban SAN 35826*, Borneo, Sabah, Tawau district, Gading (holotype SAN; isotypes K, KEP, L). **Synonyms:** *Linociera cuspidata* auct. non (Blume) Knobl.: Merrill *l.c.* (1921) 488, *l.c.* (1929) 249, Masamune *l.c.* 612, Anderson *l.c.* 285; *Chionanthus cuspidatus* auct. non Blume: Kiew *l.c.* (1980) 372, *l.c.* (1981) 152.

Tree or shrub to 23 m tall and 30 cm diameter; bole to 10 m tall, occasionally fluted or with short buttresses. **Bark** smooth, whitish grey or brown; inner bark pale yellow. **Sapwood** whitish. **Twigs** moderately slender, *quadrangular in cross-section*, drying white, lenticels inconspicuous, nodes flattened, glabrous. **Leaves** chartaceous, glabrous, drying pale grey; oblong-lanceolate to narrowly lanceolate, 10–20(–28) × 3–8.5 cm, *base tapering or cuneate*, margin not recurved, apex acuminate or acute, acumen *c.* 1 cm long; midrib and veins plane or slightly impressed above, prominent beneath; lateral veins (8–)10–11(–15) pairs, marginal vein 2–4 mm from margin; petiole 0.7–1 cm long, not thickened, drying brown. **Inflorescences** axillary, solitary or fascicled, shortly branched racemose panicle, 1–2.5(–6) cm long, branches 3–5(–11) mm long, glabrous; flowers distant; peduncle 3–5(–7) mm long; bracts scarious, ovate, *c.* 1 mm long, glabrous, persistent. **Flowers** bisexual, yellowish (sometimes yellowish green or greenish white); buds pointed; pedicel 1–2 mm long; calyx *c.* 1 mm long, divided more than halfway, lobes acute, sparsely pubescent, margin ciliate; corolla 2–4 mm long, divided almost to base, lobes narrowly linear, twisted at anthesis; stamens subsessile, attached to base of corolla, anthers *c.* 1 mm long,

oblong; ovary ovoid, *c.* 1 mm long, glabrous, stigma capitate. **Infructescences** thickened, 2–3 cm long. **Fruits** ellipsoid, *c.* 2.5 × 1.7 cm, *curved and longitudinally ridged*, acutely narrowed to base, apex rounded and apiculate; pericarp smooth, green even when mature, drying *c.* 1 mm thick, leathery; stalk 4–8 mm long. **Seeds** albuminous.

Vernacular name. Sabah—*mak ulat* (Dusun-Kaingaran).

Distribution. Sumatra, Peninsular Malaysia and Borneo (Sabah, Sarawak, Brunei, C and SE Kalimantan). In Sabah, common throughout (e.g., *SAN 24871*, *SAN 36484*, *SAN 56153*, *SAN 75309*, and *SAN 83970*). In Sarawak, occasional (G. Murut, G. Mulu, Kapit, and Kelabit Highlands; e.g., *Geh & Syamsuri 960*, *Nooteboom & Chai 1740*, *S 20212* and *S 48010*). In Brunei, recorded from Belalong and Temburong districts (e.g., *BRUN 997*, *Dransfield JD 7317* and *Wong WKM 1394*). Also occurs in E Kalimantan (e.g., *McDonald & Ismail 3621* and *Kostermans 10590*).

Ecology. Lowland primary or old secondary forest and riverine forest, usually at altitudes to 1000 m.

7. *Chionanthus evenius* (Stapf) Kiew (Latin, *even* = even; referring to the leaf surface)

Malay. For. 42 (1979) 268, *l.c.* (1980) 374, *l.c.* (1981) 159, *l.c.* (1989) 288; Coode *et al.* (eds.) *l.c.* 247. **Basionym:** *Linociera evenia* Stapf, Kew Bull. (1915) 116, Merrill *l.c.* (1921) 488, Masamune *l.c.* 612, Anderson *l.c.* 285. **Type:** *Beccari PB 3301*, Borneo, Sarawak (holotype K).

Tree to 50 m tall and 30 cm diameter; bole shortly buttressed. **Bark** grey and smooth, falling in small, thin flakes; inner bark granular, sticky, yellow-brown. **Sapwood** white or pale pink. **Twigs** stout, *round in cross-section*, drying pale grey, nodes flattened, glabrous, lenticels conspicuous. **Leaves** *thickly coriaceous*, glabrous, drying grey above, orange and *rugose beneath*; *obovate to oblong-lanceolate*, 8–18(–28) × 4–5.5(–7) cm, *base strongly tapering*, margin recurved, apex acute to apiculate; midrib slightly impressed above; *lateral veins* 8–12 pairs, plane above, *obscure beneath*, marginal vein obscure; *petiole* 1–2.5(–5) cm long, slightly thickened, *drying black*. **Inflorescences** axillary, solitary, *paniculate* with distantly spaced short branches, 2.5–11 cm long, lowest branch 0.75–1.5(–3) cm long; flowers in clusters of 5–8 at tips of branches, pubescent; peduncle slender, 1.5–3.5 cm long; bracts foliaceous, spatulate, to 5 mm long, sparsely pubescent, persistent. **Flowers** sessile, bisexual, pinkish white, buds pointed; calyx *c.* 1 mm long, divided to base, lobes acute, densely pubescent; corolla *c.* 3 mm long, divided almost to base, lobes narrowly linear, more or less straight at anthesis; stamens with filament *c.* 0.5 mm long, attached at base of corolla, anthers *c.* 1 mm long, oblong, connective apiculate; ovary ovoid, *c.* 1 mm long, glabrous, stigma slightly bilobed. **Infructescences** thickened, 5–14 cm long. **Fruits** *narrowly ellipsoid*, 3.5–4.5 × 2–2.5 cm, *smooth, not curved*, apex narrowed, base rounded, creamy or light brown on drying; epicarp *c.* 1 mm thick; mesocarp 2–3 mm thick and leathery; endocarp *c.* 2 mm thick and woody; stalk enlarged, *c.* 5 mm long and 4 mm thick. **Seeds** albuminous.

Vernacular name. Sarawak—*sapah hutan* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo (Sabah, Sarawak, Brunei, and Kalimantan). In Sabah, known only from Beaufort district (e.g., *SAN 80319*). In Sarawak, recorded from G. Penrissen, Setapok FR, Baram and Kayangeran (e.g., *Egon 340*, *Jacobs 5015*, *S 2887*, *S 4914*, and *S 30580*). In Brunei, known from Belalong area (e.g., *Coode 6479* and *S 5888*), and in Kalimantan from W Kutei.

Ecology. Freshwater or peat swamp forest in lowlands, once reported from mossy forest at *c.* 1400 m altitude (G. Penrissen).

8. *Chionanthus globosus* (Kiew) Kiew

(Latin, *globosus* = spherical; referring to the fruit)

TFSS 4, App. (2002) 352. **Basionym:** *C. elaeocarpus* (Stapf) Kiew var. *globosus* Kiew *l.c.* (1980) 374, *l.c.* (1981) 150. **Type:** *Chai S 35338*, Borneo, Sarawak, Kelabit Highlands (holotype SAR; isotype K).

Tree, 20–42 m tall, to 60 cm diameter; bole smooth, sometimes with buttresses 1.5–5 m tall. **Bark** almost smooth. **Sapwood** cream. **Twigs** stout, *round in cross-section*, drying blackish, ultimate twigs flattened, glabrous, lenticellate. **Leaves** *thickly coriaceous*, glabrous, drying dull, dark green-brown above, fawn and *smooth beneath* with lateral veins darker than leaf blade; *obovate*, 10–17 × 5–8 cm, *base strongly tapering*, margin strongly recurved, apex acute or with short acumen *c.* 3 mm long; midrib slightly raised above and prominent beneath; *lateral veins* 7–12 pairs, plane above, *prominent beneath*, marginal vein obscure; *petiole* 2.5–3.5 cm long, *drying black*. **Inflorescences** axillary, solitary, *paniculate* with third to fourth order branching, *1–9 cm long*; rachis strongly flattened, lowest branch 1–2 cm long; flowers crowded at tips of branches, glabrous; peduncle stout, 1–6 cm long; bracts foliaceous, spatulate, 4–15 × 6 mm, pubescent, persistent. **Flowers** sessile, bisexual, white; buds pointed; calyx divided *c.* halfway, *c.* 1 mm long, lobes acute, pubescent; corolla divided almost to base, *c.* 4 mm long, lobes oblong, more or less straight at anthesis; stamens sessile, epipetalous, anthers yellow, *c.* 1 mm long, oblong; ovary ovoid, *c.* 1 mm long, glabrous, stigma capitate. **Infructescences** thickened, to 11 cm long, bearing 1–3 fruits. **Fruits** *globose*, to 2–2.5 cm diameter, *smooth, not curved*, green drying black; pericarp 3–5 mm thick, leathery; stalk *c.* 5 mm long. **Seeds** albuminous.

Distribution. Endemic to Borneo. Known from Sipitang district in Sabah (e.g., *SAN 16715* and *SAN 16745*), Belaga, Kapit, Lawas, Limbang, and Marudi districts in Sarawak (e.g., *S 26013*, *S 32225*, *S 34818*, *S 35338*, and *Zainuddin et al. AZ 5616*), and W Kutei in CE Kalimantan (e.g., *Endert 3134*, *Endert 3634*, *Endert 4308*, and *Endert 4436*).

Ecology. Usually in forest on mountain ridges, occasionally in *kerangas* forest, at 200–1300 m altitude.

Notes. Pickles (*S 3592*) records the fruits as edible.

9. *Chionanthus havilandii* Kiew

(J.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Malay. For. 43 (1980) 375. **Type:** *Haviland 1873*, Borneo, Sarawak, Rejang (holotype SAR; isotype SING).

Tree to 20 m and 35 cm diameter, flowering at *c.* 2 m tall. **Bark** smooth, whitish. **Twigs** white, slender, *round in cross-section*, glabrous, slightly flattened at nodes, lenticellate. **Leaves** *coriaceous*, glabrous, *dull and plane above*, reddish brown beneath; broadly lanceolate to oblong, 5.5–10 × 3–7 cm, *base rounded* sometimes *cuneate*, margin finely recurved, *apex bluntly rounded into an acumen c. 1 cm long*; midrib slightly impressed above, prominent beneath; lateral veins 6–8 pairs, plane and obscure above, concolorous with leaf blade and slightly prominent beneath, marginal vein 2–4 mm from margin; *intercostal venation obscure*; *petiole* 0.5–1.5 cm long, not thickened, *drying black*. **Inflorescences** axillary or extra-axillary, 1–3 per axil, *racemose*, unbranched, with 3–4 pairs of opposite flowers, 1–1.5(–3) cm long; peduncle 2–3 mm long, glabrous; bracts scarious, ovate, 1–1.5 mm long. **Flowers** bisexual, yellow or white, somewhat fragrant; pedicel 1–1.5 mm long; calyx *c.* 1.5 mm long, shallowly lobed, lobes ovate, glabrous; corolla 5–5.5 mm long, free to base, lobes oblong-linear, induplicate, straight at anthesis; stamens with filament *c.* 0.5 mm long, anther oblong, *c.* 1 mm long; ovary ovoid, *c.* 1 mm long, glabrous, stigma capitate. **Fruits** ovoid, *c.* 2.5 × 1.75 cm, *not curved, longitudinally ridged*, green drying light brown; pericarp leathery, 2–3 mm thick when dry; endocarp brittle. **Seeds** endospermous.

Distribution. Endemic to Borneo and known only from Sarawak (e.g., *Egon A 837, Haviland 894, Haviland 1754, Haviland 3041, Haviland 1873, S 140, S 9042, and S 34210*).

Ecology. In swamp and *kerangas* forest, besides streams.

10. *Chionanthus kinabaluensis* Kiew

(of G. Kinabalu, Sabah)

TFSS 4, App. (2002) 352. **Type:** *Clemens 29348–30229* (p. 0189 Oleaceae), Borneo, Sabah, Tenompok, G. Kinabalu (holotype SING; isotype SING).

Tree. **Twigs** slender, *round in cross-section*, glabrous, strongly flattened at nodes, drying brown, lenticels conspicuous. **Leaves** *coriaceous*, glabrous, drying *dull pale brown and plane above*, paler chestnut-brown beneath, with midrib, lateral and intercostal veins darker; lanceolate, 9.5–12 × 3.5–5.25 cm, *base cuneate*, margin finely recurved, apex cuspidate, acumen to 1.25 cm long; midrib slightly raised above, plane beneath; lateral veins 7–9 pairs, plane and obscure above, slightly prominent beneath, *intercostal venation reticulate, conspicuous and darker than leaf blade beneath*, marginal vein 1–2 mm from margin; *petiole* 0.8–1 cm long, not thickened, *drying black*. **Inflorescences** and **flowers** unknown. **Infructescences** axillary, solitary, glabrous, *racemose*, 2–3.5 cm long; peduncle 0.4–1 cm long; pedicel *c.* 4 mm long, thickened. **Fruits** slightly obovoid, 1.4–1.5 × 1–1.3 cm, *smooth, not curved, (?immature) green with purple cheeks*; pericarp *c.* 1 mm thick; endocarp woody. **Seeds** unknown.

Distribution. Endemic to Borneo and known only from G. Kinabalu in Sabah (e.g., *Clemens 29348–30229*).

Ecology. Montane forest.

11. *Chionanthus leopoldi* Kiew

Fig. 2.

(Leopold Madani, senior research assistant, Sandakan Herbarium)

TFSS 4, App. (2002) 353. **Type:** *Leopold & Taha SAN 83546*, Borneo, Sabah, Mile 87.5 Telupid Road (holotype SAN; isotypes K, KEP, L, SAR, SING).

Small tree to 13 m tall and 30 cm diameter; bole to 10 m tall. **Bark** greyish, lenticellate; inner bark dark brown. **Sapwood** reddish or pale green. **Twigs** moderately stout, *round in cross-section*, glabrous, lenticellate, nodes slightly flattened, drying whitish. **Leaves** *thickly coriaceous*, glabrous, dull olive-brown above, rich chestnut-brown beneath with veins slightly paler than leaf blade; *broadly elliptic*, $(14-21(-24) \times (6.5-7.5(-9)$ cm, *base rounded* sometimes slightly unequal, margin recurved, apex acuminate, acumen (1-)2.5 cm long; midrib slightly raised above, plane beneath; *lateral veins 7(-8) pairs, plane and obscure above*, plane or slightly prominent beneath, marginal vein 2-5 mm from margin; intercostal venation usually obscure; *petiole 1.5-2 cm long*, slightly thickened, *drying black* and wrinkled transversely. **Inflorescences** axillary, *panicle with first order branching*, solitary, *c. 3.5 cm long*, with *c. 4 regularly spaced sparsely pubescent flowers*, lowest branch 1-1.25 cm long, glabrous; peduncle 0.5-1 cm long; bracts linear 1-3 mm long, pubescent, persistent. **Flowers** bisexual, pale greenish; pedicel 1-3 mm long; calyx *c. 1 mm long*, divided less than halfway, very sparsely pubescent, lobes acute, margin slightly ciliate; corolla 3-4 mm long, glabrous, lobes narrowly linear, scarcely joined in pairs at base, margin involute, apex acute, more or less straight at anthesis; stamens sessile attached at base of corolla, anther subglobose, *c. 0.6 mm long*, connective not apiculate; ovary narrowly ovoid, *c. 1 mm long*, glabrous, stigma slightly bilobed. **Infructescences** 2-6 cm long, slightly thickened. **Fruits** *globose, 1.6-1.8 cm diameter, smooth, not curved*, ripening purple with white spots or red-brown; pericarp *c. 0.75 mm thick*; endocarp thin and brittle. **Seeds** endospermous.

Distribution. Endemic to Borneo and known only from Kinabatangan and Labuk Sugut districts in Sabah (e.g., *SAN 83544*, *SAN 85682*, *SAN 93967*, *SAN 125946*, and *SAN 133958*).

Ecology. In mixed dipterocarp forest on hill slopes or ridges, at 100-700 m altitude.

12. *Chionanthus lucens* Kiew

(Latin, *lucens* = polished; referring to the leaf surface)

Malay. For. 44 (1981) 154. **Type:** *Mujing SAN 40652*, Borneo, Sabah, Tawau (holotype SAN; isotypes KEP, L).

Tree, 9-18 m tall, to 25 cm diameter. **Bark** whitish, lenticellate to scaly; inner bark yellow or reddish. **Sapwood** yellowish, pale reddish or greyish. **Twigs** moderately slender, *round in cross-section*, white to pale grey-brown, nodes slightly flattened, lenticels inconspicuous, glabrous. **Leaves** *subcoriaceous*, sparsely pubescent to glabrous, drying greyish brown, *wrinkled and conspicuously glossy above*; *oblong* or *broadly elliptic*, $(9-11.5-15.5(-18.5) \times (2.75-5-6.5)$ cm, *base rounded* and decurrent, margin slightly recurved, apex cuspidate, acumen to 1.5 cm long;

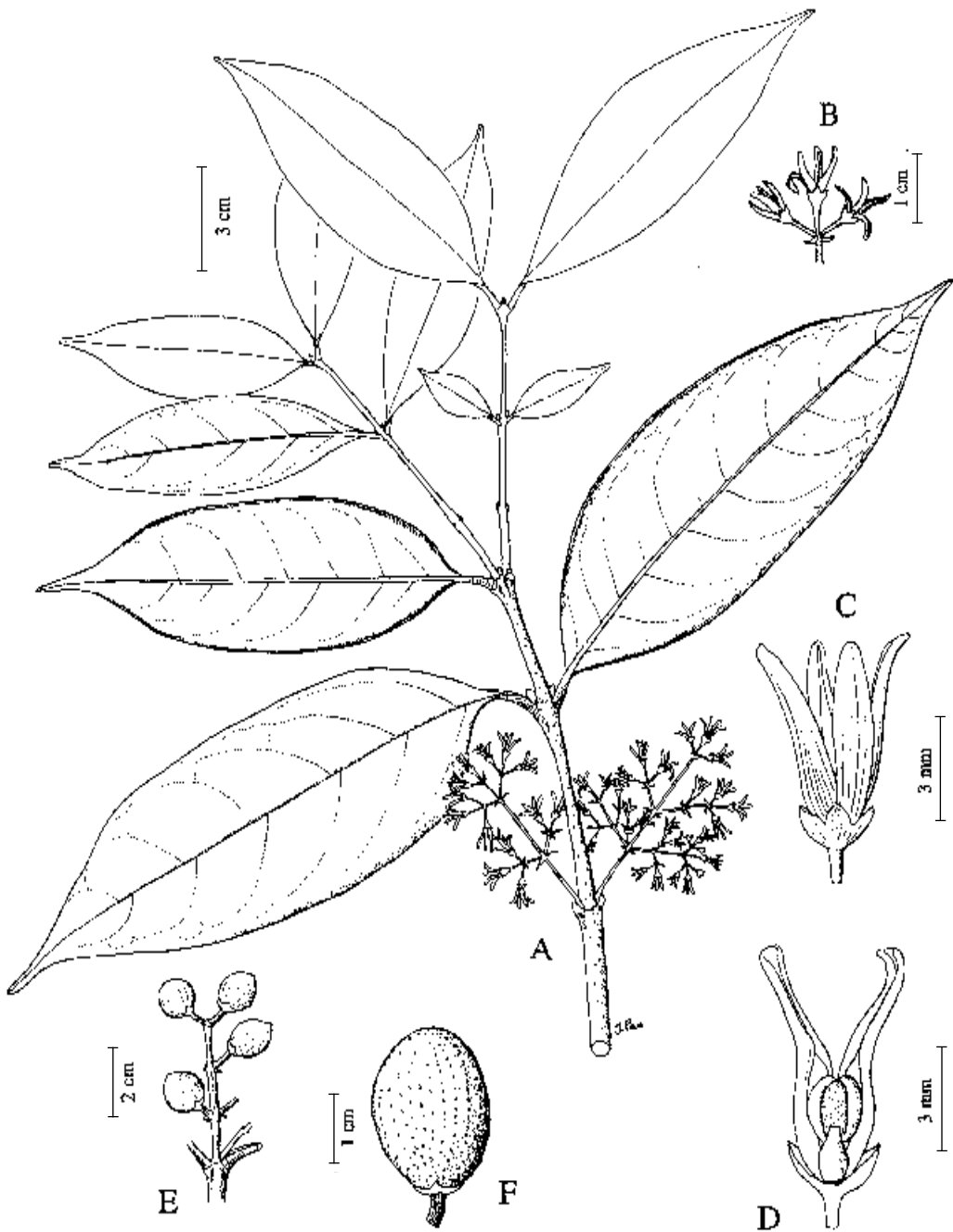


Fig. 2. *Chionanthus leopoldi*. A, flowering leafy twig; B, distal portion of inflorescence; C, open flower; D, open flower with two calyx lobes, two corolla lobes and one stamen removed; E, infructescence; F, fruit. (A–D from SAN 125946, E–F from SAN 85682.)

midrib slightly impressed above, plane beneath; lateral veins 5–7(–9) pairs, slightly impressed above, plane beneath, marginal vein (2–)3–5 mm from margin; *petiole* 0.5–1.5 cm long, not thickened, *drying black*. **Inflorescences** axillary, solitary, *racemose* with pairs of opposite flowers or *once branched panicle*, (0.75–)2–2.5 cm long, lowest branch 4–5 mm long; flowers spaced, finely pubescent; peduncle *c.* 5 mm long; bracts foliaceous, spatulate, 1–4 mm long, pubescent, persistent. **Flowers** *bisexual*, light green or yellow; buds pointed; pedicel 1–2 mm long; calyx *c.* 1 mm long, divided almost to base, lobes acute, finely pubescent or glabrous; corolla *c.* 2 mm long, divided to base, lobes narrowly linear, straight, glabrous; stamens sessile, inserted at base of corolla tube, anthers oblong, less 1 mm long; ovary conical, *c.* 1 mm long, stigma sessile, bilobed. **Infructescences** thickened, 1.5–2.5 cm long. **Fruits** ovoid, 1.2–1.5 × 0.9 cm, *smooth, not curved*, apex pointed; stalk 3–7 mm long, *c.* 2 mm thick; endocarp *c.* 1 mm thick, brittle. **Seeds** albuminous.

Vernacular name. Sarawak—*bokol* (Land Dayak).

Distribution. Peninsular Malaysia and Borneo (Sabah, Sarawak and E Kalimantan). In Sabah, known from Tawau district (e.g., *SAN 32997*, *SAN 40652* and *SAN 134079*). In Sarawak, recorded from Bau and Bintulu districts (e.g., *S 24551*, *S 47578*, *S 48202*, and *S 50174*). In Kalimantan, known from Balikpapan area (e.g., *Ambri & Arifin AA 78*) and E Kutei (e.g., *Leighton s.n.*).

Ecology. Rare, in primary and secondary mixed dipterocarp forest on flatland or hillsides, at altitudes to 750 m.

13. *Chionanthus macrocarpus* Blume

(Greek, *makro* = large, *karpos* = fruit; with large fruits)

Mus. Bot. Lugd. Bat. 1 (1850) 319; Kiew, Gard. Bull. Sing. 37 (1984) 209. **Lectotype** (Kiew, 1984): *Blume s.n.* (= *RHL Sheet No. 908161219*), Java (hololectotype L). **Synonyms:** *Chionanthus insignis* Miq., Fl. Ind. Bat. Suppl. (1862) 559; *Linociera macrocarpa* (Blume) Knob., Bot. Centralbl. 61 (1895) 87, King & Gamble *l.c.* 267, Backer & Bakhuizen *f.*, FJ 2 (1965) 214, Anderson *l.c.* 285; *L. elaeocarpa* Stapf *l.c.* 115, Merrill *l.c.* (1921) 488, Masamune *l.c.* 612; *C. elaeocarpus* (Stapf) Kiew, Malay. For. 42 (1979) 267, *l.c.* (1980) 373, exclusive var. *globosus* Kiew, *l.c.* (1981) 150, exclusive var. *globosus* Kiew.

Tree, 10–30 m tall, to 60 cm diameter; bole smooth or sometimes with buttresses to 2 m high. **Bark** almost smooth. **Sapwood** white. **Twigs** stout, *round in cross-section*, drying grey-brown or white, nodes strongly flattened, glabrous, lenticellate. **Leaves** *coriaceous* sometimes *subcoriaceous*, glabrous, drying dull reddish or dark brown on both surfaces, lateral veins darker than leaf blade beneath; *obovate*, 15–30 × 5–10 cm, *base tapering*, margin recurved, apex acute (sometimes with an acumen to 7 mm long); midrib plane above and prominent beneath; lateral veins 11–19 pairs, plane or sometimes impressed above, slightly prominent beneath, marginal vein obscure; *intercostal venation obscure*; *petiole* 1.5–3 cm long, slightly thickened, *drying black*. **Inflorescences** axillary, solitary, *paniculate* with third to fourth order branching, 5–11 cm long, lowest branch 1–2 cm long; flowers crowded at tips of branches, glabrous; *peduncle* stout, *less than half the length of inflorescence*, slightly flattened; bracts foliaceous, spatulate, 6–15 × 4–6 mm, pubescent, persistent. **Flowers** sessile, *bisexual*, white; *buds pointed*; calyx *c.* 1 mm long, divided *c.* halfway, lobes acute, pubescent; corolla divided almost to base, 3–4 mm

long, lobes oblong, more or less straight at anthesis; stamens sessile, epipetalous, anthers yellow, c. 1 mm long, oblong; ovary ovoid, c. 1 mm long, glabrous, stigma bilobed. **Infructescences** thickened, c. 12 cm long, bearing 1–3 fruits. **Fruits** oblong-ellipsoid, to 4.5 × 2.5 cm, smooth (sometimes slightly angled), *not curved*, base rounded, bluish green when fresh, drying brick red to brownish yellow to golden brown sometimes with glaucous bloom; *pericarp* 3–5 mm thick, leathery; stalk thickened, 10–15 mm long, c. 6 mm thick. **Seeds** albuminous.

Vernacular names. Sarawak—*kayu bura* (Kelabit), *kerdam* (Melanau).

Distribution. Sumatra, Peninsular Malaysia, Borneo (Sabah, Sarawak and Kalimantan), and Java. In Sabah, known from G. Kinabalu (e.g., *Carr SFN 20789*). In Sarawak, recorded from Kuching district (e.g., *Haviland 2298* and *Omar 351*). Also occurs in Kalimantan (e.g., *Kostermans 7561* and *Kostermans 7569*).

Ecology. Lowland to hill primary mixed dipterocarp forest, at altitudes to 1700 m.

14. *Chionanthus pachyphyllus* (Merr.) Kiew

(Greek, *pachy-* = thick, *phullon* = leaf; with thick leaf)

Malay. For. 43 (1980) 381; Coode *et al.* (eds.) *l.c.* 247. **Basionym:** *Linociera pachyphylla* Merr., J. Arn. Arb. 35 (1954) 150. **Type:** *Native Collector 584*, Borneo, Sarawak, without locality (holotype K; isotype L).

Tree or shrub to 22 m tall and 20 cm diameter. **Bark** light brown, smooth; inner bark brown. **Sapwood** brown or yellow. **Twigs** stout, *round in cross-section*, drying grey or light reddish brown, nodes strongly flattened and bearing large and conspicuous horseshoe-shaped leaf scars, subpubescent or glabrous. **Leaves** *thickly coriaceous*, glabrous, minutely punctate beneath, drying chestnut-brown or greenish brown and slightly glossy above and chestnut-brown beneath; *broadly elliptic*, sometimes *narrowly lanceolate*, (16–)21–24(–30) × 5.5–9(–13) cm, *base rounded* sometimes *cuneate*, apex acuminate or acute, acumen to 1.5 cm long, margin slightly recurved; midrib plane above, prominent beneath; *lateral veins* (8–)10–12(–14) pairs, *deeply impressed above*, prominent beneath, marginal vein 1–2 mm from margin; *petiole* 1–2 cm long, stout, thickened, *drying black*. **Inflorescences** axillary, solitary or fascicled, *panicle with second order branching*, in bud 1–2.5 cm long, *in flower* 3–7 cm long, lowest branch c. 3 cm long; *flowers spaced, sparsely pubescent*; peduncle c. 0.5 cm long; bracts scarious, ovate, c. 3 mm long, tomentose, caducous. **Flowers** bisexual, yellow; pedicel to 1 mm long; buds pointed; calyx c. 1.5 mm long, divided halfway, lobes acute, more or less glabrous; corolla 4–5 mm long, divided to base except where joined in pairs for c. 1 mm, fleshy, lobes narrowly linear, twisted at anthesis; stamens inserted at base of corolla, filament c. 0.5 mm long, anthers c. 1 mm long, oblong, white; ovary ovoid, c. 1 mm long, glabrous, stigma capitate. **Infructescences** thickened, to 7 cm long. **Fruits** *globose*, c. 1.5 cm diameter, *smooth, not curved*, apex rounded; pericarp brownish green, ripening dark purple, drying c. 0.5 mm thick, leathery; stalk c. 5 mm long and 3 mm thick. **Seeds** albuminous.

Distribution. Endemic to Borneo (Sabah, Sarawak and Brunei). In Sabah, recorded from Kota Belud (G. Kinabalu), Sandakan and Sipitang districts (e.g., *SAN 83645*). In Sarawak, known

from Kuching (G. Penrissen), Lawas, Limbang, and Marudi (G. Mulu) districts (e.g., *S* 32870, *S* 40746 and *S* 47687). In Brunei, recorded from Temburong district (e.g., *Coode* 6620).

Ecology. In hill mixed dipterocarp to lower montane forest on sandstone, and in *kerangas* forest, at altitudes to 1500 m.

15. *Chionanthus palustris* Kiew

(Latin, *palustris* = swampy; referring to the natural habitat of the species)

Malay. For. 43 (1980) 382. **Type:** *Anderson S* 3282, Borneo, Sarawak, Baram (holotype SAR).

Shrub or tree, 3–17 m tall, to 15 cm diameter; bole with small stilt roots to 1 m tall. **Bark** light brown, smooth or rough and scaly. **Twigs** moderately slender, *round in cross-section*, drying dark grey, nodes flattened, lenticels inconspicuous, glabrous. **Leaves** *thickly coriaceous*, glabrous, drying pale greenish or reddish brown on both surfaces; broadly elliptic to lanceolate, 7–14 × 3–6.5 cm, *base abruptly rounded or cuneate*, margin not recurved, apex abruptly caudate, acumen to 2 cm long; midrib impressed above and plane beneath; lateral veins 6–10 pairs, obscure and plane above, slightly impressed beneath, marginal vein 2–3 mm from margin; *petiole* 0.5–0.7 cm long, not thickened, *drying black*. **Inflorescences** axillary or extra-axillary, solitary, *condensed raceme* with 2–3 pairs of flowers, *c.* 0.5 cm long; peduncle *c.* 2 mm long; flowers crowded, sparsely pubescent; bracts scarious, ovate, *c.* 2 mm long, pubescent. **Flowers** bisexual, yellowish green; buds pointed; pedicel to 1 mm long, uppermost flowers sessile; calyx *c.* 1 mm, divided almost halfway, lobes acute, sparsely pubescent; corolla *c.* 6 mm long, divided almost to base, lobes narrowly linear, twisted at anthesis; stamens sessile, joined at base of corolla, anthers *c.* 1 mm long, broadly oblong; ovary ovoid, *c.* 1.5 mm long, glabrous, stigma bilobed. **Infructescences** thickened, to 1 cm long. **Fruits** globose, 1.5–2 cm diameter, *smooth, not curved*, apex rounded; pericarp cream-coloured, drying thin and brittle, *c.* 1 mm thick. **Seeds** albuminous.

Vernacular name. Sarawak—*ubah mata* (Malay).

Distribution. Endemic to Borneo (Sarawak and Brunei). In Sarawak, known from Kuching, Lawas, Marudi, and Sarikei districts (e.g., *Haviland* 2167, *S* 26622, *S* 26779, *S* 27834, and *S* 30703). In Brunei, recorded from Andulau and Badas FR (e.g., *S* 1059, *S* 2041 and *Sands* 5929).

Ecology. Lowland peat swamp, mixed swamp, *kerangas* and *alan* forests.

16. *Chionanthus plurifloroides* Kiew

(Latin, *-oides* = resembling; resembling *C. pluriflorus*)

TFSS 4, App. (2002) 353. **Type:** *Kulip & Goh SAN* 137038, Borneo, Sabah, Kinabatangan district, Tongod, G. Tingkar Waterfall (holotype SAN; isotype KEP).

Small tree to 17 m and 30 cm diameter; bole to 10 m tall, sometimes with buttresses *c.* 1 m high. **Bark** yellowish grey or dark brown, pustulate or smooth, *c.* 2 mm thick. **Sapwood** white. **Twigs** slender, *round in cross-section*, drying pale brown, lenticels not conspicuous; young

twigs, petiole and bracteoles minutely rusty pubescent. **Leaves** *subcoriaceous* to *chartaceous*, dull and plane above, drying dark chestnut-brown on both surfaces with lateral veins darker than leaf blade beneath; oblong to lanceolate, (12–)17(–20) × (4.25–)5.5(–6.75) cm, widest at the middle, base rounded, sometimes slightly cuneate, margin not recurved, apex acuminate to cuspidate, acumen to 1 cm long; midrib and veins plane above, prominent beneath; lateral veins (7–)8(–11) pairs, marginal vein 2–3 mm from margin; intercostal venation obscure; *petiole* (0.7–)0.8(–1.4) cm long, slightly thickened, drying black. **Inflorescences** axillary, panicle of cymes with first order branching at base and 3–4 regularly spaced pairs of flowers above, 2–4 cm long, lowest branch c. 1.5 cm long; peduncle 3–4 mm long; bracteoles scarious, 1–2 mm long, persistent. **Flowers** *bisexual*, yellow-green; pedicel to 1 mm long; calyx c. 1 mm long, divided almost to base, lobes acute, glabrous with sparsely ciliate margin; corolla c. 4 mm long, glabrous, narrowly linear, margin involute, apex acute, scarcely joined in pairs at base, twisted at anthesis to expose stamens; anthers sessile, joined at base of corolla, ellipsoid, c. 1 × 0.4 mm, connective slightly apiculate; ovary globose, c. 1.25 mm long, glabrous, stigma slightly bilobed. **Infructescences** thickened. **Fruits** globose, c. 1.5 × 1.4 cm, smooth, not curved, blue green; pericarp c. 2 mm thick; endocarp woody, c. 1 mm thick; stalk thickened. **Seeds** endospermous.

Vernacular name. Sabah and Sarawak—*obah putih* (Malay).

Distribution. Endemic to Borneo (Sabah, Sarawak and Kalimantan). In Sabah, common in the southern half (e.g., *Elmer 20332*, *SAN A 2064*, *SAN 16828*, *SAN 66094*, *SAN 81412*, and *SAN 124515*). In Sarawak, known from G. Lesong (e.g., *S 43242*). In Kalimantan, recorded from G. Tepian Lobang (e.g., *Kostermans 5321*).

Ecology. Mixed dipterocarp forest, at altitudes to 600 m. In Kalimantan occur on coral limestone.

17. *Chionanthus pluriflorus* (Knohl.) Kiew

Fig. 3.

(Latin, *pluri-* = many, *florus* = flower; referring to the many-flowered inflorescence)

Malay. For. 43 (1980) 384, *l.c.* (1981) 151; Kessler & Sidiyasa, TBSA-EK (1994) 188; Coode *et al.* (eds.) *l.c.* 247; Argent *et al.* (eds.) *l.c.* 481. **Basionym:** *Linociera pluriflora* Knohl. *l.c.* 130, Merrill *l.c.* (1921) 489, Fisher, Kew Bull. (1933) 181, Masamune *l.c.* 612, Anderson *l.c.* 285. **Type:** *Beccari PB 915*, Borneo, Sarawak (holotype K). **Synonym:** *Linociera verruculosa* Merr., Philip. J. Sci. Bot. 13 (1913) 119, *l.c.* (1921) 489, Masamune *l.c.* 489.

Tree, 10–25(–60) m tall, to 60 cm diameter, flowering at c. 3 m tall; bole occasionally with short buttresses or stilt roots. **Bark** smooth, greenish; inner bark yellow. **Sapwood** white. **Twigs** moderately stout, round in cross-section, white, grey or pale brown, nodes strongly flattened, lenticels inconspicuous, glabrous or sparsely pubescent. **Leaves** *chartaceous* sometimes *subcoriaceous*, glabrous or rarely densely pubescent, drying dull grey-green and plane above, chestnut-brown with lateral veins darker than leaf blade beneath; lanceolate sometimes broadly so, (12–)15–20(–30) × 4.5–6.5(–9.5) cm, base cuneate, margin not recurved, apex acuminate or acute; midrib and veins plane or slightly impressed above, prominent beneath; lateral veins 7–14

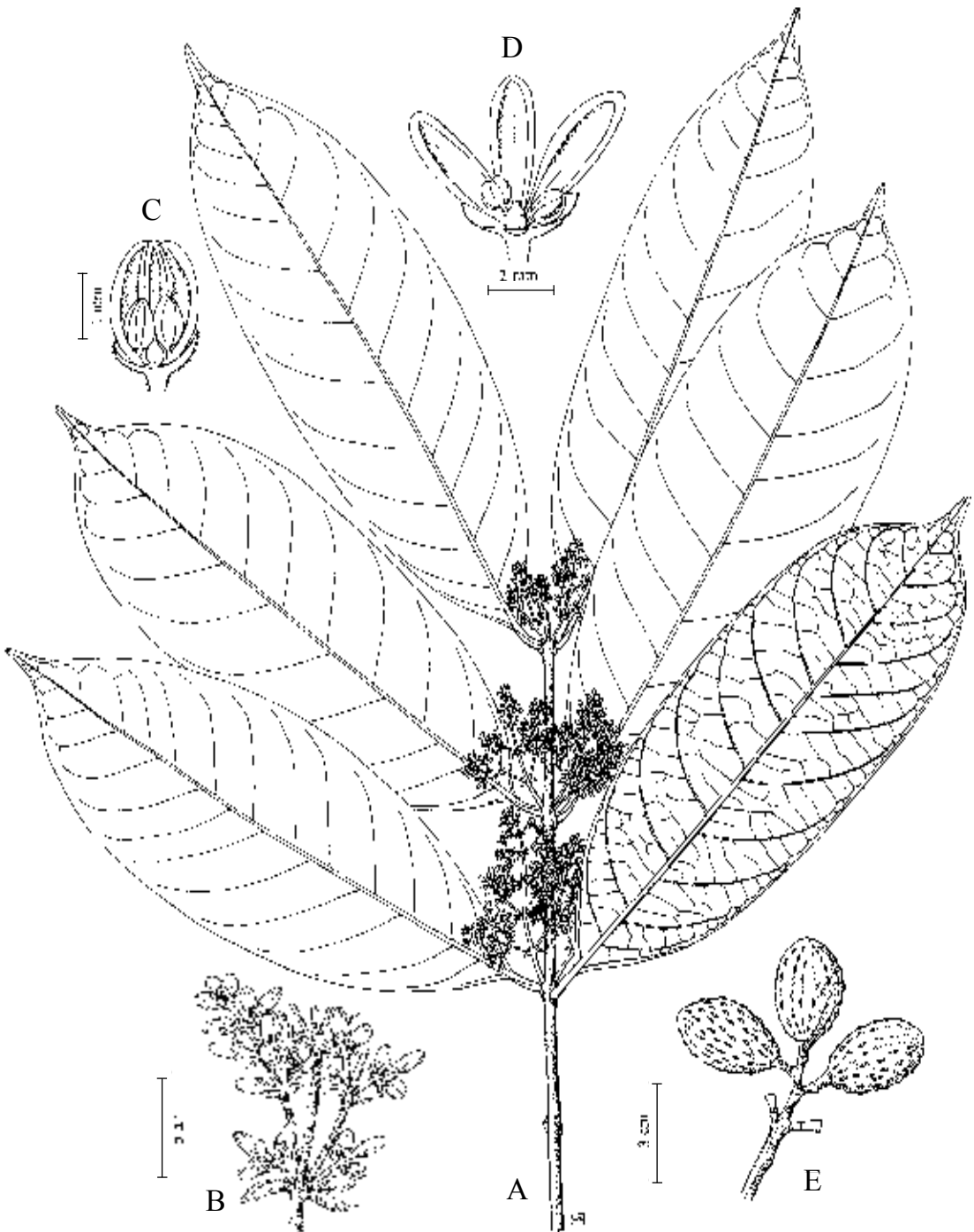


Fig. 3. *Chionanthus pluriflorus*. A, flowering leafy twig; B, part of inflorescence; C, longitudinal section of flower bud with two calyx lobes and one corolla lobe removed; D, longitudinal section of open flower with two calyx lobes and one corolla lobe removed; E, infructescence. (A–D from SAN 32274, E from S 31147.)

pairs, marginal vein 1–2 mm from margin; *petiole* 0.5–1.5 cm long, not thickened, *drying black*. **Inflorescences** axillary or extra-axillary, often fasciated, *panicle with second order branching*, 4.5–7(–21) cm long, with 3–4 branches, lowest branch 2–5.5 cm long; *flowers crowded at tips of branches*, pubescent; peduncle 0.5–2 cm long; bracts foliaceous, spatulate, *c.* 8 × 2 mm long, minutely pubescent. **Flowers** *bisexual*, subsessile or with pedicel to 1 mm long, yellow or yellowish green; *buds pointed*; faintly fragrant; calyx *c.* 1 mm long, divided *c.* halfway, lobes acute, pubescent, margin ciliate; corolla 3–3.5 mm long, divided almost to base, lobes narrowly linear, fleshy, more or less straight at anthesis; stamens filaments *c.* 0.3 mm long, joined at base of corolla, anthers less than 1 mm long, broadly oblong; ovary ovoid, less 1 mm long, glabrous, stigma bilobed. **Infructescences** thickened, to 10.5 cm long. **Fruits** ellipsoid, to 2.6 × 1.9 cm, *not curved*, apex rounded, *prominently pimply (verrucose)*, green (even when ripe); *pericarp drying c. 2 mm thick*; endocarp *c.* 1 mm thick and woody; stalk to 7 mm long, *c.* 4 mm thick. **Seeds** albuminous.

Vernacular names. Sarawak—*bekeraiah* (Kayan), *bukar* (Murut), *kuku mendo*, *mok*, *muak* (Iban).

Distribution. Endemic to Borneo (Sabah, Sarawak and Brunei). In Sabah, common and widespread (e.g., *SAN 39899*, *SAN 55806*, *SAN 60180*, *SAN 68361*, and *SAN 117569*). In Sarawak, recorded from Bintulu, Kuching, Lawas, Marudi, and Sibul districts (e.g., *Beccari PB 915*, *Haviland 3038*, *S 16294*, *S 31147*, *S 35772*, and *S 50432*). In Brunei, known from Belait and Tutong districts (e.g., *BRUN 5640* and *Coode 6366*).

Ecology. Primary lowland and hill mixed dipterocarp forest, frequently on river banks or in swamp forest, from sea level to 1500 m.

Uses. The green fruit is reported as edible by the Murut.

18. *Chionanthus polycephalus* Kiew

(Greek, *poly-* = many, *cephalus* = head; referring to the tight balls of flowers on the inflorescence branches)

Malay. For. 43 (1980) 386. **Type:** *Anderson & Chai S 32158*, Borneo, Sarawak, Bau district, Bt. Jebong (holotype SAR; isotypes L, SING).

Tree to 20 m tall and 25 cm diameter. **Bark** dark grey, rough and slightly fissured. **Twigs** moderately stout, *round in cross-section*, drying dark grey, nodes flattened with prominent horseshoe-shaped leaf scars, lenticellate, glabrous. **Leaves** *thickly coriaceous*, glabrous, drying reddish brown and sometimes slightly glossy above; *lanceolate*, 9–14 × 3–6 cm, *base rounded*, margin sometimes recurved, apex acuminate, acumen to 1 cm long; midrib slightly impressed above and plane beneath; lateral veins 8–15 pairs, plane above, obscure beneath; *petiole* 1–1.5 cm long, not thickened, *drying wrinkled and black*. **Inflorescences** axillary or extra-axillary, solitary, *paniculate*, 2.5–4 cm long, first order branches 0.5–1 cm long terminating in *tight clusters of 3–10 flowers, densely rusty brown hairy*; peduncle *c.* 5 mm long; bracts foliaceous, thick, *c.* 6 × 2 mm, densely pubescent, persistent. **Flowers** sessile, *bisexual*, creamy-white; buds pointed; calyx *c.* 2 mm long, with fleshy base, divided *c.* halfway, lobes acute, densely pubescent; corolla *c.* 5 mm long, divided almost to base, lobes narrowly linear, joined in pairs

for *c.* 1 mm, twisted at anthesis; stamens sessile, anthers oblong, *c.* 1 mm long; ovary narrowly ovoid, *c.* 1 mm long, glabrous, stigma bilobed. **Infructescences** thickened, *c.* 2 cm long. **Fruits** ovoid, *c.* 2.5 × 1.7 cm, smooth, not curved, apex apiculate; pericarp yellowish, drying *c.* 1 mm thick, leathery; stalk swollen, 7–9 mm long, *c.* 3 mm thick. **Seeds** albuminous.

Distribution. Endemic to Borneo. Known only in Sarawak from Kuching district (e.g., *Haviland s.n.*) and Bt. Bidi and Bt. Jebat in Bau district (e.g., *S 32158*).

Ecology. Confined to limestone hill forest.

19. *Chionanthus polygamus* (Roxb.) Kiew

Fig. 4.

(Latin, *polygamus* = having both unisexual and bisexual flowers)

TFSS 4, App. (2002) 354. **Basionym:** *Samara polygama* Roxb., Fl. Ind. 1 (1820) 435, *ibid.* 2nd. edition 1 (1832) 414. **Type:** *Roxburgh 2603*, Maluku (BM). **Synonyms:** *Ardisia polygama* (Roxb.) A.DC, Prod. 8 (1844) 138; *Linociera polygama* (Roxb.) S.Moore, J. Bot. (London) 51 (1913) 216; *Chionanthus laxiflorus* Blume *l.c.* 319, Kiew, Malay. For. 42 (1979) 270, *l.c.* (1980) 377, *l.c.* (1981) 151, *l.c.* (1989) 287, Coode *et al.* (eds.) *l.c.* 247, Argent *et al.* (eds.) *l.c.* 489; *L. laxiflora* (Blume) Knobl. *l.c.* 87, Merrill *l.c.* (1921) 488, Masamune *l.c.* 612, Anderson *l.c.* 285.

Tree, 12–20(–30) m tall, to 40 cm diameter; flowering at *c.* 4 m tall; bole rarely buttressed. **Bark** grey; inner bark orange-brown. **Sapwood** white or pale ochre. **Twigs** slender, *round in cross-section*, drying pale grey, nodes flattened, glabrous, lenticellate. **Leaves** coriaceous, glabrous, drying slightly glossy and greyish green sometimes brownish above; *lanceolate* (to slightly obovate), (5–)8–12(–17) × 1.5–6.5 cm, *base cuneate* or *slightly rounded*, margin not recurved, apex acuminate to cuspidate, acumen to 1.5 cm long, rarely apiculate; midrib and veins plane above, obscure or puckering along veins on drying; midrib slightly prominent beneath; lateral veins (5–)7–11(–13) pairs, plane beneath, marginal veins 1–2 mm from margin; *petiole* 0.5–1.5 cm long, not thickened, *drying black*, glabrous. **Inflorescences** axillary or extra-axillary, solitary or fascicled, *many-flowered panicle* with second and third order branching, (1.5–)3–6.5 cm, finely pubescent, lowermost branch *c.* 3 cm long, branches with 6–10 flowers clustered at the tips; peduncle (1–)4–7 mm long; bracts scarious, ovate, 1–2 mm long, persistent, minutely pubescent. **Flowers** *polygamous*, yellow-green or creamy white; buds pointed; pedicel 0–1 mm long. **Bisexual flowers:** *calyx* *c.* 1 mm long, divided about halfway, lobes acute, *densely grey hairy*; corolla 1–3 mm long, divided almost to base, lobes narrowly linear, twisted at anthesis; stamens subsessile, anthers less than 1 mm long, oblong; ovary ovoid, *c.* 1.5 mm long, glabrous, stigma bilobed. **Male flowers:** buds less than 1 mm across and strongly reflexed, other characters similar to bisexual flowers but without vestige of ovary. **Infructescences** not thickened. **Fruits** *pear-shaped*, to 1.2 × 0.8 cm, smooth, not curved; pericarp purplish red or bluish black; endocarp drying thin and brittle, *c.* 0.3 mm thick; stalk 1–5 mm long. **Seeds** albuminous.

Vernacular names. Sabah—*balit tangan* (Dusun), *kayu rambis* (Sungei Kinabatangan). Sarawak—*borah serang* (Kelabit).

Distribution. Sumatra, Peninsular Malaysia, Borneo (Sabah, Sarawak, Brunei, and Kalimantan), Sulawesi, Maluku, and New Guinea. In Sabah, common and widespread (e.g., *SAN 19195*, *SAN 28252*, *SAN 49386*, *SAN 65580*, *SAN 84823*, and *SAN 118967*). In Sarawak, widespread but not

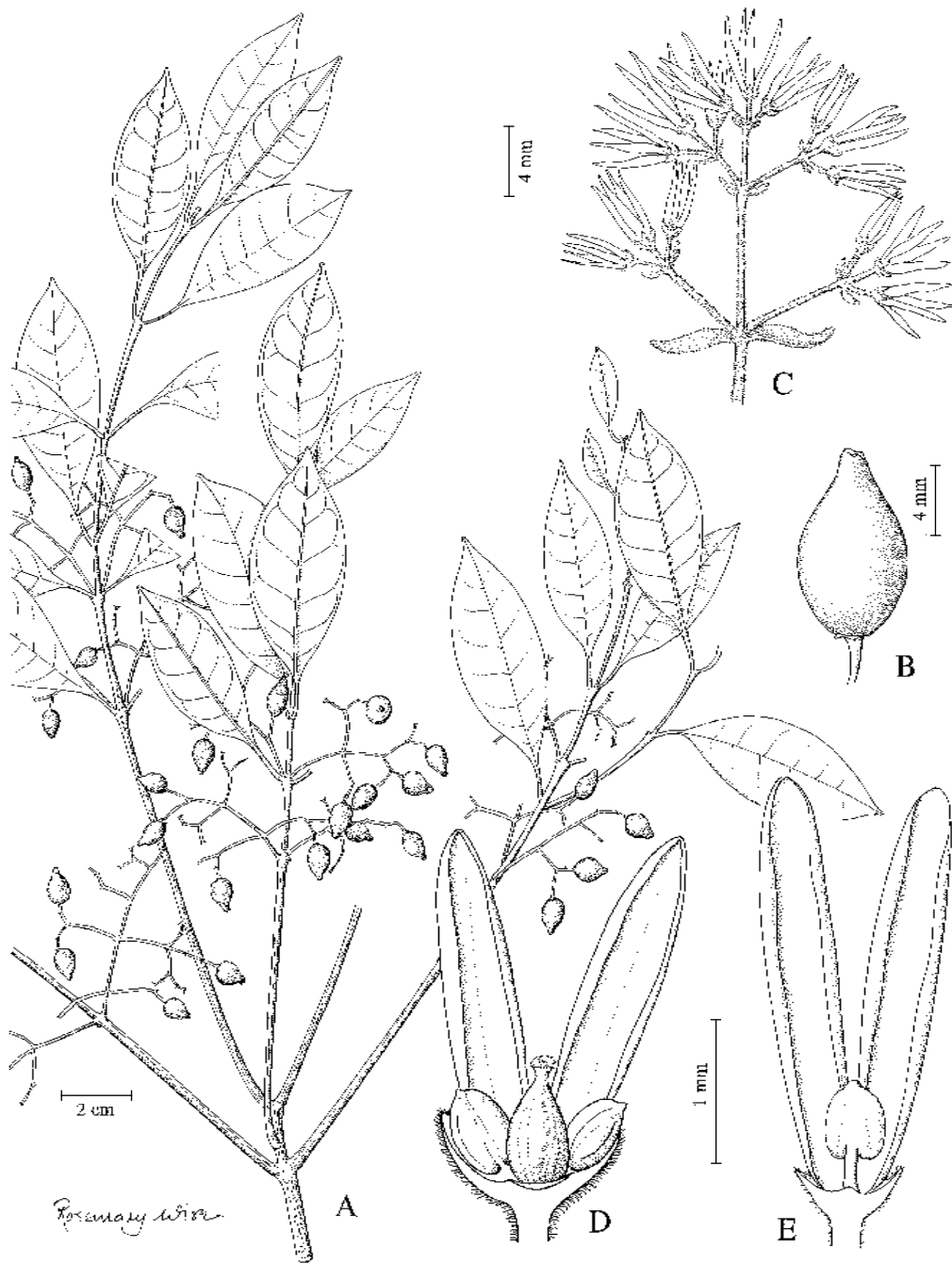


Fig. 4. *Chionanthus polygamus*. A, fructing leafy twig; B, fruit; C, part of inflorescence; D, longitudinal section of bisexual flower with two calyx lobes and two corolla lobes removed; E, longitudinal section of male flower with two calyx lobes, two corolla lobes and one stamen removed. (A–B from SAN 27505, C–D from SAN 111456, E from SAN A 429.)

as common (e.g., *S 29027*, *S 32030*, *S 34859*, *S 37588*, and *S 50994*). In Brunei, known from Belait, Temburong and Tutong districts (e.g., *BRUN 220* and *S 2001*). In Kalimantan, recorded from Martapura and W Kutei (e.g., *Korthals s.n.*, *Kostermans 12911* and *Kostermans 13036*).

Ecology. Primary or disturbed forest. In Sabah often found in forest on sandy soil or in swamp forest usually below 500 m altitude. In Sarawak usually occurs in *kerangas* forest at altitudes to 1400 m.

Uses. In the Kelabit Highlands, the wood is recorded as being used for building construction and the heartwood for carving tobacco pipes.

20. *Chionanthus porcatus* Kiew (Latin, *porcatus* = ridged; referring to the fruit)

Fig. 5.

Malay. For. 43 (1980) 387, *l.c.* (1981) 149. **Type:** *Singh SAN 28311*, Borneo, Sabah, Ranau district, Bt. Kulong (holotype SAN; isotypes KEP, L).

Tree, 7–20(–30) m tall, to 50 cm diameter; bole with buttresses to 4 m tall. **Bark** fissured or scaly, white or dark grey; inner bark greyish or orange-brown. **Sapwood** whitish. **Twigs** stout, *round in cross-section*, drying reddish brown, nodes strongly flattened, lenticels conspicuous, glabrous. **Leaves** *subcoriaceous*, glabrous, drying pale, greenish brown; *obovate*, 15–32 × 4–14 cm, *base tapering* or *narrowly cuneate*, margin slightly recurved, apex acute; midrib and veins plane or slightly impressed above, prominent beneath; lateral veins 11–16(–22) pairs, marginal veins 1–4 mm from margin; *intercostal venation obscure*; *petiole 2.5–5.5 cm long*, not thickened, *drying black*. **Inflorescences** axillary, produced on new shoots, solitary, *paniculate* with third order branching, 4–11 cm long, lowest branch 1–2.5 cm long; flowers clustered at tips of branches, pubescent; *peduncle more than half the length of inflorescences*, flattened, 2.4–8 cm long; bracts foliaceous, spatulate, to 7 × 5 mm, glabrous, persistent. **Flowers** bisexual, greenish yellow or white, fragrant; *buds pointed*; pedicel 0–2 mm long; calyx *c.* 1.5 mm long, fleshy, divided almost to base, lobes acute, pubescent; corolla *c.* 2 mm long, divided almost to base, lobes oblong, more or less straight at anthesis, minutely pubescent; stamens sessile, anthers oblong, *c.* 1 mm long, connective broad; ovary ovoid, *c.* 1.5 mm long, pubescent, stigma bilobed. **Infructescences** thickened, 8–17 cm long. **Fruits** broadly ellipsoid, 4.5–6.5 × 2.5–3.5 cm, *not curved, with deep 5 main longitudinal ridges*, based rounded, apex pointed, asymmetric, straight on one side, rounded on the other; *pericarp black, c. 6 mm thick*; mesocarp woody; pedicel *c.* 12 × 5 mm. **Seeds** albuminous.

Distribution. Endemic to Borneo (Sabah, Sarawak and SE Kalimantan). In Sabah, known from Keningau, Lahad Datu, Ranau, Sandakan, Tambunan, Tawau, and Tenom districts (e.g., *SAN 28311*, *SAN 43052*, *SAN 87768*, *SAN 121039*, and *SAN 132636*). In Sarawak, recorded only from Bario, Ulu Baram (e.g., *S 53545* and *S 53546*). In Kalimantan, reported from Sg. Kerajaan and Sg. Menumbang (e.g., *Kostermans 4963* and *Kostermans 5879*) and NE Pontianak (e.g., *Burley et al. 2952*).

Ecology. Primary, sometimes secondary, lowland forest, frequently on hillsides, at altitudes to 650 m.

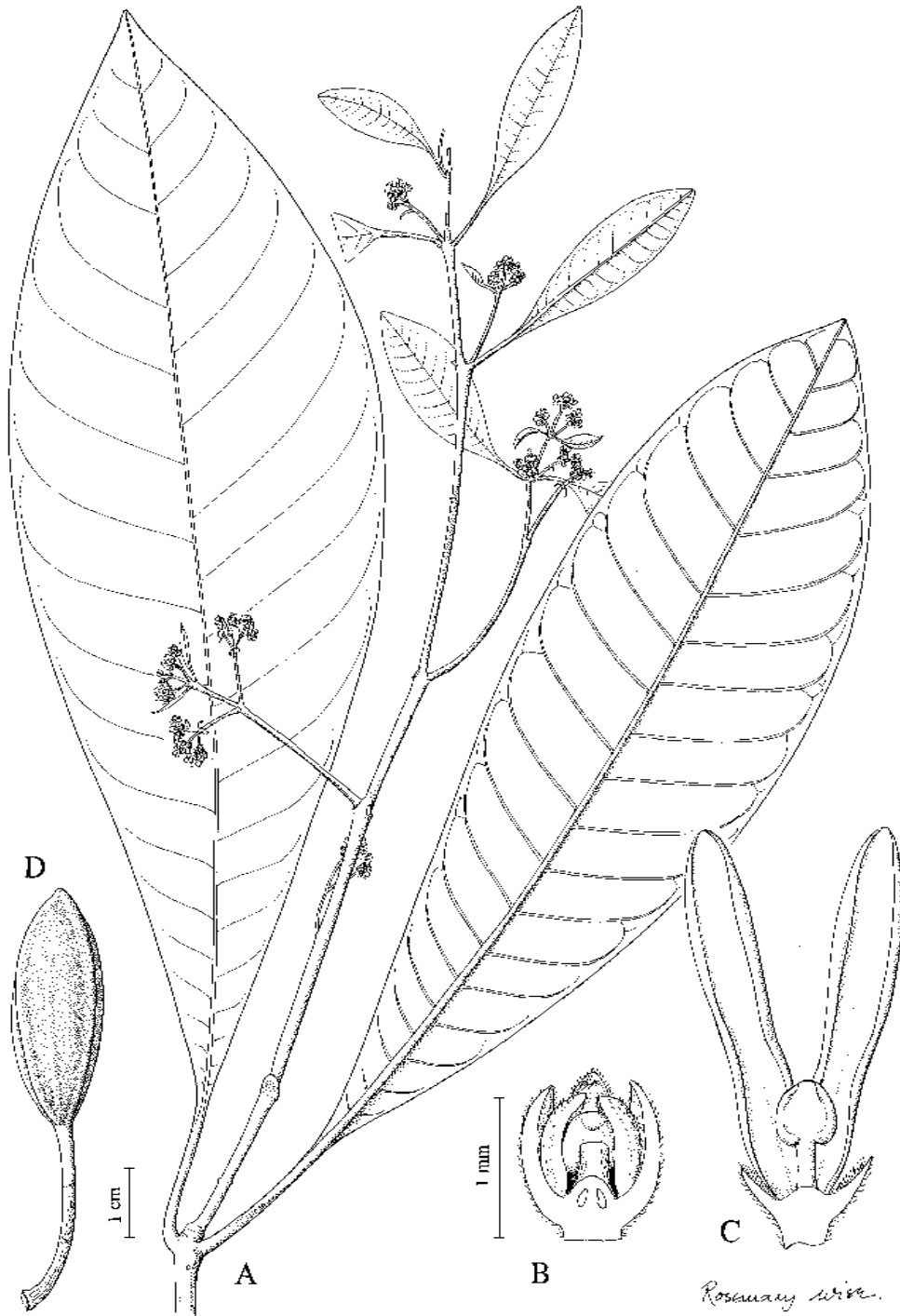


Fig. 5. *Chionanthus porcatus*. A, flowering leafy twig; B, longitudinal section of bisexual flower bud; C, longitudinal section of open male flower; D, fruit. (A–C from SAN 57768, D from SAN 28311.)

21. *Chionanthus pubicalyx* (Ridl.) Kiew

(Latin, *pubi-* = hairy; referring to hairy the calyx)

Malay. For. 44 (1981) 156. **Basionym:** *Linociera pubicalyx* Ridl., Kew Bull. (1934) 122. **Type:** *Haviland 1442*, Borneo, Sabah, Pulau Gaya (holotype K; isotypes SAR, SING).

Tree to 40 m tall and 30 cm diameter, flowering at *c.* 6 m tall; bole occasionally with buttresses *c.* 30 cm high. **Bark** whitish or grey, flaking; inner bark yellow. **Sapwood** white or yellowish, turning pinkish on exposure. **Twigs** slender, *round in cross-section*, dark grey, glabrous, flattened at nodes. **Leaves** *subcoriaceous*, glabrous, *drying dull and plane above, greenish grey or greenish brown with lateral veins slightly darker than leaf blade beneath; broadly elliptic to lanceolate, (6–)13(–15) × (2.5–)5.5 cm, broadest at the middle, base cuneate becoming shortly decurrent, margin finely recurved, apex acuminate to cuspidate, acumen 0.5–1.5 cm long; midrib slightly raised above and prominent beneath; lateral veins 5–9 pairs, plane and obscure above, slightly prominent beneath, marginal veins 2–3 mm from margin; petiole 0.5–1.25 cm long, moderately thickened, drying black.* **Inflorescence** axillary, solitary, *paniculate with first order branching, 1.5–5 cm long, branches in 4–5 tiers, lowermost 1.5–2.5 cm long, upper branches decreasing in length, each with a cluster of 3–4 flowers at the tips, glabrous; peduncle 0.25–0.75 cm long; bracts scale-like, ovate, 1.5–2 mm long, pubescent persistent.* **Flowers** *bisexual, white or pale yellow, with slight citron fragrance (Chew et al. 2762); pedicel (0.5–)1–1.5 mm long; calyx 1–1.5 mm long, divided less than halfway, lobes acute, pubescent; corolla (2–)3–5 mm long, divided almost to base, lobes narrowly linear, involute, apex cucullate, straight at anthesis, glabrous; stamens almost sessile, epipetalous, anther *c.* 1 mm long, apex apiculate; ovary ovoid, stigma capitate or obscurely bilobed.* **Infructescences** slightly thickened, to 4 cm long. **Fruits** *ovoid with rounded apex, to 2 × 1.5 cm, or rotund with diameter 1.7 cm, smooth, not curved; pericarp dull purple, brittle, *c.* 1 mm thick; stalk 1–2 mm long.* **Seed** endospermous.

Distribution. Endemic to Borneo. Common in Sabah (e.g., *Clemens 29397, SAN 28302, SAN 31651, SAN 42097, SAN 87412, and SAN 121740*), infrequent in Sarawak (e.g., *S 40309*) and Brunei (e.g., *SAN 17574*).

Ecology. Primary mixed dipterocarp forest or in disturbed or secondary forest on hill sides or ridges, at altitudes to 1600 m (G. Kinabalu).

22. *Chionanthus ramiflorus* Roxb.

(Latin, *ramiflorus* = flowering on the older branches)

Fl. Ind. 2nd. edition 1 (1832) 107; Kiew, Malay. For. 42 (1979) 274, *l.c.* (1980) 388, *l.c.* (1981) 150, *l.c.* (1989) 289; Corner, WSTM 3rd. edition 2 (1988) 601; Coode *et al.* (eds.) *l.c.* 248. **Type:** *Wight l.c. no. 734.* **Synonyms:** *Linociera ramiflora* (Roxb.) Wall. *ex A.DC.*, Prodr. 8 (1844) 297, Merrill *l.c.* (1921) 489, Masamune *l.c.* 613, Backer & Bakhuizen *f. l.c.* 214, Anderson *l.c.* 285; *Olea pauciflora* Wall. *ex DC. l.c.* 297; *L. pauciflora* (Wall. *ex A.DC.*) C.B. Clarke *in Hooker f.*, Fl. Br. Ind. 3 (1882) 609, King & Gamble *l.c.* 266, Merrill *l.c.* (1921) 489, Ridley *l.c.* (1923) 317, Masamune *l.c.* 612, Corner *l.c.* 601.

Tree to 20 m tall and 30 cm diameter. **Bark** smooth, grey-brown, lenticellate; inner bark brown. **Sapwood** whitish yellow. **Twigs** slender, *round in cross-section*, drying white or light grey, nodes flattened, lenticels conspicuous, glabrous. **Leaves** *chartaceous or subcoriaceous*, glabrous,

drying green-brown on both surfaces, glossy above; oblong-lanceolate, elliptic or obovate, (6.5–)9–15(–29) × (2–)4–7(–10.5) cm, base cuneate, rounded or sometimes decurrent, margin slightly recurved, apex acuminate, rounded or sometimes acute; midrib impressed above; lateral veins 8–12 pairs, plane above, prominent beneath, marginal vein *c.* 2 mm from margin; *intercostal venation conspicuous*; *petiole 1.5–3 cm long*, not thickened, *drying black*. **Inflorescences** axillary, solitary, *paniculate with second or third order branching* and 3–6 distant branches, (0.5–)3–13 cm long, lowest branch (0.5–)1.5–3(–5) cm long; *flowers spaced*, glabrous; peduncle 1.5–3.25 cm long; bracts foliaceous, spatulate, 3–15 mm long, glabrous, persistent. **Flowers** bisexual, white or pale yellow, fragrant; pedicel 1–3 mm long; *buds rounded*; calyx less than 1 mm long, divided almost to base, lobes acute, glabrous; corolla 2–3 mm long, divided almost to base, lobes oblong, joined in pairs for *c.* a quarter of the length, more or less straight at anthesis; stamens sessile, anther oblong, *c.* 1 mm long, yellow; ovary ovoid, *c.* 1 mm long, glabrous, stigma bilobed. **Infructescences** thickened, to 12 cm long. **Fruits** ellipsoid, 2(–4) × 1(–2) cm, *smooth, not curved*, apex blunt or apiculate, often galled; *pericarp purple-black, drying thin and brittle*; stalk 2–5 mm long, conspicuously swollen. **Seeds** exalbuminous; cotyledons fleshy.

Distribution. E India, Indo-China, Taiwan, throughout Malesia to Australia (Queensland), and the Solomon Islands. In Borneo, common and widespread. In Sabah, recorded from many localities (e.g., *SAN 20672*, *SAN 44556*, *SAN 56112*, *SAN 76234*, and *SAN 80678*). In Sarawak, known from Bau, Kuching, Limbang and Marudi districts (e.g., *Haviland 1766*, *Nooteboom & Chai 2133* and *S 41183*). Also occurs in Brunei (e.g., *Atkins SA 451*, *BRUN 5143*, *Simpson DS 2182*, and *Wong WKM 150*) and Kalimantan.

Ecology. Primary and secondary forests, frequent in coastal and riverine vegetation at altitudes below 300 m, but occasionally also found in lower and upper montane forests, at altitudes to 2200 m.

Notes. Galls replacing fruits are not infrequent in this species. One type is easily recognisable as a gall as it is composed of disorganised corky abnormal growth; the other type has the appearance of a fruit rather resembling those of *C. polygamus* in the acutely pointed apex. Besides the shape, the galls also differ from normal fruits in being smaller, *c.* 1 × 0.5 cm, brown and somewhat shiny.

23. *Chionanthus rugosus* Kiew

(Latin, *rugosus* = rough and pimply; referring to fruit surface)

Malay. For. 43 (1980) 389, *p.p.* **Type:** *Banyeng & Sibat S 27067*, Borneo, Sarawak, Semengoh FR (holotype SAR; isotypes A, L).

Tree to 20 m and 10 cm diameter. **Bark** smooth, greyish. **Twigs** slender, *round in cross-section*, drying white, slightly flattened at nodes, without lenticels, sparsely pubescent when young. **Leaves** *subcoriaceous*, glabrous, *drying dull and plane above*, chestnut- or olive-brown on both surfaces; *lanceolate, widest at or above the middle*, 8–14.5 × 2.5–5 cm, *base tapered*, margin recurved, *apex cuspidate*, acumen 1–1.5 cm long; midrib slightly impressed above, prominent beneath; *lateral veins 4–7 pairs*, slightly impressed above, *prominent beneath*, marginal vein *c.* 2 mm from margin; *intercostal venation obscure*; *petiole 0.3–0.6 cm long*, not thickened, *drying black*. **Inflorescences** and **flowers** unknown. **Infructescences** axillary or extra-axillary, *racemose*, 0.3–2 cm long; peduncle to 0.5 cm long, thickened. **Fruits** green (?immature), ovoid,

c. 0.7 × 0.5 cm, rugose, not curved, apex rounded, base narrowed; stalk *c.* 4 mm long and 2 mm thick. **Seeds** unknown.

Distribution. Endemic to Borneo and known only from the Semengoh FR in Sarawak (e.g., S 24925, S 26287 and S 27067).

Ecology. Lowland mixed dipterocarp forest on hill slopes or river banks.

24. *Chionanthus sabahensis* Kiew

(of Sabah, Borneo)

TFSS 4, App. (2002) 354. **Type:** Carr SFN 27170, Borneo, Sabah, G. Kinabalu, Ulu Kinunut (holotype SING).

Tree to 13 m tall and 10 cm diameter. **Bark** smooth, green; inner bark grey-brown. **Sapwood** white. **Twigs** slender, *round in cross-section*, glabrous, flattened at nodes, drying pale brown, sometimes lenticellate. **Leaves** *slightly subcoriaceous*, glabrous, *dull and plane above, drying greenish grey above and green-brown beneath; narrowly lanceolate, 14–21.5 × 3.5–6 cm, widest at the middle, base cuneate* sometimes unequal, margin slightly recurved, *apex acute to acuminate*; midrib impressed above, prominent beneath; *lateral veins* 9–11 pairs, slightly impressed above, *slightly concolorous with leaf blade and prominent beneath*, marginal vein 1–3 mm from margin; intercostal venation obscure; *petiole* 0.75–1.5 cm long, not thickened, *drying black*. **Inflorescences** axillary, solitary, *racemose panicle with first order branching, 7–13 cm long*, lower branches 2–3 cm long with flowers clustered at tips of branches; peduncle 1–2 cm long; bracts scarious, ovate, *c.* 0.75 cm long, minutely pubescent, persistent. **Flowers** *bisexual*, greenish white; pedicel 1–1.5 mm long; calyx *c.* 0.5 mm long, divided *c.* halfway, lobes acute, margin ciliate; corolla and stamens not known; ovary ovoid, *c.* 1 mm long, glabrous, stigma capitate. **Infructescences** thickened, 4–10 cm long. **Fruits** *globose, up to 2.3 cm diameter, smooth, not curved*, ripening cream-green or bright-green; pericarp sometimes with white lenticels, *c.* 1.5 mm thick; endocarp woody; stalk 2–3 × 3 mm. **Seeds** endospermous.

Distribution. Endemic to Borneo and known only from Sabah (e.g., Beaman *et al.* 10447, Clemens 27568, Clemens 28847, Clemens 31588, Price 218, and SAN 41890).

Ecology. Lower montane forest at 1350–2200 m altitude.

25. *Chionanthus spicatus* Blume

(Latin, *spicatus* =bearing a spike; referring to the spicate inflorescence)

Mus. Bot. Lugd. Bat. 1 (1850) 318; Coode *et al.* (eds.) *l.c.* 248. **Type:** Korthals *s.n.* (= RHL Sheet No. 908161119), Borneo, Kalimantan, G. Bataran (holotype L). **Synonyms:** *Linociera spicata* (Blume) Knobl. *l.c.* 87; *L. oligantha* Merr. *l.c.* (1918) 118, *l.c.* (1921) 489, *l.c.* (1929) 249, Masamune *l.c.* 612, Anderson *l.c.* 285; *Chionanthus oliganthus* (Merr.) Kiew *l.c.* (1980) 379, *l.c.* (1981) 152.

Small tree, 3–8(–17) m tall, to 20 cm diameter. **Bark** smooth, greyish; inner bark yellow-orange. **Sapwood** pinkish white. **Twigs** *slender, round in cross-section*, drying white, slightly flattened at nodes, lenticels inconspicuous, glabrous. **Leaves** chartaceous to subcoriaceous, glabrous, *drying*

dull, pale grey-green; narrowly lanceolate to elliptic-oblong, sometimes slightly obovate, 10–17 × 3.5–7 cm, base narrowly cuneate to shortly decurrent, margin not recurved, apex cuspidate (or sometimes acuminate), acumen 1–2 cm long; midrib and lateral veins slightly impressed above, prominent beneath; lateral veins 5–8 pairs, marginal vein 2–5 mm from margin; petiole 0.5–0.7(–1) cm long, thickened, drying fawn. **Inflorescences** axillary or sometimes extra-axillary, solitary or in pairs, racemose with 3–5 pairs of distant flowers, 0.5–1.5 cm long; peduncle 0.2 cm long, glabrous or sparsely pubescent; bracts scarious, ovate, c. 1.5 mm long, pubescent. **Flowers** bisexual, creamy white or yellowish green, sometimes purple inside, fragrant; buds pointed; pedicel to 1 mm long; calyx 0.5–1.5 mm long, divided almost to base, lobes ovate or rounded, glabrous or sparsely pubescent; corolla 4–8(–11) mm long, divided almost to base, lobes narrowly linear, slightly twisted at anthesis; stamens sessile, attached at base of corolla, anther oblong, c. 1 mm long; ovary ovoid, c. 1 mm long, glabrous, stigma bilobed. **Infructescences** thickened, to 2 cm long. **Fruits** globose, c. 1.8 cm diameter, smooth, not curved, apex rounded; pericarp purple-black, 1–2 mm thick; endocarp leathery; stalk c. 3 mm long and 3 mm thick. **Seeds** albuminous.

Vernacular name. Kalimantan—*nginjojo* (Land Dayak).

Distribution. Borneo (Sabah, Sarawak, Brunei, and Kalimantan) and the Philippines. In Sabah, recorded from most districts (e.g., *SAN 16094*, *SAN 16590*, *SAN 54361*, and *SAN 56850*). In Sarawak, known from Bau, G. Buri, G. Pueh, Bt. Mersing, Kelabit Highlands, and Melinau (e.g., *S 36767*, *S 48920*, *S 48986*, and *S 53526*). In Brunei, recorded by two collections (*Dransfield JD 7394* and *Schatz 3252*) from Kuala Belalong Field Study Centre in Temburong district and in Kalimantan known from Bt. Baka NP and Kota Waringin (e.g., *Argent & Amiril 9382*, *Church et al. 158* and *Church et al. 490*).

Ecology. Lowland mixed dipterocarp to lower montane forest, at altitudes to 1500 m, on limestone scree and occasionally in *kerangas* forest.

Incompletely known species

1. *Chionanthus* sp. 1

Tree to 7 m tall. **Twigs** white. **Leaves** drying deep chestnut-brown on both surfaces; broadly lanceolate, to 23 × 11 cm; lateral veins 12–14 pairs, impressed above, prominent beneath; petiole stout, c. 1.25 cm long, drying black. **Inflorescence** a twice branched panicle, c. 2.5 cm long. **Fruits** unknown.

Specimens examined: Borneo, Sarawak, G. Santubong, *Banyeng & Sibat S 21518*; G. Pueh, *Clemens 20115* (previously identified as *C. longipetalus*).

2. *Chionanthus* sp. 2

Tree c. 20 m tall. **Twigs** drying brown. **Leaves** drying pale brown; lanceolate to slightly ovate, 10–16 × 5–6 cm; lateral veins 8–10 pairs, deeply impressed above, prominent beneath; petiole stout, c. 1 cm long, drying black. **Inflorescence** a twice branched panicle, 3.5–6 cm long. Petals c. 4 mm long, twisted on anthesis. **Fruits** unknown.

Specimens examined: Borneo, Sabah, G. Kinabalu, *Chew et al. 286*; Brunei, Bt. Belalong, Wong *WKM 1394*.

3. *Chionanthus* sp. 3

Twigs white. **Leaves** drying chestnut-brown on both surfaces; lanceolate, *c.* 11 × 4.5 cm, apex cuspidate; lateral veins 9–11 pairs, deeply impressed above, prominent beneath; petiole *c.* 0.5 cm long, drying black. **Inflorescence** a short raceme, 1–1.5 cm long. Petals 5–6 mm long, twisted at anthesis. **Fruits** unknown.

Specimens examined: Borneo, Sarawak, Kuching, *Haviland 2167* (previously identified as *C. longipetalus*).

2. *LIGUSTRUM* L.

(Latin name for the privet bush)

Sp. Pl. 1 (1753) 7; Backer & Bakhuizen *f.*, FJ 2 (1965) 215; Kiew, *Blumea* 24 (1978) 143, TFM 4 (1989) 290; Corner, WSTM 3rd. edition 2 (1988) 602.

Shrubs or *small trees*. **Leaves** *simple and entire*, elliptic to more or less ovate, rarely linear. **Inflorescences** *terminal*, sometimes also axillary, paniculate, usually hairy; bracts foliaceous. **Flowers** bisexual, *to 8 mm long*; calyx shortly tubular with 4 small teeth; *corolla tubular with 4 lobes as long or longer than tube*, lobes induplicate-valvate in bud, opening more or less horizontally, white or yellow; stamens with thin filaments, anthers projecting beyond corolla tube; ovary globose, *style 1–2 mm long*, projecting beyond calyx after the corolla has fallen. **Fruits** *fleshy, drupaceous*, with 1 to 3 endospermic, *non-winged* seeds.

Distribution. About 40 species, the majority occur in temperate Asia, extending to Europe and through Malesia to Australia. In Sabah, one species is known.

Ecology. Usually in open places in lowland to montane forest.

Uses. In Europe, the Japanese *L. ovalifolium* Hassk. is a common hedge plant. *L. sinense* Lour. is used for a similar purpose in Asia, for example, it has been planted in the hill stations in Peninsular Malaysia.

Ligustrum glomeratum Blume

Fig. 6.

(Latin, *glomeratum* = collected closely together in a head; referring to the crowded flowers on the tips of inflorescence branches)

Mus. Bot. Lugd. Bat. 1 (1850) 314; Backer & Bakhuizen *f. l.c.* 215; Kiew *l.c.* (1978) 147, *l.c.* (1989) 290. **Lectotype** (Kiew, 1978): *Blume 945*, Java (holotype L).

Shrub or small tree to 15 m tall. **Twigs** pale brown, densely pubescent near apex, lenticellate. **Leaves** chartaceous to subcoriaceous, glossy above, glabrous beneath, or densely hairy on midrib

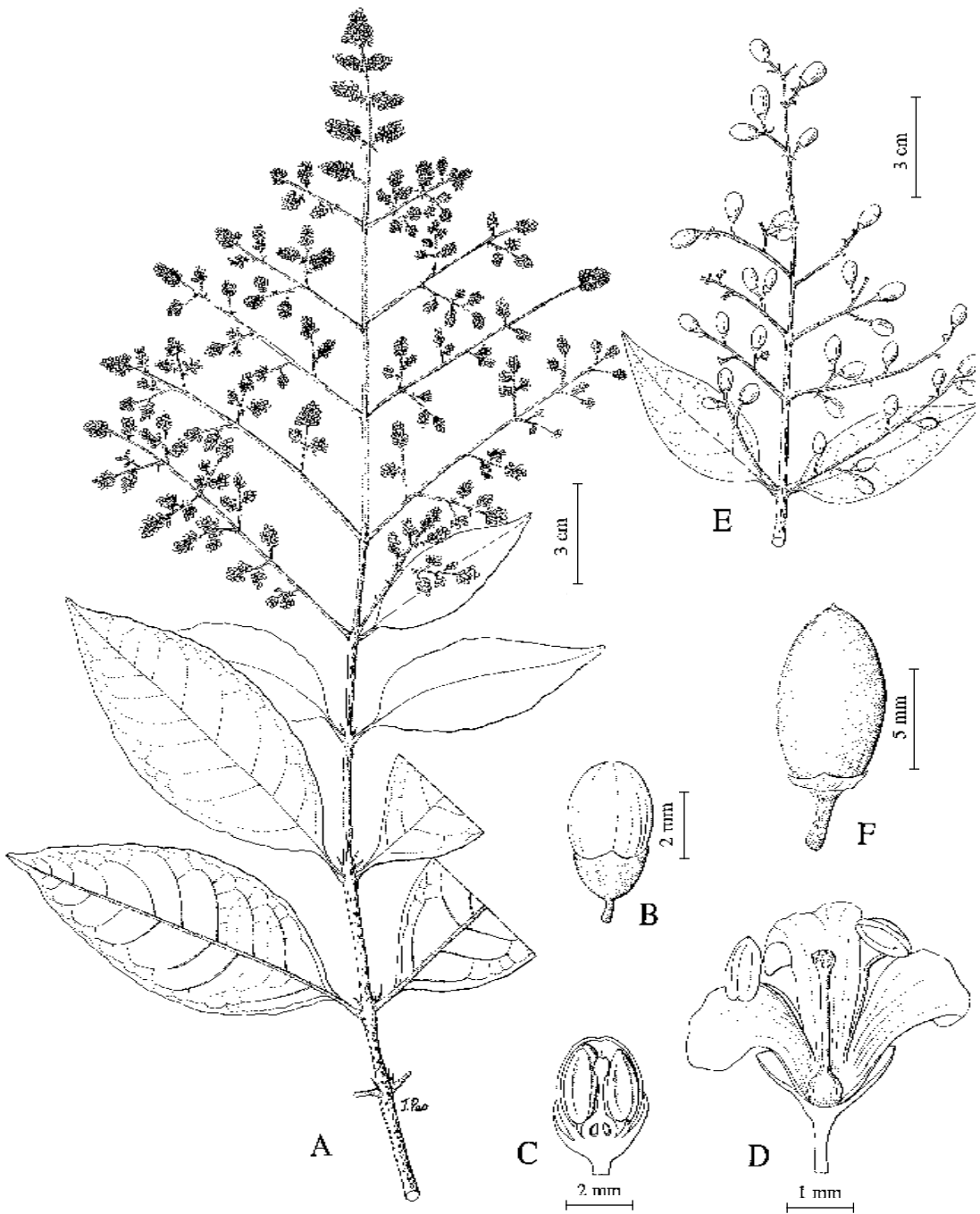


Fig. 6. *Ligustrum glomeratum*. A, flowering leafy twig; B, flower bud; C, longitudinal section of flower bud; D, longitudinal section of flower with one corolla lobe removed; E, infructescence; F, fruit. (A–D from *SAN 123276*, E–F from *SAN 124962*.)

beneath; ovate-lanceolate to oblong, (3–)7–8(–9) × (2–)3.5(–5) cm, base cuneate to decurrent, apex acuminate to cuspidate (rarely obtuse); midrib grooved above; lateral veins conspicuous above and beneath, 6–7 pairs; petiole 0.5–0.9 cm long, glabrous or pubescent. **Inflorescences** pyramidal, 8–17 cm long, with 5–7 tiers of branches, lowest branch 6–10 cm long, branches decreasing in length towards apex, more or less horizontal, pubescent to villous; bracts *c.* 3 cm long. **Flowers** sweetly scented, densely clustered, subsessile or with pedicel to 1 mm long; calyx scarcely lobed, tube *c.* 1 mm long, glabrous; corolla white or yellow, tube *c.* 1 mm long, lobes 1–2(–3) mm long; stamens with filaments *c.* 2 mm long, anthers projecting beyond corolla tube in open flowers; style 1–2 mm long, slender and projecting beyond calyx in open flower. **Fruits** ellipsoid to obovoid, 0.5–0.8 × 0.4–0.5 cm, fleshy, ripening dark purple, tasting bitter sweet, 1(–3)-seeded; stalk 1–5 mm long.

Distribution. S Thailand, Peninsular Malaysia, Sumatra, Borneo (Sabah), the Philippines, Java, Lesser Sunda Islands, Sulawesi, Maluku, and New Guinea. In Sabah, locally common in Kota Belud, Ranau and Tambunan districts (e.g., *SAN 28544*, *SAN 33070*, *SAN 89464*, *SAN 95525*, and *SAN 116550*).

Ecology. In primary and secondary lowland and hill mixed dipterocarp forest, near rivers or on hill slopes, at altitudes to 1600 m.

3. OLEA L.

(Latin name for olive tree)

Sp. Pl. 1 (1753) 18; King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 269; Ridley, FMP 2 (1923) 318; Backer & Bakhuizen *f.*, FJ 2 (1965) 214; Kiew, Blumea 25 (1979) 307, TFM 4 (1989) 291, Gard. Bull. Sing. 51 (1999) 85; Corner, WSTM 3rd. edition 2 (1988) 603.

Shrubs or small to medium-sized trees. **Twigs** whitish or brown, glabrous, sometimes minutely pubescent. **Leaves** *simple*, *margin entire* or *toothed*, coriaceous, sometimes membranaceous, elliptic-lanceolate to ovate, minutely lepidote. **Inflorescences** paniculate, *axillary* or *ramiflorus*, glabrous or minutely pubescent; bracts foliaceous, small and caducous. **Flowers** *1–5 mm long*, *polygamous* or *unisexual*; *buds rounded*; calyx short, tubular, divided *c.* halfway, persistent; *corolla tube as long or slightly longer than lobes*, *lobes 4*, induplicate-valvate, apex cucullate and scarcely opening, white or yellow, glabrous; stamens 2, attached near base of corolla tube, anthers subsessile, broadly oblong, *c.* 1 mm long; ovary *c.* 2 mm long, *style very short*, *stigma sessile* or *subsessile*, weakly bilobed. **Fruits** *fleshy and drupaceous*; epicarp thin and fleshy; mesocarp and endocarp thin and crustose or bony. **Seeds** *not winged*, with bony or fleshy endocperm.

Distribution. About 30 species; Mediterranean, Africa, Madagascar, E Asia, Malesia, Australia, New Zealand, and Polynesia. In Sabah and Sarawak three (3) species are known.

Ecology. Mostly in primary lowland mixed dipterocarp forest but *Olea rubrovenia* extends to upper montane forest, at altitudes to 3800 m on G. Kinabalu.

Key to *Olea* species

1. Leaf margin entire; lateral veins deep red and conspicuous beneath. Axillary buds large and mammiform.....**3. *O. rubrovenia***
 Leaf margin serrate or subserrate; lateral veins concolourous with leaf blade beneath. Axillary buds small.....**2**
2. Leaves frequently obovate; petiole conspicuously thickened, drying pale fawn. Flowers to 1 mm long. Fruits 0.8–1.5 × 0.5–0.8 cm.....**1. *O. borneensis***
 Leaves lanceolate; petiole not thickened, drying black. Flowers 1.5–2.5 mm long. Fruits to 0.5 cm diameter.....**2. *O. brachiata***

1. *Olea borneensis* Boerlage (of Borneo)

Fig. 7.

Handl. Fl. Ned. Ind. 2 (1899) 332; Kiew, Blumea 25 (1979) 308, *l.c.* (1989) 291, *l.c.* (1999) 89. **Type:** *Korthals s.n.* (= RHL Sheet No. 90815551), Borneo, Kalimantan, without locality (holotype L).

Tree to 25 m tall and 20 cm diameter; clear bole to 5 m tall. **Bark** smooth or scaly, whitish or light grey; inner bark reddish or orange-brown. **Sapwood** white. **Twigs** white, glabrous, flattened at nodes; *axillary buds small*. **Leaves** thinly coriaceous, minutely punctate beneath, drying greyish or brownish green; *frequently obovate*, (7–)14(–17) × 3–8 cm, base cuneate, *margin serrate* or *subserrate in the upper half*, finely recurved, apex broadly acute to shortly acuminate, rarely rounded; midrib slightly impressed above; *lateral veins* 6–9 pairs, ascending, *concolorous with leaf blade beneath*, inconspicuous or slightly impressed above, obscure or slightly prominent beneath, marginal vein *c.* 3 mm from margin; intercostal venation obscure; *petiole* 0.5–1 cm long, *conspicuously thickened*, *drying pale fawn*. **Inflorescences** solitary or fascicled, slender, 1.5–8 cm long, lateral branches 0.5–1.5 cm long, of equal length; flowers distantly spaced, 4–8 per branchlet; peduncle (0.2–)0.5–1.5 cm long; bracts minute. **Flowers** polygamous, *to 1 mm long*; pedicel 1–1.5 mm long; calyx margin sparsely ciliate; corolla whitish or yellowish green, tube twice as long as the cucullate lobes; stamens subsessile, attached halfway on corolla tube, anthers 0.5–0.75 mm long and wide, apex scarcely exposed as the lobes open. **Male flowers** (buds) spherical and minute to 1 mm diameter, calyx lobes acute, corolla 1–2.5 mm long. **Bisexual flowers** with scarcely lobed calyx, corolla *c.* 1.8 mm long, stamens as in male flowers, ovary ellipsoid, *c.* 1 mm long, narrowing abruptly to the slightly bifid minute stigma. **Fruits** broadly ellipsoid to almost globose, 0.8–1.5 × 0.6–0.8 cm, apex rounded, stigma persistent, ripening black; endocarp thin and woody, *c.* 0.5 mm thick. **Seeds** endospermic.

Distribution. Borneo (Sabah and Kalimantan) and the Philippines. In Sabah, common (e.g., *SAN 18808*, *SAN 54929*, *SAN 57438*, *SAN 77236*, and *SAN 90777*). In Kalimantan, known by the type and *bb. 12037* from Martapura.

Ecology. In primary mixed dipterocarp to lower montane forest, frequently on steep slopes and ridges, at altitudes to 1650 m, including on ultramafic soils (Bt. Hampuan, Sabah).

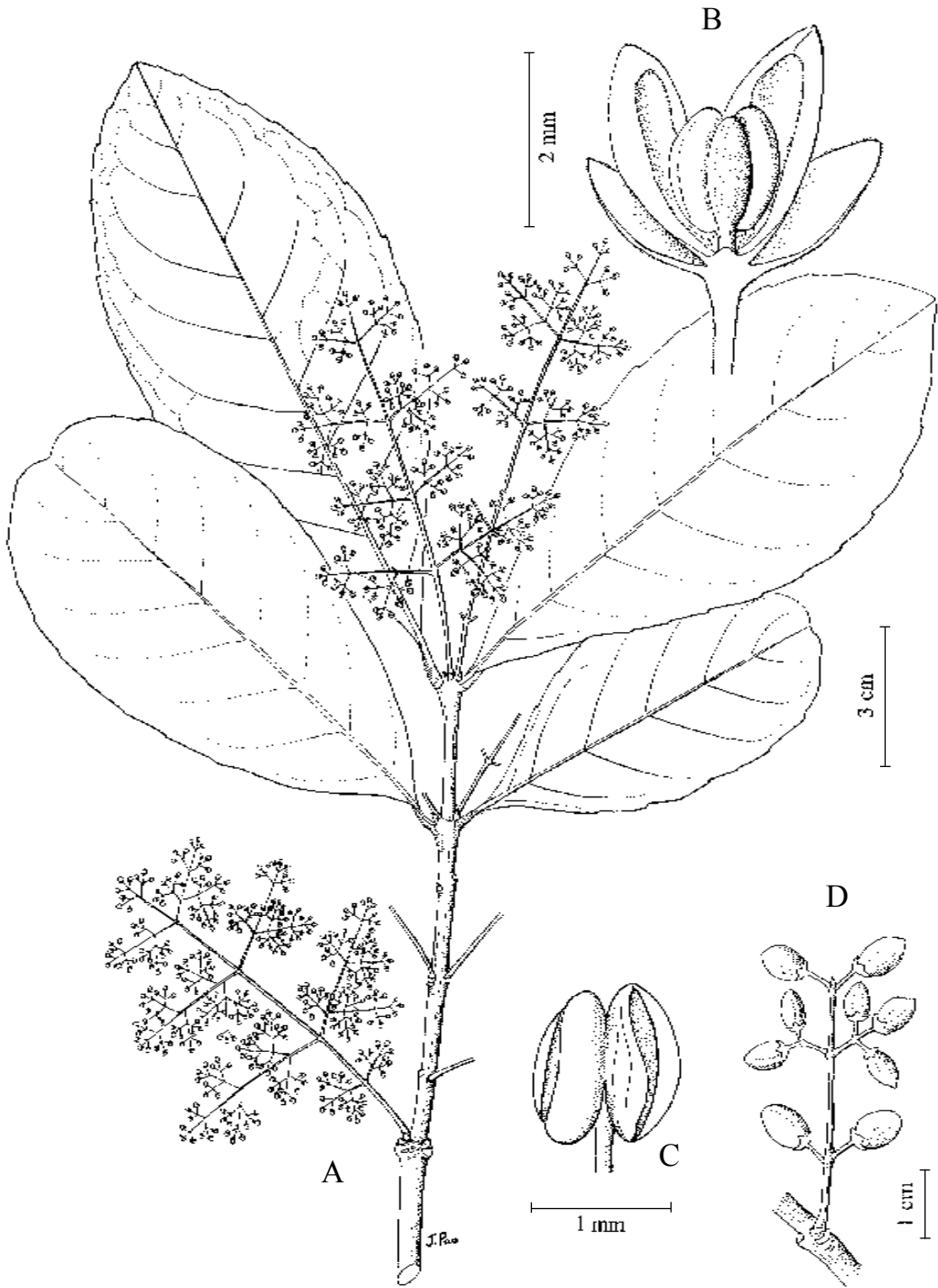


Fig. 7. *Olea borneensis*. A, flowering leafy twig; B, longitudinal section of male flower with two calyx lobes, two corolla lobes and one stamen removed; C, dehiscent stamen; D, infructescence. (A–C from SAN 54929, D from SAN 90777.)

2. *Olea brachiata* (Lour.) Merr.

(Latin, *brachiatus* = branched in a decussate manner; referring to the inflorescence)

Lingn. Agr. Rev. 2 (1925) 127; Kiew, *Blumea* 25 (1979) 308, *l.c.* (1989) 291, *l.c.* (1999) 90; Corner *l.c.* 603.

Basionym: *Tetrapilus brachiatus* Lour., Fl. Cochinchina 2 (1790) 611. **Type:** *Louriero s.n.*, Indo-China (holotype BM). **Synonym:** *O. maritima* Wall. ex G. Don, Gen. Syst. 4 (1838) 49, Anderson *l.c.* 285.

Shrub or small tree to 10 m tall and 5 cm diameter. **Twigs** pale brown, minutely pubescent; *axillary buds small*. **Leaves** subcoriaceous, glabrous, not punctate beneath, drying greyish green; *lanceolate*, (4.5–)8–10(–13) × (2–)3–5(–6) cm, base cuneate or somewhat rounded, margin *serrate or subserrate in upper half*, finely recurved, apex strongly acuminate; midrib impressed above, prominent beneath; *lateral veins* 7–10 pairs, obscure and *concolourous with leafblade beneath*; *petiole* 5–7 mm long, *not thickened, drying black*, minutely pubescent when young. **Inflorescences** axillary or extra-axillary, 1–3 cm long, trichotomously branched panicle terminating in subumbels of 3–10 flowers, lowest branches 2–5 mm long, minutely pubescent; peduncle 1–1.5 cm long; bracts leafy, narrowly ovate-lanceolate, caducous. **Flowers** unisexual, 1.5–2.5 mm long; pedicel to 3 mm long; calyx *c.* 1 mm long, deeply divided, lobes ovate-acute, minutely pubescent; corolla dull white, 1.5–2.5 mm long, divided about halfway down, lobes elliptic with rounded apex, spreading at anthesis. **Male flowers:** buds globose, 1–1.5 mm long, stamens subsessile, anthers *c.* 1–2 mm long. **Female flowers:** ovary globose, stigma subsessile, broadly and slightly bilobed. **Fruits** globose, *c.* 5 mm diameter, purple-black when ripe; stalk *c.* 2 mm long. **Seeds** endospermic.

Distribution. Indo-China, Thailand, Sumatra, Peninsular Malaysia, Anambas Is., and Borneo (W Sarawak). In Sarawak, rare, found only on rocky shores around G. Santubong (e.g., *Haviland 3040*).

3. *Olea rubrovenia* (Elmer) Kiew

Fig. 8.

(Latin, *rubro* = red, *venia* = veins; referring to the deep red lateral veins)

Gard. Bull. Sing. 51 (1999) 95. **Basionym:** *Linociera rubrovenia* Elmer, Leaf. Philip. Bot. 2 (1909) 586, *ibid.* 5 (1913) 1613; Merrill, Enum Philip. Pl. 3 (1923) 305. **Type:** *Elmer 10224*, the Philippines, Negros Is. (holotype US; isotypes A, K, L). **Synonym:** *Tetrapilus rubrovenius* (Elmer) L.A.S. Johnson, Contrib. N.S.W. Herb. 2 (1957) 408; *Ilex decussata* Heine, Mitt. Bot. Staatsaml. Muenchen 6 (1953) 209; *Olea decussata* (Heine) Kiew, *Blumea* 25 (1979) 309.

Shrub or tree to 30 m tall and 20 cm diameter. **Bark** smooth, whitish; inner bark orangey. **Sapwood** pale yellow. **Twigs** when young green, drying black, older twigs white with scattered lenticels, glabrous; *axillary buds large and mammiform*, leaving a collar of persistent stiff bud scales around origin of new shoots. **Leaves** coriaceous to thickly coriaceous, glabrous and minutely punctate beneath, drying tan or reddish brown; broadly to rarely narrowly elliptic, 7–14(–22) × (2–)3–5.5(–8) cm, base cuneate or rounded, *margin entire* (in coriaceous leaves strongly recurved), apex acute to acuminate, acumen *c.* 1 cm long; midrib impressed above, prominent beneath; *lateral veins* 6–9 pairs, ascending, plane to finely impressed above, *slightly prominent and deep red* (discolorous with leaf blade) *beneath*, marginal veins 1.5–2 mm from margin; *petiole* 0.5–1.2(–2.5) cm long, glabrous, drying black and in thickly coriaceous leaves thick and wrinkled. **Inflorescences** axillary and frequently extra-axillary, glabrous or minutely pubescent, (1.5–)3.5–4(–6) cm long, lowest branch *c.* half the length of inflorescence; peduncle

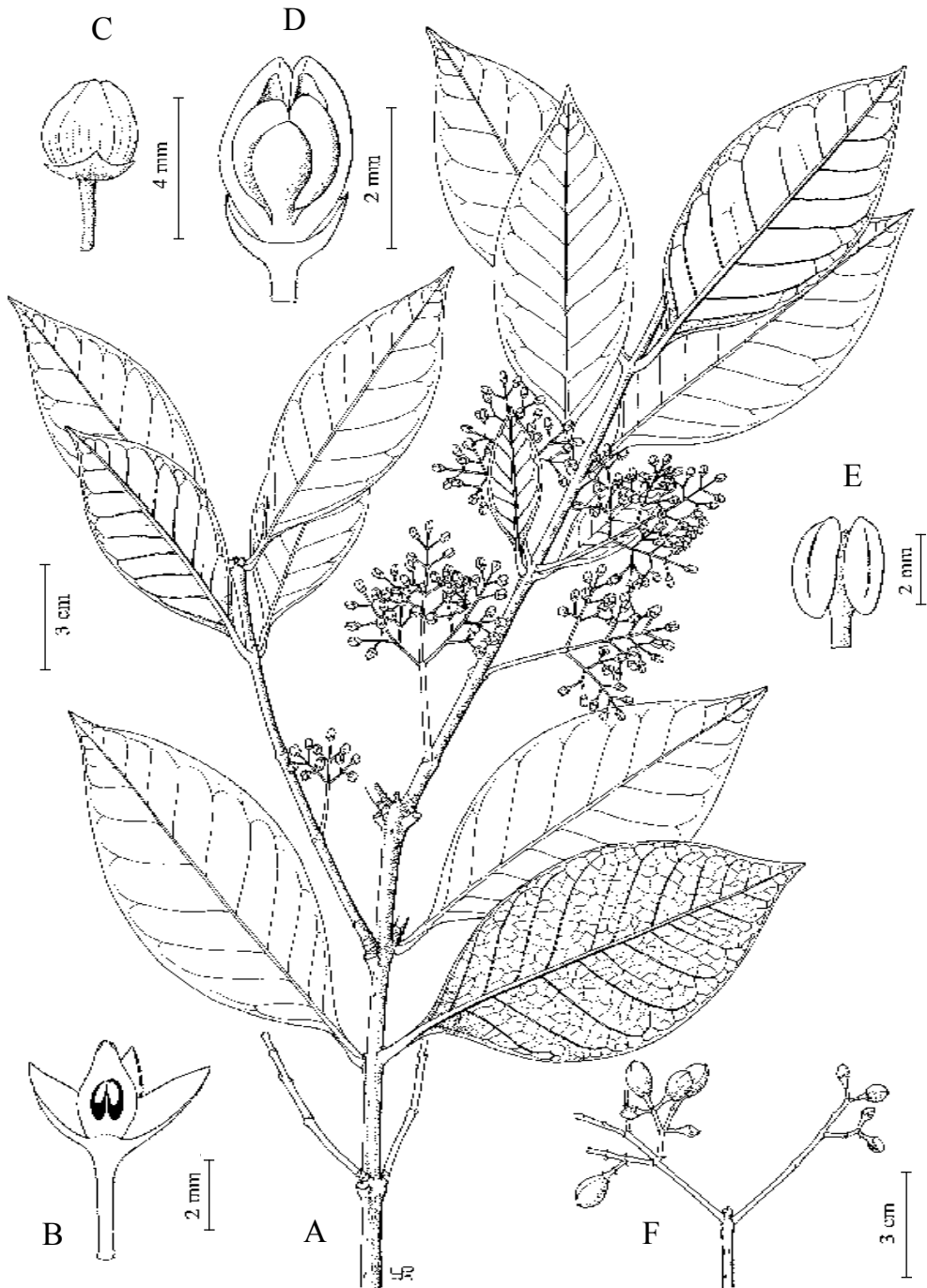


Fig. 8. *Olea rubrovenia*. A, flowering leafy twig; B, longitudinal section of bisexual flower with corolla lobes and stamens removed; C, male flower bud; D, longitudinal section of male flower bud; E, adaxial side of stamen; F, infructescence. (A–B from *RSNB* 939, C–E from *SAN* 123235, F from *SAN* 41831.)

1.5–4 cm long; bracts foliaceous, 7–15 × 3 mm. **Flowers** polygamous; pedicel 1–3 mm long, stout; buds almost globose, *c.* 1.5 mm diameter; calyx *c.* 1 mm long, acute, pubescent with ciliate margin; corolla 1.5–3 mm long, divided for *c.* one third, lobes cucullate, scarcely opening, creamy white or greenish yellow, sweetly scented; stamens subsessile, attached near base of corolla tube, hardly exposed in open flower, anthers *c.* 1 mm long. **Male flowers** frequently spreading. **Bisexual flowers** as for male but with ovary *c.* 2 × 1.3 mm, stigma slightly bilobed. **Fruits** ellipsoid, *c.* 1.5 × 0.5 cm, apex rounded, ripening purple-black; pericarp fleshy; endocarp thin and brittle. **Seeds** endospermic.

Vernacular names. Sarawak—*empala, mok* (Iban).

Distribution. Borneo (Sabah and Sarawak) and the Philippines. In Sabah, known from G. Kinabalu, G. Alab, Tenompok and Crocker Ranges (e.g., *Clemens 28986, RSNB 939, SAN 54207, SAN 65047, SAN 123235, and SAN 132875*). In Sarawak, recorded from Bt. Mersing, G. Dulit, G. Kalulong, G. Mulu, and G. Murut (e.g., *S 22172, S 22516 and S 37066*).

Ecology. Common in lower and upper montane mossy forest at altitudes above 1500 m, particularly on ridges and summits where the trees are shrubby and the leaves are thickly coriaceous. At lower altitudes, the leaves are larger and less coriaceous. Occasionally also occurs in *kerangas* forest (e.g., in Tenompok, Sabah).

4. SCHREBERA Roxb.

(J.C.D. van Schreber, 1739–1810, a German botanist)

Corom. Pl. 2 (1799) 1, 101; Hooker *f.*, Fl. Brit. Ind. 3 (1882) 604.

Trees or shrubs. **Twigs** terete. **Leaves** imparipinnate, 3–7-foliolate; leaflets chartaceous to subcoriaceous, margin entire. **Inflorescences** terminal or axillary, corymbose-paniculate. **Flowers** bisexual, to 20 mm long, heterostylous, white or yellow, with dense brown or purple hairs inside; calyx tubular to campanulate, irregularly 4–8-lobed or obscurely dentate; corolla salverform, tomentose on both sides, tube cylindric, often with dense beard of hairs inside, lobes (4–)6–8, imbricate in bud, spreading at anthesis, apex obtuse; stamens attached near top and included in corolla tube, filaments short, anthers ovate; ovary 2-loculed, style long and filiform, stigma shortly 2-lobed; ovules 4 per locule, pendulous. **Fruits** capsules, pendulous, *thick-walled and woody*, laterally compressed, ellipsoid to obovoid, *splitting into 2 concave parts each with a perpendicular central wall*. **Seeds** 4–8, pendulous, *winged apically and laterally*, endosperm thin or absent.

Distribution. A genus with 27 species, distributed in tropical Africa (24 species), Peru (1 species), India to N Thailand (1 species), and Borneo (1 species).

Schrebera kusnotoi Kosterm.

(Kusnoto Setyodiwiryo, 1911–1981, the first Indonesian Director of the Bogor Botanic Gardens)

Fig. 9.

Reinwardtia 2 (1953) 360; Meijer, Bot. Bull. Herb. Sandakan 10 (1968) 185. **Type:** *Kostermans 5989*, Borneo, Kalimantan, E Kutei, Sangkulirang, G. Sekrat (holotype BO; isotypes K, L, SING).

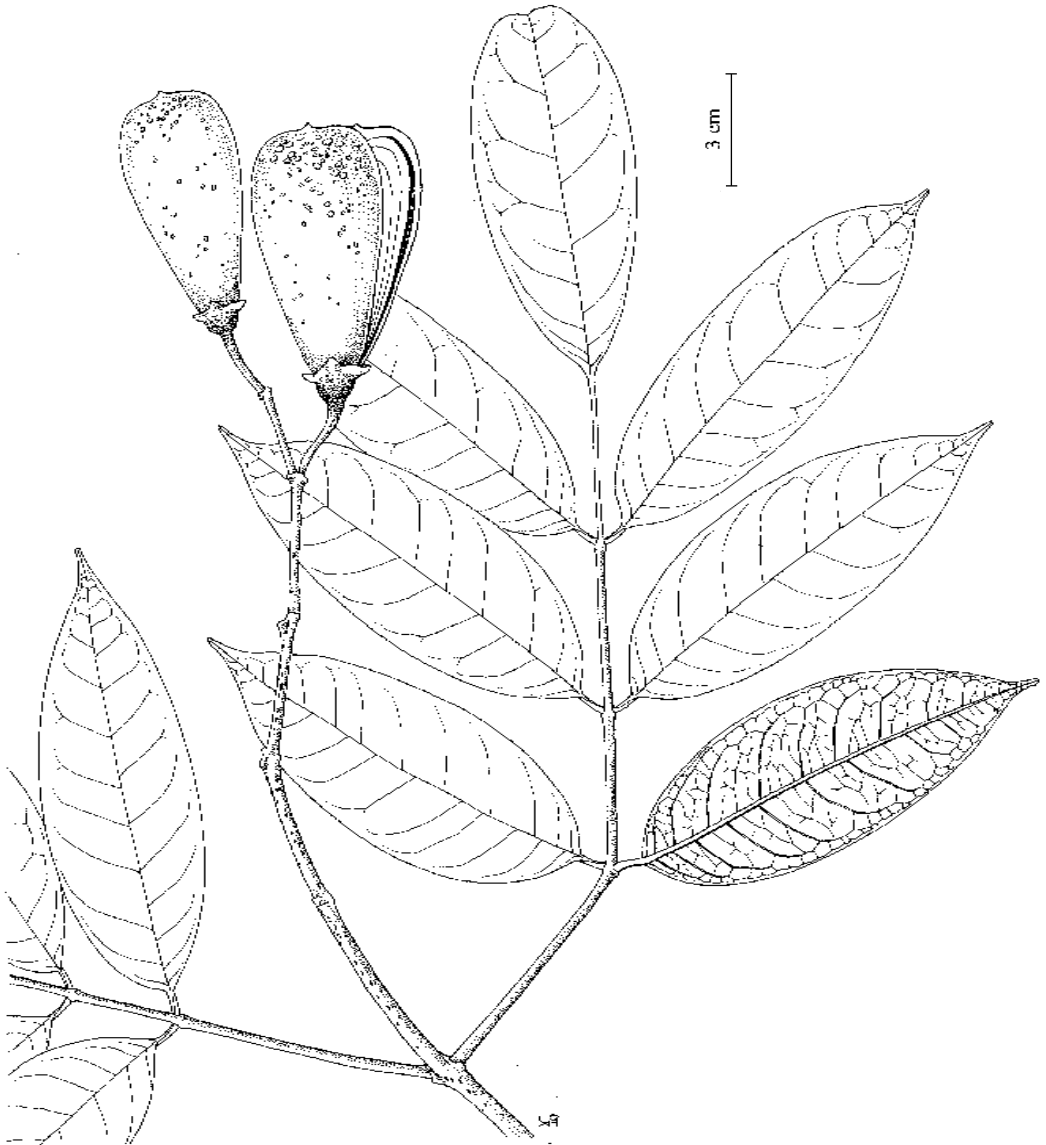


Fig. 9. *Schrebera kusnotoi*. Fruiting leafy twig. (All from SAN 64150.)

Tree, 24–45 m tall, to 90 cm diameter; buttresses 1–3 m high. **Bark** whitish or grey, scaling off profusely into 5-cm-long, subquadrangular, irregular flakes. **Sapwood** pale brown; heartwood blackish with paler streaks. **Twigs** thick, flattened at nodes, with prominent leaf scars. **Leaves** clustered at end of twigs, 2–3-jugate; petiole 5–8 cm long, slender but thickened at point of insertion; rachis 8–14 cm long, grooved above. **Leaflets** with petiolules *c.* 1 cm long, slender, grooved above; blade subcoriaceous and glossy above, lanceolate, 6–10 × 1.5–4.5 cm, base acute, usually oblique and decurrent, apex acute to caudate-acuminate with slender acumen *c.* 0.5 cm long; midrib impressed above; lateral veins 8–10 pairs; intercostal veins forming prominent reticulation on both surfaces, glabrous. **Inflorescences** axillary and terminal, to 10 cm long; peduncle stout and glabrous; bracts foliaceous, lanceolate, 5–5 × 1.5–2 mm at base, decreasing in size toward apex, persistent, glabrous or minutely pubescent. **Flowers:** pedicel to 12 mm long; calyx urceolate, *c.* 5–9 mm long, coriaceous, lobes 5–6, ovate, *c.* 2–3 mm long; corolla white, tube almost cylindrical, 7–20 mm long and *c.* 3 mm diameter, minutely and sparsely pilose, lobes 7, obovate-suborbicular, 2–5 × 2–3 mm, stamens with filaments attached to corolla tube, anthers enclosed within the tube, *c.* 1.5 mm long; ovary subglobose, *c.* 1 mm long, style glabrous, stigma large. **Fruits** obovoid, 5–7 cm long, *c.* 1 cm wide at base, expanding to 3.3–2.7 cm long and *c.* 1.5 cm wide toward the flat-topped, minutely apiculate apex; endocarp *c.* 3 mm wide; stalk *c.* 2 cm long. **Seeds** curved, *c.* 1.8 cm long, with apically positioned papery wing *c.* 4 cm long, filling the fruit cavity below.

Distribution. Endemic to Borneo (Sabah and NE Kalimantan). In Sabah, known by two collections from Ranau district (*SAN 20658* and *SAN 64150*), and in Kalimantan recorded from Sangkulirang district (e.g., *bb. 7974* and *Kostermans 5989*).

Ecology. In lowland and hill mixed dipterocarp forest and limestone hill forest, at altitudes to 1600 m.

PROTEACEAE

R.C.K. Chung

Forest Research Institute Malaysia,
Kepong, Malaysia

Merrill, EB (1921) 235; Ridley, FMP 3 (1924) 140; Masamune, EPB (1942) 257; Sleumer, Blumea 8 (1955) 2, FM 1, 5 (1955) 147; Backer & Bakhuizen *f.*, FJ 1 (1964) 273; Kochummen, TFM 2 (1973) 311; Anderson, CLTS (1980) 288; Cockburn, TS 2 (1980) 75; Ashton, MNDTS 2 (1988) 328; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 291; Turner, Gard. Bull. Sing. 47 (1995) 409; Coode *et al.* (eds.), CLBD (1996) 258; Argent *et al.* (eds.), MNDT-CK 2 (1997) 516.

Trees or shrubs; without buttress. Stipules absent. **Leaves** spiral or in pseudowhorls, sometimes subopposite; blade often dimorphous, unlobed or deeply lobed, margin entire or serrate. **Inflorescences** many-flowered racemes, axillary or borne on leafless older branches; bracts minute, early caducous; bracteoles very small. **Flowers** radially symmetrical or sometimes bilaterally symmetrical, bisexual or unisexual (plants dioecious); buds usually cylindrical, straight or curved, more or less widen towards base, with clavate or globular apex; perianth-segments (tepals) 4, valvate, with a distinctly broadened limb, recurved, adhering to each other in the lower portion to various degree; torus flat or oblique; stamens 4, filaments connate with tepals to various degree, sometimes very short, anthers basifixed, 2-loculed, introrse, dehiscent lengthwise, connective often prolonged; disk with 4 free or variously united glands around ovary and alternating with stamens, rarely absent; ovary superior, 1-loculed, sessile or stipitate; style thickened at apex, stigma small, punctiform or discoid, terminal or lateral. **Fruit** a nut or drupe-like, usually indehiscent. **Seeds** 1(–2) per fruit, with fleshy cotyledons.

Distribution. About 60 genera, with *c.* 1300 species. Mostly in the tropics and subtropics, mainly of the southern hemisphere (Africa, C and S America, Asia, Malesia, Australia, New Caledonia, New Hebrides, New Zealand, Fiji, and Samoa). In Sabah and Sarawak, the family is represented by two genera (*Helicia* and *Heliciopsis*) with 20 species. Of these, seven species are endemic to Borneo.

Ecology. In Borneo, species of the Proteaceae are found in primary *kerangas*, mixed dipterocarp to upper montane forests from sea level to 3350 m, on river-banks and ridges but are nowhere abundant. In Australia, pollination appears to be frequently affected by birds, mammals or insects, but observations have not been made in Borneo. The mode of fruit and seed dispersal is little understood.

Uses. Although the timber is attractive, neither *Helicia* nor *Heliciopsis* are harvested commercially. Several species of Australian Proteaceae with showy inflorescences are cultivated in Malaysia as ornamentals, e.g. *Grevillea banksii* R.Br. and *Stenocarpus sinuatus* Endl. Some species produce edible seeds, for instance the Queensland nuts (*Macadamia ternifolia* F.v.M.

and *M. tetraphylla* L.A.S. Johnson), which are imported into Malaysia and other countries. The feathery-leafed *Grevillea robusta* A. Cunn. is used for reforestation, and extensively planted as a shade tree in tea plantations.

Taxonomy. Sleumer (FM 1, 5 (1955) 150) stated that the family can be divided into two subfamilies, viz. the Persoonioideae and Grevilleoideae, with the two genera occurring in Sabah and Sarawak belonging to the latter. The subfam. Grevilleoideae can be segregated into 3 tribes, viz. the Grevilleae, Embotriaceae and Banksiaceae, with *Helicia* and *Heliciopsis* are included in the Grevilleae.

The two genera found in Sabah and Sarawak are very similar and closely related. *Heliciopsis* was only recognised as a distinct genus in 1955 when Sleumer (*l.c.*) revised the family for the Flora Malesiana. In addition to the characters given in the key, there are consistent differences in wood anatomy and pollen morphology for these two genera.

Notes. Timbers are moderately hard and moderately heavy to heavy, not durable; grain straight; texture slightly coarse and uneven because of broad rays; sapwood susceptible to attack by powderpost beetles, yellowish pink, sharply differentiated from the brown heartwood, and with conspicuous silver figure on quarter sawn surfaces.

Key to genera

Leaves not lobed. Flowers bisexual; stigma punctiform, terminal, stigmatic surface without cleft; ovules anatropous. Fruit pericarp not differentiated into distinct layers; mesocarp without a distinct fibrous tissue..... **1. Helicia**

Leaves of two forms, unlobed and deeply lobed. Flowers unisexual, plants dioecious; stigma (in female flowers) discoid, lateral, stigmatic surface with distinct cleft; pistillode without stigmatic surface; ovules orthotropous. Fruit pericarp differentiated into three distinct layers; mesocarp with a distinct fibrous tissue..... **2. Heliciopsis**

1. HELICIA Lour.

(Greek, *helix* = a coil; referring to the twisted perianth-segments at anthesis)

kajo tata (Berawan), *kayo talat* (Kayan), *kayu tatah* (Kenyah), *kayu tatat* (Punan),
palih (Dusun and Iban), *palis* (Iban), *pasis* (Bidayuh)

Fl. Cochinch. 1 (1790) 83; Gamble, J. As. Soc. Beng. 75, 2 (1914) 340; Merrill, EB (1921) 235; Ridley, FMP 3 (1924) 140; Masamune, EPB (1942) 257; Sleumer, Blumea 8 (1955) 7, FM 1, 5 (1955) 164; Backer & Bakhuizen *f.*, FJ 1 (1964) 274; Kochummen, TFM 2 (1973) 313; Anderson, CLTS (1980) 288; Cockburn, TS 2 (1980) 75; Ashton, MNDTS 2 (1988) 330; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 291; Kessler & Sidiyasa, TBSA-EK (1994) 195; Argent *et al.* (eds.), MNDT-CK 2 (1997) 516; PROSEA 5, 3 (1998) 284; Chung, J. Trop. For. Sci. 13 (2001) 536. **Synonym:** *Helittophyllum* Blume, Bijdr. Fl. Ned. Ind. (1825) 652.

Small to medium-sized trees, rarely shrubs. **Leaves** mostly spiral, rarely subopposite or 3–4-verticillate, sessile or petiolate, *unlobed*, margins entire or serrate, intercostal venation reticulate. **Inflorescences** racemose, many-flowered, axillary or borne on leafless older branches, rarely subterminal; bracts small, ovate-acuminate to subulate, subsistent or caducous; bracteoles minute. **Flowers** *bisexual*; pedicels mostly in pairs or solitary, free or partially connate at base, rarely entirely connate; perianth-tube straight, slender, with a clavate to subglobose limb, somewhat swollen at base, limb straight, segments 4, becoming free and twisted at anthesis; stamens 4, nearly sessile, inserted at the inner base of perianth limb, anthers oblong, connective apiculate; ovary ovoid or globose, sessile, style filiform, *stigma punctiform, terminal, stigmatic surface glandular, without cleft*; *ovules 2, anatropous*, inserted at the inner base of ovary or laterally attached to the wall on ventral suture; disk-glands free or connate into a cup. **Fruits** nut- or drupe-like, ellipsoid to subglobose or ovoid to depressed ovoid or obovoid, mostly indehiscent, sometimes very tardily splitting irregularly along ventral suture when dry; pericarp mostly thickly coriaceous and rather hard when dry, *exocarp and endocarp usually not clearly differentiated, mesocarp without fibrous tissue*. **Seeds** 1(–2, not in Borneo), subglobose or hemispheric; testa thin; cotyledons fleshy, rugulose in the upper part.

Distribution. About 90 species in S India, Sri Lanka, SE Asia, SE China, Hainan, S Japan, Taiwan, throughout Malesia, Melanesia, and NE Australia. In Sabah and Sarawak, the genus is represented by 13 species, of which 5 species are Bornean endemics.

Ecology. In lowland to montane rain forests, from sea level to 2000(–3350) m altitude. Some (e.g., *H. robusta*) prefer habitats along streams but others (e.g., *H. excelsa*) are found on hill tops or ridges.

Uses. As the species do not reach timber size, *Helicia* is of no commercial importance. The nicely figured and hard wood is used for superior joinery, high class furniture, cabinet work and interior finish, flooring and also (but rarely) for axe handles, house building and mining poles. In Peninsular Malaysia, *H. petiolaris* is occasionally planted for ornamental purposes. In Java, young shoots of *H. robusta* and *H. serrata* are eaten raw as a vegetable (PROSEA, 1998).

Taxonomy. Sleumer (FM 1, 5 (1955) 166) subdivided the genus into 3 sections, *viz.* sect. *Macadamiopsis* Sleumer, characterised by perulate inflorescences; sect. *Cyanocarpus* (Bailey) Sleumer, characterised by drupes with a distinct hard endocarp; and sect. *Helicia* (Lour.) Sleumer with undifferentiated pericarp.

Key to *Helicia* species

1. Leaves sessile or subsessile; base rounded, truncate or subcordate, not decurrent.....2
 Leaves with a distinct petiole; base attenuate or cuneate, decurrent.....5
2. Young twigs terete. Leaf margin serrate, sometimes subentire with some sharp or obtuse teeth on each side in the upper part. Pericarp with 6 distinct obtuse vertical ribs..... **8. H. robusta**
 Young twigs subangular or angular. Leaf margin entire or occasionally with 1–3 minute glandular teeth on both sides. Pericarp smooth.....3

3. Leaves thickly coriaceous, shining above when dry. Inflorescences, pedicels and perianths hairy; disk-glands connate at base only. Fruits subglobose.....
 **4. H. maxwelliana**
 Leaves chartaceous to thinly coriaceous, on drying not shining above. Inflorescences, pedicels and perianths glabrous; disk-glands connate into a crenulate ring. Fruits ellipsoid.....4
4. Leaves oblanceolate or obovate-oblong. Pedicels distinctly wrinkled; limb of perianth 1.5–2 mm diameter; anthers 2.5–3 mm long. Fruits smaller, 0.8–1.7 × 0.6–1.1 cm, black when dry, not apiculate or stiped; pericarp *c.* 0.5 mm thick.....
 **5. H. obovata**
 Leaves broadly elliptic or obovate. Pedicels with smooth surface; limb of perianth 0.8–1.2 mm diameter; anthers 1–1.5 mm long. Fruits larger, 4–4.5 × 2.4–2.7 cm, chesnut-brown when dry, shortly apiculate and stiped; pericarp 2.5–3 mm thick...
 **11. H. sessilifolia**
5. Leaves smaller, 5–10 × 2.5–5 cm, thickly coriaceous; apex emarginate or obtuse..... **12. H. symplocoides**
 Leaves generally larger, (5–)10–20(–30) × (2.5–)3–8(–13) cm; chartaceous to thinly coriaceous; apex acute or acuminate..... 6
6. Ovary glabrous..... 7
 Ovary hairy..... 10
7. Petiole slender, to 1 mm thick. Pedicels with membranaceous wing on each side; disk-glands free..... **7. H. pterygota**
 Petiole stout, 1.5–3 mm thick. Pedicels not winged; disk-glands connate into a crenulate ring..... 8
8. Leaves subopposite or verticillate; margin recurved when dry. Found exclusively in montane forest (Mt. Kinabalu), at *c.* 3350 m altitude..... **13. H. sp. A**
 Leaves spiral; margin entire, plane when dry. Found in lowland mixed dipterocarp to lower montane forests, at altitudes to 2100 m.....9
9. Leaves greenish or yellowish brown or sometimes pale brown when dry; petiole 0.4–0.8(–1) cm long, 1.5–2 mm thick, greyish brown, bright or deep brown when dry. Rachis 1–1.5(–2) mm diameter. Limb of perianth 1–1.5 mm diameter..... **1. H. attenuata**
 Leaves olive-green to grey-brown above and dull or dark brown below when dry; petiole (1–)1.5–2.5(–4) cm long, 2–3 mm thick, dark green to dull brown or black when dry. Rachis (2–)2.5–3(–4) mm diameter. Limb of perianth 2–2.5 mm diameter..... **6. H. petiolaris**
10. Petiole, inflorescences, perianths, and fruits reddish-brown tomentose. Fruits brown to rusty brown when dry; pericarp 2–2.5 mm thick..... **3. H. fuscotomentosa**
 Petiole, inflorescences, perianths, and fruits glabrous or glabrescent. Fruits dark brown to black when dry; pericarp to 1.5 mm thick..... 11
11. Leaves narrowly elliptic, glaucous below, margin recurved when dry; petiole more than 1.5 cm long..... **9. H. rufescens**

Leaves elliptic, oblong, oblanceolate or obovate, not glaucous below, margin not recurved when dry; petiole less than 1.5 cm long.....12

12. Leaf margin serrate, rarely subserrate or entire. Inflorescences axillary in axils of lower leaves or borne on leafless older branches.....**10. H. serrata**
 Leaf margin always entire. Inflorescences axillary in axils of upper leaves, sometimes subterminal.....**2. H. excelsa**

1. *Helicia attenuata* (Jack) Blume

(Latin, *attenuatus* = drawn out; referring to the leaf base)

Ann. Sci. Nat. 2, 1 (1834) 216; Gamble *l.c.* (1914) 341; Ridley *l.c.* (1924) 141; Merrill, J. Arn. Arb. 33 (1952) 243; Sleumer, Blumea 8 (1955) 61, FM 1, 5 (1955) 186; Backer & Bakhuizen *f. l.c.* 275; Kochummen, TFM 2 (1973) 313; Anderson *l.c.* 288; Cockburn *l.c.* 76; Ashton *l.c.* 330; Whitmore, Tantra & Sutisna *l.c.* 291; Turner, Gard. Bull. Sing. 47 (1995) 409; Coode *et al.* (eds.), CLBD (1996) 258; PROSEA *l.c.* 285. **Basionym:** *Roupala* (“*Rhopala*”) *attenuata* Jack, Mal. Misc. 1, 5 (1821) 10. **Type:** Jack, *Herb. Wallich 1040.1*, Peninsular Malaysia, Penang (holotype K!; isotype BM!). **Synonyms:** *Roupala moluccana auct. non R.Br., nec* Jack: Roxburgh, Fl. Ind. ed. Carey & Wallich 1 (1820) 364; *H. oblongifolia* Benn. in J. Bennett & R. Brown, Pl. Jav. Rar. (1838) 83; *H. bennettiana* Miq., Fl. Ind. Bat. 1, 1 (1858) 984; *H. sumatrana* Miq., Fl. Ind. Bat., Suppl. 1 (1860) 148, 364; *Finschia sumatrana* Miq. ex Boerl., Handl. 3, 1 (1900) 151; *H. suffruticosa* Ridl., J. Fed. Mal. St. Mus. 6 (1915) 171; *H. lanceolata auct. non* Koord. & Valetton: Baker *f.*, J. Bot. 63 (1925) Suppl. 89; *H. kingiana auct. non* Prain: Merrill, Pap. Mich. Acad. Sci. 24 (1939) 67.

Shrub or small tree to 15 m tall, 30 cm diameter. **Bark** dark brown, cracked or scaly; inner bark orange-yellow, granular. **Sapwood** yellow. **Twigs** terete, light brown, glabrous. **Leaves** spiral, chartaceous to thinly coriaceous, glabrous, greenish or yellowish brown or sometimes pale brown when dry, not shining above; oblong or elliptic-oblong, rarely oblanceolate or obovate, 9–25(–30) × 3–8(–11) cm, base cuneate or attenuate, decurrent, margin entire, plane, apex acute or acuminate; midrib prominent on both surfaces; lateral veins 7–9(–10) pairs, curving and joining near leaf margin, prominent below, slightly raised above, intermediate veins sometimes conspicuous; intercostal venation visible on both surfaces; *petiole* 0.4–0.8(–1) cm long, 1.5–2 mm thick, swollen and wrinkled at base, greyish brown, bright or deep brown when dry, glabrous.

Inflorescences axillary or borne on leafless older branches, solitary, 12–18(–25) cm long, laxly flowered except for 1.5–3 cm from base; *rachis* terete, 1–1.5(–2) mm diameter, glabrous; bracts subulate, minute, to 1 mm long, glabrous. **Flowers:** *pedicels* glabrous, 4–5 mm long, not winged, mostly in pairs, connate to about 1.5–2.5 mm from base; perianth 10–20(–22) mm long, glabrous, limb ellipsoid, 1–1.5 mm diameter; anthers 1.5–2(–2.5) mm long; *ovary* narrowly ovoid, glabrous; *disk-glands* subtruncate, nearly entirely connate into a crenulate ring. **Fruits** broadly ellipsoid or subglobose, 3–4(–5) × (2–)2.5–3(–3.5) cm, slightly asymmetric, glabrous, dull brown to dirty brown when dry, shortly apiculate, tip 1–2 mm long, at base contracted into a short stipe of 2–3 mm long, or subglobose, sessile and non-apiculate; pericarp smooth, 1.5–2 mm thick; stalks 4–5(–8) mm long, 2–2.5(–3) mm thick, persistent.

Vernacular name. Sarawak—*katjang* (Iban).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, and Bali. In Sabah (e.g., SAN 46172, SAN 79157, SAN 91252, SAN 123776, and SAN 128355) and Sarawak

(e.g., *S 18481*, *S 28981*, *S 36365*, *S 41258*, and *S 53933*), common and widespread. Also occurs in Brunei (e.g., *Dransfield JD 7163*) and Kalimantan (e.g., *Amdjah 281*, *bb. 11097* and *Jaheri 1092*).

Ecology. In lowland mixed dipterocarp and lower montane forests at altitudes to 1700 m, along streams, on hill slopes and mountain ridges.

2. *Helicia excelsa* (Roxb.) Blume

(Latin, *excelsus* = lofty; referring to its outstanding growth habit)

Ann. Sci. Nat. 2, 1 (1834) 219; Gamble *l.c.* (1914) 346; Merrill, J. Str. Br. Roy. As. Soc. 85 (1922) 168, PEB (1929) 53; Ridley *l.c.* (1924) 143; Masamune *l.c.* 257; Sleumer, Blumea 8 (1955) 36, FM 1, 5 (1955) 174; Kochummen, TFM 2 (1973) 315; Anderson *l.c.* 288; Cockburn *l.c.* 76; Ashton *l.c.* 331; Whitmore, Tantra & Sutisna *l.c.* 291; Turner *l.c.* 409; Argent *et al.* (eds.) *l.c.* 516; PROSEA *l.c.* 285. **Basionym:** *Roupala* (“*Rhopala*”) *excelsa* Roxb., Fl. Ind. ed. Carey & Wallich 1 (1820) 363. **Type:** *Roxburgh s.n.*, India, E Bengal, Chittagong (holotype BM!). **Synonyms:** *Helicia salicifolia* Presl., Epim. (1851) 247; *Alseodaphne crassipes* Hook.f., Fl. Br. Ind. 5 (1886) 146; *H. oblanceolata* Merr., Pap. Mich. Acad. Sci. 24 (1939) 67.

Small to medium-sized tree to 20 m tall, 25 cm diameter. **Bark** dark grey to blackish, smooth; inner bark pale yellow to ochre-brown. **Sapwood** pale yellow. **Twigs** terete, greyish yellow, reddish-brown tomentose at tips, becoming glabrescent and finally glabrous. **Leaves** spiral, *chartaceous* to *thinly coriaceous*, greenish to yellowish green when dry, not shining, reddish-brown tomentose on both surfaces when very young, soon-glabrescent or glabrous; *narrowly oblong*, *oblanceolate*, or *obovate-oblong*, (6–)10–17(–26) × (2.5–)3–5(–7) cm, smaller at high elevations, *base cuneate and decurrent*, *margin entire*, *apex abruptly acuminate* or *subacute*; midrib slightly raised above, distinctly so below; lateral veins (6–) 7–8(–10) pairs, curving and joining near leaf margin, slightly prominent on both surfaces; intercostal venation prominently raised on both surfaces; *petiole 0.5–1(–1.5) cm long*, 1–1.5 mm thick, swollen and wrinkled at base, yellowish grey when dry, reddish-brown tomentose when very young, soon-glabrescent and *finally glabrous*. **Inflorescences** *axillary in axils of upper leaves*, *sometimes subterminal*, solitary or in clusters of 2–3, (5–)7–12(–15) cm long, densely flowered except for 1–1.5 cm from base; rachis terete, 1–1.5 mm diameter, initially densely reddish-brown tomentose, *glabrescent* but never entirely glabrous; bracts ovate-lanceolate, (1.5–)2–3 mm long, reddish-brown tomentose. **Flowers:** pedicels 2–3(–4) mm long, not winged, mostly in pairs, free or connate to 1–1.5(–2) mm from base, reddish-brown tomentose; perianth (5–)6–8 mm long, initially reddish-brown tomentose, *glabrescent*, limb ellipsoid, *c.* 1 mm diameter; anthers *c.* 1.5 mm long; *ovary oblong*, *reddish-brown tomentose*; disk-glands free, nearly rounded or truncate. **Fruits** ellipsoid, ovoid or obovoid, 1–2(–3) × 0.8–1.3(–1.5) cm, asymmetric, *glabrous*, *black when dry*, shortly or not apiculate, tip 0.5–1 mm long, without stipe; *pericarp smooth*, *0.2–1 mm thick*; stalks 2.5–3(–6) mm long, 1–1.5(–2) mm thick, persistent.

Vernacular names. Sabah—*pasir-pasir* (Sandakan). Sarawak—*luang* (Kelabit).

Distribution. E Bengal, Burma, Indo-China, Thailand, Peninsular Malaysia, Sumatra, and Borneo. In Sabah (e.g., *Clemens 28292*, *RSNB 4169*, *SAN 74508*, *SAN 109188*, and *SAN 117132*) and Sarawak (e.g., *Nooteboom & Chai 2174*, *S 8428*, *S 24938*, and *S 48444*), common and

known from many districts/divisions. Also recorded from C Kalimantan (e.g., *Hallier 2385*, *bb. 7917* and *bb. 15623*).

Ecology. In swamp, mixed dipterocarp and lower montane forests, at altitudes to 1700 m. On sandy soils and ridges.

Uses. The timber is locally used for house construction and mining poles.

3. *Helicia fuscotomentosa* Suesseng.

Fig. 1.

(Latin, *fusco*- = dark brown, *tomentosus* = densely pubescent with matted woolly or short hairs; referring to the indumentum of young parts)

Mitt. Bot. Staatssamml. München 2 (1950) 61; Sleumer, *Blumea* 8 (1955) 24, FM 5, 1 (1955) 170; Anderson *l.c.* 289; Cockburn *l.c.* 76; Ashton *l.c.* 331; Whitmore, Tantra & Sutisna *l.c.* 292; Coode *et al.* (eds.) *l.c.* 258. **Type:** *Clemens 28724*, Borneo, Sabah, Mt. Kinabalu, Tenompok (holotype M; isotypes A, B, BO!, BM, K!, L, NY).

Small or medium-sized tree to 25 m tall, 30 cm diameter. **Bark** mottled grey and black, smooth; inner bark orange-brown, invaginating into sapwood. **Sapwood** dark yellow with harder radial pale striations. **Twigs** terete, blackish grey, densely and persistently dark reddish-brown tomentose at tips, greyish to yellowish tomentose in older parts, finally glabrescent. **Leaves** spiral, *thinly coriaceous*, yellowish green to yellowish olivaceous when dry, not shining, young ones reddish-brown tomentose on both surfaces, soon-glabrescent and mostly glabrous except midrib and petiole; elliptic to oblong-elliptic, rarely obovate, (5-)7-18(-25) × (2.5-)3-9(-11) cm, smaller at high elevation, *base cuneate, decurrent*, margin entire, *apex abruptly acuminate to subacute*; midrib slightly raised above, very distinctly so below; lateral veins (6-)7-11(-12) pairs, curved upwards, not clearly joining near leaf margin, prominent on both surfaces; intercostal venation raised on both surfaces; *petiole 1-2.5(-3) cm long*, 1-3 mm thick, swollen and smooth at base, grey or yellowish brown when dry, *reddish-brown tomentose*. **Inflorescences** axillary or borne on leafless older branches, solitary, 6-13(-14) cm long, densely flowered except for 1-1.5 cm from base; rachis terete, 1-2 mm diameter, *densely reddish-brown tomentose*; bracts ovate-acuminate, 1-1.5 mm long. **Flowers:** pedicels 1-2(-3) mm long, not winged, mostly in pairs, more or less connate, reddish-brown tomentose; perianth 10-12 mm long, *densely reddish-brown tomentose* externally, limb clavate, 2-2.5 mm diameter; anthers *c.* 2 mm long; *ovary* globose, *reddish-brown tomentose*; disk-glands broadly triangular, free, spaced. **Fruits** elongate-ellipsoid, ovoid or subglobose, (2.5-)3-3.5 × (2-)2.5-3 cm, asymmetric, *reddish-brown tomentose*, shortly apiculate, tip 1-2 mm long, at base shortly contracted into a short stipe of *c.* 1(-4) mm long; *pericarp 2-2.5 mm thick*, smooth or rarely with two tiny vertical ribs; stalks (5-)7-9 mm long, 4-5 mm thick, persistent.

Distribution. Endemic to Borneo. In Sabah, known from Beaufort, Ranau, Keningau, and Sandakan districts (e.g., *Chew & Corner RSNB 4102*, *Clemens 28724*, *SAN 31127*, *SAN 60792*, and *SAN 83845*). In Sarawak, recorded from Lundu, Kuching, Bintulu, Miri, Kapit, and Limbang divisions (e.g., *S 12782*, *S 26179*, *S 36859*, *S 47168*, and *S 52966*). Also occurs in Brunei (e.g., *BRUN 5504*, *BRUN 15262* and *BRUN 17634*) and Kalimantan (e.g., *Endert 3890* and *bb. 28336*).

Ecology. Frequent in lowland mixed dipterocarp and montane forests, at altitudes to 2000 m, especially on sandstone ridges.

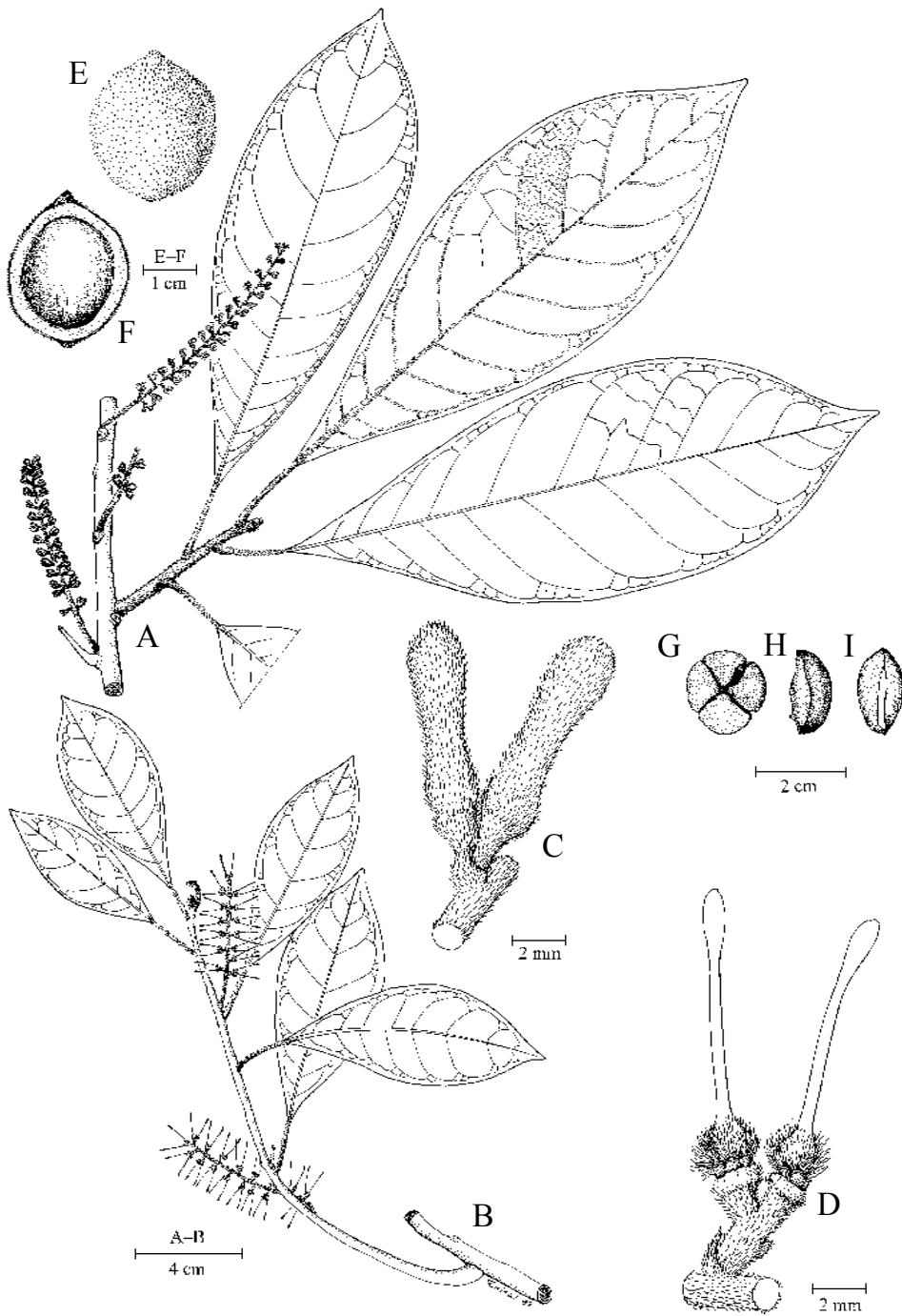


Fig. 1. *Helicia fuscotomentosa*. A–B, flowering leafy twigs; C, flower buds; D, flowers with perianths removed; E, fruit; F, longitudinal section of fruit; G, top view of seed; H, side view of one cotyledon; I, radial view of one cotyledon. (A from *S 12782*, B and D from *SAN 51362*, C from *RSNB 1841*, E–I from *S 35995*.)

4. *Helicia maxwelliana* Gibbs

Fig. 2.

(D.R. Maxwell, officer of the North Borneo Company who accompanied Gibbs to climb Mt. Kinabalu in 1910)

J. Linn. Soc. Bot. 42 (1914) 131; Merrill *l.c.* (1921) 235; Masamune *l.c.* 257; Sleumer, *Blumea* 8 (1955) 42, FM 1, 5 (1955) 178; Cockburn *l.c.* 76; Whitmore, Tantra & Sutisna *l.c.* 292. **Type:** *Gibbs 3137*, Borneo, Sabah, Mt. Kinabalu, Marai Parai spur (holotype BM!).

Treelet to 3 m tall. **Twigs** dark brown, *young parts subangular*, laxly covered by short appressed, pale reddish-brown hairs, older ones terete, glabrous. **Leaves** spiral, *thickly coriaceous*, olive-green to dark brown when dry, *shining above*, glabrous; broadly elliptic, obovate-oblong, 15–23 × (7–)8–11 cm, *base subcordate* or *rounded*, *margin entire* or *occasionally with 1–3 minute glandular teeth on both sides*, slightly recurved, apex broadly attenuate to rounded; midrib slightly prominent above, very stout and prominent below; lateral veins (8–)9–10 pairs, curving and joining near leaf margin, *distinctly raised above*, prominent below; *intercostal venation prominent above*, conspicuous below; petiole 0.3–0.5 cm long, 3–4(–6) mm thick, swollen or wrinkled at base, dark brown when dry, glabrous. **Inflorescences** axillary or borne on leafless older branches, solitary, 10–14 cm long, densely flowered except for 1 cm from base; rachis terete, *c.* 2 mm diameter, *appressed reddish-brown hairy*; bracts ovate-acuminate, 1–1.5 mm long, densely reddish-brown hairy. **Flowers:** pedicels 3–4(–5) mm long, not winged, mostly in pairs or in fours, free or connate at base, *densely appressed reddish-brown hairy*; perianth 12–13(–14) mm long, *sparsely reddish-brown hairy*, limb clavate, *c.* 1.5 mm diameter; anthers *c.* 2 mm long; ovary glabrous; disk-glands ovate, *connate at base*. **Fruits** *subglobose*, 2–2.5 × 1.8–2.2 cm, oblique, glabrous, black when dry, shortly apiculate, tip 1–1.5 mm long, at base contracted into a short stipe of *c.* 1.5 mm long; *pericarp smooth*, *c.* 2 mm thick.

Distribution. Endemic to Borneo (Sabah). Rare and known only from Mt. Kinabalu (e.g., *Clemens 11082*, *Clemens 31898*, *Gibbs 3137*, and *Nais et al. SNP 5164*).

Ecology. Lower montane forest, at 1600–1700 m altitude, on ridge top on ultrabasic soils.

5. *Helicia obovata* Benn.

Fig. 3.

(Latin, *ob-* = reversed, *ovatus* = egg-shaped; the shape of the leaf)

In J. Bennett & R. Brown, *Pl. Jav. Rar.* (1838) 83; Chung *l.c.* (2001) 542. **Type:** *Horsfield s.n.*, Java (holotype BM!, isotype K). **Synonym:** *Helicia attenuata auct. non* (Jack) Blume: Sleumer, *Blumea* 8 (1955) 61, FM 1, 5 (1955) 186, *p.p.*, *quoad syn. H. obovata* Benn.

Treelet or small tree, 4–15 m tall, 5–20 cm diameter. **Bark** brownish grey, smooth; inner bark pale yellow. **Sapwood** yellowish. **Twigs** yellowish or greyish brown, *young parts angular*, older parts terete, glabrous. **Leaves** subopposite, *thinly coriaceous*, olive-green on drying, *not shining above*, glabrous; *oblanceolate* or *obovate-oblong*, (13–)16–28(–38) × 6–9.5(–12) cm, *base subcordate*, *nearly auriculate* or *truncate*, *margin entire* or *occasionally with 2–3 minute glandular teeth on both sides*, apex acute; midrib raised above, prominent below; lateral veins (7–)8–11 pairs, curving and joining near leaf margin, *prominent on both surfaces*; intercostal venation *prominent on both surfaces*; *petiole very short*, swollen at base. **Inflorescences** subterminal or axillary, solitary, (16–)18–28 cm long, laxly flowered except for 4–7 cm from base; *rachis* terete, (2–)2.5–3 mm diameter, *glabrous*; bracts ovate-acuminate, 1–1.5 mm long,

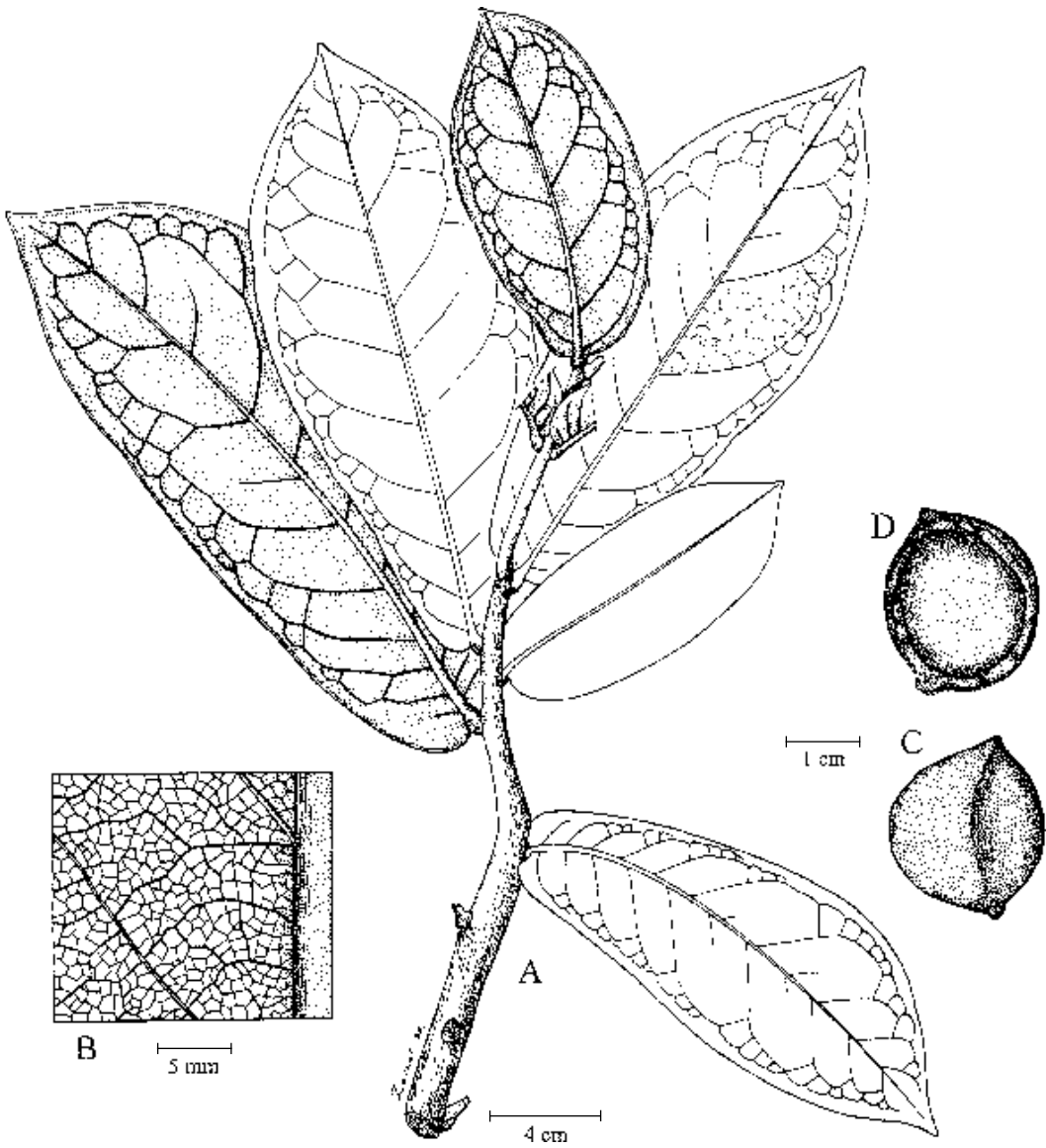


Fig. 2. *Helicia maxwelliana*. A, leafy twig; B, detail of lower leaf surface; C, fruit; D, longitudinal section of fruit. (All from *Nais et al. SNP 5164.*)

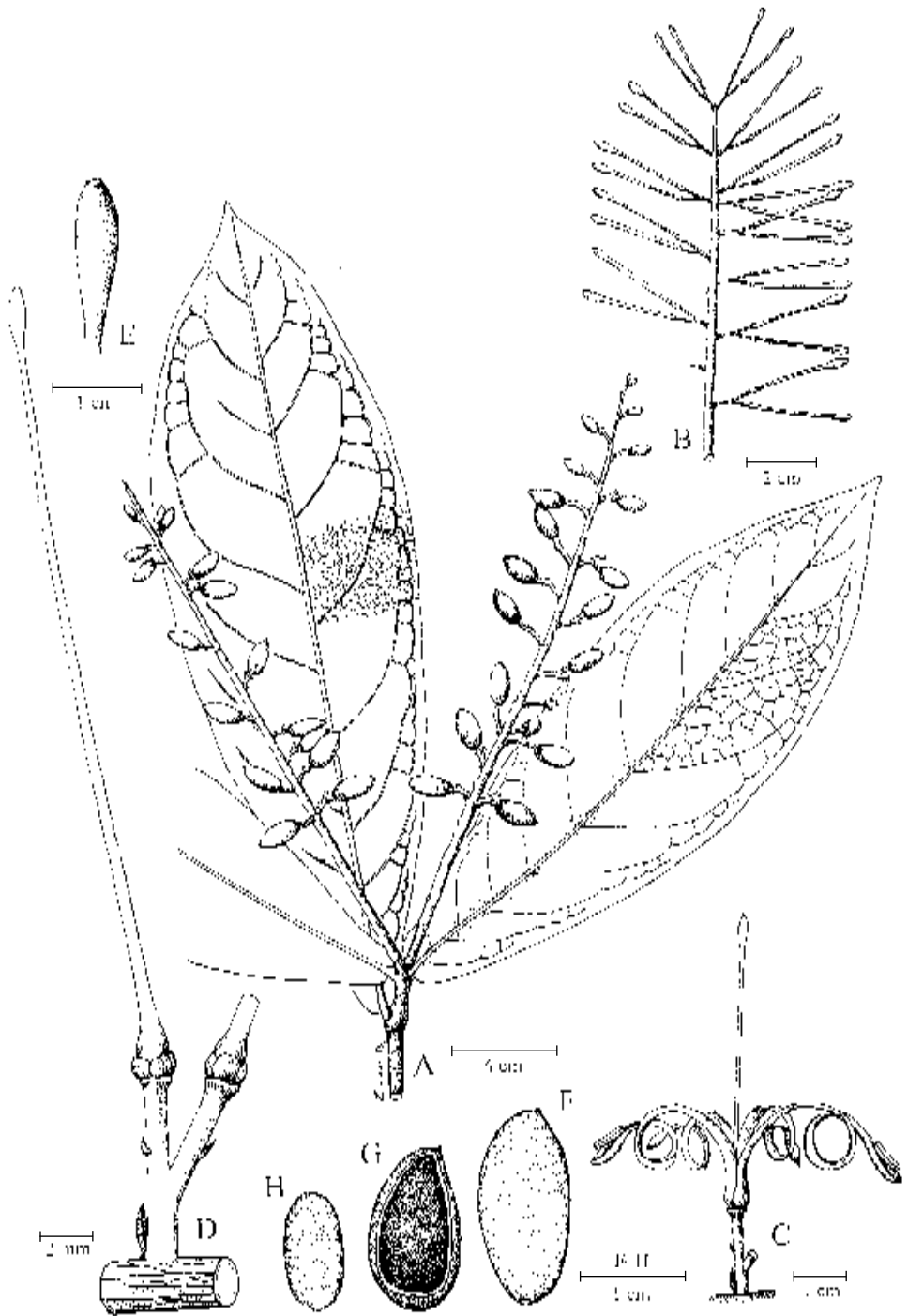


Fig. 3. *Helicia obovata*. A, fruiting leafy twig; B, inflorescence; C, open flower; D, open flowers with perianths removed; E, stigma; F, fruit; G, longitudinal section of fruit; H, lateral view of seed. (A and F–H from SAN 132690, B from SAN 122694, C–E from S 52402.)

glabrous. **Flowers:** *pedicels* 5–8(–9) mm long, *distinctly wrinkled*, mostly in pairs, connate to 2–4 mm from base, *glabrous*; *perianth* (12–16–)25–28 mm long, *glabrous*, *limb* ellipsoid, 1.5–2 mm diameter; *anthers* 2.5–3 mm long; *ovary* ovoid, glabrous; *disk-glands* broadly ovate, *connate into a crenulate ring*. **Fruits** ellipsoid, 0.8–1.7 × 0.6–1.1 cm, slightly asymmetric, glabrous, *black when dry, not apiculate or stiped; pericarp smooth, c. 0.5 mm thick*; stalks 5–6 mm long, 1.5–2 mm thick, persistent.

Distribution. Java and Borneo. In Sabah, common, known from Ranau, Tambunan, Tenom, Keningau, and Kota Belud districts (e.g., *Nooteboom 1316*, *SAN 55813*, *SAN 76827*, *SAN 121704*, and *SAN 122694*). In Sarawak, rare, known only from a single collection, *S 52402*, from Bt. Tebunan, Lawas.

Ecology. Lowland to hill mixed dipterocarp forests, sometimes also found in lower montane forest, at 200–1000(–1500) m altitude.

6. *Helicia petiolaris* Benn.

Fig. 4.

(Latin, *petiolaris* = stalked; referring to the leaves)

In J. Bennett & R. Brown, *Pl. Jav. Rar.* (1838) 84; Merrill *l.c.* (1921) 235; Masamune *l.c.* 257; Sleumer, *Blumea* 8 (1955) 67, FM 1, 5 (1955) 188; Kochummen, *TFM* 2 (1973) 315; Anderson *l.c.* 289; Cockburn *l.c.* 76; Ashton *l.c.* 332; Whitmore, *Tantra & Sutisna l.c.* 292; Turner *l.c.* 409; Coode *et al.* (eds.) *l.c.* 258; Argent *et al.* (eds.) *l.c.* 516; PROSEA *l.c.* 286; Chung *l.c.* (2001) 542. **Type:** *Jack, Herb. Wallich 1041.1*, Peninsular Malaysia, Penang (holotype K!; isotype BM!). **Synonyms:** *Roupala* (“*Rhopala*”) *moluccana auct. non R.Br., nec Roxb.*: Jack, *Mal. Misc.* 1 (1820) 10; *Helicia attenuata auct. non* (Jack) Blume: Ridley, *J. Fed. Mal. Stat. Mus.* 7 (1916) 49; *H. erratica auct. non Hook.f.*: Suessenguth *in* Fedde, *Rep.* 54 (1951) 226, *p.p.*; *H. kingiana* Prain, *Kew Bull.* (1912) 342; *H. obscurinervis* Chatterjee, *Kew Bull.* (1948) 65; *H. petiolaris* Benn. var. *kingiana* (Prain) Sleumer, *Blumea* 8 (1955) 67, FM 1, 5 (1955) 188.

Small tree to 15 m tall, 20 cm diameter; sometimes treelets of only 3 m tall and 8 cm diameter may become reproductively matured. **Bark** grey-brown, smooth; inner bark pale brown, with radial lines of fibrous tissue invaginating into the sapwood. **Sapwood** pale yellowish to pale brown. **Twigs:** young parts triangular, older ones terete, greyish brown to dark brown, glabrous. **Leaves** *spiral* or rarely subopposite, *thinly coriaceous*, on drying *olive-green to grey-brown* and shining *above, dull or dark brown below*, glabrous; obovate or oblong-obovate, (9–)12–20(–24) × (4–)6–12(–13) cm, *base attenuate to cuneate and slightly decurrent, margin entire and plane, apex shortly acuminate, acute or broadly acute*; midrib slightly raised above, prominent below; lateral veins 7–8(–10) pairs, ascending and inarching towards leaf margin and forming intramarginal veins-loops, prominent on both surfaces; intercostal venation raised on both surfaces; *petiole stout*, (1–)1.5–2.5(–4) cm long, 2–3 mm thick, swollen and sometimes wrinkled at base, *dark green to dull brown or black when dry*, glabrous. **Inflorescences** axillary, solitary, 15–25(–30) cm long, densely flowered near base, blackish when dry; *rachis* terete, (2–)2.5–3(–4) mm diameter, with distinct pedicel scars, sparsely hairy with fine pale reddish-brown appressed hairs or glabrous; bracts subulate or ovate acuminate, minute, to 1 mm long, hairy. **Flowers:** *pedicels* 5–6(–8) mm long, *not winged*, in pairs, connate to *c. 5(–8) mm from base, hairy*; *perianth* (10–)15–22(–25) mm, glabrous, *limb* clavate, 2–2.5 mm diameter; *anthers* 2.5–3 mm long; *ovary* narrowly ovoid, *glabrous*; *disk-glands* obtusely ovate, close together, mostly *connate forming a crenate or fimbriate ring*. **Fruits** depressed ovoid, subglobose to broadly ellipsoid, (1.2–)1.5–3.9 × 1.6–4

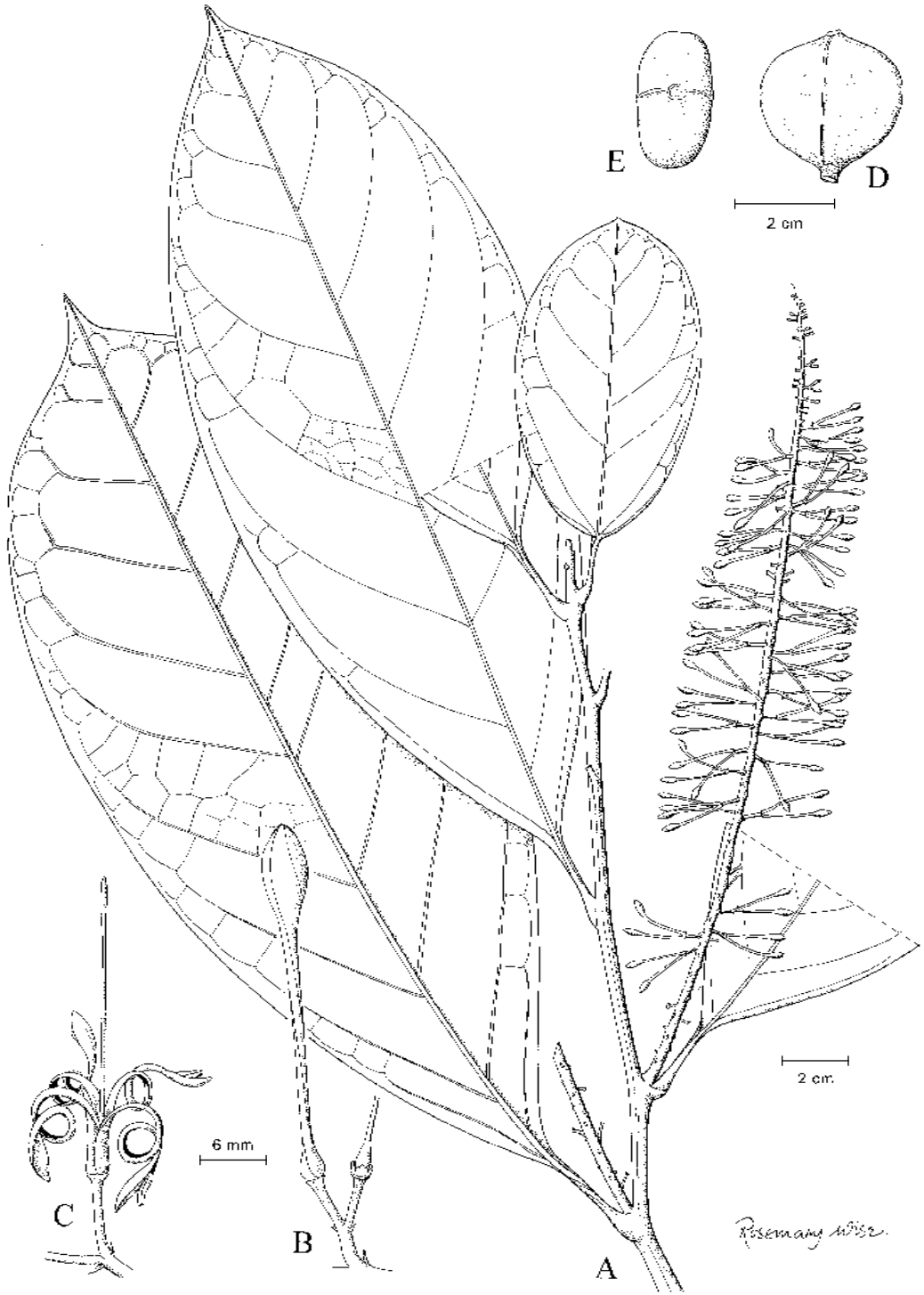


Fig. 4. *Helicia petiolaris*. A, flowering leafy twig; B, flower buds; C, open flower; D, lateral view of fruit; E, dorsal view of fruit. (A–B from *SAN* 27726, C–E from *S* 39729.)

cm, slightly asymmetric, glabrous, black to dark brown when dry, shortly apiculate, tip 1–2 mm long, at base contracted into short stipe of 2–4 mm long, or not apiculate nor stiped in depressed ovoid fruit; pericarp with a tiny vertical rib surrounding fruit, (1–)1.5–3(–4) mm thick; stalks branched or unbranched, (6–)7–10 mm long, (1–)1.5–2.5(–4) mm thick.

Vernacular name. Sabah—*kurungu* (Dusun).

Distribution. Peninsular Malaysia, Singapore and Borneo. Common in Sabah (e.g., *SAN 33635*, *SAN 84792*, *SAN 103091*, *SAN 113142*, and *SAN 118366*), Sarawak (e.g., *S 19086*, *S 25877*, *S 37231*, *S 42990*, and *S 50576*), Brunei (e.g., *BRUN 258*, *S 7849*, *SAN 17494*, *Simpson 2515*, and *Wong WKM 1110*), and W and C Kalimantan (e.g., *Church 196*).

Ecology. Scattered in lowland mixed dipterocarp and *kerangas* forests on leached acid yellow sandy soils and locally abundant in lower montane forest (Mt. Kinabalu, Mt. Mulu and Mt. Pueh), on sandstone ridges to 2100 m altitude.

Uses. The timber is locally used for house-building, but not durable.

7. *Helicia pterygota* Sleumer

(Greek, *pterygotus* = winged; referring to the pedicel)

Blumea 8 (1955) 40, FM 1, 5 (1955) 178; Cockburn *l.c.* 78; Whitmore, Tantra & Sutisna *l.c.* 292. **Type:** *Clemens 28070*, Borneo, Sabah, Mt. Kinabalu, Tenompok jungle (holotype L; isotypes A, BM!, BO!, K!, NY). **Synonym:** *Helicia erratica auct. non Hook.f.*: Stapf, FMK (1894) 220, Merrill *l.c.* (1921) 235, Masamune *l.c.* 257.

Shrub or small tree, 1.5–7 m tall, to 6 cm diameter. **Bark** brownish, smooth; inner bark greyish white. **Sapwood** yellowish. **Twigs** terete, greyish or yellowish brown, glabrous. **Leaves** spiral, *chartaceous* to *thinly coriaceous*, light olive-green or light yellowish green when dry, not shining above, glabrous; narrowly elliptic or lanceolate, (7–)8–12(–17) × 2–4(–5) cm, *base long-cuneate*, *slightly decurrent*, margin entire or with a few widely spaced teeth in upper part, *apex acute* to *acuminate*; midrib slightly raised above, distinctly prominent below; lateral veins (6–)8–9 pairs, curved upwards near leaf margin and joined with next one to form looped intramarginal veins, raised on both surfaces; intercostal venation slightly prominent on both surfaces; *petiole slender*, 1–1.5 cm long, 0.5–1 mm thick, swollen and wrinkled at base, often black when dry, glabrous. **Inflorescences** axillary or subterminal, solitary, (5–)8.0–17.5 cm long, laxly flowered except for about one fourth from base; rachis angular, 0.5–1 mm diameter, glabrous; bracts ovate-acuminate, membranaceous, *c.* 1 mm long, glabrous. **Flowers:** pedicels (2.5–)3–5(–6) mm long, *mostly with very distinct membranaceous wing on both sides*, mostly in paired, connate to about 1–2.5(–3) mm from base, glabrous; perianth (8–)10–12(–14) mm long, glabrous, limb ellipsoid, *c.* 1 mm diameter; anthers *c.* 1.6 mm long; *ovary* ovoid, *glabrous*; *disk-glands* ovate-oblong, *free*, close together. **Fruits** ellipsoid, 0.8–0.9 × 0.5–0.6 cm, symmetric, glabrous, black when dry, not apiculate and without stipe; pericarp smooth, 0.5–1 mm thick.

Distribution. Endemic to Borneo (Sabah). So far known only from Mt. Kinabalu (e.g., *SAN 28070*, *SAN 57706*, *SAN 60838*, *SAN 125465*, and *SAN 127810*).

Ecology. Hill mixed dipterocarp to lower montane forests, at 1000–1800 m altitude, on ridges.

8. *Helicia robusta* (Roxb.) R.Br. ex Wall.

(Latin, *robustus* = stout, coarse; the petiole)

Cat. (1831) 2702; Gamble *l.c.* (1914) 344; Ridley *l.c.* (1924) 142; Sleumer, *Blumea* 8 (1955) 55, FM 1, 5 (1955) 184; Backer & Bakhuizen *f.l.c.* 275; Kochummen, TFM 2 (1973) 315; Anderson *l.c.* 289; Cockburn *l.c.* 76; Ashton *l.c.* 334; Whitmore, Tantra & Sutisna *l.c.* 292; Turner *l.c.* 409; Coode *et al.* (eds.) *l.c.* 258; PROSEA *l.c.* 286. **Basionym:** *Roupala robusta* Roxb., Fl. Ind. ed. Carrey & Wall. 1 (1820) 366. **Type:** *Roxburgh s.n.*, India, Assam, Silhet (holotype BM!). **Synonyms:** *Helittophyllum javanicum* Blume, Bijdr. Fl. Ned. Ind. (1826) 652; *Helicia javanica* Blume, Ann. Sci. Nat. 2, 1 (1834) 217; *H. cumingiana* Presl., Epim. (1851) 246, var. *parvifolia* Merr., Philip. J. Sci. 1 (1906) Suppl. 49, En. Philip. 2 (1923) 99; *H. philippinensis* Meisn. in DC., Prod. 14 (1856) 441; *H. castaneaefolia* Meisn. *l.c.* 441; *H. attenuata auct. non* (Jack) Blume: Kurz, Nat. Tijd. Ned. Ind. 27 (1864) 172; *H. obovata auct. non* Benn.: Kurz *l.c.* 172; *H. travancorica* Bedd. ex Hook. *f.*, Fl. Br. Ind. 5 (1886) 191; *H. oligophlebia* Merr., Philip. J. Sci. 11 (1916) Bot. 6; *H. obovata auct. non* Benn.: Ridley, J. Mal. Br. Roy. As. Soc. 1 (1923) 90.

Distribution. A species consisting of two varieties distributed in India, Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, and the Philippines. In Sabah and Sarawak, only var. *robusta* is known. Another one, var. *integrifolia* (Elmer) Sleumer, occurs in the Philippines.

var. *robusta*

Small tree or shrub to 10(–18) m tall, 6(–10) cm diameter, frequently coppicing. **Bark** greyish white or pale yellow, smooth; inner bark yellow-green. **Sapwood** pale yellow. **Twigs** *terete*, greyish brown, tips reddish-brown hairy with appressed hairs, glabrescent. **Leaves** subopposite, sometimes spiral or verticillate, chartaceous to thinly coriaceous, on drying sometimes dark olivaceous or yellowish green above, brownish or dull brown below, not shining above, initially with appressed hairs below, glabrescent and finally glabrous; obovate-oblong or obovate, 10–25(–30) × 6–12(–15) cm, *base obtuse, truncate, subcordate*, or sometimes subacute, *not decurrent*, *margin* regularly and coarsely *serrate*, *sometimes subentire with some sharp or obtuse teeth on each side in upper part*, apex acuminate; midrib prominent on both surfaces; lateral veins (7–)10–12(–13) pairs, curved upwards and joined near leaf margin, prominent on both surfaces; intercostal venation faintly visible on both surfaces; petiole very short, to 0.5 cm long, 2–4 mm thick, swollen and wrinkled at base, greyish or dark brown when dry, glabrous. **Inflorescences** axillary or borne on leafless older branches, solitary or rarely in pairs, 12–25(–30) cm long, densely flowered except for (1–)1.5–2.5 cm from base; rachis subangular, 1.5–2 mm diameter, densely reddish-brown hairy, becoming sparsely hairy but never entirely glabrous; bracts ovate, 1–1.5 mm long, reddish-brown hairy, soon-glabrescent. **Flowers:** pedicels (2–)3–5(–7) mm long, not winged, mostly in pairs, connate to about (0.5–)1–1.5 mm from base, reddish-brown hairy, soon-glabrescent; perianth (8–)14–18(–20) mm long, reddish-brown hairy, soon-glabrescent, limb ellipsoid, 1–1.5 mm diameter; anthers 1.5–2 mm long; ovary narrowly ovoid, glabrous; disk-glands broadly elliptic, broadly ovate or subtruncate, sometimes with bidentate apex, free and close together or slightly connate at base, but later slightly spaced. **Fruits** broadly ellipsoid or subglobose, 2–2.5(–3.5) × 2–3 cm, glabrous, asymmetric, black when dry, shortly apiculate, slightly contracted at base; *pericarp* 2–3 mm thick, *mostly with 6 obtuse vertical ribs*; stalks 4–6(–7) mm long, 3–5(–6) mm thick, persistent.

Vernacular name. Sabah—*jaring-jaringan jawa*.

Distribution. India, Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, and the Philippines. Common in Sabah (e.g., *Clemens 27083*, *SAN 52038*, *SAN 87168*, *SAN 122383*, and *SAN 129127*) and Sarawak (e.g., *Nooteboom & Chai 1850*, *S 15595*, *S 22130*, *S 35506*, and *S 44688*). Also known from Brunei (e.g., *BRUN 5226*) and Kalimantan (e.g., *Labohm 1208*)

Ecology. In primary and secondary forests, on steep slopes and hills, at altitudes to 1600 m, locally common on basalt ridges and riversides.

Uses. The wood is occasionally used for shafts of axes and sometimes for house building. Young shoots are eaten as a vegetable in Java. The fruit is reported to be poisonous.

9. *Helicia rufescens* Prain

Fig. 5.

(Latin, *rufescens* = becoming reddish; referring to the indumentum of the leaves, twigs, and inflorescences)

Kew Bull. (1912) 342; Gamble *l.c.* (1914) 435; Ridley *l.c.* (1924) 142; Sleumer, *Blumea* 8 (1955) 25, FM 1, 5 (1955) 171; Kochummen, *TFM* 2 (1973) 315; Anderson *l.c.* 289; Ashton *l.c.* 334; Whitmore, *Tantra & Sutisna l.c.* 292; Turner *l.c.* 409; Coode *et al.* (eds.) *l.c.* 258; PROSEA *l.c.* 286. **Lectotype** (Sleumer, 1955): *Kunstler 8504*, Peninsular Malaysia, Perak, Taiping waterfall (holotype K!).

Medium-sized tree to 25 m tall, 35 cm diameter. **Bark** grey, smooth, lenticellate; inner bark yellow mottled pink, becoming brown on exposure. **Sapwood** yellowish brown. **Twigs** terete, grey to greyish brown, glabrous. **Leaves** spiral, *thinly coriaceous*, dull olive-green above and *glaucous below* when dry, shining above, glabrous; *narrowly elliptic*, (6–)9–15(–17) × (2.5–)3–3.5(–4.5) cm, *base long-cuneate, decurrent, margin entire, recurved, apex acuminate*; midrib raised on both surfaces; lateral veins 8–12 pairs, curving and joining near leaf margin, faint on both surfaces; intercostal venation invisible on both surfaces; *petiole 1.5–2 cm long*, 1–1.5 mm thick, swollen and smooth at base, greyish brown when dry, *glabrous*. **Inflorescences** axillary or borne on leafless older branches, solitary or in pairs, (10–)15–20 cm long, densely flowered except for 1 cm from base; *rachis terete*, 1.5–2 mm diameter, dark reddish-brown tomentose, *glabrescent*; bracts ovate, minute, *c.* 1 mm long, dark reddish-brown tomentose. **Flowers:** *pedicels 1–2(–3) mm long*, not winged, mostly in pairs and connate to about 0.5–1(–1.5) mm from base, dark reddish-brown tomentose, *glabrescent*; *perianth c.* 12 mm long, dark reddish-brown tomentose, *glabrescent*, limb clavate, *c.* 1.5 mm diameter; anthers *c.* 2 mm long; *ovary reddish-brown hairy*; disk-glands obtuse, free, spaced. **Fruits** ellipsoid, flattened laterally, 2.5–3 × (1.5–)2–2.5 cm, asymmetric, *glabrous, black when dry*, shortly apiculate, tip *c.* 1 mm long, at base contracted into a short stipe of *c.* 1 mm long; *pericarp c. 1 mm thick*.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sarawak, rare (e.g., *S 27236*). Also known from Brunei (e.g., *S 4867*).

Ecology. From sea level to 1500 m altitude (Peninsular Malaysia). In Sarawak and Brunei, the species is confined to lowland mixed dipterocarp forest on yellow sandy soils and *kerangas* forest respectively.

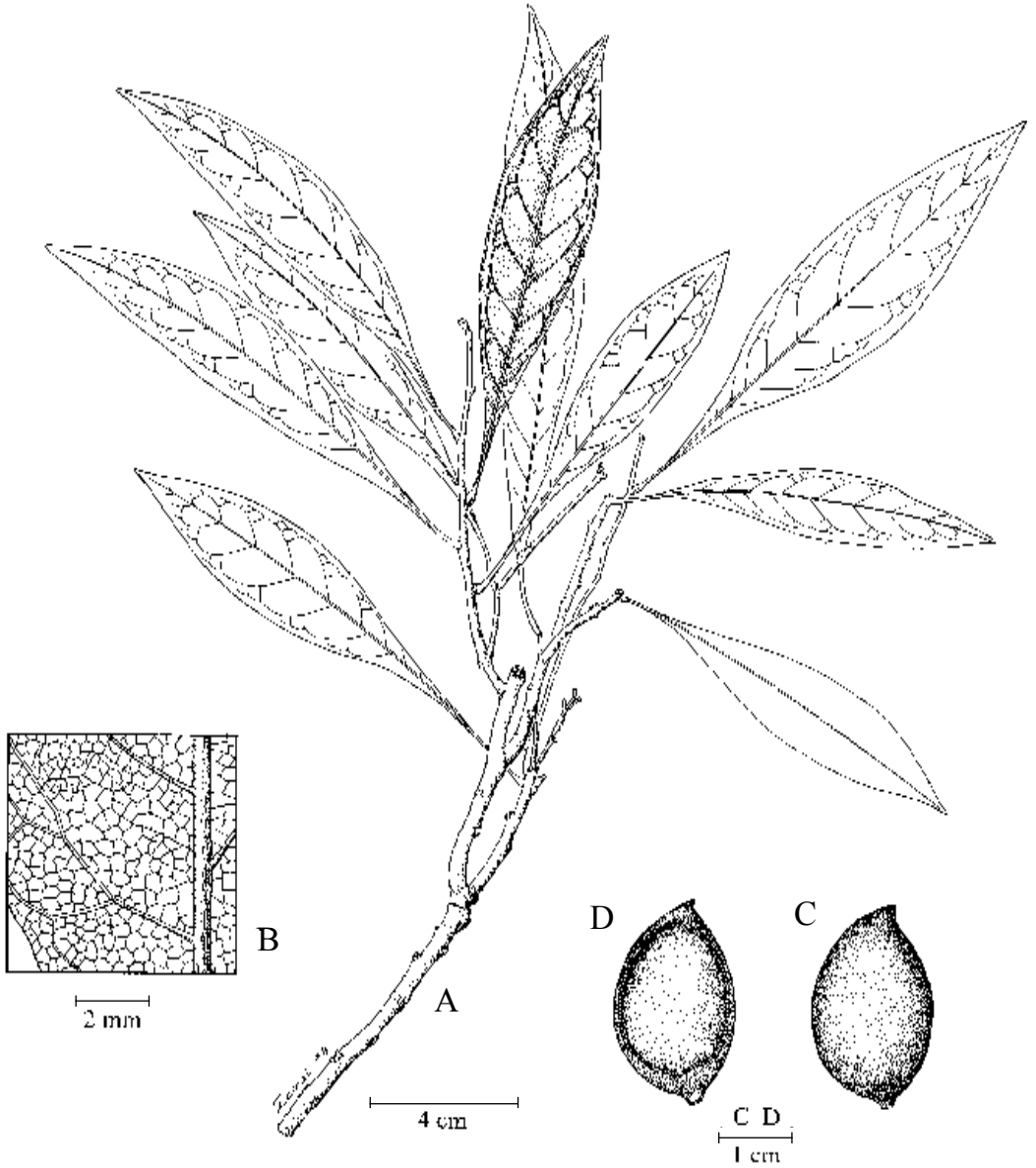


Fig. 5. *Helicia rufescens*. A, leafy twig; B, detail of lower leaf surface; C, fruit; D, longitudinal section of fruit. (All from S 27236.)

10. *Helicia serrata* (R.Br.) Blume(Latin, *serratus* = toothed; the leaf margin)

Ann. Sci. Nat. 2, 1 (1834) 215; Sleumer, Blumea 8 (1955) 34, FM 1, 5 (1955) 176; Backer & Bakhuizen *f. l.c.* 275; Kochummen, TFM 2 (1973) 316; Anderson *l.c.* 289; Ashton *l.c.* 335; Whitmore, Tantra & Sutisna *l.c.* 292; Turner *l.c.* 409; Coode *et al.* (eds.) *l.c.* 258; PROSEA *l.c.* 286. **Basionym:** *Roupala serrata* R.Br., Trans. Linn. Soc. 10 (1810) 192. **Type:** *Chr. Smith s.n.*, Moluccas, Ambon, Nusalaut (holotype BM!). **Synonyms:** *Helicia curtisii* Gamble, Kew Bull. (1913) 116, Ridley *l.c.* (1924) 142; *H. scortechinii* Gamble *l.c.* (1913) 117, Ridley *l.c.* (1924) 143; *H. brachyantha* Merr., Pap. Mich. Acad. Sci. 24 (1939) 66.

Distribution. A species consisting of two varieties distributed in Sumatra, Peninsular Malaysia, Java, Borneo, and Maluku. In Sabah and Sarawak, only var. *serrata* is known. Another one, var. *oreophila* Sleumer, occurs in Sumatra and Java.

var. *serrata*

Small to medium-sized tree, 20(–25) m tall, 25(–60) cm diameter. **Bark** grey to dark brown, smooth; inner bark pale brown, invaginating into sapwood. **Sapwood** pale yellow. **Twigs:** young parts subangular, older parts terete, greyish or yellowish brown, tips densely reddish-brown hairy when young, soon-glabrescent, older ones glabrous. **Leaves** spiral, *thinly coriaceous*, olivaceous and not shining above, *dull brownish below*, appressed hairy on both surfaces, becoming glabrous above and glabrescent below; *elliptic* or *elliptic-oblong*, sometimes *oblanceolate* or *obovate*, (8–)10–20(–24) × (3.5–)4–8(–10) cm, base attenuate and decurrent, margin serrate at least apically or sometimes entire, not recurved, apex short-acuminate to acute; midrib slightly raised above, prominent below; lateral veins 8–10 pairs, curved and more or less joined near leaf margin, faintly visible above, prominent below; intercostal venation invisible above, slightly raised below; *petiole* (0.2–)0.3–0.6(–1) cm long, 1–2 mm thick, swollen and wrinkled at base, deep brown when dry, *glabrous*. **Inflorescences** axillary in axils of lower leaves or borne on leafless older branches, solitary or paired, (5.5–)9–12(–15) cm long, densely flowered except for 0.5–1(–1.5) cm from base; *rachis* terete, *c.* 1 mm diameter, initially densely reddish-brown tomentose, *glabrescent*; bracts ovate-acuminate, minute, *c.* 1.5(–2) mm long, reddish-brown tomentose. **Flowers:** pedicels (1.5–)2–3(–4) mm long, not winged, mostly in pairs, connate to 1–2 mm from base, reddish-brown tomentose; *perianth* (4–)5–8(–10) mm long, initially reddish-brown tomentose, *glabrescent*, limb ellipsoid, 0.8–1(–1.5) mm diameter; anthers 1.5–2 mm long; *ovary* narrowly ovoid, *densely reddish-brown hairy*; disk-glands oblong or ovate-oblong, free, slightly spaced. **Fruits** depressed ovoid, 1.5–1.9(–2.2) × (1.3–) 1.5–2.2(–2.5) cm, slightly asymmetric, *glabrous*, dark brown or black when dry, rarely shortly apiculate, tip *c.* 0.5 mm long, without stipe; *pericarp* smooth, 0.5–1 mm thick, with a distinct prominent rib; stalks 3–4 mm long, 2–3.5 mm thick, persistent.

Vernacular names. Sarawak—*breyanlana* (Iban); *gagelap* (Bisayah).

Distribution. Sumatra, Peninsular Malaysia, Java, Borneo, and Maluku. In Sabah, found in Kinabatangan, Beluran (e.g., Bongaya FR), and Lamag districts (e.g., SAN A 4651, SAN 36404, SAN 70906, SAN 81852, and SAN 95287). In Sarawak, known from Bintulu and Limbang districts (e.g., Ding Hou 430, S 15571, S 22550, S 26033, and S 59359). In Brunei, recorded from Belait, Tutong and Brunei-Muara districts (e.g., BRUN 15339, Coode MC 7720, Kirkup DK 697, Sands MS 5969, and Wong WKM 1632).

Ecology. Lowland mixed dipterocarp to lower montane forests, at altitudes to 1600 m; locally common on river banks on clay-rich alluvium soils, and on basalt and shale ridges.

11. *Helicia sessilifolia* R.C.K.Chung

Fig. 6.

(Latin, *sessilis*- = stalkless, *folius* = -leafed; with sessile leaves)

Gard. Bull. Sing. 50 (1998) 151. **Type:** *Lee S 52436*, Borneo, Sarawak, Limbang Division, Lawas, Ulu Trusan, Bt. Tebunan (holotype KEP!; isotypes K, L, MO, SAN!, SAR!).

Treelet to small tree to 10 m tall. **Twigs** slender, young parts subangular, older ones terete, light brown, glabrous. **Leaves** spiral or subopposite, *thinly coriaceous*, yellowish brown when dry, *not shining above*, glabrous; *broadly oblong to elliptic, rarely obovate*, (6–) 9–17 × (4.5–) 5–8.5 cm, *base rounded to subcordate, margin entire*, apex acute; midrib slightly raised above, prominent below; lateral veins 6–7 pairs, curving and joining near leaf margin, prominent on both surfaces; intercostal venation inconspicuous on both surfaces; petiole very short, slightly swollen at base, dull brown, glabrous. **Inflorescences** axillary, solitary, *c.* 7 cm long, laxly flowered near base; *rachis* terete, *c.* 1 mm diameter, *glabrous*; bracts minute, less than 0.5 mm long, glabrous. **Flowers:** *pedicels* 5–6 mm long, not winged, *smooth*, paired, connate to *c.* 2–3 mm from base, *glabrous*; *perianth* (12–) 16–19 mm long, *glabrous*, *limb* ellipsoid, *0.8–1.2 mm diameter*; *anthers* 1–1.5 mm long; ovary ovoid, glabrous; *disk-glands* nearly entirely connate into a crenulate ring. **Fruits** ellipsoid, 4–4.5 × 2.4–2.7 cm, slightly asymmetric, glabrous, *chestnut-brown when dry, shortly apiculate, tip 1–4 mm long, at base contracted into a short stipe of c. 3 mm long; pericarp smooth, 2.5–3 mm thick.*

Distribution. Endemic to Borneo, and restricted to Sarawak and Sabah. In Sarawak, known from Bt. Tebunan, Lawas (*S 52434* and *S 52436*), and in Sabah recorded from Tambunan (*SAN 60837* and *SAN 111305*).

Ecology. Mixed dipterocarp forest, at altitudes to 900 m.

12. *Helicia symplocoides* R.C.K.Chung

(Greek, *-oides* = resembling; with leaves resembling those of *Symplocos*, Symplocaceae)

Gard. Bull. Sing. 50 (1998) 154. **Type:** *Chew & Corner RSNB 4786*, Borneo, Sabah, Mt. Kinabalu, Mesilau Cave (holotype SAN!; isotypes K, L).

Tree *c.* 15 m tall, 25 cm diameter. **Twigs** terete, grey or greyish brown, glabrous with distinct leaf scars to 3 mm diameter. **Leaves** spiral, *thickly coriaceous*, deep green and not shining above, brown below, glabrous; *obovate*, 5–10 × 2.5–5 cm, *base cuneate, decurrent*, margin entire or occasionally with 1–3 minute teeth in the upper half, recurved, *apex obtuse or emarginate*; midrib raised above, prominent below; lateral veins 6–8 pairs, curving near leaf margin and joining with next one to form looped intramarginal veins, visible below, inconspicuous above; intercostal venation inconspicuous on both surfaces; *petiole* 0.2–0.4 cm long, 1.5–2 mm thick, swollen and wrinkled at base, dark brown when dry, glabrous. **Flowers** unknown. **Fruits** ellipsoid to broadly ellipsoid, 1.5–1.7 × 1.2–1.4 cm, asymmetric, glabrous, black when dry, shortly apiculate, tip *c.*

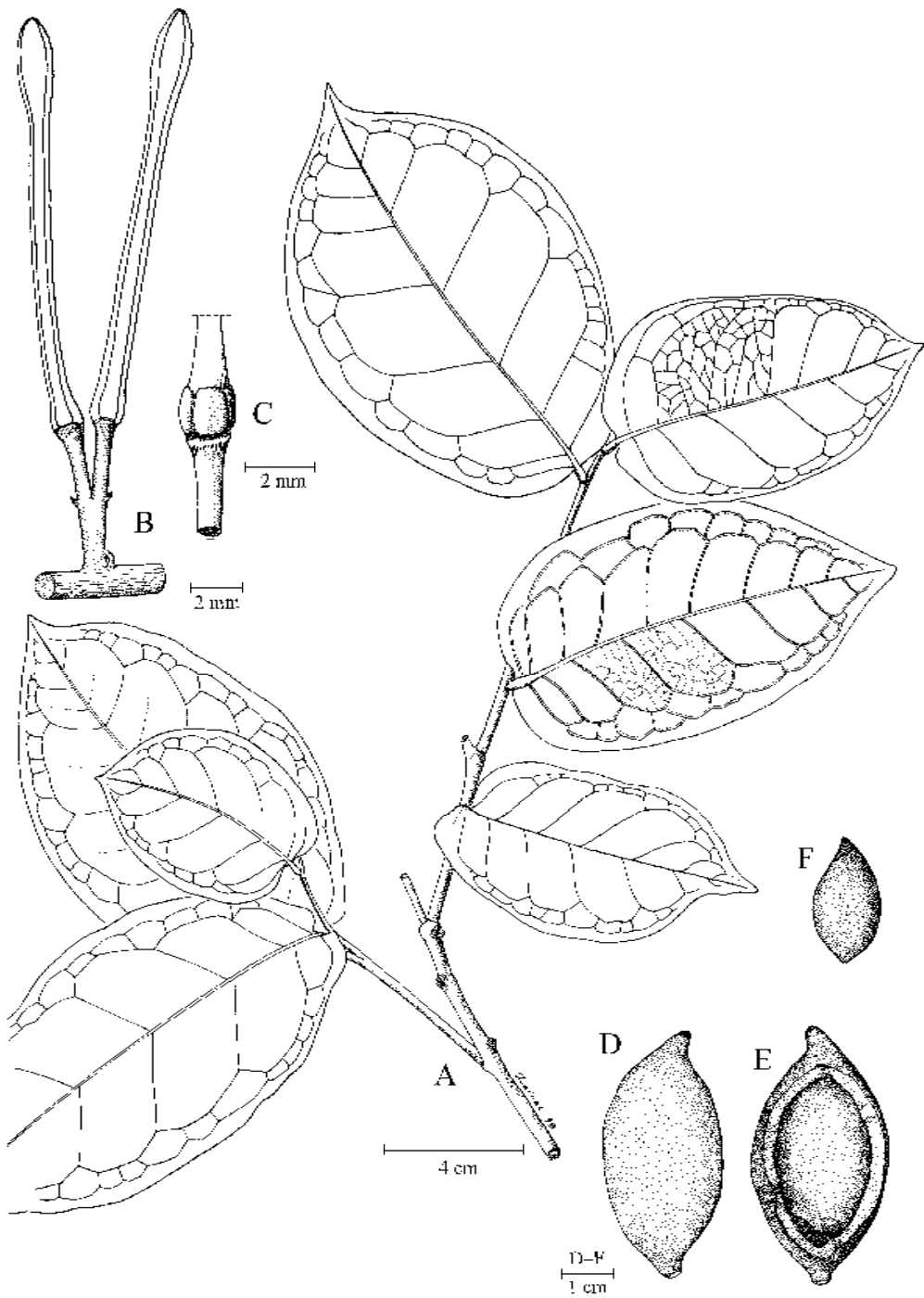


Fig. 6. *Helicia sessilifolia*. A, leafy twig; B, flower buds; C, base of ovary with disk-glands; D, fruit; E, longitudinal section of fruit; F, seed. (A–C from *S* 52436, D–F from *S* 52434.)

1 mm long, at base contracted into a short stipe of *c.* 2 mm long; pericarp smooth, 0.8–1.5 mm thick; stalks 5–7 mm long, 1.5–2 mm thick, persistent.

Distribution. Endemic to Borneo (Sabah). So far known from a single collection, *Chew & Corner RSNB 4786*, from Mt. Kinabalu, Mesilau Cave, on ultramafic soils.

Ecology. Lower montane forest at *c.* 1850 m altitude.

13. *Helicia* sp. A

Chung *l.c.* (2001) 543. **Synonym:** *Helicia robusta* var. *integrifolia* auct. non (Elmer) Sleumer: Sleumer, *Blumea* 8, 1 (1955) 57, FM 1, 5 (1955) 186, *p.p.*, *quoad specim.* *Clemens 55095*.

Treelet. **Leaves** subopposite or verticillate, thinly coriaceous, glabrous; oblanceolate, (8–) 11–16.5 × (2.5–) 3.5–5 cm, base cuneate, decurrent, margin entire, recurved, apex acute; midrib raised on both surfaces; lateral veins 8–10 pairs, curving and joining near leaf margin, prominent on both surfaces; intercostal venation raised on both surfaces; *petiole* 0.8–1 cm long, 2–3 mm thick, swollen at base, glabrous. **Inflorescences** axillary or borne on leafless older branches, solitary, 28–32 cm long, laxly flowered except for 2.5 cm from base; rachis terete, *c.* 3 mm diameter. **Flowers:** *pedicels* 9–10 mm long, *not winged*, mostly in pairs, connate at base; perianth 20–25 mm long; *ovary glabrous; disk-glands connate into a crenulate ring.* **Fruits** unknown.

Distribution. Known only from Marai Parai, Mt. Kinabalu, Sabah (*Clemens 55095*), on ultramafic soils.

Ecology. Montane forest at *c.* 3400 m altitude.

2. HELICIOPSIS Sleumer (resembling the genus *Helicia*)

palis (Iban), *pasis* (Bidayuh)

Blumea 8 (1955) 79, FM 1, 5 (1955) 190; Backer & Bakhuizen *f.*, FJ 1 (1964) 275; Kochummen, TFM 2 (1973) 317; Anderson, CLTS (1980) 289; Cockburn, TS 2 (1980) 78; Ashton, MNDTS 2 (1988) 336; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 292; Coode *et al.* (eds.), CLBD (1996) 259; PROSEA 5, 3 (1998) 286; Chung, *J. Trop. For. Sci.* 13 (2001) 536.

Small to medium-sized trees. **Leaves** spiral, *generally of 2 forms, unlobed or deeply lobed*, entire, sessile or petioled, intercostal venation reticulate. **Inflorescences** racemose, many-flowered, axillary or borne on leafless older branches; bracts subulate, small, or linear-elongate, caducous or persistent; bracteoles minute, caducous; pedicel mostly in pairs, free or connate to four fifths of their length. **Flowers** *unisexual (plants dioecious)*; perianth tube straight, slender, limb clavate or ellipsoid, attenuate towards base in male flowers, dilated at base by the swollen ovary in female flowers, segments 4, curled and twisted at anthesis; stamens 4, sessile or nearly

so, inserted at base of perianth limb; anthers oblong, connective apiculate; ovary sessile, style slender, glabrous, clavate towards apex; *stigma* in female flowers *discoïd, lateral, stigmatic surface* glandular, *with distinct cleft, absent in male flowers*; *ovules* 2, *orthotropous*, hanging from top of the cavity; disk-glands 4, free, mostly forming a cup. **Fruit** a drupe, cylindrical-ellipsoid; *pericarp differentiated into 3 distinct layers*, exocarp smooth, leathery, thin, *mesocarp with numerous radial fibrous tissue*, persistent, sometimes early dissolved or nearly absent, endocarp hard, woody at least in inner part, mostly thick, outer face reticulate-lacunose, lacunae sometimes perforated. **Seed** 1, nearly globose, or seeds 2, hemispherical, wrinkled in the upper part; testa thin; cotyledons large, fleshy.

Distribution. About 13 species, distributed in Burma, Indo-China, SE China, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, and the Philippines (Palawan, Mindanao). Seven species are known in Sabah and Sarawak, of which two are endemic.

Ecology. In primary lowland to lower montane forest, at altitudes to 1600 m. Often associated with small streams. *H. montana* is confined to montane forest.

Uses. The wood of *Heliciopsis* has a nice oak-like streaks, and is used for making high class furniture, superior joinery, interior finish and veneer (PROSEA *l.c.* 286).

Taxonomy. The genus shares a few similar morphological characters with *Helicia* Lour. (sessile anthers) and *Macadamia* F.v.M. (orthotropous ovules, pendent from the top of the cavity), but is very different from both by the unisexual flowers, the peculiar structure of the pericarp, and the pollen which has a reticulate sexine. Sleumer (1955) observed that the stigma of *Heliciopsis* is punctiform and terminal. However, Chung (2001) showed that the stigma is discoïd, lateral, and the stigmatic surface is provided with distinct cleft. Such a stigma was, however, not observed in the functionally male flowers, a character found consistently in all species of *Heliciopsis*. The characters of the stigma just described can be used to distinguish species of *Heliciopsis* from those of *Helicia* which have a punctiform, terminal stigma without a cleft.

Key to *Heliciopsis* species

1. Petioles of unlobed leaves shorter than 3 cm.....2
 Petioles of unlobed leaves longer than 4 cm.....4
2. Base of unlobed leaves attenuate and decurrent; lateral veins 5–6 pairs.. **H. litseifolia**
 Base of unlobed leaves cuneate, non-decurrent; lateral veins 12–18 pairs.....3
3. Unlobed leaves obovate or broadly obovate-oblong, initially covered with crisp reddish-brown hairs on both surfaces, glabrescent, apex broadly rounded, dark brown when dry. Fruits broadly ellipsoid, black when dry; exocarp 0.5–1 mm thick, mesocarp made up of *c.* 1 mm long fibres, endocarp *c.* 1 mm thick.....**6. H. rufidula**
 Unlobed leaves lanceolate or oblanceolate-oblong, glabrous on both surfaces, apex short-acuminate or subacute, olivaceous, greenish or yellowish brown when dry. Fruits

- cylindric-ellipsoid, brown when dry; exocarp 1–1.5 mm thick, mesocarp made up of 2–3 mm long fibres, endocarp 1–2 mm thick.....7. **H. velutina**
4. Petiole of unlobed leaves 8–14 cm long; base of unlobed leaves attenuate and decurrent.....1. **H. artocarpoides**
 Petiole of unlobed leaves 3.5–7 cm long; base of unlobed leaves cuneate and non-decurrent.....5
5. Unlobed leaves oblong-lanceolate, margin plane, apex obtuse; lateral veins 26–30 pairs.....3. **H. mahmudii**
 Unlobed leaves elliptic, broadly elliptic to narrowly oblong, margin recurved, apex rounded; lateral veins 6–14 pairs.....6
6. Petiole of unlobed leaves glabrous, 4.5–6 cm long; lateral veins 6–14 pairs. Pedicels of male flowers 4–5 mm long; perianth of male flowers 4–5 mm long. 4. **H. montana**
 Petiole of unlobed leaves initially reddish-brown hairy, glabrescent, 3.5–4.5 cm long; lateral veins 7–8 pairs. Pedicels of male flowers 8–10 mm long; perianth of male flowers 12–15 mm long.....5. **H. percoriacea**

1. **Heliciopsis artocarpoides** (Elmer) Sleumer

Fig. 7.

(Greek, *-oides* = resembling; with leaves resembling those of *Artocarpus*, Moraceae)

Blumea 8 (1955) 83, FM 1, 5 (1955) 192; Anderson *l.c.* 289; Cockburn *l.c.* 78; Ashton *l.c.* 336; Whitmore, Tantra & Sutisna *l.c.* 292; Coode *et al.* (eds.) *l.c.* 259; PROSEA *l.c.* 287. **Basionym:** *Helicia artocarpoides* Elmer, *Leafl. Philip. Bot.* 5 (1913) 1826, Merrill, PEB (1929) 52, Masamune, EPB (1942) 257. **Type:** *Elmer 12946*, the Philippines, Palawan, Puerto Princessa, Mt. Pulgar (holotype PNH†; isotypes A, B, BM!, BO, E, K!, L, M, NY).

Tree to 25 m tall, 25 cm diameter. **Bark** dark, smooth with knobby scars; inner bark brittle, yellow, brown, or whitish. **Sapwood** yellow or white with prominent rays. **Twigs** terete, greyish brown to dark brown, reddish-brown hairy when young, soon-glabrescent. **Unlobed leaves** thinly coriaceous, dark brown when dry, slightly shining above, glabrous; obovate-oblong, 30–40 × 9–12.5 cm, *base attenuate* and *decurent*, margin entire, apex rounded; midrib raised above, prominent below; lateral veins 14–16 pairs, slightly curved upwards, slightly raised above, distinctly prominent below; intercostal venation slightly raised on both surfaces; *petiole* (0.5–)0.8–1.4 mm long, 1–3 mm thick, swollen at base, dark brown when dry, glabrous. **Deeply lobed leaves** glabrous, 35–90 × 25–55 cm; lobes in 2–8 pairs, narrowly oblong or lanceolate, apex shortly acuminate, sinuses rounded and mostly 1–3 cm distant from common midrib; lateral veins 10–15 pairs, most straight, curving into a distinct intramarginal vein; intercostal venation visible on both surfaces; *petiole* (6–)10–18 cm long, 3–5 mm thick, swollen and wrinkled at base, initially reddish-brown hairy, glabrescent or glabrous. **Inflorescences** borne on stems or leafless older branches, solitary or in clusters of 2–3 (rarely up to 10), 12–30 cm long, densely flowered except for 2–3 cm from base; rachis 1.5–2.5(–3) mm diameter, densely reddish-brown hairy with appressed hairs; bracts subulate, 0.5–1 mm long, caducous. **Flowers:** pedicels (3–)5–7(–8) mm long, mostly in pairs, free or connate to 2–5 mm from base, reddish-brown hairy; perianth 14–15 mm long, reddish-brown hairy, limb clavate, 1.5–2.3 mm diameter; male flower with anthers 2–2.5 mm long; female flower with ovary narrowly ovoid, glabrous; disk-glands ovate-

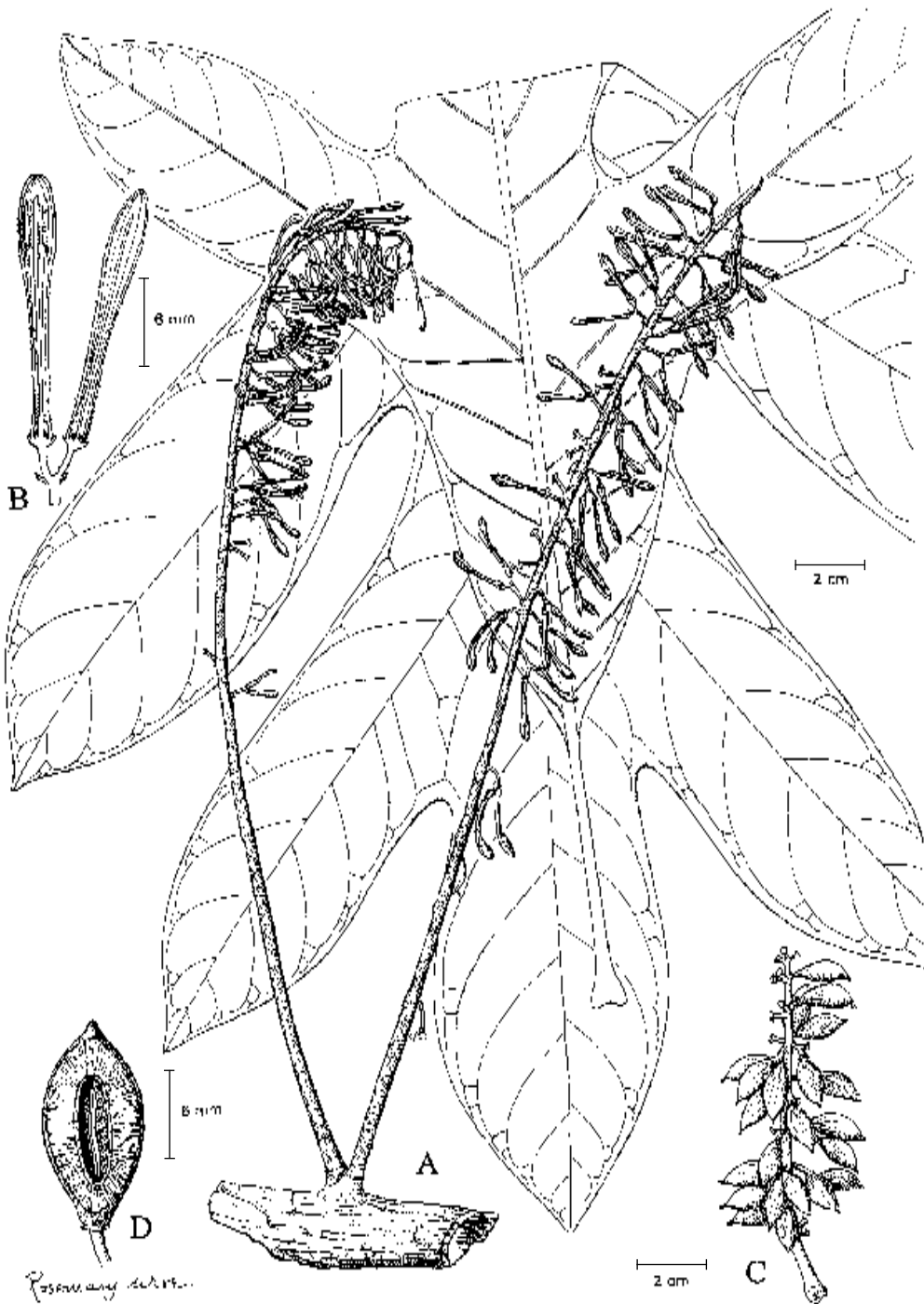


Fig. 7. *Heliciopsis artocarpoides*. A, flowering (male) leafy twig; B, longitudinal section of male flower buds; C, fruits; D, longitudinal section of fruit. (A–B from *S* 40002, C–D from *KEP* 80440.)

oblong, free, closed together. **Fruits** cylindrical-ellipsoid, $3.2-4(-4.5) \times (2-)2.5-3$ cm, smooth, shining and dark-coloured when dry; exocarp leathery, thin; mesocarp built up by radial, soft brown fibres *c.* 3 mm long; endocarp hard, woody, reticulate-lacunose, *c.* 1 mm thick; stalks *c.* 10 mm long, *c.* 3 mm thick, persistent.

Vernacular names. Sabah—*kerungguon* (Dusun Kinabalu), *kurunggu*, *putat* (Malay). Sarawak—*dagu* (Bidayuh).

Distribution. Borneo and the Philippines. In Sabah, known from Mt. Kinabalu, Kinabatangan, Sandakan, and Tawau (e.g., *KEP 80440*, *SAN 21791*, *SAN 35570*, *SAN 87241*, and *SAN 108210*). In Sarawak, scattered (e.g., *S 25403*, *S 28703*, *S 40002*, *S 45251*, and *S 52500*). Also occurs in Brunei (*Coode MC 6973* and *Sands MS 5704*) and Kalimantan (*Argent & Amiril 9368*).

Ecology. Moderately common in mixed dipterocarp forest at altitudes to 1600 m; also in *kerangas* forest.

Uses. Paste of burnt leaves is used as a poultice for rheumatism (Bidayuh, Sarawak).

2. *Heliciopsis litseifolia* R.C.K.Chung (with leaves resembling those of *Litsea*, Lauraceae)

Fig. 8.

Gard. Bull. Sing. 50 (1998) 154. **Type:** *Jacobs 5401*, Borneo, Sarawak, Kapit, Belaga (holotype SAR!; isotypes B, CANB, G, K, L, S, US).

Small to medium-sized tree, 6–25 m tall, 10–25(–50) cm diameter. **Bark** mottled greyish green and brown, smooth, hoop-marked; inner bark yellowish brown, brittle. **Sapwood** white. **Twigs:** youngest parts angular, older ones terete, grey-brown, glabrous. **Unlobed leaves** thinly coriaceous, yellowish green, olivaceous brown, not shining above, glabrous; elliptic to broadly elliptic, $10-25 \times 4-11.5$ cm, *base attenuate, decurrent*, margin entire, apex acute or acuminate; midrib slightly raised above, prominent below; *lateral veins 5–6 pairs*, curved upwards and joining near leaf margin to form intramarginal vein-loops, prominent on both surfaces; intercostal venation reticulate, faint above, visible below; *petiole (0.5–)1–2.5 cm long*, 2–2.5 mm thick, swollen at base, black and rarely yellowish brown when dry, glabrous. **Deeply lobed leaves** unknown. **Inflorescences** axillary or borne on leafless older branches, solitary, 12–26 cm long, laxly flowered except for *c.* 3 cm from base; rachis 1–1.5(–2) mm diameter, reddish-brown hairy, soon-glabrescent; bracts subulate, 1–2 mm long, caducous, reddish-brown hairy. **Flowers:** pedicels 5–8 mm long, mostly in pairs, connate up to 3–5 mm from base, reddish-brown hairy; perianth 8–10 mm long, reddish-brown hairy to glabrescent, limb clavate, *c.* 1.5 mm diameter; male flower with anthers 1–1.5 mm long; female flower with ovary ovoid, glabrous; disk-glands truncate, free, spaced. **Fruits** cylindrical-ellipsoid, $(2.7-)3-3.5(-4.5) \times (1.7-)-2-2.2(-3.5)$ cm, smooth, shining black when dry; exocarp leathery, *c.* 1 mm thick; mesocarp made up of radial, soft brown fibres of *c.* 2.5 mm long; endocarp woody, up to 3 mm thick; stalks 10–12 mm long, 3–4 mm thick, persistent.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, scattered and known by several collections from Sabah (e.g., *SAN 35872*, *SAN 67659* and *SAN 110338*), Sarawak (e.g.,

F

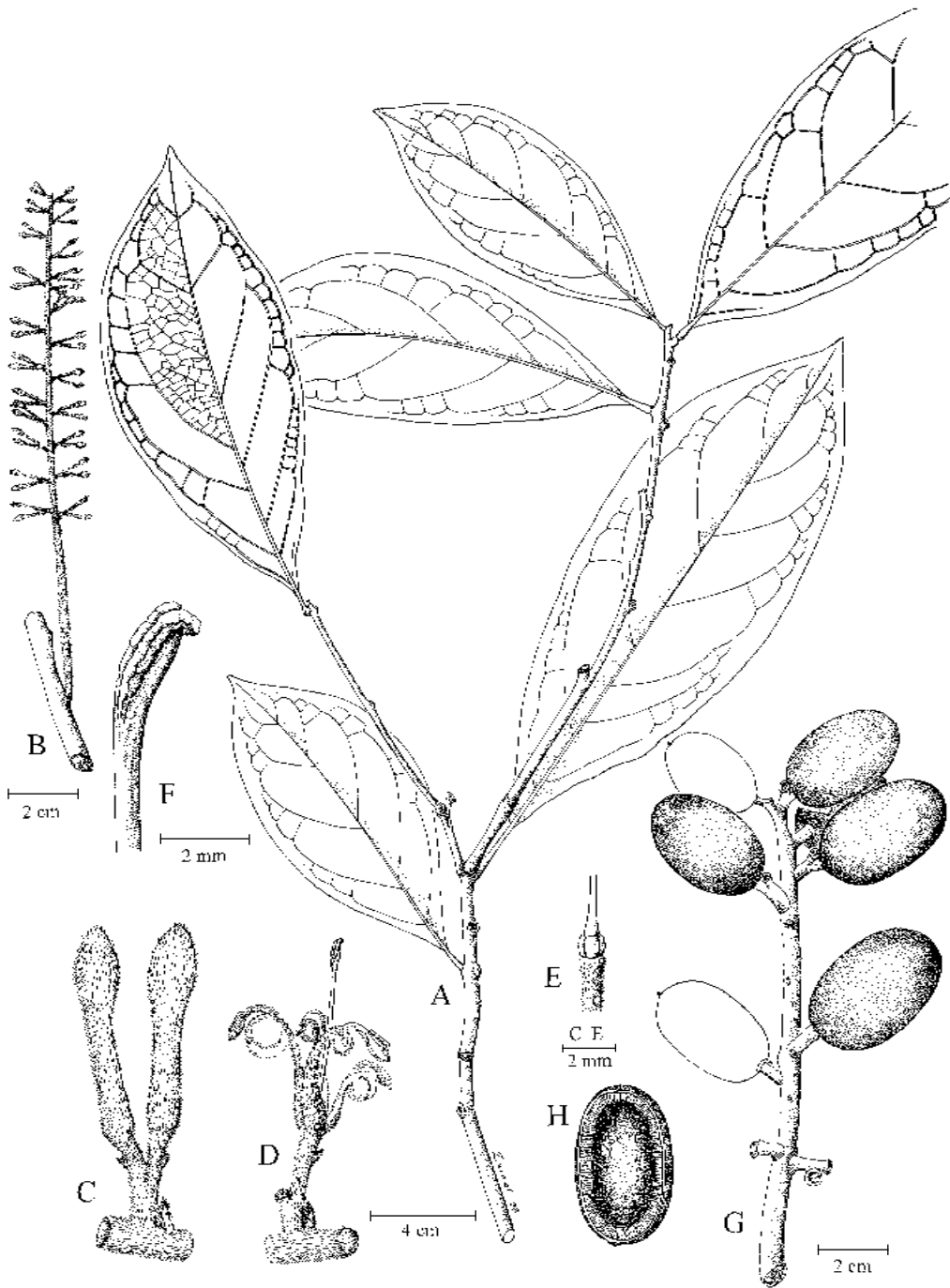


Fig. 8. *Heliciopsis litseifolia*. A, leafy twig; B, male inflorescence; C, male flower buds; D, open female flower; E, base of ovary with disk-glands; F, stigma; G, infructescence; H, longitudinal section of fruit. (A and G–H from *SAN 67659*, B–C from *S 34497*, D–F from *Jacobs 5401*.)

Jacobs 5401, S 19547, S 29994, S 34320, and S 48191) and Kalimantan (e.g., *Ridsdale PBU 595* and *Church 173*).

Ecology. Lowland and hill dipterocarp forest, at altitudes to 900 m.

3. *Heliciopsis mahmudii* (P.Chai) R.C.K.Chung Fig. 9. (named in honour of Haji Abdul Taib Mahmud, the Honourable Chief Minister of Sarawak)

J. Trop. For. Sci. 13 (2001) 540. **Basionym:** *Helicia mahmudii* P.Chai, Sandakania 7 (1996) 59. **Type:** *Chai S 33791*, Borneo, Sarawak, Lanjak-Entimau Wildlife Sanctuary (holotype SAR!; isotypes K, KEP!, L, MO, SAN).

Small tree *c.* 5 m tall, 4 cm diameter. **Bark** surface dark brown, thin, finely vertically cracked. **Twigs** terete, dark brown, youngest part reddish-brown hairy, late-glabrescent. **Unlobed leaves** thinly to thickly coriaceous, dull olive-green above, light creamy brown below when dry, slightly bullate and shining above, glabrous; *oblong-lanceolate*, 29–42 × 9–11.5 cm, *base cuneate, non-decurrent, margin entire, plane, apex obtuse* and shortly pointed; midrib distinctly raised and with sharp angle on both surfaces; *lateral veins* ascending, 26–30 pairs, visible above, raised below; intercostal venation visible on both surfaces; *petiole 4.5–6(–7) cm long*, 7–13 mm thick, swollen and wrinkled at base, deep brown when dry, glabrous. **Deeply lobed leaves** unknown. **Female inflorescences** borne on stem *c.* 30 cm above ground, solitary, *c.* 5 cm long, laxly flowered except for *c.* 1 cm from base; rachis terete, *c.* 1.5 mm diameter, reddish-brown hairy; bracts subulate, to *c.* 2 mm long, reddish-brown hairy, caducous. **Female flowers:** pedicels (4–)5–6 mm long, solitary or mostly in pairs, connate to 0.8–1.5 mm from base, reddish-brown hairy; perianth 7–8 mm long, reddish-brown hairy; limb ellipsoid, *c.* 1(–1.5) mm diameter; anthers 1.5–2 mm long, sterile; ovary ovoid, glabrous; disk-glands truncate, free, 0.2–0.4 mm apart from each others. **Male inflorescences, male flowers and fruits** unknown.

Distribution. Endemic to Borneo. Rare and known from Lanjak-Entimau Wildlife Sanctuary (*S 33791*) and Bintulu (*S 66455*), Sarawak.

Ecology. In open places colonised by secondary pioneer vegetation following landslips, at 600–850 m altitude.

4. *Heliciopsis montana* Symington *ex* Kochummen (Latin, *montanus* = growing in the mountains)

Gard. Bull. Sing. 26 (1973) 287, TFM 2 (1973) 317; Turner, Gard. Bull. Sing. 47 (1995) 409; Chung *l.c.* (2001) 543. **Type:** *Kochummen FRI 16172*, Peninsular Malaysia, Pahang, Fraser's Hill (holotype KEP!).

Medium-sized tree to 26 m tall, 60 cm diameter. **Sapwood** white. **Twigs** terete, grey-brown, young parts hairy, later glabrous. **Unlobed leaves** thickly coriaceous, yellowish green when dry, slightly shining above, glabrous; *elliptic to narrowly oblong*, (9–)15–21(–39.5) × (3.5–)6–9.8(–19.5) cm, *base cuneate, not decurrent*, occasionally slightly asymmetric, *margin entire, recurved, apex rounded*; midrib slightly raised on both surfaces; *lateral veins 6–10(–14) pairs*, arching and

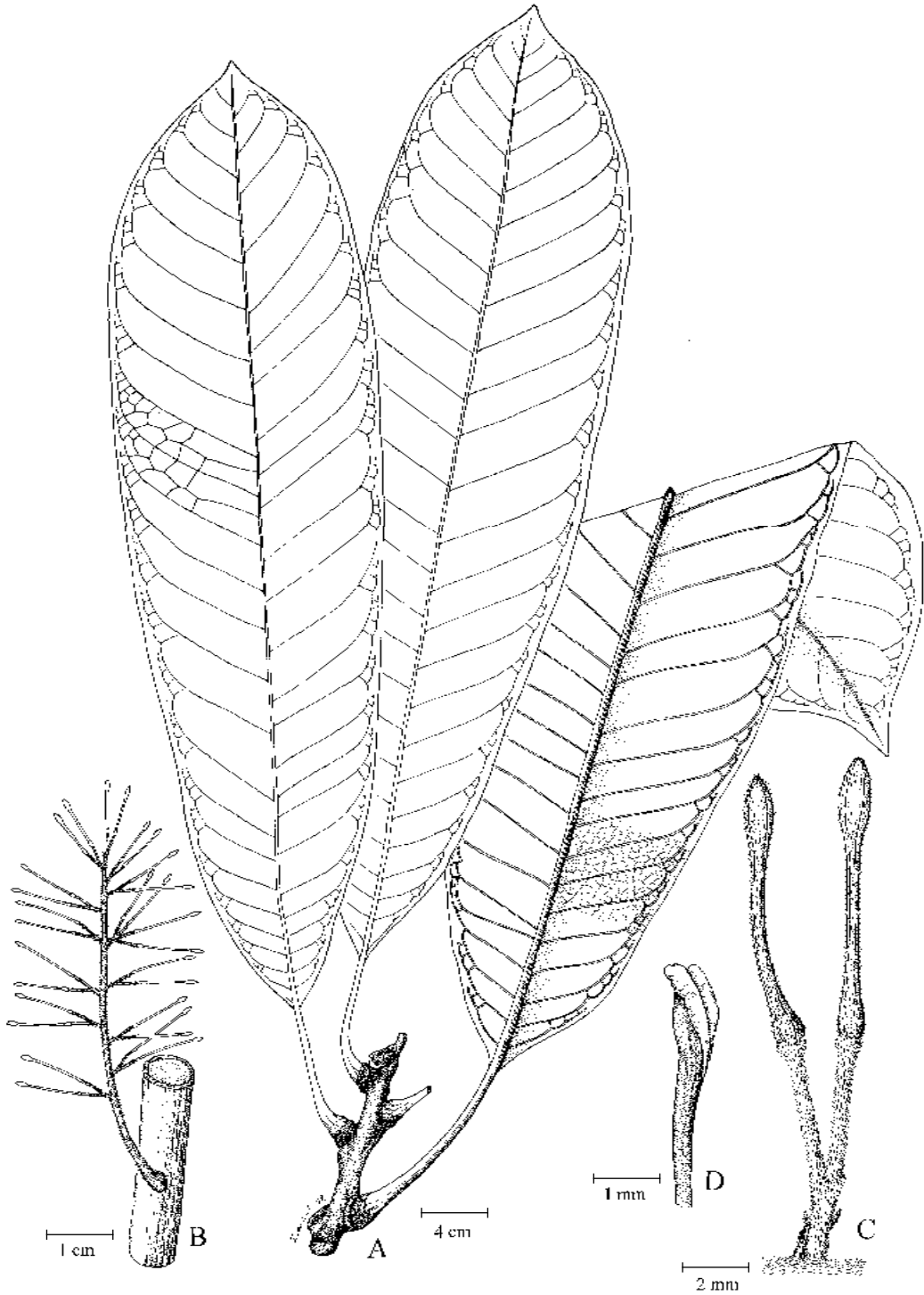


Fig. 9. *Heliciopsis mahmudii*. A, leafy twig; B, female inflorescence; C, female flower buds; D, stigma. (All from S 33791.)

joining near leaf margin to form intramarginal veins, slightly raised on both surfaces; intercostal venation faintly visible on both surfaces; *petiole* 4.5–6 cm long, 1.5–3 mm thick, slightly swollen at base, dark brown, *glabrous*. **Deeply lobed leaves** glabrous, 48–53.5 × 24–27 cm; lobes in 3–5 pairs, oblong, apex acute, sinuses rounded and 1.5–2 cm distant from common midrib; lateral veins 9–11 pairs, looping and joining at leaf margin to form a distinct intramarginal vein; intercostal venation distinct below, visible above; petiole to 10 cm long, to 5 mm thick, dark brown, *glabrous*. **Male inflorescences** axillary, solitary, *c.* 14 cm long, laxly flowered except for *c.* 3 cm from base; rachis *c.* 2 mm diameter, densely reddish-brown hairy; bracts subulate, 1–2 mm long, caducous, reddish-brown hairy. **Male flowers:** *pedicels* 4–5 mm long, mostly in pairs, connate to 3–4 mm from base, reddish-brown hairy; *perianth* 4–5 mm long, reddish-brown hairy, limb clavate, 1–1.5 mm diameter; anthers *c.* 1 mm long. **Female inflorescences and female flowers** unknown. **Fruits** oblong, 2.8–3.8 × 2.5–3 cm, smooth, shining black when dry; exocarp leathery, *c.* 2 mm thick; mesocarp made up of radial, soft brown fibres of *c.* 3 mm long; endocarp hard, woody, thin; stalks *c.* 6 mm long, *c.* 3 mm thick, persistent.

Distribution. Peninsular Malaysia and Borneo. In Borneo, uncommon and known by a single collection (*SAN 76428*) from Pinosuk Plateau, Mt. Kinabalu, Ranau, Sabah.

Ecology. Lower montane forest, at 1500–1800 m altitude.

5. *Heliciopsis percoriacea* R.C.K.Chung

Fig. 10.

(Latin, *per-* = very; *coriaceus* = leathery; referring to the leaves)

Gard. Bull. Sing. 50 (1998) 158. **Type:** *Othman et al. S 49967*, Borneo, Sarawak, Lundu, G. Pueh (holotype KEP (Sheet 1)!; isotypes K, KEP (Sheet 2)!, L, MO, SAN!, SAR!).

Medium-sized tree to 21 m tall, 36 cm diameter. **Bark** greyish brown, smooth. **Twigs** terete, greyish brown, reddish-brown hairy when young, soon becoming glabrous. **Unlobed leaves** thickly *coriaceous*, olivaceous or yellowish brown when dry, shining above, *glabrous*; *broadly elliptic*, (10–)12–18(–21) × (7–)8–11(–12.5) cm, *base acute*, *margin entire*, *recurved*, *apex rounded*; midrib slightly raised above, prominent below, reddish-brown hairy, soon-glabrescent; *lateral veins* 7–8 pairs, curving and joining near leaf margin, slightly raised above, prominent below; intercostal venation prominent on both surfaces; *petiole* 3.5–4.5 cm long, 2.5–3 mm thick, *reddish-brown hairy when young*, *glabrescent*. **Deeply lobed leaves** unknown. **Inflorescences** borne on leafless older branches, solitary, 26–28 cm long, laxly flowered except for 1–2 cm from base; rachis terete, *c.* 2.5 mm diameter, reddish-brown hairy; *bracts subulate*, *c.* 1 mm long, caducous, reddish-brown hairy. **Flowers:** *pedicels* 8–10 mm long, in pairs, connate to 4–6 mm from base, reddish-brown hairy; *perianth* 12–15 mm long, reddish-brown hairy, limb ellipsoid, *c.* 2.5 mm diameter; male flower with anthers *c.* 2 mm long; female flower with ovary ovoid, *glabrous*; disk-glands ovoid, free, slightly distant from each other. **Fruits** unknown.

Distribution. Endemic to Borneo. Rare, known from G. Pueh, Sarawak (*S 49967*) and Mt. Tambuyukon, Sabah (*Nais et al. SNP 4891*).

Ecology. In *kerangas* forest and forest on ultramafic soils.

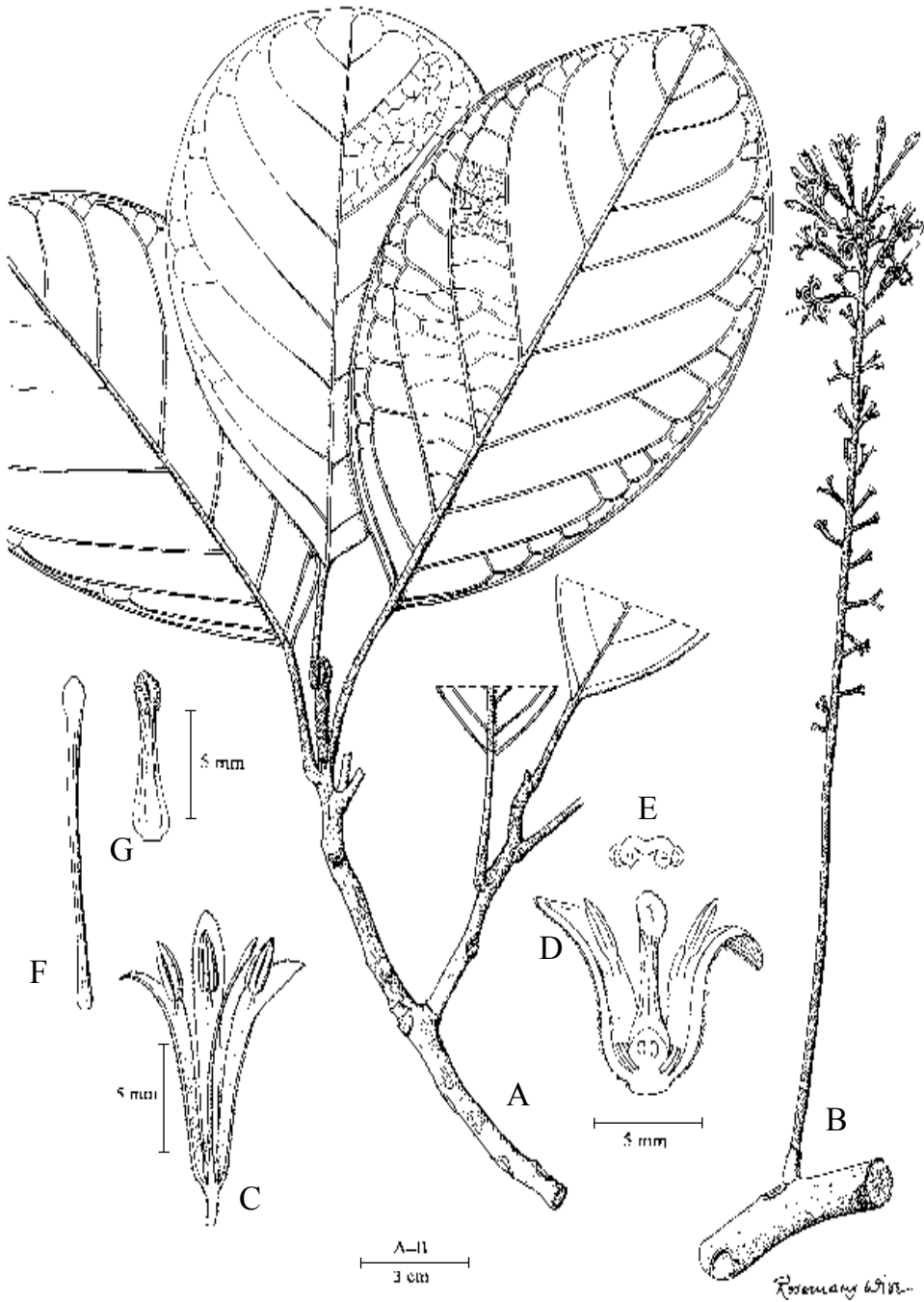


Fig. 10. *Heliciopsis percoriacea*. A, leafy twig; B, male inflorescence; C, longitudinal section of male flower; D, longitudinal section of female flower; E, cross section of anther (female flower); F, stigma of male flower; G, stigma of female flower. (A–C and F from *S* 49967 (Sheet 1), D–E and G from *Nais et al.* SNP 4891.)

6. *Heliciopsis rufidula* Sleumer

(Latin, *rufidulus* = somewhat red; the indumentum of young leaves, branches, rachis)

Blumea 8 (1955) 82, FM 1, 5 (1955) 192; Kochummen *l.c.* 319; Anderson *l.c.* 289; Ashton *l.c.* 337; Whitmore, Tantra & Sutisna *l.c.* 293; Turner *l.c.* 409; PROSEA *l.c.* 287. **Type:** *Browne FMS 43457*, Peninsular Malaysia, Perak, Trolak FR (holotype KEP!).

Tree to 30 m tall, 60 cm diameter. **Bark** hoop-marked. **Sapwood** white. **Twigs** terete, grey to dull brown, initially reddish-brown hairy, glabrescent. **Unlobed leaves** *thinly coriaceous, dark brown when dry*, slightly shining above, *initially covered with crisp reddish-brown hairs on both surfaces, glabrescent, obovate or broadly obovate-oblong*, (12–)15–28 × (6–)7–13 cm, base cuneate, margin entire, *apex broadly rounded*; midrib slightly raised above, prominent below, hairy; lateral veins 14–18 pairs, straight and parallel, inarching near leaf margin, visible above, prominent below, hairy; intercostal venation visible on both surfaces; petiole (1–)1.5–3 cm long, 1–2 mm thick, initially reddish-brown hairy, soon-glabrescent. **Deeply lobed leaves** *c.* 55 × 35 cm, with 3–4 lobes on each side, 12–18 × 5–8 cm, densely dark reddish-brown hairy below, 4–6 cm from common midrib; lateral veins 10–12 pairs; petiole to 11 cm long, 4–6 mm thick, dark reddish-brown hairy. **Inflorescences** (immature) borne on leafless older branches, solitary, 8–15 cm long, laxly flowered except for 3.5–8 cm from base; rachis 1.5–2 mm diameter, densely reddish-brown hairy; bracts linear, 2.5–3 mm long, persistent, reddish-brown hairy. **Flowers** (immature): pedicels 1.5–2 mm long, in pairs, connate to halfway from base, reddish-brown hairy; perianth 4–5 mm long, reddish-brown hairy, limb clavate, *c.* 1.5 mm diameter; male flower with anthers 1.5 mm long; female flower with ovary ovoid, glabrous. **Fruits** *broadly ellipsoid*, 3.5–4 × 2.5 cm, smooth, *not shining black when dry*; *exocarp* leathery, 0.5–1 mm thick; *mesocarp* made up of radial, soft brown *fibres c. 1 mm long*; *endocarp c. 1 mm thick*; stalks 7–9 mm long, 2–2.5 mm thick, persistent.

Distribution. Peninsular Malaysia and Borneo. In Borneo, uncommon, known only from one collection, *Jacobs 5406*, from Belaga, Kapit, Sarawak.

Ecology. Lowland mixed dipterocarp forest on clay-rich soils, at about 500 m altitude.

7. *Heliciopsis velutina* (Prain) Sleumer

Fig. 11.

(Latin, *velutinus* = velvety; the petiole)

Blumea 8 (1955) 81, FM 1, 5 (1955) 191; Kochummen, TFM 2 (1973) 320; Anderson *l.c.* 289; Cockburn *l.c.* 78; Ashton *l.c.* 338; Whitmore, Tantra & Sutisna *l.c.* 293; Turner *l.c.* 409; PROSEA *l.c.* 287. **Basionym:** *Helicia velutina* Prain, Kew Bull. (1912) 343. **Type:** *Kunstler 7316*, Peninsular Malaysia, Perak, Larut, G. Bubu (holotype K!).

Tree, 10–25 m tall, 20–25 cm diameter. **Bark** dark brown with grey patches, smooth to cracked, with horizontal rings; inner bark pinkish brown, fibrous. **Sapwood** white. **Twigs** terete, greyish brown, initially reddish-brown hairy, soon-glabrescent. **Unlobed leaves** *thinly coriaceous, olivaceous, greenish or yellowish brown when dry*, slightly shining above, *glabrous; lanceolate or oblanceolate-oblong*, (10–)12–28 × (3–)4–7 cm, *base cuneate, non-decurrent*, margin entire, *apex short-acuminate or subacute*; midrib raised above, prominent below, pubescent on both surfaces, soon-glabrescent; *lateral veins 12–14(–16) pairs*, rather straight below and parallel to each other, curved above and inarching, with some short and less distinct intermediate

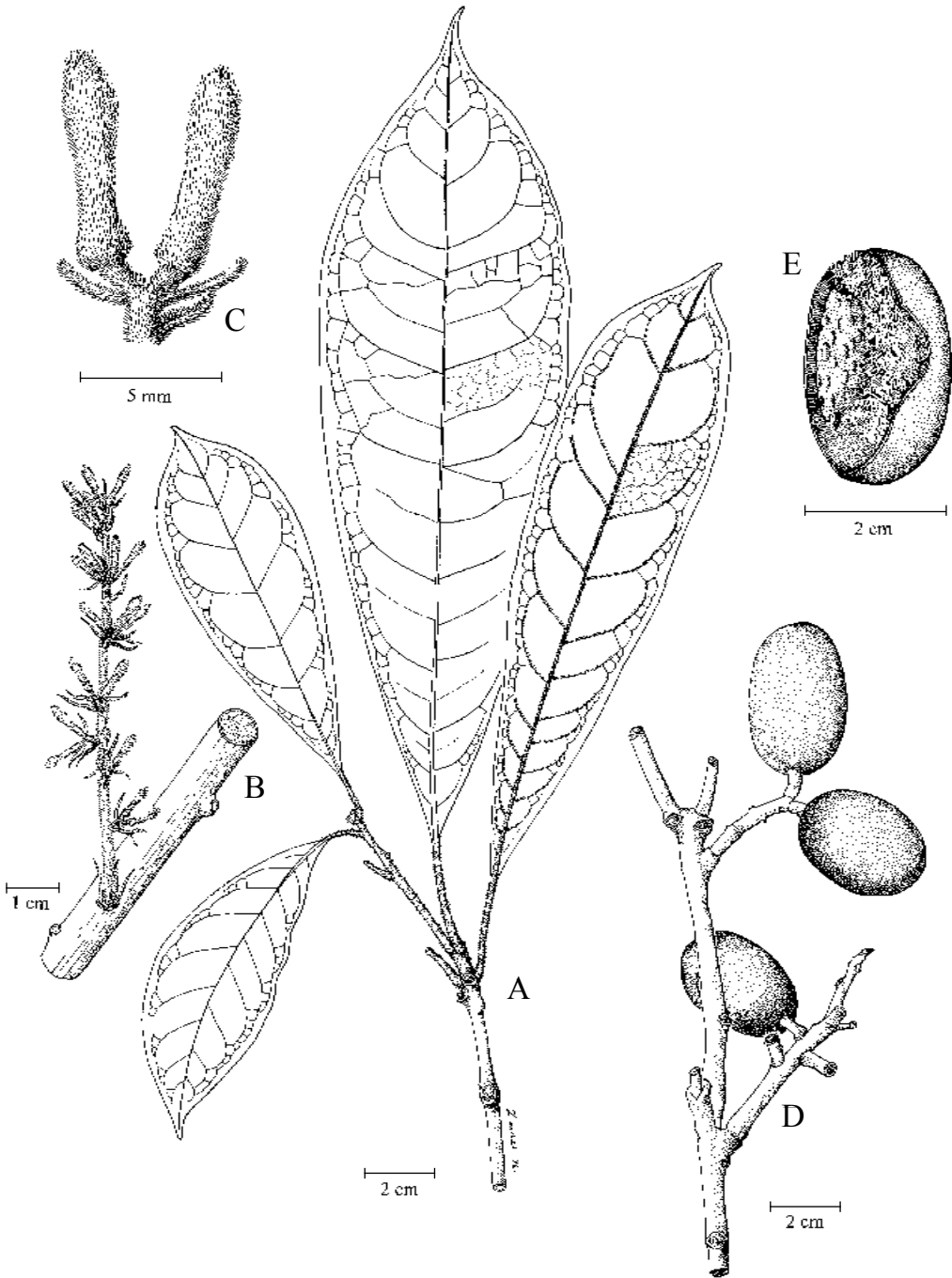


Fig. 11. *Heliciopsis velutina*. A, leafy twig; B, male inflorescence; C, male flower buds; D, infructescence; E, fruit with exocarp removed. (A and D–E from *SAN 134087*, B–C from *SAN 91494*.)

veins between lateral veins, visible above, prominent below; intercostal venation visible to inconspicuous on both surfaces; *petiole* 1.5–2(–3) cm long, 1–2 mm thick, slightly swollen at base, greenish brown when dry, initially reddish-brown hairy, late-glabrescent. **Deeply lobed leaves** unknown. **Inflorescences** axillary or borne on leafless older branches, solitary or rarely in pairs, (6–)7–12 cm long, densely flowered except for 1–2 cm from base; rachis *c.* 1.5 mm diameter in male inflorescences and 2–2.5 mm diameter in female inflorescences, reddish-brown hairy; bracts linear, (6–)8–10 mm long, persistent, reddish-brown hairy. **Flowers:** pedicels 4–5 mm long, mostly in pairs, free or connate to 2–2.5 mm from base, reddish-brown hairy; perianth 10–12 mm long, reddish-brown hairy, glabrescent on top, limb clavate, 2–2.5 mm diameter; male flower with anthers *c.* 2 mm long; female flower with ovary narrowly ovoid, glabrous; disk-glands broadly obovate-truncate, free, slightly distant from each other. **Fruits** *cylindric-ellipsoid*, 3–4 × 2–2.5 cm, smooth, not shining, *brown when dry*; *exocarp* leathery, 1–1.5 mm thick; *mesocarp* made up of radial, soft brown fibres of 2–3 mm long; *endocarp* hard, woody, 1–2 mm thick; stalks 8–10 mm long, *c.* 3 mm thick, persistent.

Vernacular name. Sarawak—*palis* (Iban).

Distribution. Peninsular Malaysia and Borneo. In Sabah, known from a few collections (e.g., *Elmer 21674*, *SAN 15232*, *SAN 38270*, *SAN 72476*, *SAN 78559*, *SAN 91494*, and *SAN 134087*), and in Sarawak, uncommon (*S 36740* and *S 44647*). Also known from Brunei (e.g., *BRUN 3186*) and Kalimantan (e.g., *Church & Mahyar 1848*, *Kostermans 4364* and *van Balgooy & van Setten 5630*).

Ecology. In lowland mixed dipterocarp forest on well-drained sandy-clay or leached clay soils, at altitudes to 600 m.

SAPOTACEAE

P.P.K. Chai¹ & P.C. Yii²

With contributions by A.P. Abang Mohd. Mohtar¹ (*Palaquium*),
L.C.J. Julaihi¹ (*Chrysophyllum*, *Isonandra* and *Mimusops*),
M. Mohizah¹ (*Aulandra* and *Diploknema*), A. Noorsiha³ (*Sarcosperma*),
J.T. Pereira⁴ (*Payena*), and Stephen P. Teo¹ (*Pouteria*)

Jussieu, Gen. Pl. (1789) 151; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 157; Ridley, FMP 2 (1923) 256; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 1, *ibid.* 3, 8 (1927) 381; Merrill, EB (1921) 476, PEB (1929) 238; H.J. Lam & Varossieau, Blumea 3 (1938) 184; Masamune, EPB (1942) 587; Jeuken, Blumea 6 (1952) 547; H.J. Lam & P. Royen, Blumea 7 (1952) 148; Van den Assem, Blumea 7 (1953) 364; Wyatt-Smith, FRI Res. Pamp. 4 (1954) 1; Browne, FTSB (1955) 320; Vink, Blumea 9 (1958) 21; P. Royen, Blumea 9 (1958) 75, *ibid.* 10 (1960) 1 & 432; Kochummen & Wyatt-Smith, Mal. For. Rec. 17 (1964) 1; Backer & Bakhuizen *f.*, FJ 2 (1965) 189; Burgess, TBS (1966) 447; Sinclair, Gard. Bull. Sing. 22 (1967) 227; Keng, OFMSP (1969) 225; Ng, TFM 1 (1972) 388; Anderson, CLTS (1980) 314; Corner, WSTM 3rd edition 2 (1988) 690; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 315; Pennington, Gen. Sapot. (1991) 1; Brummitt, Vasc. Pl. Fam. & Gen. (1992) 662; Kessler & Sidiyasa, TBSA-EK (1994) 211; Turner, Gard. Bull. Sing. 47 (1995) 462; Coode *et al.* (eds.), CLBD (1996) 305; Argent *et al.* (eds.), MNDT-CK 2 (1997) 574.

Trees or shrubs. Latex present, white or yellowish. Indumentum always present on young parts. **Stipules** present, caducous, or absent (*Chrysophyllum* and *Pouteria*). **Leaves** simple, spirally arranged and frequently crowded at end of twigs, or alternate and distichous, or rarely opposite or subopposite; margin entire or very rarely erose (gnawed), plane or revolute; petiole rarely bearing a pair of minute stipels (*Sarcosperma*). **Inflorescences** fasciculate, or flowers rarely solitary, in axils of leaves or leaf scars, or borne on older leafless branches or stems, occasionally paniculate and borne on leafless axillary short shoots (brachyblasts). **Flowers** bisexual, rarely unisexual (plants monoecious or dioecious), radially symmetrical; sepals either in a single whorl of (4–)5(–11), or in two whorls of 2, 3 or 4, free or partly fused at base; corolla rotate, cyathiform or tubular, tube shorter, equal or exceeding the lobes, lobes 4–18, each lobe entire or divided into 3 segments, with the median segment entire and two lateral ones entire, lacinate or shallowly or deeply lobed; stamens either of the same number as corolla lobes and opposite them or numerous and arranged in one, two or three whorls, inserted at the base or at the throat of corolla tube, exerted or included; filaments geniculate in bud, free or rarely fused into staminal tube; anthers dehiscing extrorsely, introrsely or laterally; staminodes if present, alternating with stamens or fixed in the sinuses of corolla lobes; ovary superior, 3–18-loculed, each locule with one anatropous to hemianatropous ovule, style simple, exerted or included, stigma small and indistinct, simple or minutely lobed. **Fruit** a fleshy berry, rarely a drupe or a loculicidal capsule, with persistent sepals at base and style at tip. **Seeds** 1–10, ovoid to ellipsoid, often laterally

¹Sarawak Forestry Department, Kuching, Malaysia; ²P.O. Box 454, 96000 Sibuluan, Sarawak, Malaysia; ³Forest Research Institute Malaysia (FRIM), Kepong, Malaysia; ⁴Sabah Forestry Department, Sandakan, Malaysia.

compressed; testa glossy, brown to black; scar adaxial, basi-ventral or basal, narrow or broad, occasionally covering most of seed surface; cotyledons thin and foliaceous, or flat and thick or plano-convex; endosperm present or absent.

Distribution. About 53 genera and 1100 species, mostly in the humid tropics and subtropics, but some genera extending to semi-arid and arid areas. In Sabah and Sarawak, the family is represented by 11 genera and 121 species comprising 118 native, 1 incompletely known and 2 introduced species.

Ecology. One of the common components of the lowland forest, occurring from beach forest at sea level to mossy montane forest, at altitudes to 4000 m.

Uses. Timber is classified into 2 main groups. *Bitis* or *nyatoh temiang* is a name given to the heavy hardwood of some species that is extremely strong and durable. It seasons badly with high shrinkage, resulting in both surface and end checking. It is strong and resistant to attack by powder-post beetles. It contains silica; grain is straight and slightly interlocked, hard to work; texture is fine and even, and it planes and turns to a very fine finish. Sapwood is paler and less durable than heartwood; heartwood is reddish brown, hard, heavy and durable, suitable for heavy structural and general construction work. *Nyatoh* is the other group that is much lighter and more commonly available than *bitis* or *nyatoh temiang*. It is moderately hard and heavy. It is resistant to preservatives but is moderately durable when used indoors. It has fine and even texture with interlocked and wavy grains, suitable for solid doors and veneer and plywood. Gutta percha, a latex obtained by tapping Sapotaceae trees, contains isoprene and caoutchine. The latex was used for insulating telegraph cables before the invention of plastic. Other uses include surgical and chemical apparatus, corks, golf-balls and dental filling. The flowers of *Madhuca longifolia* and *M. latifolia* are rich in nectar. The nectar has been used for sweetening food, extracting sugar and even for making fermented liquors and acetone. In Sarawak, fat extracted by crushing kernels of *Madhuca motleyana* and other species is used for cooking by local people. Similarly, in India, fat extracted from kernels of *M. latifolia* and *M. longifolia* is used as substitute for ghi, for making soap and candle-wax. Fruits of *Manilkara zapota* (L.) P.Royen, *Chrysophyllum cainito* L. and several species of *Madhuca* are edible.

Taxonomy. Together with the Ebenaceae, Styracaceae and Symplocaceae, Sapotaceae are included in the order Ebenales. Members of the Sapotaceae are easily distinguished from those of other families within the Ebenales by the presence of free flowing rubbery white or yellowish latex in the bark, leaves, flowers and fruits. However, the genera are difficult to define without taking floral characters into consideration. The present delimitation of genera is based on Pennington's monograph (*l.c.*).

Key to genera

1. Sepals in a single whorl of 4–6.....2
 - Sepals in two whorls of 2, 3 or 4.....6

2. Stipules present.....3
 Stipules absent.....5
3. Leaves usually opposite or subopposite, often with glandular pits in axils of lateral veins; petiole often with stipels at distal end. Inflorescences racemose or paniculate.....
 **11. Sarcosperma**
 Leaves usually spirally arranged or alternate and distichous, without glandular pits in axils of lateral veins; petiole without stipels at distal end. Inflorescences 1–many-flowered fascicles, in axils of leaves or leaf scars on leafless older twigs or rarely borne on leafless axillary short shoots (brachyblasts).....4
4. Stipules large and persistent. Inflorescences axillary. Corolla lobes 5, each lobe divided into 3 segments; stamens 5; staminodes much longer than stamens, with distinct sagittate appendages at apex. Fruits constricted between seeds.....**4. Eberhardtia**
 Stipules small and caducous. Inflorescences borne in axils of leaf scars on leafless older twigs. Corolla lobes 8–16, each lobe not divided into segments; stamens (10–)16–30(–80); staminodes shorter than stamens, without sagittate appendages. Fruits not constricted between seeds.....**3. Diploknema**
5. Leaves alternate and distichous or rarely spirally arranged along twigs; lateral veins dense and numerous; intercostal venation descending from leaf margin and parallel to lateral veins. Staminodes usually absent or rarely present as small subulate vestigial structures.....**2. Chrysophyllum**
 Leaves spirally arranged; lateral veins well-spaced; intercostal venation reticulate or subscalariform. Staminodes (4–)5(–6), rarely absent.....**10. Pouteria**
6. Sepals in two whorls of 2.....7
 Sepals in two whorls of 3 or 4.....9
7. Leaves alternate and distichous on horizontal shoots; intercostal venation descending from leaf margin and parallel to lateral veins, and branching out towards midrib.....
 **9. Payena**
 Leaves spirally arranged; intercostal venation subscalariform, oblique, reticulate-tessellate or rarely descending from leaf margin and parallel to lateral veins.....8
8. Flowers subsessile; corolla tube glabrous at the throat, lobes 4(–5); stamens 8–10; ovary 4–5-loculed.....**5. Isonandra**
 Flowers distinctly pedicellate; corolla tube hirsute or barbate at the throat, lobes 6–17; stamens 12–43; ovary 4–15-loculed.....**6. Madhuca**
9. Sepals in two whorls of 3 or 4; petals (6–)8, each lobe divided into 3 segments; stamens (6–)8; staminodes (6–)8.....10
 Sepals in two whorls of 3; petals 5–6, each lobe not divided into segments; stamens (10–)12(–30); staminodes absent.....11
10. Sepals in two whorls of 4; petals 8; stamens and staminodes usually 8; staminodes hairy. Seed scar small and mostly basal. Indigenous forest trees.....**7. Mimusops**

Sepals in two whorls of 3; petals, stamens and staminodes usually 6; staminodes glabrous. Seed scar elongate, basi-ventral. Introduced cultivated trees.....

Manilkara zapota (L.) P.Royen

(Latinised abbreviation of a Mexican plant name—*cochit-zapotl*)

Blumea 7 (1953); Pennington *l.c.* 135. Basionym: *Achras zapota* L., Sp. Pl. 2 (1753) 1190.

Native of C America, Mexico and West Indies. Widely cultivated in the tropics for its fruits.

Tree to 30 m tall; trunk with low branches; crown dense, globose; all parts rich in white and gummy latex. Leaves spirally arranged and crowded at apex of twigs; lateral veins numerous, parallel. Flowers bisexual, solitary in axils of upper leaves; calyx deeply 6-lobed, lobes in two whorls of 3; corolla campanulate, 6-lobed, lobes about half as long as tube; stamens 6, staminodes 6, petaloid; ovary 10–12-loculed, style subulate, exserted. Fruit a pendulous berry, globose, ovoid or ellipsoid, 3–8 × 3–6 cm, 6–12-seeded; rind thin, dull reddish to yellowish brown, covered with sandy brown scurf; mesocarp fleshy, juicy, yellow to red-brown, sweet. Seeds asymmetrically ovoid, laterally compressed, brown or black, scar basi-ventral.

- 11. Inflorescences 1–many-flowered fascicles, borne in axils of leaves or leaf scar. Filaments of stamens free or only partially united at base.....**8. Palaquium**
- Inflorescences few-flowered fascicles, borne terminally on brachyblasts. Filaments of stamens united for about half of their length or more into a staminal tube.....
- **1. Aulandra**

1. AULANDRA H.J.Lam

(Greek, *aulos* = tube, *andrus* = male; the well-developed staminal tube)

M. Mohizah

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 415; Masamune, EPB (1942) 587; P. Royen, Blumea Suppl. 4 (1958) 263; Anderson, CLTS (1980) 314; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 315; Pennington, Gen. Sapot. (1991) 152; Coode *et al.* (eds.), CLBD (1996) 305.

Trees. **Stipules** present, small, caducous. **Leaves** spirally arranged, without glandular pits in axils of lateral veins; lateral veins diminishing and becoming inconspicuous towards leaf margin; intercostal venation dense, obliquely subscalariform; petiole without stipels at distal end. **Inflorescences** few-flowered fascicles borne terminally on densely scaly, simple or branched brachyblasts up to 3 cm long. **Flowers** bisexual; sepals 6, in two whorls of 3, free or united at base, lobes of outer whorl more or less valvate; petals 6, glabrous, fused at base, free lobes not divided into segments, contorted or imbricate, spreading or reflexed, exceeding corolla tube; stamens 18–19, in a single whorl, inserted at top of corolla tube, exserted, filaments united for about half of their length or more into a staminal tube, anthers extrorse, hairy, staminodes absent; disk (nectary) absent; ovary 6–7-loculed, styles filiform, exserted, ovules anatropous. **Fruits** 1-seeded. **Seeds** broadly ovoid with a broad adaxial scar covering about two thirds of its surface; cotyledons plano-convex; endosperm absent.

Distribution. Two species, endemic to Borneo (Sarawak and Kalimantan).

Taxonomy. *Aulandra* is closely related to *Palaquium* but can be distinguished by its cauliflorous or ramiflorous habit, flowers that are borne terminally on a brachyblast and by the filaments which are fused for about half of their length or more into a staminal tube.

Key to *Aulandra* species

Leaves well-spaced along twigs, coriaceous, obovate-elliptic, 23–30 × 5–9.5 cm; lateral veins 9–15 pairs, ascending at an angle of 50–55° from midrib. Stipules *c.* 1.5 × 1 mm. Brachyblasts up to 1 cm long. Anthers cordate-sagittate, 1–1.5 mm long. Ovary subconical, style subulate, *c.* 2 mm long.....**1. *A. beccarii***

Leaves clustered near ends of twigs, chartaceous to subcoriaceous, oblanceolate or obovate-oblong, 32–97 × 7–28 cm; lateral veins 22–40 pairs, ascending at an angle of 60–80° from midrib. Stipules 2–3 × 1–1.5 mm. Brachyblasts up to 3 cm long. Anthers lanceolate-oblong, 2–3 mm long. Ovary ovoid-globose, style filiform, 4–9.5 mm long.....**2. *A. longifolia***

1. *Aulandra beccarii* (Pierre *ex* Dubard) P.Royen (Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Blumea Suppl. 4 (1958) 263; Whitmore, Tantra & Sutisna *l.c.* 316; Pennington *l.c.* 152. **Basionym:** *Palaquium beccarii* Pierre *ex* Dubard, Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 20. **Type:** *Beccari PB 3347*, Borneo, Sarawak, Bt. Balang, Batang Lupar (holotype P; isotypes K, L).

Small tree. **Twigs** stout, angular, reddish-brown tomentose, glabrescent. **Terminal buds** to 5 mm long, greyish-brown tomentose. **Stipules** lanceolate, *c.* 1.5 × 1 mm, reddish-brown tomentose outside, glabrous inside. **Leaves** *well-spaced along twigs*, glabrous on both surfaces except for the sparsely tomentose basal part of midrib above and along midrib below, *coriaceous; obovate-elliptic*, (17–)23–30 × (5–)7.5–9.5 cm, base cuneate and slightly decurrent, apex acuminate with an obtuse acumen to 12 mm long; midrib prominently crested on both sides; *lateral veins 9–15 pairs, ascending at an angle of 50–55° from midrib*, impressed above, prominent below; intercostal venation slender, obscure above, prominent below; petiole 1.5–5 cm long, flat on adaxial side, reddish-brown tomentose, glabrescent. **Inflorescences:** *brachyblasts to 1 cm long*, with numerous bract-scars; bracts deltoid, *c.* 1.5 × 1 mm. **Flowers** pale yellow; pedicel angular, 2–5.5 mm long, reddish-brown tomentose; outer sepals ovate, 2.5–3 × 2–2.5 mm, inner sepals elliptic-ovate, slightly smaller than outer ones; corolla to 3 mm long in bud, lobes oblong, *c.* 2.5 × 1 mm, glabrous; stamens 18, staminal tube 1.5–2 mm long, free filaments subulate, *c.* 0.3 mm long, *anthers cordate-sagittate, 1–1.5 mm long; ovary subconical, c.* 0.5 × 1 mm, reddish-brown pubescent at apex, glabrous at base, *style subulate, c.* 2 mm long with 6 longitudinal slits, glabrous except for scattered hairs at apex. **Fruits** unknown.

Distribution. Endemic to Borneo. So far only known from the type collection (*Beccari PB 3347*) from Sarawak.

2. *Aulandra longifolia* H.J.Lam

Fig. 1.

(Latin, *longus* = long, *folium* = leaf; with long leaves)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 415; Masamune *l.c.* 587; P. Royen, *Blumea* Suppl. 4 (1958) 266; Anderson *l.c.* 314; Whitmore, Tantra & Sutisna *l.c.* 316; Pennington *l.c.* 153; Coode *et al.* (eds.) *l.c.* 305.

Type: *Amdjah* 238, Borneo, Kalimantan, Lumbis (holotype BO; isotype L). **Synonym:** *A. cauliflora* H.J.Lam in Hooker, *Icon. Pl.* (1938) 3360, Pennington *l.c.* 153.

Tree to 20 m tall, 25 cm diameter. **Bark** smooth to slightly fissured, greyish brown. **Twigs** stout, glabrous. **Stipules** lanceolate, $2-3 \times 1-1.5$ mm, reddish-brown tomentose outside, glabrous inside. **Leaves** clustered near ends of twigs, sparsely reddish-brown tomentose, glabrescent; chartaceous to subcoriaceous; oblanceolate or obovate-oblong, $(24-32-97) \times (4.5-7.2-28)$ cm, base attenuate, decurrent, apex short-acuminate; midrib slightly impressed above, prominently raised below; lateral veins 22-40 pairs, ascending at an angle of $60-80^\circ$ from midrib, impressed above, prominent below; intercostal venation faint above, distinct below; petiole 2-8.5 cm long, flat on adaxial side, rugulose at basal part. **Inflorescences:** brachyblasts to 3 cm long, branched and covered with scars; bracts ovate-triangular, *c.* 1.5 mm long. **Flowers:** pedicel angular, reddish-brown tomentose, 4-8 mm long; sepals ovate-lanceolate, crested, outer sepals $2-6 \times 2-3.5$ mm, tomentose, inner sepals $4.5-5 \times 2-2.5$ mm, glabrous; corolla white to creamy, 6-8.5 mm long, glabrous, lobes ovate, obovate or spatulate, $5-6.5 \times 2-4$ mm; stamens 18-19, staminal tube 2.5-3.5 mm long, free filaments 1.5-4 mm long, anthers lanceolate-oblong, 2-3 mm long, glabrous but with reddish brown hairs when young; ovary ovoid-globose, *c.* 1.5×2 mm, style filiform, glabrous, 4-9.5 mm long. **Fruits** ovoid to subglobose, slightly oblique, $2-3.5 \times 2-3$ cm, acute with remnant of style at apex; pericarp woody, thin, glabrous. **Seeds** pear-shaped, $1.5-1.8 \times 0.6-0.8$ cm, obtusely acuminate at apex, rounded at base; scar large, covering about three-fourths of seed surface.

Vernacular name. Sarawak—*palawak* (Murut).

Distribution. Endemic to Borneo. Scattered throughout Sarawak (e.g., *S* 13978, *S* 23308, *S* 28156, *S* 36090, *S* 46644, and *S* 52041). Also known in Brunei and Kalimantan.

Ecology. In lowland to hill mixed dipterocarp forest, at altitudes to 1000 m.

2. CHRYSOPHYLLUM L.

(Greek, *chrusos* = golden, *phullon* = leaf; the golden coloured leaf under surface)

L.C.J. Julaihi

Sp. Pl. 1 (1753) 192; King & Gamble, *J. As. Soc. Beng.* 74, 2, Extra No. 17 (1906) 158; Merrill, *EB* (1921) 483; Ridley, *FMP* 3 (1923) 257; H.J. Lam, *Bull. Jard. Bot. Buitenz.* 3, 7 (1925) 186, *ibid.* 3, 8 (1927) 466; Masamune, *EPB* (1942) 587; Vink, *Blumea* 9 (1958) 21; Backer & Bakhuizen *f.*, *FJ* 2 (1965) 154; Burgess, *TBS* (1966) 447; Ng, *TFM* 1 (1972) 395; Anderson, *CLTS* (1980) 314; Corner, *WSTM* 3rd edition 2 (1988) 692; Whitmore, Tantra & Sutisna, *CLK* 2,1 (1990) 316; Pennington, *Gen. Sapot.* (1991) 216; Argent *et al.* (eds.), *MNDT-CK* 2 (1997) 574. **Synonym:** *Nycterisition* Ruiz & Pavon, *Prod.* (1794) 30.

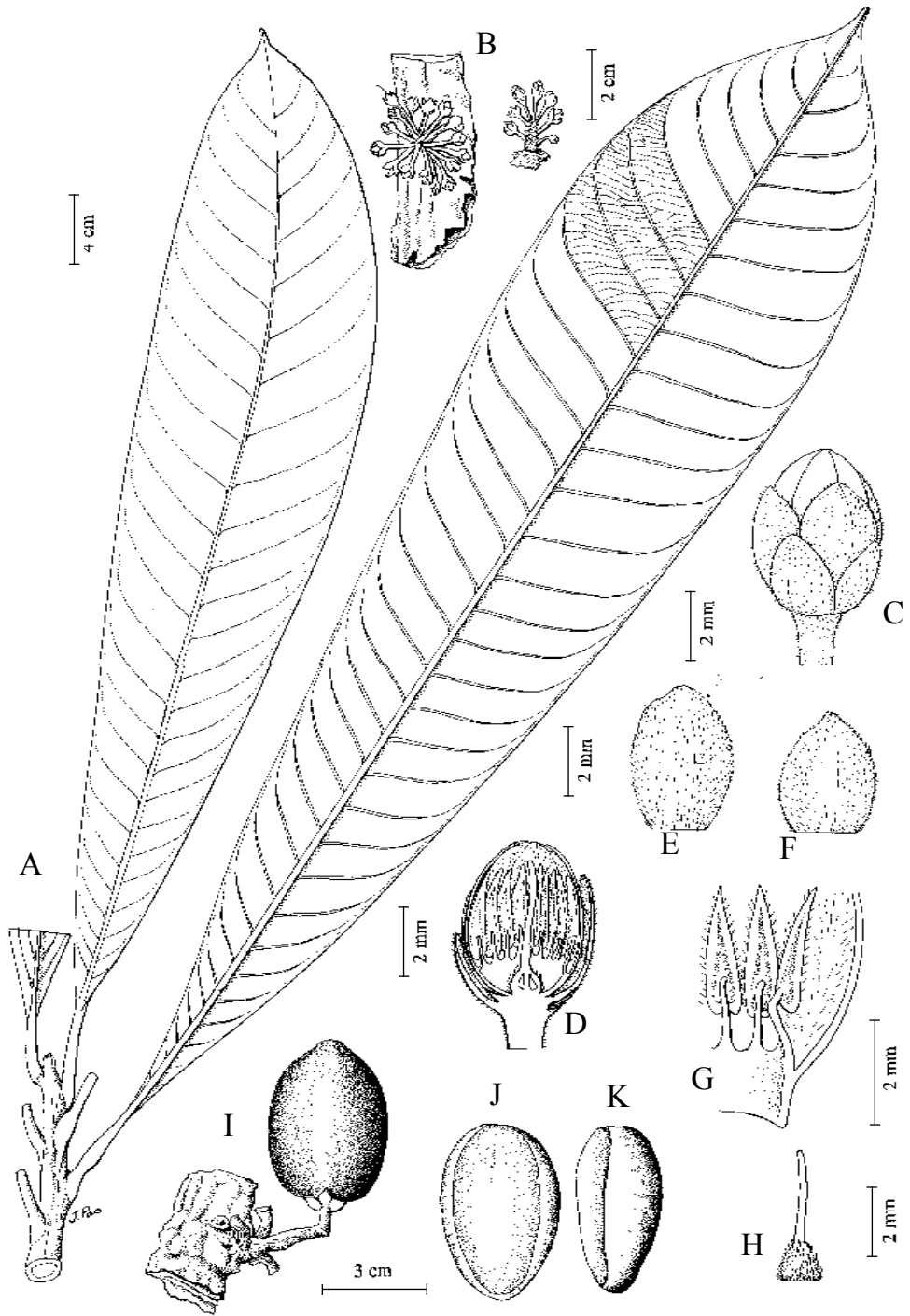


Fig. 1. *Aulandra longifolia*. A, leafy twig; B, inflorescence borne on brachyblast; C, mature flower bud; D, longitudinal section of mature flower bud; E, inner sepal; F, outer sepal; G, stamens; H, gynoecium; I, infructescence with one mature fruit; J, seed in ventral view showing the broad scar; K, seed in side view. (A–H from *S* 28156, I–K from *S* 29662.)

Trees or shrubs. **Stipules** *absent*. **Leaves** *alternate and distichous* or *rarely spirally arranged along twigs*, without glandular pits in axils of lateral veins; *lateral veins dense and numerous*, diminishing and becoming inconspicuous towards leaf margin or arching and joining to form a smooth intramarginal vein or vein-loops; *intercostal venation descending from leaf margin and parallel to lateral veins* or reticulate. **Inflorescences** 1–many-flowered fascicles, axillary or borne on leafless older branches. **Flowers** unisexual or bisexual; *sepals (4–)5(–6), in a single whorl*, imbricate; corolla campanulate or tubular, lobes (4–)5(–8), each lobe not divided into segments, shorter, equal or slightly exceeding the length of corolla tube, erect or slightly spreading; stamens (4–)5(–8), inserted on the throat of corolla tube, anthers extrorse; *staminodes absent* or *rarely present as small subulate vestigial structures* located in corolla lobes' sinuses, alternating with stamens; disk (nectary) absent; ovary (4–)5(–12)-loculed, villous or glabrous, style included. **Fruits** 1–many-seeded; pericarp thin. **Seeds** ellipsoid, laterally compressed; scar narrow, adaxial; cotyledons thin foliaceous or thick and flat; endosperm abundant.

Distribution. About 43 species, distributed in C America, C Africa, Madagascar, India, Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Pacific Islands, and Australia. One indigenous species, *C. roxburghii*, occurs in Sabah and Sarawak; another species, *C. cainito*, has been introduced and cultivated for its fruits.

Key to *Chrysophyllum* species

Leaves glabrous on both surfaces, apex acute to acuminate, acumen 5–18 mm long; midrib prominent on both surfaces; petiole 0.3–0.7 cm long, flat or rounded on adaxial side, glabrous. Ovary subglobose, 5-ribbed. Fruits 5-ridged, 1.5–4 cm diameter. Indigenous forest tree..... **C. roxburghii**

Leaves densely reddish-brown hairy below, apex obtuse, short-acuminate, acumen to 8 mm long; midrib impressed above, raised below; petiole 0.9–2 cm long, reddish-brown tomentose, grooved on adaxial side. Ovary subconical, 7–10-ribbed. Fruits not ridged, c. 5.5 × 4 cm. Introduced cultivated tree.....

C. cainito L.

(a West Indies plant name—*cainito* or *caimito*)

Sp. Pl. (1753) 192; H.J. Lam *l.c.* (1925) 188, *l.c.* (1927) 466; Corner *l.c.* 693; Vink *l.c.* 26; Backer & Bakhuizen *f.* 154; Ng *l.c.* 395; Whitmore, Tantra & Sutisna, CLS (1986) 217; Pennington *l.c.* 224. Type: unknown.

Native to tropical America, the species has been introduced and cultivated in Peninsular Malaysia, Java, Sabah, Sarawak, the Philippines and other tropical countries for its edible fruits.

Tree to 30 m tall, 40 cm diameter. *Leaves* chartaceous, *densely reddish-brown hairy* and shining below; elliptic to ovate, 6–11.5 × 3–6.5 cm, base broadly cuneate to rounded, *apex obtuse* to *short-acuminate*, *acumen to 8 mm long*; petiole 0.9–2 cm long, *reddish-brown tomentose*, *grooved on adaxial side*. *Inflorescences* 5–10-flowered; *ovary subconical*, *7–10-ribbed*. *Fruits* ovoid, c. 5.5 × 4 cm, *not ridged*; pericarp up to 10 mm thick, turning purplish black when ripe. *Seeds* ovoid to ellipsoid, 1.3–1.9 × 0.6–0.9 cm; testa light brown, shining.

Chrysophyllum roxburghii G. Don

Fig. 2.

(W. Roxburgh, 1751–1815, Scottish botanist and physician, 1781–1793 superintendent of the Calcutta Botanic Garden, India)

Gard. Dict. 4 (1838) 33; King & Gamble *l.c.* 158; Ridley *l.c.* (1923) 257; H.J. Lam *l.c.* (1925) 187, *l.c.* (1927) 466; Masamune *l.c.* 587; Backer & Bakhuizen *f. l.c.* 154; Anderson *l.c.* 314; Turner, Gard. Bull. Sing. 47 (1995) 462. **Type:** unknown. **Synonyms:** *Nycterisition lanceolatum* Blume, Bijdr. Fl. Ned. Ind. 12 (1826) 676; *Chrysophyllum lanceolatum auct. non* Casar.: A.DC., Prodr. 8 (1844) 162, Merrill *l.c.* (1921) 483, Vink *l.c.* 28, Ng *l.c.* 395, Whitmore, Tantra & Sutisna *l.c.* 316, Pennington *l.c.* 221; *Lucuma lanceolata* (Blume) Zippel in Macklot, Bijdr. Natuurk. Wet. 5 (1830) 178.

Tree to 30 m tall, 40 cm diameter; bole usually fluted at base; buttresses small or absent. **Bark** smooth to shallowly fissured, grey to dark brown; inner bark pale brown. **Sapwood** yellowish. **Twigs** slender, terete, 1–4 mm thick, reddish-brown tomentose, glabrescent. **Leaves** chartaceous, *glabrous on both surfaces*; oblong, ovate or lanceolate, 5–15 × 2–6 cm, base cuneate, oblique, *apex acute to acuminate, acumen 5–18 mm long; midrib prominent on both surfaces*; lateral veins numerous, slender, closely parallel, arching and joining into intramarginal vein; intercostal venation descending from leaf margin and parallel to lateral veins, obscure on both sides; *petiole slender, 0.3–0.7 cm long, flat or rounded on adaxial side, glabrous*. **Inflorescences** axillary, 5–45-flowered. **Flowers:** pedicel 0.3–0.6 cm long; sepals ovate, *c.* 0.8 × 0.7 mm; corolla 1.8–2.1 mm long, glabrous, tube 0.7–1.2 mm long, lobes ligulate to trapezoid; stamens 5, filaments slender, anthers ovoid; *ovary subglobose, c.* 0.6 × 0.9 mm, *5-ribbed*, reddish-brown villous, style cylindrical, *c.* 1.5 mm long, glabrous. **Fruits** globose, *1.5–4 cm diameter, 5-ridged*, ripening yellow, brownish to purplish black when dry; pericarp thin. **Seeds** 5, obovoid, laterally compressed, 1.3–2.6 × 0.45–0.8 cm; testa brown; scar narrowly oblong to oblanceolate.

Vernacular names. Brunei—*nyatoh empelit, nyatoh entalit* (Iban).

Distribution. West coast of India, Sri Lanka, Myanmar, Thailand, Indo-China, Hainan, Hong Kong, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Papua New Guinea and surrounding islands, and the Solomon Islands. Rare and scattered in Sabah (e.g., *SAN 30879, SAN 53446, SAN 71153, SAN 83853, and SAN 138776*) and Sarawak (e.g., *S 28792, S 34650 and S 45629*). Also occurs in Brunei and Kalimantan.

Ecology. Middle-storey trees, usually occur in lowland mixed dipterocarp forest on clay soils, from sea level to 700 m altitude.

Uses. Produces good quality white, fine grained and moderately hard *nyatoh* timber, suitable for interior construction and kris-scabbards. Fruits are edible.

3. DIPLOKNEMA Pierre

(Greek, *diploous* = double, *knemis* = shin plate; the arrangement of sepals)

M. Mohizah

Arch. Néerl. Sci. Exact. Nat. 19 (1884) 103; Merrill, EB (1921) 479; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 183, *ibid.* 3, 8 (1927) 463; Masamune, EPB (1942) 587; P. Royen, Blumea 9 (1958) 75; Ng,

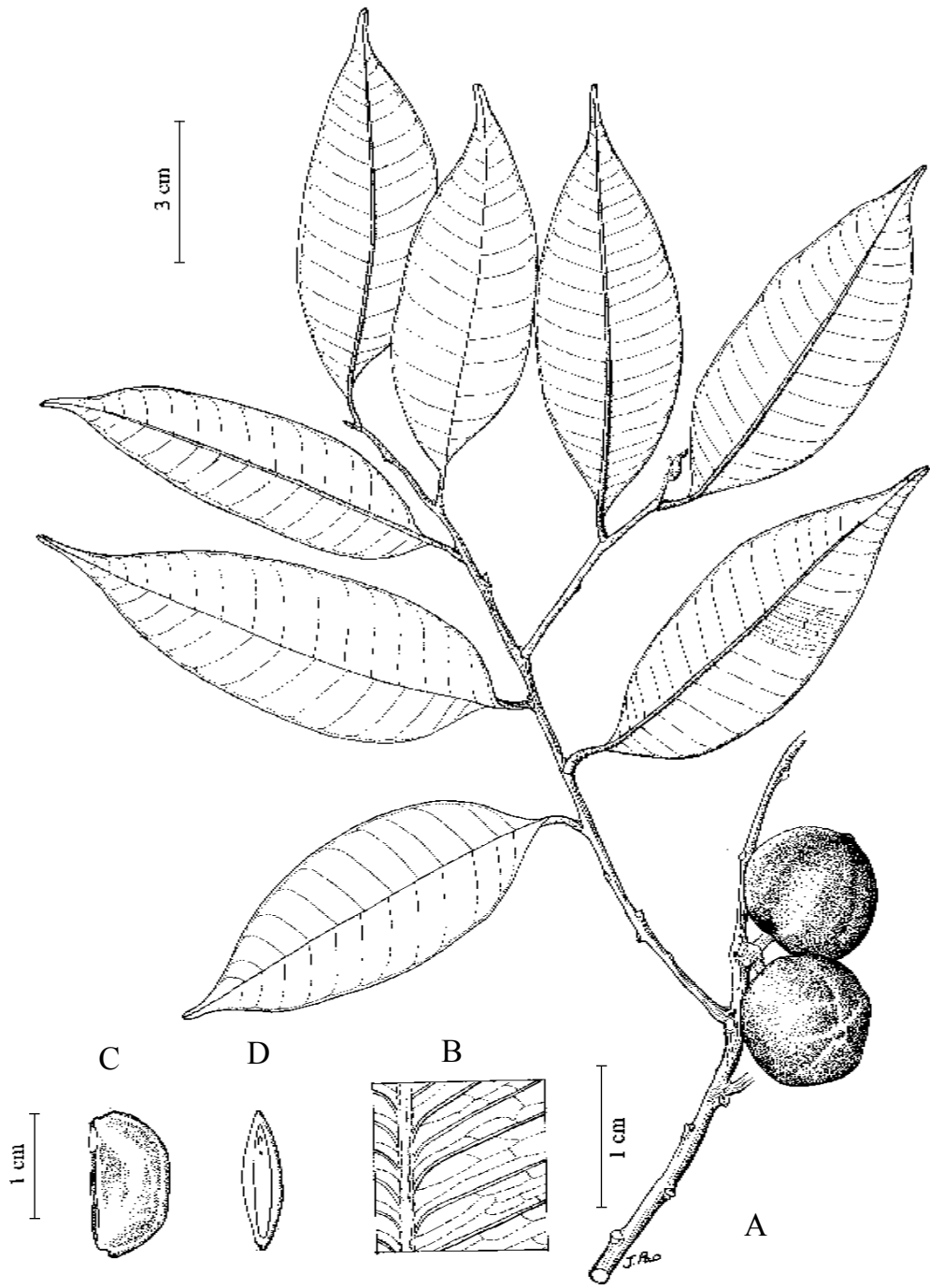


Fig. 2. *Chrysophyllum roxburghii*. A, fruiting leafy twig; B, detailed venation of leaf under surface; C, seed in side view; D, seed in ventral view showing the narrow seed scar. (A–B from S 34650, C–D from SAN 83853.)

TFM 1 (1972) 396; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 316; Pennington, Gen. Sapot. (1991) 162. **Synonym:** *Aesandra* Pierre, Not. Bot. Sapot. (1890) 1, van Bruggen, Blumea 9 (1958) 139.

Trees. **Stipules** present, often *small and caducous*. **Leaves** spirally arranged, usually crowded near ends of twigs, *without glandular pits in axils of lateral veins*; lateral veins diminishing and becoming inconspicuous towards leaf margin or rarely arching and joining to form intramarginal vein-loops; intercostal venation obliquely subscalariform or reticulate; *petiole without stipels at distal end*. **Inflorescences** 1–many-flowered fascicles, borne in axils of leaf scars on leafless older twigs. **Flowers** bisexual or rarely unisexual (plant dioecious); *sepals (4–)5(–6), in a single whorl, free or partly united at base*, imbricate, quincuncial; *corolla lobes 8–16, each lobe not divided into segments*, contorted, spreading or recurved, exceeding the length of corolla tube, corolla tube hairy or glabrous; *stamens (10–)16–30(–80)*, in one or two dense whorls, inserted at top of corolla tube, filaments free or partially united in pairs or small bundles, anthers extrorse, tapering to an acute apex, hairy or glabrous; *staminodes* in female flowers sometimes reduced in size and petal-like, *shorter than stamens, without sagittate appendages*; disk (nectary) absent or rudimentary; ovary (5–)6–15-loculed, hairy or glabrous, style stout, truncate; placentation central or apical. **Fruits** 1–4(–5)-seeded, *not constricted between seeds*. **Seeds** large, ellipsoid or laterally compressed; scar broad or narrow, adaxial; cotyledons plano-convex or thin foliaceous; endosperm present or absent.

Distribution. About 10 species, distributed in the northern part of India, Nepal, Bhutan, Myanmar, Thailand, Cambodia, Vietnam, Peninsular Malaysia, Borneo, the Philippines, and Maluku. In Borneo, only one species is known from Sabah and Kalimantan.

Diploknema sebifera Pierre

Fig. 3.

(Latin, *sebifer* = wax-bearing; referring to the seeds)

Arch. Néerl. Sci. Exact. Nat. 19 (1884) 103; Merrill *l.c.* (1921) 479; H.J. Lam *l.c.* (1925) 184, *l.c.* (1927) 463; Masamune *l.c.* 587; P. Royen *l.c.* (1958) 75; Ng *l.c.* 396; Whitmore, Tantra & Sutisna *l.c.* 316; Pennington *l.c.* 164; Turner Gard. Bull. Sing. 47 (1995) 463. **Type:** *Knappert s.n.*, Borneo, Kalimantan, Amuntai district (holotype L; isotype K).

Tree to 40 m tall, 60 cm diameter, slightly buttressed. **Bark** greyish brown, smooth, slightly fissured to slightly flaky; inner bark fibrous or laminated, pinkish. **Sapwood** pale yellow. **Twigs** usually brown hairy when young, ultimately glabrous. **Stipules** small, deltoid, *c.* 2.5 × 2.5 mm. **Leaves** coriaceous, glabrous; obovate, 3–25 × 1–8 cm, base narrowly cuneate, shortly decurrent, apex obtuse to cuspidate or bluntly pointed; midrib sunken above, raised below; lateral veins 8–19 pairs, ascending at an angle of 40–60° from midrib, slightly curving and diminishing toward leaf margin, slightly impressed above, prominent below; intercostal venation obliquely subscalariform, faint above, prominent below; petiole 2–4 cm long, glabrous, narrowly and shallowly grooved on adaxial side, thickened at base. **Inflorescences** 3–10-flowered, borne on prominent warts below leaves in axils of lanceolate bracts to 2 mm long. **Flowers** unisexual; pedicel angular, 2–5 mm long, reddish-brown tomentose; sepals 5, ovate to elliptic, 2.5–4 × 1–3 mm; corolla 3.5–5.5 mm long, lobes 11–12, spatulate, 2.5–3.5 mm long, tube 0.5–1 mm long; stamens (or petaloid staminodes) 16–20, in two whorls, filaments 2–3.5 mm long, with inner

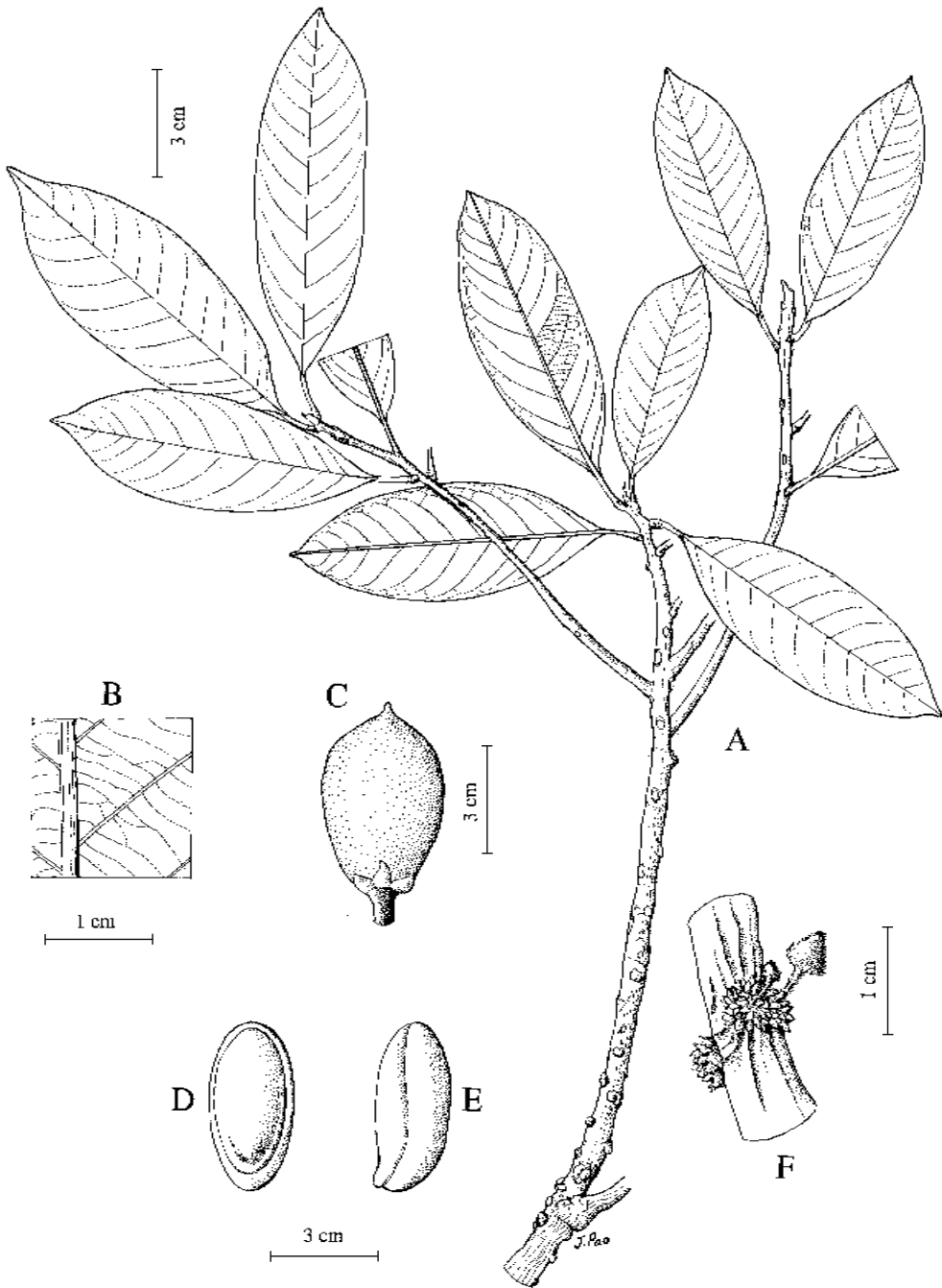


Fig. 3. *Diploknema sebifera*. A, leafy twig; B, detailed venation of leaf under surface; C, fruit; D, seed in ventral view; E, seed in side view; F, inflorescence. (A–E from SAN 15547, F from Knappert s.n. = RHL Sheet No. 202390.)

whorl longer; ovary (6–)7(–8)-loculed, *c.* 1.5 × 1 mm, reddish-brown sericeous, style angular, to 4 mm long, stigma cup-shaped, *c.* 1.5 mm diameter; ovules campylotropous. **Fruits** ellipsoid, 3.5–6 × 1.4–2 cm, apex acuminate with an obtuse tip, 1–4-seeded, brownish floss, glabrescent. **Seeds** obovoid, apex obtuse, base acute; scar covering almost half of the seed.

Distribution. Endemic to Borneo. In Sabah, known only from Sandakan and Lahad Datu districts (e.g., *SAN 15547*, *SAN 27022*, *SAN 36662*, *SAN 76048*, and *SAN A 3135*). Also known from Kalimantan.

Ecology. In lowland mixed dipterocarp forest, at altitudes to 200 m.

Uses. *Tengkawang* oil extracted from the seeds contains glycerin of stearic, palmitic and oleic acids. It is used by local people for cooking.

4. **EBERHARDTIA** Lecomte

(A.G. Eberhardt, German botanist)

P.C. Yii & P.P.K. Chai

Bull. Mus. Hist. Nat., Paris 26 (1920) 345; P. Royen, *Blumea* 10 (1960) 118; Pennington, *Gen. Sapot.* (1991) 145.

Trees. **Stipules** present, large, persistent. **Leaves** spirally arranged, without glandular pits in axils of lateral veins; lateral veins diminishing and becoming inconspicuous towards leaf margin; intercostal venation obliquely scalariform or reticulate-areolate; *petiole without stipels at distal end*. **Inflorescences** 1–many-flowered fascicles, axillary. **Flowers** bisexual; *sepals* 5, more or less free, in a single whorl, quincuncial; *corolla lobes* 5, each lobe divided for about two thirds of its length into 3 segments, with median segment linear or narrowly subulate, and lateral segments broader and longer than median one, corolla tube equal or slightly shorter than lobes; *stamens* 5, in a single whorl, inserted at top of corolla tube; filaments short, free, anthers glabrous, laterally dehiscent; *staminodes* 5, alternating with stamens, exceeding stamens, narrowly lanceolate, glabrous, bearing a large sagittate, caducous appendage at apex; ovary 5-loculed, hairy or glabrous, style included. **Fruit** a loculicidal capsule, 3–5-seeded, constricted between seeds. **Seeds** ellipsoid, laterally compressed; scar narrow or broad, adaxial; cotyledons thin, foliaceous; endosperm copious.

Distribution. Three species, distributed in China, Vietnam, Laos and Borneo; 1 species occurs in Sabah.

Taxonomy. *Eberhardtia* is closely related to *Manilkara* Adans. and *Mimusops* L. but differs from both by the corolla lobes which are each dissected into 3 segments. It can be distinguished from other Bornean genera by its sagittate appendages on the staminodes, and by its fruit that is few-seeded and constricted between seeds.

Eberhardtia aurata (Pierre *ex* Dubard) Lecomte
(Latin, *auratus* = flecked with gold; the colour of the indumentum)

Fig. 4.

Bull. Mus. Hist. Nat., Paris 26 (1920) 348; P. Royen *l.c.* (1960) 121; Pennington *l.c.* 146. **Basionym:** *Planchonella aurata* Pierre *ex* Dubard, Notul. Syst. 2 (1911) 1344. **Type:** *Balansa* 4338, Indo-China, Tonkin, Mt. Bluir, alt. 1400 m (holotype P). **Synonym:** *Pouteria aurata* (Pierre *ex* Dubard) Baehni, Candollea 9 (1942) 415.

Tree to 8 m tall. **Twigs** stout, ridged, 10 mm thick, densely rusty-brown pubescent, ultimately glabrous; terminal buds to 10 mm long, rusty-brown tomentose. **Stipules** lanceolate and slightly oblique, *c.* 9 × 2.5 mm, apex acuminate, crested and rusty-brown pubescent outside, glabrous inside. **Leaves** coriaceous, glabrous above except along midrib, densely rusty-brown pubescent below; oblong-obovate, 12–25 × 5–8.5 cm, base cuneate, margin entire, apex rounded-emarginate or broadly acuminate with an acumen to 1.5 cm long; midrib crested and prominent above, rounded below; lateral veins 16–18 pairs, ascending at an angle of 60–70° from midrib, curved and stronger near leaf margin, faint above, prominent below; intercostal venation faint on both sides; petiole stout, 2–3.5 cm long, angular, pubescent or subglabrous. **Inflorescences** and **flowers** unknown. **Fruits** subglobose 2.5–4.5 × 1–5 cm, 5-seeded; pericarp rusty-brown pubescent. **Seeds** ellipsoid, 2–4 × 1 cm, obtuse at both ends; scar linear; cotyledons elliptic.

Distribution. Southern China, Indo-China and Borneo. In Sabah, only known from three collections (*SAN 66309*, *Soepadmo et al. FRI 41348* and *Zainuddin et al. AZ 5024*).

Ecology. Rare in mossy montane forest and in forest on ultramafic soils.

5. ISONANDRA Wight

(Greek, *iso* = equal, *andro* = male; with stamens of equal length)

L.C.J. Julaihi

Icon. Pl. 2 (1840) 359; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 165; Ridley, FMP 2 (1923) 260; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 108, *ibid.* 3, 8 (1927) 418; Masamune, EPB (1942) 589; Jeuken, Blumea 6 (1952) 554; Ng, TFM 1 (1972) 400; Anderson, CLTS (1980) 315; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 589; Pennington, Gen. Sapot. (1991) 153; Coode *et al.* (eds.), CLBD (1996) 305.

Trees. **Stipules** present, often small, caducous. **Leaves** *spirally arranged*, well-spaced along twigs or crowded at ends of twigs, without glandular pits in axils of lateral veins; lateral veins arching and joining into intramarginal veins or diminishing and becoming inconspicuous towards leaf margin; *intercostal venation densely oblique-scalariform* or *reticulate*. **Inflorescences** 2–many-flowered fascicles, axillary or in axils of leaf scars on older, leafless branchlets. **Flowers** bisexual, *subsessile*; *sepals* 4, in two whorls of 2, rarely 5 in two whorls of 2 and 3, outer sepals valvate, inner ones imbricate; corolla campanulate, *lobes* 4(–5), imbricate, rarely contorted, erect or slightly spreading, equal or exceeding the length of corolla tube, *corolla tube glabrous*

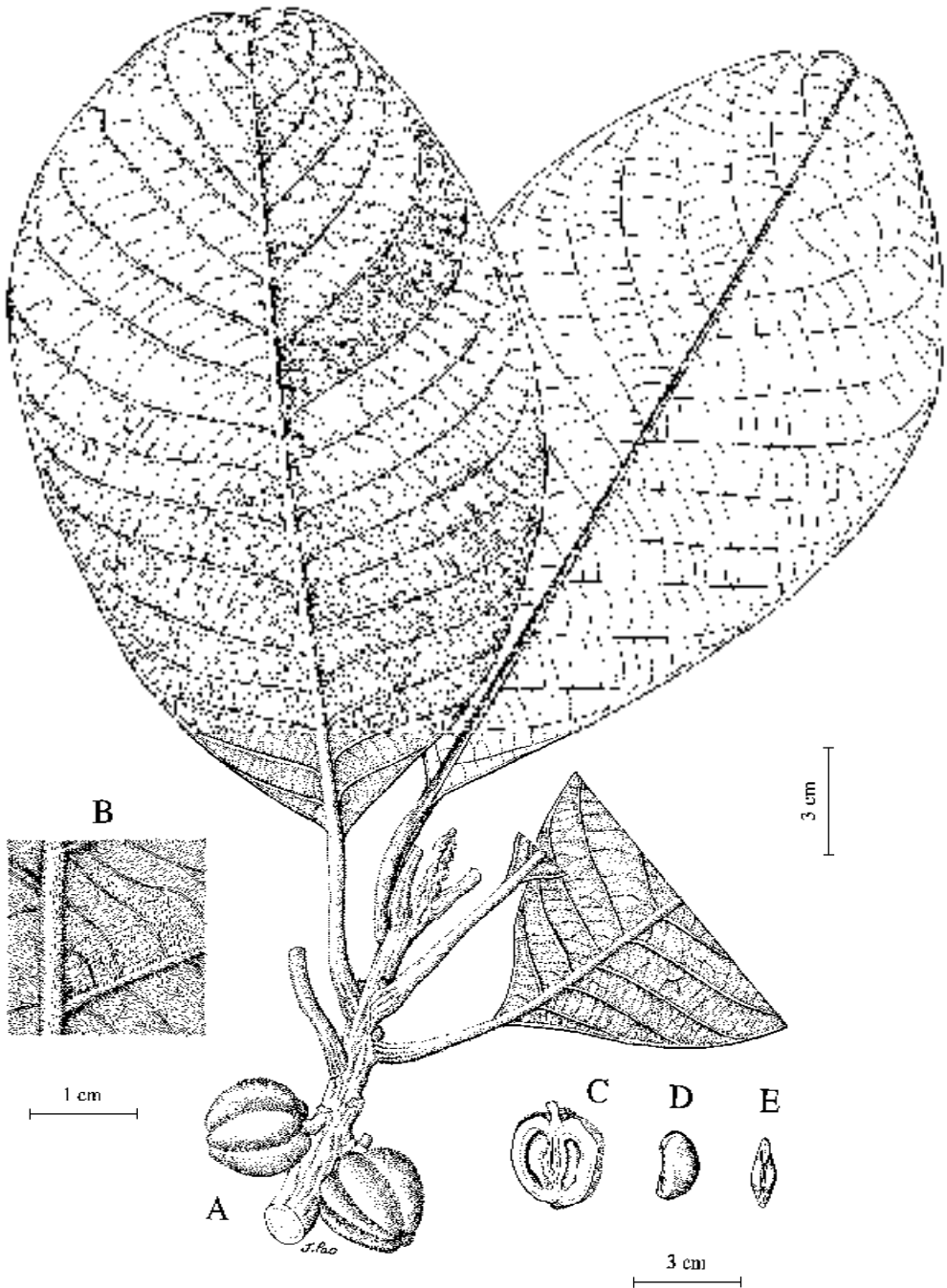


Fig. 4. *Eberhardtia aurata*. A, fruiting leafy twig; B, detailed venation of lower leaf surface; C, longitudinal section of fruit; D, seed in side view; E, seed in ventral view. (All from *FRI* 41348.)

at the throat; stamens 8–10, in a single whorl, inserted at top of corolla tube; filaments free or partially fused at base, anthers extrorse, usually hairy at tips; disk (nectary) absent; *ovary 4(–5)-loculed*, hairy, style slightly exerted. **Fruits** 1–2-seeded. **Seeds** ellipsoid, laterally compressed; scar long and narrow; cotyledons foliaceous; endosperm copious.

Distribution. Ten species, distributed in the southern part of India, Sri Lanka, Peninsular Malaysia and Borneo (2 species in Sarawak, Brunei and Kalimantan).

Taxonomy. *Isonandra* is intermediate between *Palaquium* and *Madhuca*. It differs from *Palaquium* and *Madhuca* by its flower with 4(–5)-lobed corolla, glabrous corolla tube, 8 stamens and 4(–5)-loculed ovary.

Key to *Isonandra* species

Leaves well-spaced along twigs, densely appressed tomentose beneath; coriaceous, elliptic to obovate; lateral veins diminishing near leaf margin. Inflorescences 2–3-flowered, axillary. Fruits fusiform..... **1. *I. borneensis***

Leaves densely clustered at end of twigs; glabrous or sparsely tomentose beneath; chartaceous to subcoriaceous, broadly ovate, oblong-lanceolate to obovate-lanceolate; lateral veins arching and joining into intramarginal veins. Inflorescences 2–10-flowered, axillary or in axils of leaf scars on older, leafless branchlets. Fruits oblong to ovoid-globose..... **2. *I. lanceolata***

1. *Isonandra borneensis* H.J.Lam (of Borneo)

Fig. 5.

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 108, *l.c.* (1927) 418; Masamune *l.c.* 589; Jeuken *l.c.* 574. **Type:** *Amdjah (exp. Nieuwenhuis) 162*, Borneo, Kalimantan, Bt. Mili (holotype BO).

Tree to 40 m tall, 70 cm diameter; buttresses steep, to 3.5 m tall and 3 m wide. **Bark** finely fissured and thinly flaky, dirty brown; inner bark soft, reddish brown. **Sapwood** yellow. **Twigs** slender and terete, sparsely pubescent. **Stipules** deltoid to lanceolate, rusty-brown hairy. **Leaves** well-spaced along twigs, coriaceous, glabrous above, densely appressed tomentose beneath; elliptic to obovate, 2.7–9.5 × 1.5–4.3 cm, base cuneate, apex shortly acute or retuse; midrib raised and prominent below; lateral veins 8–13 pairs, ascending at an angle of 50–55° from midrib, diminishing near leaf margin; intercostal venation slender, obliquely scalariform, distinct on both sides; petiole 0.3–1.8 cm long. **Inflorescences** 2–3-flowered, axillary. **Flowers** white; pedicel 0.1–0.15 cm long; sepals 4(–5), ovate, rusty-brown hairy outside, glabrous within; corolla c. 2 mm long, glabrous, 4-lobed, lobes as long as corolla tube; stamen filaments c. 1 mm long, anther lanceolate; ovary 4-loculed. **Fruits** fusiform, c. 1.2 × 0.3 cm, densely appressed rusty-brown hairy. **Seeds** c. 0.5 × 0.1 cm.

Distribution. Endemic to Borneo. Known from Sarawak (e.g., *S 29286*), Brunei (e.g., *BRUN 149*) and Kalimantan.

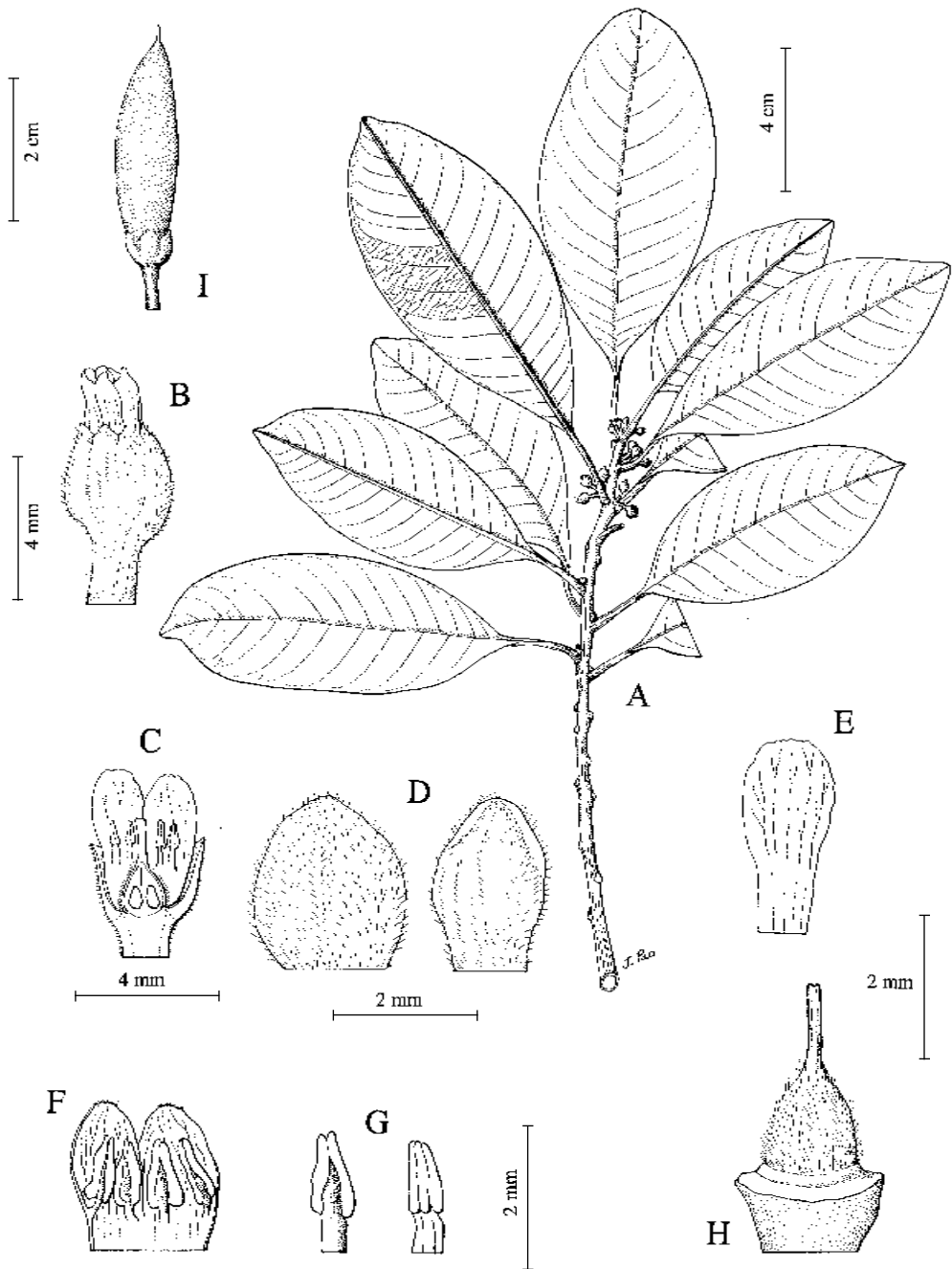


Fig. 5. *Isonandra borneensis*. A, flowering leafy twig; B, nearly open flower; C, longitudinal section of flower; D, outer and inner sepals; E, petal; F, inner side of petals showing the attachment of stamens; G, stamens in dorsal and ventral views; H, pistil; I, fruit. (All from BRUN 149.)

Ecology. In *kerangas* forest, at altitudes to 1000 m.

2. *Isonandra lanceolata* Wight

(Latin, *lanceolatus* = spear-shaped; the leaves)

Icon. Pl. 2 (1840) 359; H.J. Lam *l.c.* (1925) 110, *l.c.* (1927) 421; Jeuken *l.c.* 557; Anderson *l.c.* 315; Whitmore, Tantra & Sutisna *l.c.* 589; Pennington *l.c.* 154; Coode *et al.* (eds.) *l.c.* 305. **Lectotype** (Jeuken, 1952): *Herb. Wight No. 1732*, India, Deccan, Courtallum (holotype K). **Synonyms:** *I. wightiana* A.D.C., *Prodr.* 8 (1844) 187; *Bassia wightiana* (A.D.C.) Beddome, *For. Man. Bot.* (1870) 141; *I. gracilis* H.J.Lam *l.c.* (1927) 418.

Tree to 26 m tall, 46 cm diameter. **Bark** scaly to flaky, chocolate brown. **Leaves** *densely clustered at ends of twigs; chartaceous to subcoriaceous*, glabrous above, *glabrous or sparsely tomentose beneath; broadly ovate, oblong-lanceolate to obovate-lanceolate*, 3–9 × 1.2–4.6 cm, base acute, attenuate to cuneate, apex acute, acuminate, obtuse or mucronate; midrib flat or crested above, raised and prominent below; *lateral veins* 5–14 pairs, ascending at an angle of *c.* 60° from midrib, *arching and joining into intramarginal veins*; intercostal venation slender, obliquely scalariform, obscure on both sides; petiole 0.5–2 cm long, grooved on adaxial side. **Inflorescences** *2–10-flowered, axillary or in axils of leaf scars on older, leafless branchlets*. **Flowers** pale yellow; pedicel 0.2–0.7 cm long; sepals 4–5, ovate to lanceolate, *c.* 2–3 × 2 mm, silky-brown tomentose outside, glabrous within; corolla 4–5-lobed, glabrous; filaments *c.* 2 mm long, anthers white, glabrous or sparsely hairy; ovary 4–5-loculed. **Fruits** *oblong to ovoid-globose*, 0.8–1.8 × 0.6–1 cm.

Distribution. Southern part of India, Sri Lanka and Borneo. In Sarawak occurs in lowland limestone hills at Bau and Niah NP (e.g., *S 34532*, *S 38646* and *S 40060*). In Brunei (e.g., *BRUN 742* and *BRUN 1668*), recorded from the summit of G. Pagon Periok.

Key to varieties

Leaves ovate to oblong-lanceolate, base acute; lateral veins 4–12 pairs. Inflorescences 6–10-flowered. Fruits oblong, 0.8–1.8 × 0.6–0.8 cm.....

var. **lanceolata**

Leaves 2–23 × 1.5–10 cm, apex obtuse to acuminate, acumen 0.2–2 cm. Pedicels 0.2–0.5 cm long. Sepals *c.* 3 mm long; corolla 4–5-lobed; stamens 8–10; ovary 4–5-loculed.

In lowland to montane forest, at altitudes to 2000 m.

Leaves obovate-lanceolate; base attenuate to cuneate; lateral veins 12 pairs or more. Inflorescences 2–3-flowered. Fruits ovoid-globose, 0.8–1 cm across.....

var. **gracilis** (H.J.Lam) Jeuken

(Latin, *gracilis* = slender)

l.c. 561. Basionym: *I. gracilis* H.J.Lam *l.c.* (1927) 418. Type: *Amdjah 985*, Borneo, Kalimantan, Samenggaris (BO).

Leaves 6–10 × 2–4.7 cm, apex acuminate with an obtuse point; lateral veins 12–13 pairs. Pedicels to 0.7 cm long. Sepals *c.* 2 mm long; corolla 4-lobed; stamens 8–9; ovary 4-loculed.

Endemic to Borneo. In lowland and hill mixed dipterocarp forests.

6. **MADHUCA** Buch.-Ham. *ex* J.F.Gmelin(After an Indian plant name—*madhuka*)**P.C. Yii & P.P.K. Chai**

Syst. Nat. 2, 1 (1791) 773 & 799; Merrill, Enum. Phil. Fl. Pl. 3, 3 (1923) 276, PEB (1929) 238; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 152, *ibid.* 3, 8 (1927) 443; Ridley, FMP 5 (1925) 319; Masamune, EPB (1942) 590; Browne, FTSB (1955) 320; P. Royen, Blumea 10 (1960) 2; Backer & Bakhuizen *f.*, FJ 2 (1965) 192; Burgess, TBS (1966) 447; Keng, OFMSP (1969) 225; Ng, TFM 1 (1972) 401; Anderson, CLTS (1980) 316; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 318; Pennington, Gen. Sapot. (1991) 154; PROSEA 5, 1 (1993) 283; Kessler & Sidiyasa, TBSA-EK (1994) 212; Turner, Gard. Bull. Sing. 47 (1995) 463; Coode *et al.* (eds.), CLBD (1996) 305; Argent *et al.* (eds.), MNDR-CK 2 (1997) 575. **Synonyms:** *Bassia auct. non* All.: J. König *ex* L., Mantissa 2 (1771) 555, *nom. illeg.*, Bentham & Hooker *f.*, Gen. Pl. 2 (1876) 658, Hooker *f.*, Fl. Br. Ind. 3 (1882) 543, King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 176, Foxworthy, Philip. J. Sci. 4, (1909) 539, Merrill, Philip. J. Sci. Bot. 10 (1915) 56, EB (1921) 478, Ridley, FMP 2 (1923) 265; *Azaola* Blanco, Fl. Filip. ed. 1 (1837) 402; *Kakosmanthus* Hassk., Flora 38 (1855) 577, Merrill *l.c.* (1921) 478; *Illipe* J. König *ex* Gras, Bull. Soc. Bot. Fr. 11 (1864) 83 (substitute name for *Bassia* L. (1771), *non* All.), Foxworthy *l.c.* 539; *Ganua* Pierre *ex* Dubard, Rev. Gen. Bot. 20 (1908) 201, H.J. Lam *l.c.* (1925) 118, *l.c.* (1927) 424, Masamune *l.c.* 588, Van den Assem, Blumea 7 (1953) 369, Van den Assem & Kostermans, Blumea 7 (1954) 481, H.J. Lam, Blumea 8 (1957) 510, Ng *l.c.* 397, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 316.

Trees. **Stipules** present, sometimes large and persistent or absent. **Leaves** *spirally arranged* or very rarely alternate and distichous, well-spaced along twigs, or densely clustered on nodes, or crowded at ends of twigs, distinctly stalked, rarely sessile; blade with plane, revolute or rarely erose (gnawed) margin; lateral veins diminishing and becoming inconspicuous towards leaf margin or arching and joining into intramarginal smooth veins or vein-loops; *intercostal venation subscalariform*, or *reticulate-tessellate*, or rarely descending from leaf margin and parallel to lateral veins, or a combination of these. **Inflorescences** *1-many-flowered fascicles* axillary or *in axils of leaf scars*. **Flowers** bisexual, *distinctly pedicellate*; *calyx of two whorls of 2 sepals*, occasionally of 5 sepals with 3 inner and 2 outer ones, outer sepals thick, usually valvate, inner sepals imbricate, thinner; *corolla* tubular, (6-)8-12(-17)-lobed, lobes imbricate, spreading or reflexed, each lobe not divided into segments, *corolla tube* shorter or about the same length with lobes, *barbate* or *hirsute at the throat*; *stamens* (12-)14-36(-43), in one, two or three whorls, inserted at throat of corolla tube, occasionally with the lowermost whorl attached near the base of corolla tube, filaments short or absent, anthers extrorse, lanceolate or sagittate, laterally or extrorsely dehiscent; nectary (disk) occasionally present; *ovary* (4-)6-8(-15)-loculed, glabrous or hairy, style long-tapering and exserted. **Fruits** 1(-4)-seeded; pericarp thin or thick, woody or fleshy. **Seeds** plano-convex or laterally compressed; scar adaxial, oblong or linear; cotyledons plano-convex, or thick and flat, or rarely foliaceous; endosperm scanty or absent.

Distribution. About 100 species; India, Myanmar, Thailand, Indo-China, S China, Sumatra, Peninsular Malaysia, Borneo, the Philippines, and New Guinea. In Borneo, 50 species are known, of which 47 occur in Sabah and Sarawak.

Ecology. Common in primary forest from lowland to about 2500 m altitude.

Uses. *Madhuca* produces high quality *nyatoh* timber, well known for its fine texture and decorative grains. It is highly valued for panelling, flooring, solid doors, veneer and plywood. Except for

M. betis, it is not durable when used outdoors. Many species also produce ‘gutta-percha’. In the Philippines, the fruits of *M. obovatifolia* are reported to be edible, having similar taste to that of *ciku* (*Manilkara zapota*). In Sarawak, fat extracted from seeds of *M. motleyana* is used for cooking. Seeds of a few other species are also reported to be edible. In India, nectar extracted from flowers of *M. motleyana* is used for sweetening food and fermenting liquors. The fat extracted from the seeds is used for making margarine, soap and candle wax.

Taxonomy. *Ganua*, first described by Dubard in 1908, had been recognised as a distinct genus by subsequent authors until 1991, when Pennington showed that *Madhuca* and *Ganua* could not be separated in both vegetative and floral characters and concluded that the two genera should be combined.

Key to *Madhuca* Species

1. Leaves well-spaced along twigs.....2
 Leaves in dense clusters of 4–10 on nodes, or crowded at ends of twigs, or spirally arranged and well-spaced along the apical part of twigs.....26
2. Leaf lateral veins arching and joining to form a smooth intramarginal vein or vein-loops near or rather far from leaf margin.....3
 Leaf lateral veins diminishing and becoming inconspicuous toward leaf margin.....14
3. Leaf lateral veins arching and joining to form a smooth intramarginal vein near leaf margin.....4
 Leaf lateral veins arching and joining to form intramarginal vein-loops.....5
4. Leaves elliptic-lanceolate, 11–17 × 1.5–5 cm; lateral veins 15–23 pairs, ascending at an angle of *c.* 80° from midrib; intercostal venation descending from leaf margin and parallel to lateral veins..... **32. *M. palembanica***
 Leaves narrowly obovate, 25–40 × 6.5–11 cm; lateral venation ascending at an angle of *c.* 65° from midrib; intercostal veins scalariform..... **44. *M. spectabilis***
5. Stipules absent..... 6
 Stipules present..... 9
6. Twigs subangular. Leaves chartaceous; lateral veins ascending at an angle of 35–40° from midrib; intercostal venation scalariform..... **6. *M. costulata***
 Twigs terete. Leaves subcoriaceous to thickly coriaceous; lateral veins ascending at an angle of 75–80° from midrib; intercostal venation descending from leaf margin and parallel to lateral veins..... 7
7. Twigs glabrous. Leaves subcoriaceous, glabrous on both surfaces. Corolla lobes lanceolate. Stamen filaments *c.* 2 mm long. Fruits ovoid, *c.* 1.2 × 0.9 cm. Seed scars *c.* 7 × 2 mm..... **9. *M. daemonica***
 Twigs densely rusty-brown or greyish-brown tomentose. Leaves thickly coriaceous, densely rusty-brown tomentose or velvety hairy below. Corolla lobes spatulate or

- obovate. Stamen filaments very short. Fruits subglobose, *c.* 2.5 × 1.5 cm. Seed scar 12–18 × 2–4 mm..... 8
8. Twigs densely rusty-brown tomentose. Leaves elliptic to elliptic-obovate. Pedicel densely tomentose; sepals orbicular, *c.* 5–7 mm across; corolla lobes spatulate. Fruits densely rusty-brown tomentose..... **8. *M. curtisii***
Twigs densely greyish-brown tomentose. Leaves ovate-elliptic. Pedicel glabrous; sepals ovate, *c.* 4 mm long; corolla lobes obovate. Fruits glabrous..... **28. *M. motleyana***
9. Leaves chartaceous; lateral veins ascending at an angle of 45–50° from midrib..... **25. *M. mindanaensis***
Leaves coriaceous; lateral veins ascending at an angle of 60–85° from midrib...10
10. Stipules *c.* 1–4 × 2–4 mm. Leaf lateral veins 9–15 pairs; intercostal venation reticulate..... 11
Stipules 9–10 × 2–4 mm. Leaf lateral veins 20–50 pairs; intercostal venation scalariform..... 12
11. Twigs terete, glabrous. Stipules triangular, *c.* 1 × 0.4 mm. Leaves glabrous on both surfaces; lateral veins prominent on both sides. Petiole 2–3.5 cm long, flat or slightly raised on adaxial side. Stamens 16, filaments very short. Ovary subconical, hairy. Fruits ellipsoid, densely brownish-tomentose..... **13. *M. engkikiana***
Twigs ridged, densely reddish-brown woolly hairy. Stipules lanceolate, *c.* 4 × 1 mm. Leaves reddish-brown hairy on midrib and lateral veins below; lateral veins impressed above, distinct below. Petiole 0.5–1 cm long, grooved on adaxial side. Stamens 12, filaments *c.* 1 mm long. Ovary discoid, glabrous. Fruits fusiform, glabrous..... **37. *M. rufa***
12. Twigs terete, rusty-brown velvety hairy at tips. Leaves glabrous on both surfaces; petiole 1.5–2.5 cm long. Sepals suborbicular, *c.* 10 × 14 mm; corolla *c.* 12 mm long; stamen filaments *c.* 5 mm long; ovary disciform..... **24. *M. markleeana***
Twigs subangular, densely rusty-brown tomentose all over. Leaves hairy at least on midrib and lateral veins below; petiole 2.5–7 cm long. Sepals triangular and 5–7 mm long or ovate-lanceolate and 6–9 × 3–5 mm; corolla 7–8 mm long; stamen filaments 0.5–3 mm long; ovary ovoid or subconical..... 13
13. Leaves densely golden-brown tomentose below, lanceolate or elliptic-oblong; lateral veins prominent on both sides; petiole broadly furrowed on adaxial side. Sepals triangular; stamens 22–28, filaments *c.* 0.5 mm long, anthers ovate-lanceolate, *c.* 2 mm long; ovary subconical, style clavate-subulate, 8–9 mm long..... **22. *M. lancifolia***
Leaves sparsely hairy on midrib and lateral veins only, oblanceolate; lateral veins impressed above, prominent below; petiole flat on adaxial side. Sepals ovate-lanceolate; stamens 13–16, filaments *c.* 3 mm long, anthers narrowly sagittate, *c.* 4 mm long; ovary ovoid, style filiform, *c.* 3 mm long..... **39. *M. sarawahensis***
14. Leaf intercostal venation reticulate..... 15
Leaf intercostal venation scalariform or scalariform-tessellate..... 16

15. Twigs slender, terete. Stipules ovate-lanceolate, *c.* 2.5 × 1 mm. Leaves coriaceous, glabrous on both surfaces; lateral veins 6–11 pairs, ascending at an angle of 45–55° from midrib. Petiole 0.5–2 cm long, flat on adaxial side.....**12. *M. endertii***
 Twigs stout, subangular. Stipules triangular, *c.* 4 × 4 mm. Leaves thickly coriaceous, silvery brown tomentose on both surfaces; lateral veins 15–19 pairs, ascending at an angle of 70–80° from midrib. Petiole 3–4 cm long, grooved on adaxial side.....**43. *M. silamensis***
16. Twigs glabrous.....17
 Twigs variously hairy.....20
17. Stipules triangular, *c.* 4 × 2.5 mm. Leaf lateral veins ascending at an angle of 50–60° from midrib. Stamens 16–22; ovary disciform.....**4. *M. burckiana***
 Stipules ovate or lanceolate, 1.5–2 × 0.5–1 mm. Leaf lateral veins ascending at an angle of 40–50° from midrib. Stamens 12–18; ovary ovoid.....18
18. Twigs terete. Leaf lateral veins 13–20 pairs. Ovary hairy.....**47. *M. woodii***
 Twigs subangular. Leaf lateral veins 6–13 pairs. Ovary glabrous.....19
19. Stipules lanceolate. Leaf intercostal venation distinct on both sides. Petiole 1–3 cm long. Corolla lobes obovate-spathulate. Stamens 12.....**38. *M. sandakanensis***
 Stipules ovate. Leaf intercostal venation faint above, distinct below. Petiole 3–3.5 cm long. Corolla lobes oblong. Stamens 18.....**40. *M. sepilokensis***
20. Twigs woolly pubescent. Stipules 7–12 × 3–7 mm.....**36. *M. pubicalyx***
 Twigs covered with persistent appressed yellowish-brown indumentum, sericeous or greyish or brownish velvety hairy. Stipules 2–5 × 1–2 mm or minute.....21
21. Leaves glabrous on both surfaces.....22
 Leaves variously pubescent at least on lower surface.....23
22. Twigs slender. Leaf intercostal venation laxly scalariform. Petiole puberulous at base. Corolla *c.* 6 mm long, 8-lobed, lobes ovate. Stamens 18, anthers oblong-ovoid. Fruits ellipsoid.....**20. *M. korthalsii***
 Twigs stout. Leaf intercostal venation scalariform-tessellate. Petiole glabrous. Corolla *c.* 12 mm long, 10–12-lobed, lobes elliptic-lanceolate. Stamens 22–25, anthers sagittate. Fruits oblong-obovoid.....**23. *M. malaccensis***
23. Twigs covered with persistent appressed yellowish-brown indumentum. Leaves chartaceous to subcoriaceous; lateral veins 5–9 pairs, ascending at an angle of 35–45° from midrib.....**14. *M. engleri***
 Twigs greyish or brownish velvety hairy or greyish sericeous. Leaves coriaceous; lateral veins (8–)10–20 pairs, ascending at an angle of 60–80° from midrib.....24
24. Twigs stout. Stipules *c.* 5 × 2 mm. Leaf lateral veins to 20 pairs, ascending at an angle of 65–80° from midrib.....**30. *M. oblongifolia***
 Twigs slender. Stipules *c.* 2.5 × 1 mm or minute. Leaf lateral veins to 14 pairs, ascending at an angle of *c.* 60° from midrib.....25

25. Twigs brownish velvety hairy. Leaf apex obtuse; lateral veins obscure above, distinct below. Petiole 0.8–1 cm long. Inflorescences 1–3-flowered; anthers oblong, *c.* 0.6 mm long; ovary disciform.....**26. *M. montana***
 Twigs greyish sericeous. Leaf apex acuminate; lateral veins prominent on both sides. Petiole 1.3–4.5 cm long. Inflorescences 3–7-flowered; anthers sagittate, *c.* 2.5 mm long; ovary ovoid.....**41. *M. sericea***
26. Leaves in dense clusters of 4–10 on nodes.....27
 Leaves crowded at ends of twigs or spirally arranged and well-spaced along apical part of twigs.....28
27. Stipules absent. Leaves coriaceous, base attenuate; lateral veins diminishing and becoming inconspicuous toward leaf margin, ascending at an angle of 50–60° from midrib, obscure above, prominent beneath; intercostal venation descending from leaf margin and parallel to lateral veins.....**5. *M. cheongiana***
 Stipules present, subulate. Leaves chartaceous to subcoriaceous, base cuneate or abruptly truncate or subcordate and slightly oblique; lateral veins arching and joining to form intramarginal vein-loops, ascending at an angle of 70–85° from midrib, prominent on both sides; intercostal venation distinctly reticulate.....**33. *M. pallida***
28. Leaves variously hairy at least on lower surface.....29
 Leaves glabrous on both surfaces or covered with remnants of scattered silvery hairs especially on midrib below.....34
29. Leaves rusty-brown tomentose on both surfaces.....**15. *M. erythrophylla***
 Leaves glabrous above, variously hairy below.....30
30. Leaf lateral veins diminishing and becoming inconspicuous toward leaf margin...31
 Leaf lateral veins arching and joining to form a smooth intramarginal vein or vein-loops along leaf margin.....32
31. Twigs rusty-brown hairy, terete. Stipules triangular, *c.* 1 × 0.5 mm. Leaf margin plane; intercostal venation reticulate or reticulate-tessellate near leaf margin...**10. *M. dubardii***
 Twigs glabrous, angular. Stipules broadly ovate, *c.* 5 × 4 mm. Leaf margin recurved; intercostal venation descending from leaf margin and parallel to lateral veins.....
**31. *M. ochracea***
32. Stipules 5–7 × 1 mm. Leaves smaller, 11–15 × 4.5–6 cm; intercostal venation descending from leaf margin and parallel to lateral veins.....**16. *M. fusca***
 Stipules 7–18 × 1.5–8 mm. Leaves larger, 15–40 × 6–18 cm; intercostal venation scalariform.....33
33. Leaves subcoriaceous; petiole 1.6–2.5 cm long. Twigs angularly ridged. Stipules ovate-acuminate to linear-lanceolate.....**2. *M. borneensis***
 Leaves coriaceous; petiole 2.5–4 cm long. Twigs with rounded ribs. Stipules ovate-lanceolate or triangular-lanceolate.....**34. *M. primoplagensis***
34. Leaf lateral veins diminishing and becoming inconspicuous toward leaf margin.....
35

- Leaf lateral veins arching and joining to form a smooth intramarginal vein or vein-loops near or rather far from leaf margin.....36
35. Stipules broadly ovate, *c.* 1 × 0.5 mm. Leaves coriaceous, waxy above; intercostal venation laxly scalariform.....**17. M. glabrescens**
 Stipules linear, *c.* 3 × 1 mm. Leaves membranaceous to chartaceous, not waxy above; intercostal venation reticulate.....**45. M. utilis**
36. Leaf lateral veins arching and joining into a smooth intramarginal vein.....37
 Leaf lateral veins arching and joining to form vein-loops near or rather far from leaf margin.....39
37. Stipules 5–10 × 4–8 mm. Leaves coriaceous; intercostal venation densely scalariform....
**19. M. kingiana**
 Stipules *c.* 2 mm long, or absent. Leaves subcoriaceous; intercostal venation descending from leaf margin and parallel to lateral veins.....38
38. Twigs sparsely hairy. Terminal buds *c.* 3 mm long. Stipules absent. Leaves oblanceolate or obovate, drying pale yellowish brown; intercostal venation obscure above, distinct below. Pedicel 2.8–3.5 cm long.....**1. M. barbata**
 Twigs glabrous. Terminal buds *c.* 5 mm long. Stipules present, *c.* 2 mm long. Leaves oblong or oblong-lanceolate, drying reddish brown; intercostal venation obscure on both sides. Pedicel 1.5–2.5 cm long.....**27. M. monticola**
39. Leaf intercostal venation descending from leaf margin and parallel to lateral veins.....
**3. M. brochidodroma**
 Leaf intercostal venation scalariform, reticulate or reticulate-tessellate.....40
40. Leaf intercostal venation scalariform.....41
 Leaf intercostal venation reticulate or reticulate-tessellate.....42
41. Twigs densely woolly-tomentose. Stipules shield-shaped, *c.* 6 × 2 mm. Leaf lateral veins 18–26 pairs. Sepals ovate, 6–7 × 4–5 mm. Fruit pericarp fleshy. Seeds pointed at both ends.....**11. M. elmeri**
 Twigs rusty-brown velvety hairy at apex only. Stipules broadly ovate, *c.* 6 × 4 mm. Leaf lateral veins 28–45 pairs. Sepals orbicular, *c.* 6 mm across. Fruit pericarp thin. Seeds obtuse at both ends.....**29. M. multinervia**
42. Twigs glabrous. Stipules absent. Leaf intercostal venation laxly reticulate. Petiole very short, leaves almost sessile.....**42. M. sessilis**
 Twigs hairy, at least on nodes. Stipules present. Leaf intercostal venation laxly to densely reticulate or reticulate-tessellate. Petiole (1.5–)2–5(–8) cm long.....43
43. Twigs densely woolly-brown or greyish tomentose. Terminal buds 7–15 mm long. Stipules 3–12 × 1–5 mm.....44
 Twigs rusty-brown velvety-hairy. Terminal buds 2–3 mm long. Stipules 2–3 × 1–1.5 mm 46

44. Twigs ridged or angular, densely woolly-tomentose on nodes only. Terminal buds 12–15 mm long. Stipules lanceolate, *c.* 12 × 5 mm. Leaves broadly obovate; margin erose (gnawed); lateral veins 19–25 pairs. Sepals oblanceolate. Fruits ellipsoid.....
 **18. *M. hirtiflora***
 Twigs terete, densely woolly-brown tomentose or greyish tomentose all over. Terminal buds 7–10 mm long. Stipules linear or narrowly triangular, 3–4 × 1–2 mm. Leaves spatulate, obovate, or narrowly obovate; margin entire and plane or slightly recurved; lateral veins 10–20 pairs. Sepals lanceolate or oblong-ovate. Fruits ovoid-ellipsoid or subglobose..... 45
45. Stipules linear. Leaves spatulate or obovate, 5–10 × 2.5–4 cm; margin slightly recurved; lateral veins 10–12 pairs, ascending at an angle of *c.* 60° from midrib. Sepals lanceolate; corolla 8–9-lobed; stamens 17–19. Fruits obovoid-ellipsoid, 4–5.5 × 2–3.3 cm; pericarp thick and fleshy, granular..... **7. *M. crassipes***
 Stipules narrowly triangular. Leaves narrowly obovate, 16–24 × 6–9 cm; margin plane; lateral veins 15–20 pairs, ascending at an angle of 80–85° from midrib. Sepals oblong-ovate; corolla 12-lobed; stamens 24. Fruits subglobose, *c.* 2 × 1.7 cm; pericarp thin, smooth..... **35. *M. proluxa***
46. Leaves elliptic to oblong-elliptic; lateral veins 11–13 pairs. Inflorescences 5–8-flowered; corolla 8-lobed; stamens 16 in two whorls..... **21. *M. kuchingensis***
 Leaves oblanceolate, obovate or obovate-elliptic; lateral veins (9–)15–20 pairs. Inflorescences 1–3 (rarely to 8)-flowered; corolla 8–16-lobed; stamens 16–32 in two or three whorls..... **46. *M. vulpina***

1. *Madhuca barbata* T.D.Penn.

(Latin, *barbatus* = bearded with tufted, long soft hairs; the sepals)

Gen. Sapot. (1991) 156. **Type:** *Haviland & Hose 3482A*, Borneo, Sarawak, Kuching (holotype L).
Synonym: *Ganua pierrei auct. non* (Williams) H.J.Lam: Van den Assem *l.c.* 392, Anderson *l.c.* 315.

Small tree. **Twigs** subangular, *sparsely hairy*. **Terminal buds** *c.* 3 mm long, with distinct caducous bud-scales. **Stipules** *absent*. **Leaves** crowded at end of twigs, *subcoriaceous, glabrous on both surfaces, drying pale yellowish brown; oblanceolate or obovate*, 10–16 × 4–6.5 cm, base narrowly cuneate, margin entire and plane, apex obtuse or acuminate with a blunt tip; midrib flat or slightly raised above, prominent beneath; *lateral veins* slender, 12–17 pairs, ascending at an angle of 70–80° from midrib, *arching and joining into a smooth intramarginal vein*, obscure above, distinct below; *intercostal venation* slender, *descending from leaf margin and parallel to lateral veins*, laxly reticulate near leaf margin, *obscure above, distinct below*; petiole 2–2.8 cm long, broadly grooved on adaxial side, thickened and black at base. **Inflorescences** in axils of leaf scars below leafy parts of twigs, 6–12-flowered. **Flowers:** *pedicel 2.8–3.5 cm long*, sepals ovate or deltoid, 5 × 3–5 mm, apex set with tufted, long, soft, dark hairs; corolla 2–3 mm long, lobes 8–12, ribbon-like; stamens 16–24, filaments *c.* 15 mm long, anthers with short acumen; ovary glabrous, 8–12-loculed. **Fruits** unknown.

Vernacular name. Sarawak—*ketiau putih* (Malay).

Distribution. Endemic to Borneo and confined to Sarawak (e.g., *S 203*, *S 521*, *S 528*, *S 534*, *S 2683*, *S 2690*, *S 9737*, *S 30154*, and *S 30164*).

Ecology. Uncommon in peat swamp forest, occasionally also found in lowland mixed dipterocarp forest.

2. *Madhuca borneensis* P.Royen (of Borneo)

Blumea 10 (1960) 20; Anderson *l.c.* 316; Whitmore, Tantra & Sutisna *l.c.* 318; Vink, Blumea 46 (2001) 193. **Type:** *Jaheri s.n. (exp. Nieuwenhuis)*, Borneo, Kalimantan (holotype L; isotype BO). **Synonym:** *M. eriobrachyon* P.Royen *l.c.* (1960) 40.

Tree to 30 m tall, 50 cm diameter. **Bark** greyish with dark-grey mottles; inner bark dull orange. **Twigs** slender, *angularly ridged*, densely covered with persistent yellowish-brown woolly tomentum. **Terminal buds** to 12 mm long. **Stipules** *ovate-acuminate* to *linear-lanceolate*, *c. 7–18 × 1.5–4.5 mm*, densely woolly tomentose outside. **Leaves** *crowded at ends of twigs* or *spirally arranged and well-spaced along ends of twigs*, *subcoriaceous*, except for midrib *glabrous above, densely woolly-tomentose below*; *oblanceolate* or *obovate*, *15–40 × 6–13 cm*, base cuneate, acute to subrotundate and slightly oblique, margin plane, apex acuminate with a sharp tip; midrib grooved and narrowly crested above, prominent below; *lateral veins* 16–22 pairs, ascending at an angle of *c. 60°* from midrib, *arching and joining into a smooth intramarginal vein*, impressed above, prominent below; *intercostal venation* slender, *laxly scalariform*, *distinct above, prominent below*; *petiole 1.6–2.5 cm* long, narrowly grooved on adaxial side, thickened and rugose at base, densely woolly-tomentose. **Inflorescences** in axils of leaf scars, 4–7-flowered. **Flowers:** pedicel angular, 2–3 cm long, densely woolly-tomentose; sepals oblong-ovate, 5–6.5 × 4–6 mm, yellowish-brown tomentose; corolla bell-shaped, white, 6–8 mm long, lobes 8, lanceolate to elliptic; stamens 16–20, filaments 1.5–3 mm long, anthers *c. 2 mm* long, oblong-ovate, villous; ovary ovoid to depressed globose, villous, style glabrous. **Fruits** ovoid to ellipsoid, 2–2.8 × 1–1.7 cm, 1-seeded; pericarp fleshy, densely reddish-brown woolly-tomentose. **Seeds** laterally compressed, ellipsoid to obovoid, 1.8–2.3 × 0.7–1.2 cm, obtuse at both ends; testa thin, pale brown, smooth; scar *c. 17 × 5 mm*.

Vernacular name. Sarawak—*nyatoh bulu merah* (Malay).

Distribution. Endemic to Borneo. Known from C Sarawak (e.g., *S 15120*, *S 23226*, *S 26058*, *S 29065*, *S 29691*, *S 31929*, and *S 43611*) and western part of Kalimantan (e.g., *Hotta K-577*, *Jacobs 5380*, *Jaheri s.n.*, and *Kostermans 21166*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 200 m.

3. *Madhuca brochidodroma* T.D.Penn. (Greek, *brochidodroma* = loop-veined; the leaves)

Gen. Sapot. (1991) 157; Coode *et al.* (eds.) *l.c.* 305. **Type:** *Beccari PB 3085*, Borneo, Sarawak (holotype FI; isotype P). **Synonym:** *Ganua coriacea* Pierre ex Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 408,

H.J. Lam *l.c.* (1925) 121, *l.c.* (1927) 424, *l.c.* (1957) 510, Masamune *l.c.* 588, Van den Assem *l.c.* 389, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 317.

Tree to 25 m tall, 30 cm diameter, with numerous pointed pneumatophores. **Bark** brown, relatively smooth; inner bark dull orange, soft and fibrous. **Twigs** slender, terete, glabrous. **Terminal buds** glabrous, *c.* 2 mm long. **Stipules** absent. **Leaves** crowded at ends of twigs, thickly coriaceous, *glabrous on both surfaces*, drying dark blackish above, brownish black below; obovate to obovate-elliptic, 4–7 × 2–3 cm, base attenuate, margin plane, apex rounded or retuse; midrib raised and prominent on both sides; *lateral veins* slender, 9–13 pairs, ascending at an angle of 80–85° from midrib, *arching and joining into vein-loops near leaf margin*, obscure on both sides; *intercostal venation descending from leaf margin and parallel to lateral veins*, laxly reticulate-tessellate near leaf margin, obscure on both sides; petiole 0.7–1.2 cm long, terete, thickened at base, dark brown. **Inflorescences** axillary or in axils of leaf scars, 2–6-flowered. **Flowers:** pedicel *c.* 0.5 cm long; sepals deltoid, *c.* 2.5 × 2 mm, apex acute, silvery tomentose; corolla cream, *c.* 4 mm long, lobes 8, round; stamens 16, filaments very short, anthers ovate; ovary ovoid, glabrous, 8-loculed, style glabrous. **Fruits** ovoid, *c.* 2.1 × 1.2 cm, 1-seeded, acute at apex and round at base; pericarp thin, glabrous. **Seeds** laterally compressed, ellipsoid, 1.2 × 0.3–0.6 cm, pointed at both ends; testa thin, pale brown, smooth; scar linear, *c.* 14 × 2 mm.

Vernacular names. Sarawak—*ketiau merah* (Malay), *nyatoh cabi* (Melanau-Oya).

Distribution. Sumatra and Borneo. Uncommon and scattered throughout Sarawak (e.g., *S 406*, *S 545*, *S 875*, *S 1454*, *S 2714*, *S 5005*, and *S 30158*). Also known from Brunei (e.g., *SAN 17432*).

Ecology. In the inner zone of peat swamp forest.

Uses. Pole-sized trees are used as construction poles and for rafting logs.

4. *Madhuca burckiana* (Koord.) H.J.Lam (W. Burck, 1848–1927, a Dutch botanist)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 172, *l.c.* (1927) 453; P. Royen *l.c.* (1960) 68; Anderson *l.c.* 316; Whitmore, Tantra & Sutisna *l.c.* 319; Pennington *l.c.* 156. **Basionym:** *Illipe burckiana* Koord., Med.'s Lands Pl. Buitenz. 19 (1898) 518 & 640. **Type:** *Koorders 18883β*, Sulawesi, Minahasa, Manado (holotype BO; isotype L). **Synonyms:** *Illipe burckiana* (“*burckeana*”) (Koord.) Pierre ex Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 406 in errore pro “*Bassia burckiana* Koord.”; *Payena fusicarpa* Elmer, Leaf. Philip. Bot. 8 (1915) 2820; *Bassia cagayanensis* Merr., Philip. J. Sci. Bot. 13 (1918) 48; *Madhuca fusicarpa* (Elmer) Merr. *l.c.* (1923) 276; *Illipe schlechteri* Krause, Bot. Jahrb. 58 (1923) 467.

Tree to 15 m tall, 20 cm diameter. **Bark** greyish brown, smooth; inner bark dull orange. **Twigs** terete or subangular, *glabrous*. **Terminal buds** glabrous, *c.* 4 mm long. **Stipules** triangular, *c.* 4 × 2.5 mm, crested. **Leaves** well-spaced along twigs, subcoriaceous, glabrous on both sides; elliptic or elliptic-obovate, 9–29 × 4–9 cm, base cuneate or subrotundate, margin plane, apex short-acuminate; midrib grooved and finely crested above, prominent below; *lateral veins* 9–17 pairs, *ascending at an angle of 50–60° from midrib, diminishing and becoming inconspicuous toward leaf margin*, apical pairs arching and joining to form vein-loops, obscure above, prominent below; *intercostal venation scalariform*, obscure above, distinct below; petiole 1.2–4.5 cm long,

flat to shallowly grooved on adaxial side, thickened at base. **Inflorescences** axillary, 3–10-flowered. **Flowers:** pedicel angular, 1.5–2 cm long; sepals broadly ovate, *c.* 5 × 4 mm, apex acute; corolla *c.* 7 mm long, lobes 8, oblong, rounded at apex; *stamens* 16–22, in two whorls, filaments subulate, anthers oblong-ovoid; *ovary disciform*, glabrous, 8–9-loculed, style filiform. **Fruits** ovoid-fusiform, 1.8–2.4 × 0.8–1 cm, 1-seeded, acute at both ends; pericarp thin, sparsely hairy, glabrescent. **Seeds** ellipsoid, *c.* 1.5 × 0.6 cm; testa thin, shining; scar linear.

Distribution. Borneo, the Philippines, Sulawesi, Maluku and Papua New Guinea. Scattered throughout Sabah (e.g., *SAN 17432*, *SAN 41325*, *SAN 65483*, *SAN 73689*, *SAN 74011*, and *SAN 121254*) and Sarawak (e.g., *S 36847*, *S 40782* and *S 43828*). Also occurs in Kalimantan.

Ecology. In lowland to hill mixed dipterocarp forest, at altitudes to 1000 m.

5. *Madhuca cheongiana* Yii & P.Chai

(Cheong Ek Choon, Director of the Sarawak Forestry Department)

Gard. Bull. Sing. 53 (2001) 343. **Type:** *Beccari PB 3105*, Borneo, Sarawak, Kuching (holotype FI, *n.v.*). **Synonyms:** *Ganua sarawahensis* Pierre ex Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 409, H.J. Lam *l.c.* (1925) 130 (“*sarawakensis*”), *l.c.* (1927) 429 (“*sarawakensis*”), Van den Assem *l.c.* 375 (“*sarawakensis*”); *G. attenuata* Griffioen & H.J. Lam, *nom. ined.*, Anderson *l.c.* 314, *nom. nud.*

Tree to 30 m tall, 50 cm diameter. **Bark** pale brown or brown with greyish mottles, smooth to papery scaly; inner bark dull orange, soft and fibrous. **Twigs** subangular, pale greyish brown, glabrous. **Terminal buds** *c.* 10 × 3 mm, rusty hairy, with conspicuous narrowly triangular bud-scales. **Stipules absent.** **Leaves** in dense clusters of 6–10 on nodes, coriaceous, glabrous on both sides; obovate to elliptic-obovate, 11–25 × 3–6 cm, *base attenuate*, decurrent, margin plane, apex short-acuminate; midrib grooved above, round beneath; *lateral veins* 10–16 pairs, *ascending at an angle of 50–60° from midrib, diminishing and becoming inconspicuous toward leaf margin, obscure above, prominent beneath; intercostal venation descending from leaf margin and parallel to lateral veins*, laxly reticulate near leaf margin, slender, obscure above, prominent beneath; petiole stout, 0.6–1.6 cm long, glabrous, thickened and rugose at base, upper parts broadly furrowed on adaxial side. **Inflorescences** in axils of lower leaves or leaf scars, 5–10-flowered. **Flowers:** pedicel 1.5–3.5 cm long, glabrous; sepals ovate-elliptic, *c.* 6 × 4 mm, apex obtuse or acuminate; corolla white, *c.* 11 mm long, lobes 8, lanceolate; stamens 16, filaments short, anthers lanceolate, villous; ovary subconical, 7–8-loculed, sparsely villous, style glabrous. **Fruits** unknown.

Vernacular name. Sarawak—*nyatoh daun mata lembing* (Malay).

Distribution. Endemic to Borneo. Uncommon and scattered throughout Sabah (e.g., *SAN 33601*, *SAN 36601* and *SAN 126691*) and Sarawak (e.g., *S 2162*, *S 2222*, *S 15437*, *S 29477*, and *S 32947*). Also known from Brunei and Kalimantan.

Ecology. In lowland mixed dipterocarp and *kerangas* forests, at altitudes below 200 m.

6. *Madhuca costulata* (Pierre ex Dubard) H.J.Lam

(Latin, *costulatus* = finely ribbed; the distinctly veined leaves)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 181, *l.c.* (1927) 462; Masamune *l.c.* 462; P. Royen *l.c.* (1960) 18; Whitmore, Tantra & Sutisna *l.c.* 319. **Basionym:** *Kakosmanthus costulatus* Pierre ex Dubard, Rev. Gen. Bot. 20 (1908) 198, Merrill *l.c.* (1921) 478. **Type:** *Beccari PB 3000*, Borneo, Sarawak, Matang (holotype P; isotype L).

Tree to 8 m tall, 10 cm diameter. **Bark** greyish; inner bark pale orange. **Twigs** slender, *subangular*, rusty-brown tomentose, glabrescent. **Terminal buds** *c.* 2 mm long, rusty-brown tomentose. **Stipules** *absent*. **Leaves** *well-spaced along twigs; chartaceous*, glabrous on both surfaces except for the finely silky-hairy midrib and lateral veins; elliptic to elliptic-obovate, 10–17 × 2.5–5 cm, base cuneate, margin plane, apex acuminate, acumen to 1.5 cm long, sharp-pointed; midrib narrowly raised above, round and prominent below; *lateral veins* 8–14 pairs, *ascending at an angle of 35–40° from midrib, arching and joining into intramarginal vein-loops rather far from leaf margin*, impressed above, prominent below; *intercostal venation* fine, *scalariform*, obscure on both sides; petiole slender, glabrous, 1.5–2.1 cm long, shallowly grooved and narrowly crested on adaxial side. **Inflorescences** axillary or in axils of leaf scars, 5–6-flowered. **Flowers:** pedicel 0.7–1.4 cm long, sparsely tomentose; sepals broadly ovate, 3.5–5 × 4–4.5 mm, apex subobtusate; corolla *c.* 5 mm long, lobes 7–9, lanceolate, apex obtuse; stamens 14, filaments subulate, anthers oblong; ovary ovoid, glabrous, style glabrous. **Fruits** laterally compressed, ellipsoid, 2–2.5 × 0.8–1.3 cm, 1-seeded, drying not black; pericarp fleshy and glabrous. **Seeds** ellipsoid, 1.5–2.2 × 0.5–1 cm, apex obtuse, base cuneate; testa thin, scar linear.

Vernacular name. Sarawak—*nyatoh semukau* (Iban).

Distribution. Endemic to Borneo and confined to the western part of Sarawak (e.g., *S 40754* and *S 41024*).

Ecology. Usually found along ridges and upper slopes of hill mixed dipterocarp forest below 300 m altitude.

7. *Madhuca crassipes* (Pierre ex Becc.) H.J.Lam

(Latin, *crassus* = thick, *pes* = foot or stalk; the thick fruit stalk)

Fig. 6.

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 180, *l.c.* (1927) 462; Masamune *l.c.* 590; P. Royen *l.c.* (1960) 101; Anderson *l.c.* 316; Whitmore, Tantra & Sutisna *l.c.* 319; Argent *et al.* (eds.) *l.c.* 576. **Basionym:** *Bassia crassipes* Pierre ex Becc., Nelle For. Born. ed. 1 (1902) 580, Merrill *l.c.* (1921) 478. **Type:** *Beccari PB 904*, Borneo, Sarawak, Kuching (holotype FI; isotypes L, P). **Synonym:** *Illipe crassipes* (Pierre ex Becc.) Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 405; *Croixia crassipes* (Pierre ex Becc.) Baehni, Boissiera 11 (1965) 109.

Tree to 40 m tall, 70 cm diameter, with steep plank buttresses to 2.5 m high, 1.2 m wide. **Bark** brown with greyish mottles, shallowly fissured; inner bark dull orange, soft and laminated. **Twigs** *terete*, *densely woolly-brown tomentose*. **Terminal buds** *c.* 7 mm long, densely woolly-brown tomentose. **Stipules** *linear*, *c.* 4 × 1 mm, woolly tomentose, caducous. **Leaves** *crowded at ends of twigs*, subcoriaceous, *glabrous on both surfaces*, glaucous below; *spathulate* or *obovate*, 5–10 × 2.5–4 cm, base narrowly cuneate and slightly decurrent, *margin slightly recurved*, apex

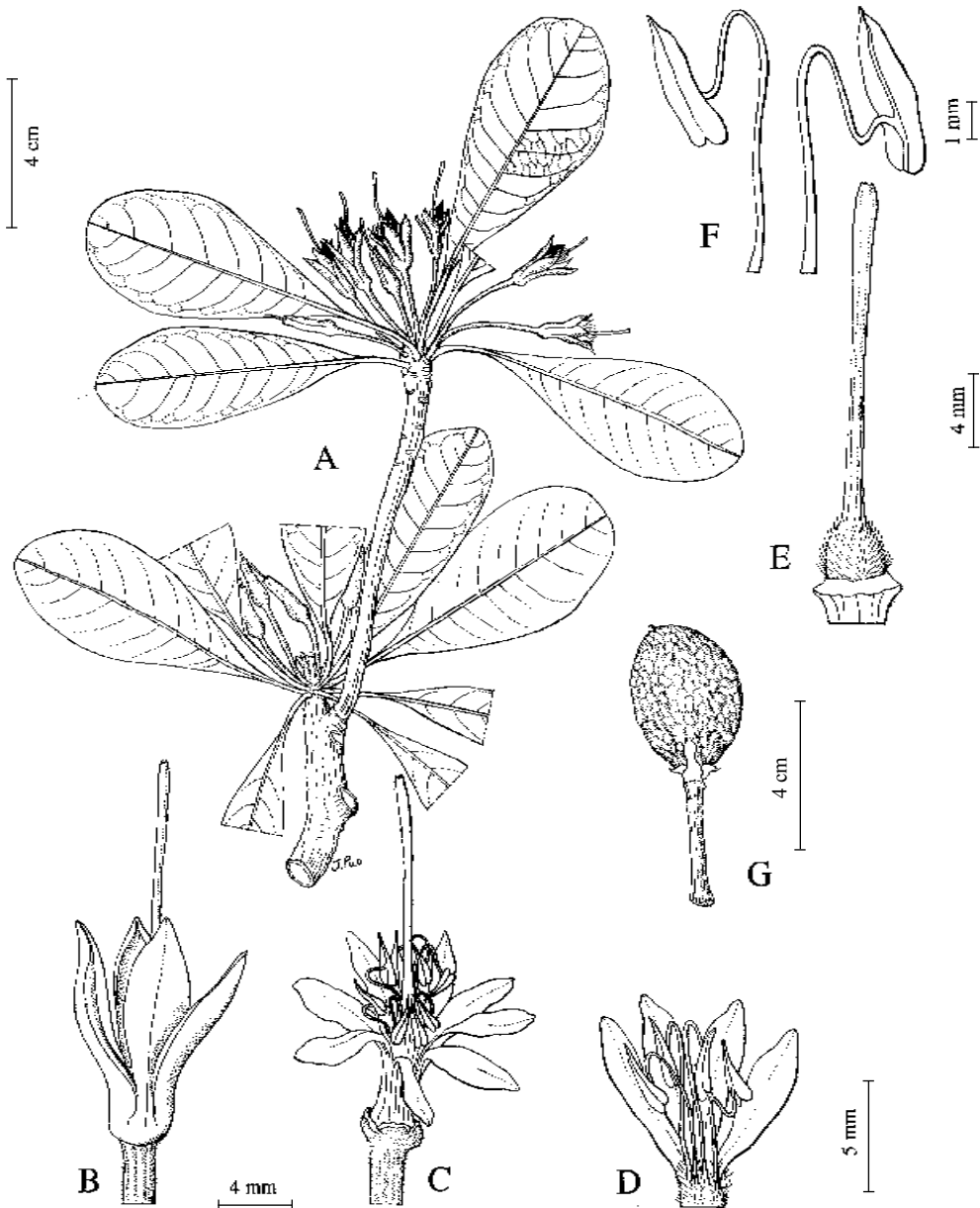


Fig. 6. *Madhuca crassipes*. A, flowering leafy twig; B, flower with petals and stamens removed to show sepals and style; C, flower with sepals removed; D, petals and stamens; E, pistil; F, stamens in different views; G, fruit. (A–F from *S* 16657, G from *S* 32197.)

rounded or retuse, rarely acuminate with an obtuse tip; midrib raised and prominent on both sides; *lateral veins* 10–12 pairs, ascending at an angle of c. 60° from midrib, arching and joining to form vein-loops by thickened intercostal veins, obscure above, distinct below; *intercostal venation* slender, *reticulate-tessellate*, occasionally intercepted by transverse veins, obscure above, distinct below; *petiole* slender, 1.5–2 cm long, flat on adaxial side, round on abaxial side, sparsely pubescent by long brown silky-hairs. **Inflorescences** crowded in axils of leaves at ends of twigs, 5–10-flowered. **Flowers:** fragrant; pedicel angular, 0.7–2 cm long, to 3.5 cm long in fruit, woolly tomentose; *sepals* lanceolate, 9–11 × 2.5–3 mm, obtuse, densely woolly tomentose; corolla cream, 12–14 mm long, *lobes* 8–9, lanceolate, narrowly obtuse at apex; *stamens* 17–19, filaments filiform, anthers oblong, villous; ovary ovoid, glabrous, 8–9-loculed, style glabrous. **Fruits** oblique and laterally compressed, *obovoid-ellipsoid*, 4–5.5 × 2–3.3 cm, 1-seeded, tapering at both ends; *pericarp* thick and fleshy, granular; stalk stout, 3–3.5 cm long, glabrous. **Seeds** laterally compressed, ellipsoid; testa thin, smooth and reddish brown; scar narrowly linear.

Vernacular name. Sarawak—*nyatoh jelutong* (Malay).

Distribution. Sumatra and Borneo. Uncommon and scattered throughout Sabah (e.g., *SAN* 49629, *SAN* 50999, and *SAN* 78097) and Sarawak (e.g., *S* 10684, *S* 16657, *S* 23757, *S* 30604, and *S* 32197). Also occurs in Brunei and Kalimantan.

Ecology. In seasonal fresh water swamp, lowland mixed dipterocarp and lower montane forests, at altitudes to 1000 m.

8. *Madhuca curtisii* (King & Gamble) Ridl.

(Charles Curtis, 1852–1928, sometime superintendent of the Penang Botanic Garden, Malaysia)

FMP 5 (1925) 319; Pennington *l.c.* 157; Turner *l.c.* 463; Coode *et al.* (eds.) *l.c.* 306. **Basionym:** *Bassia curtisii* King & Gamble *l.c.* 181. **Type:** *Curtis 1451*, Peninsular Malaysia, Penang, Government Hill (holotype SING; isotype L). **Synonyms:** *Ganua chrysocarpa* Pierre ex Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 407, H.J. Lam *l.c.* (1925) 130, *l.c.* (1927) 429, P. Royen *l.c.* (1960) 111; *G. curtisii* (King & Gamble) H.J. Lam *l.c.* (1925) 126, *l.c.* (1927) 425, Van den Assem *l.c.* 388, Ng *l.c.* 397, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 317; *Isonandra curtisii* (King & Gamble) Baehni *l.c.* 84; *Bassia perakensis* King & Gamble *l.c.* 183; *Madhuca perakensis* (King & Gamble) Ridl. *l.c.* (1925) 319; *M. chrysocarpa* (Pierre ex Dubard) Ridl. *l.c.* (1925) 342.

Tree to 28 m tall, 50 cm diameter, with low buttresses. **Bark** coarse, shedding off into small irregular flakes, exposing verrucose lenticellate reddish brown surface; inner bark dull orange, soft with conspicuous white latex. **Twigs** stout, *terete*, strongly marked with leaf scars and inflorescence warts, *densely rusty-brown tomentose*, glabrescent. **Terminal buds** c. 2.5 mm long, rusty-brown tomentose. **Stipules** absent. **Leaves** well-spaced along twigs, *thickly coriaceous*, glabrous above, *densely rusty-brown tomentose* below; *elliptic* to *elliptic-obovate*, 8–14 × 5.5–7 cm, base cuneate, margin plane, apex acuminate with an obtuse tip, or rounded or retuse; midrib raised on both sides, stronger below; *lateral veins* 11–17 pairs, ascending at an angle of 75–80° from midrib, arching and joining to form vein-loops near leaf margin, obscure above, prominent below; *intercostal venation* descending from leaf margin and parallel to lateral veins, laxly reticulate-tessellate near leaf margin, obscure above, prominent below; petiole slender, 1.5–2.5 cm long, *terete*, slightly thickened and curved at base. **Inflorescences** axillary or in axils of leaf

scars, 3–12-flowered. **Flower:** sweet scented; *pedicel* angular, *c.* 1 cm long, to 0.5 cm thick in fruit, *densely tomentose*; *sepals* orbicular, 5–7 mm across, rusty-brown tomentose; *corolla* greenish cream, thick and fleshy, *c.* 8 mm long, *lobes* 8–10, *spathulate*, apex obtuse; stamens 16–20, *filaments* short and villous, anthers ovate-acute, extrorse; ovary ovoid, villous, 8-loculed, style glabrous. **Fruits** *subglobose*, *c.* 2.5 × 1.5 cm, 1-seeded, *densely rusty-brown tomentose*. **Seeds** laterally compressed, ellipsoid, 1.2 × 0.6–1 cm; testa thin, smooth; *scar* narrowly linear, *c.* 12 × 2 mm.

Vernacular name. Sarawak—*ketiau badas* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. Common and scattered throughout Sabah (e.g., *SAN* 27133 and *SAN* 32234) and Sarawak (e.g., *S* 8657, *S* 8855, *S* 12362, *S* 27679, and *S* 37629). Also known from Brunei (e.g., *BRUN* 952, *S* 5866, *S* 27679, *SAN* 17437, and *Sinclair* 10472) and Kalimantan.

Ecology. In transitional fringe forest behind sandy beach vegetation, peat swamp, lowland mixed dipterocarp, *kerangas*, and lower montane forests, at altitudes to 1400 m.

9. *Madhuca daemonica* (Van den Assem) Yii & P.Chai

(Latin, *daemon* = ghost, translation of a Malay word ‘*hantu*’; inference unknown)

Gard. Bull. Sing. 53 (2001) 344. **Basionym:** *Ganua daemonica* Van den Assem *l.c.* 394. **Type:** *Egar A 0932*, Borneo, Sarawak, Setapok FR (KEP).

Tree to 24 m tall, 50 cm diameter. **Bark** reddish brown mottled, with rows of light brown lenticels, smooth; inner bark reddish brown. **Twigs** slender, *terete*, finely marked with horizontal cracks, *glabrous*. **Stipules** *absent*. **Leaves** *well-spaced along twigs*, *subcoriaceous*, *glabrous on both surfaces*, drying reddish brown; elliptic, 6.5–14.5 × 3–6 cm, base cuneate, margin plane, apex acuminate with a sharp tip; midrib round and raised on both sides; *lateral veins* 14–20 pairs, *ascending at an angle of 75–80° from midrib*, *arching and joining to form vein-loops near leaf margin*, obscure above, prominent below; *intercostal venation descending from leaf margin and parallel to lateral veins*, laxly reticulate-tessellate near leaf margin, obscure above, prominent below; petiole slender, 1.6–2.5 cm long, subangular, thickened and black at base. **Inflorescences** axillary, 4–7-flowered. **Flowers:** pedicel 0.6–0.9 cm long, hairy; sepals ovate, *c.* 3 × 4 mm, silvery tomentose; *corolla* translucent white, *c.* 4 mm long, *lobes* 7–9, *lanceolate*, apex obtuse; stamens 12–16, *filaments* *c.* 2 mm long, villous, anthers *c.* 2 mm long, lanceolate; ovary ovoid, villous, style glabrous. **Fruits** *ovoid*, *c.* 1.2 × 0.9 cm, 1-seeded; pericarp thin, smooth. **Seeds** ellipsoid, 0.9 × 0.4–0.5 cm, acute at both ends; testa thin, smooth; *scar* narrowly linear, *c.* 7 × 2 mm.

Vernacular name. Sarawak—*ketiau hantu* (Malay).

Distribution. Endemic to Borneo. Uncommon and scattered throughout Sabah (e.g., *SAN* 17437, *SAN* 17448 and *SAN* 24305) and Sarawak (e.g., *S* 2618, *S* 4423, *S* 5866, *S* 14462, *S* 30039, and *S* 129965).

Ecology. In peat swamp, *kerangas* and mixed dipterocarp forests, at altitudes to 700 m.

10. *Madhuca dubardii* H.J.Lam.

(M.M.M. Dubard, 1873–1914, a French botanist)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 162, *l.c.* (1927) 444; Masamune *l.c.* 590; P. Royen *l.c.* (1960) 104; Whitmore, Tantra & Sutisna *l.c.* 319. **Type:** *Agama* 538, Borneo, Sabah (holotype BO; isotype K).

Tree to 16 m tall, 40 cm diameter. **Bark** reddish brown, smooth or scaly; inner bark dull brown. **Twigs** slender, *terete*, *rusty-brown hairy*, glabrescent. **Terminal buds** *c.* 7 mm long, hairy. **Stipules** *triangular*, *c.* 1×0.5 mm. **Leaves** *crowded at ends of twigs*, coriaceous, *glabrous above*, *greyish sericeous below*; lanceolate to obovate, $9\text{--}28 \times 3\text{--}8$ cm, base cuneate, *margin plane*, apex acuminate with a sharp tip; midrib broadly grooved and narrowly crested above, rounded and prominent below; *lateral veins* 16–25 pairs, ascending at an angle of $75\text{--}80^\circ$ from midrib, *diminishing and becoming inconspicuous toward leaf margin*, impressed above, prominent below; *intercostal venation reticulate*, *reticulate-tessellate near leaf margin*, indistinct on both sides; petiole 1.5–2.8 cm long, flat or shallowly grooved on adaxial side, rounded on abaxial side. **Inflorescences** axillary, 2–4-flowered. **Flowers:** pedicel angular, 1.6–2.4 cm long, greyish-brown hairy; sepals ovate, $6\text{--}7 \times 4\text{--}5$ mm, apex rounded, greyish hairy; corolla 10–12 mm long, 8-lobed, lobes lanceolate, obtuse; stamens 16, in two whorls, filaments *c.* 2 mm long, anthers *c.* 2 mm long, lanceolate; ovary ovoid, rusty-brown hairy, style glabrous. **Fruits** ellipsoid, $2.3\text{--}3 \times 1.2\text{--}1.5$ cm, 1-seeded, acute at both ends; pericarp fleshy, greyish-brown hairy. **Seeds** ellipsoid, $1.5 \times 0.6\text{--}0.8$ cm, acute at both ends; testa thin, smooth; scar linear, *c.* 15×2 mm.

Vernacular name. Sabah—*manatu* (Dusun).

Distribution. Sumatra, Peninsular Malaysia, and Borneo. In Borneo, known from the east coast of Sabah (e.g., *SAN* 8873, *SAN* 16675, *SAN* 29694, *SAN* 39915, *SAN* 42958, and *SAN* 54486) and the east coast of Kalimantan.

Ecology. In lowland coastal mixed dipterocarp forest, at altitudes to 200 m.

11. *Madhuca elmeri* Merr. ex H.J.Lam

(A.D.E. Elmer, 1870–1942, plant collector in Sabah and the Philippines)

Bull. Jard. Bot. Buitenz. 3, 7 (1927) 460; Merrill *l.c.* (1929) 239; Masamune *l.c.* 590; P. Royen *l.c.* (1960) 21; Burgess *l.c.* 449; Whitmore, Tantra & Sutisna *l.c.* 319; Argent *et al.* (eds.) *l.c.* 577. **Lectotype** (P. Royen, 1960): *Elmer* 21172, Borneo, Sabah, Tawau (hololectotype PNH; isolectotypes BM, K, L, P, S, SING, U).

Tree to 20 m tall, 30 cm diameter. **Bark** dark greyish brown, smooth or scaly; inner bark brown. **Twigs** slender, subangular or ridged, *densely woolly-tomentose*, glabrescent. **Terminal buds** *c.* 6 mm long, hairy. **Stipules** *shield-shaped*, *c.* 6×2 mm, acute, glabrous. **Leaves** *crowded at ends of twigs*, subcoriaceous, *glabrous on both surfaces*, drying reddish brown; elliptic to elliptic-obovate, $13\text{--}29 \times 4\text{--}10$ cm, base cuneate, margin plane, apex abruptly acuminate; midrib grooved and narrowly crested above, rounded and prominent below; *lateral veins* 18–26 pairs, ascending at an angle of $65\text{--}75^\circ$ from midrib, *distinctly arching and joining to form intramarginal vein-loops rather far from leaf margin*, impressed above, prominent below; *intercostal venation scalariform*, with a few veins descending from leaf margin and parallel to lateral veins, distinct on both sides; petiole 2–3 cm long, flat or shallowly grooved on adaxial side, densely tomentose.

Inflorescences axillary or in axils of leaf scars, 2–5-flowered. **Flowers:** pedicel angular, 1.3–2 cm long, densely tomentose; *sepals ovate*, 6–7 × 4–5 mm, apex rounded, hairy; corolla *c.* 6 mm long, 7–9-lobed, lobes lanceolate, obtuse at apex; stamens 16–20, filaments subulate, *c.* 3 mm long, anthers *c.* 2 mm long, oblong; ovary globose, glabrous, style *c.* 10 mm long, glabrous. **Fruits** ellipsoid, 3 × 1.4–1.9 cm, 1-seeded, rounded at both ends; *pericarp fleshy*. **Seeds** ellipsoid, 2.2 × 0.6–1 cm, *pointed at both ends*; testa thin, smooth; scar linear, *c.* 21 × 5 mm.

Distribution. Endemic to Borneo and confined to the east coast of Sabah (e.g., *SAN A 2148*, *SAN 33026*, *SAN 40501*, *SAN 54486*, *SAN 63018*, *SAN 101296*, and *SAN 101346*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 200 m.

12. *Madhuca endertii* H.J.Lam

(F.H. Ender, 1891–1953, forester at the Forest Research Institute, Bogor, Indonesia)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 458; P. Royen *l.c.* (1960) 75. **Type:** *Ender 4455*, Borneo, Kalimantan, W Kutei, Kemul, Mt. Kong (holotype BO; isotypes K, L).

Tree to 30 m tall, 60 cm diameter. **Twigs** *slender, terete*, glabrous. **Terminal buds** *c.* 4 mm long. **Stipules** *ovate-lanceolate*, *c.* 2.5 × 1 mm, acute, pubescent, caducous. **Leaves** *well-spaced along twigs, coriaceous, glabrous on both surfaces*; ovate to elliptic-obovate, 5–13 × 3–6 cm, base cuneate and decurrent, margin plane, apex obtuse; midrib stout and prominent on both sides; *lateral veins 6–11 pairs, ascending at an angle of 45–55° from midrib, diminishing and becoming inconspicuous toward leaf margin* or rarely joined by thickened intercostal veins to form vein-loops near leaf margin, prominent on both sides; *intercostal venation laxly reticulate*, distinct on both sides; *petiole 0.5–2 cm long, glabrous, flat on adaxial side*. **Inflorescences** in axils of upper-most leaves, 1–3-flowered. **Flowers:** pedicel angular, 0.15–0.25 cm long, sparsely hairy or glabrous; sepals broadly ovate, *c.* 3 mm across, apex acuminate with an obtuse tip; corolla 7–10 mm long, 6–8-lobed, lobes oblong, apex rounded; stamens 16, in two whorls, filaments subulate, *c.* 2 mm long, villous, anthers oblong, villous, *c.* 2 mm long; ovary globose, *c.* 1.5 mm across, 6–7-loculed, glabrous, style slender, 1–2 mm long, glabrous. **Fruits** ellipsoid, 2.2–4.5 × 0.8–1 cm, 1-seeded, with remnant of style *c.* 2 cm long.

Distribution. Endemic to Borneo. Common in montane forest at Mt. Kinabalu, Sabah (e.g., *RSNB 4087*, *RSNB 4328*; *SAN 24508*, *SAN 32428*, *SAN 56367*, and *SAN 66815*) and Mt. Pueh, Sarawak (e.g., *Stevens 630*). Also occurs in Kalimantan.

Ecology. In lower to upper montane forest, at 1300–3700 m altitudes.

13. *Madhuca engkikiana* Yii & P.Chai

Fig. 7.

(Engkik Soepadmo, Coordinator and Chief Editor of the Tree Flora of Sabah and Sarawak project)

Gard. Bull. Sing. 53 (2001) 345. **Type:** *Kodoh SAN 83612*, Borneo, Sabah, Sandakan, Telupid (holotype SAR; isotypes AA, K, KEP, L, SAN, SING).

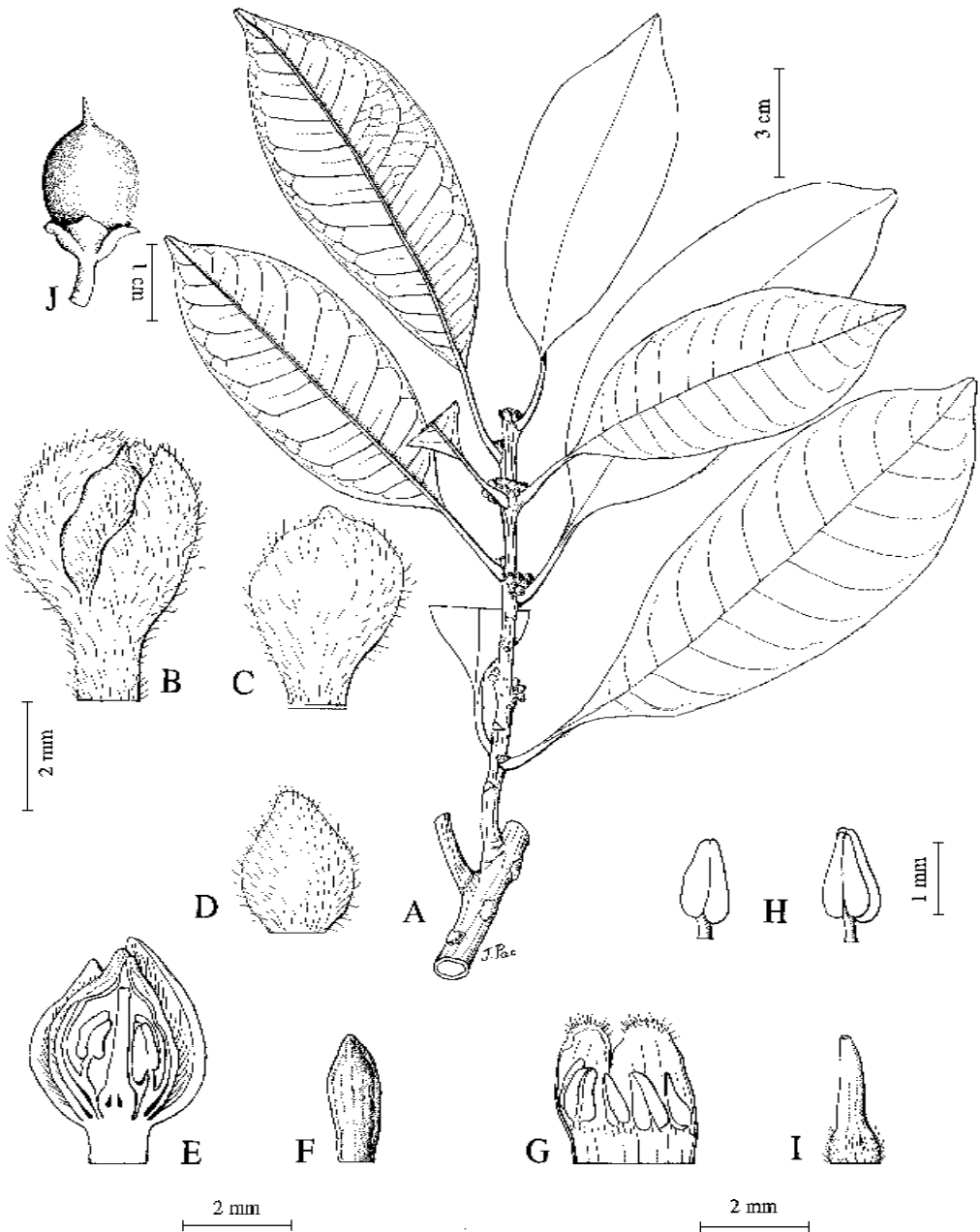


Fig. 7. *Madhuca engkikiana*. A, flowering leafy twig; B, flower bud; C, outer sepal; D, inner sepal; E, longitudinal section of flower bud; F, petal; G, petals and stamens; H, stamens in different views; I, pistil; J, fruit. (A–I from SAN 83612, J from SAN 131963.)

Tree to 25 m tall, 42 cm diameter. **Bark** reddish grey; inner bark yellowish red. **Sapwood** yellow. **Twigs** slender, *terete*, *glabrous*. **Terminal buds** *c.* 3 mm long, puberulous. **Stipules** *triangular*, *c.* 1×0.4 mm. **Leaves** *well-spaced along twigs*, *coriaceous*, *glabrous on both surfaces*; elliptic to elliptic-obovate, $9\text{--}13 \times 3.5\text{--}4.8$ cm, base cuneate, slightly decurrent and oblique, margin plane, apex short-acuminate; midrib raised on both sides; *lateral veins 11–15 pairs*, *ascending at an angle of *c.* 80° from midrib*, *distinctly connected by thickened intercostal veins to form intramarginal vein-loops*, *prominent on both sides*; *intercostal venation reticulate*, with a few veins arising from midrib and parallel to lateral veins; *petiole 2–3.5 cm long*, *flat or slightly raised on adaxial side*, thickened, black and puberulous at base. **Inflorescences** axillary, 6–8-flowered. **Flowers**: pedicel to 0.3 cm long, yellowish appressed-hairy; sepals suborbicular, *c.* 3×2.5 mm, tufted hairy at apex; corolla *c.* 2 mm long, tube *c.* 0.7 mm long, lobes 7, oblanceolate, densely pubescent with tufted yellowish hairs at apex; *stamens 16*, in two whorls, *filaments very short*, anthers lanceolate, *c.* 1×0.5 mm, slightly hairy; *ovary subconical*, *c.* 2 mm long, *hairy*, 6–7-loculed, style stout, *c.* 1.5 mm long. **Fruits** (young) *ellipsoid*, laterally compressed, $1.5 \times 0.6\text{--}1.2$ cm, *densely brownish-tomentose*. **Seeds** laterally compressed, pointed at both ends; testa thin, smooth; scar linear.

Distribution. Endemic to Borneo. Only known from four collections from Sabah (*SAN 131963*, *SAN 53982*, *SAN 54205*, and the type).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 250 m.

14. *Madhuca engleri* (Merr.) Vink

(H.G.A. Engler, 1844–1930, a prominent German botanist)

TFSS 4, App. (2002) 355. **Basionym:** *Payena beccarii* Engl., Bot. Jahrb. Syst. 12 (1890) 508, *nom. illeg.*, *non Payena beccarii* Pierre, Bull. Mens. Soc. Linn., Paris (1885) 525; *Payena engleri* Merr. *l.c.* (1921) 477, *l.c.* (1929) 477. **Type:** *Beccari PB 1598*, Borneo, Sarawak, Kuching (holotype FI; isotypes K, P). **Synonym:** *Madhuca beccarii* (Engl.) H.J.Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 177, P. Royen *l.c.* (1960) 52, Anderson *l.c.* 316, Whitmore, Tantra & Sutisna *l.c.* 318.

Tree to 35 m tall, 50 cm diameter. **Twigs** slender, *terete*, *covered with persistent appressed yellowish-brown indumentum*. **Terminal buds** *c.* 3 mm long, rusty-brown hairy. **Stipules** lanceolate, *c.* 3×1.5 mm, caducous. **Leaves** *well-spaced along twigs*, *chartaceous to subcoriaceous*, *sparsely yellowish-brown appressed tomentose on both sides*; narrowly elliptic to elliptic-obovate, $7\text{--}16 \times 3.5\text{--}6.5$ cm, base narrowly cuneate, margin entire and plane, apex acuminate or subcaudate; midrib broadly raised on both sides; *lateral veins 5–9 pairs*, *ascending at an angle of 35–45° from midrib*, *diminishing and becoming inconspicuous toward leaf margin*, prominent on both sides; *intercostal venation* slender, *scalariform*, distinct on both sides; petiole 1–2 cm long, flat on adaxial side, thickened at base, sparsely tomentose. **Inflorescences** axillary or in axils of leaf scars, 2–4-flowered. **Flowers**: pedicel 0.6–0.9 cm long, sparsely tomentose; sepals ovate, $4\text{--}5 \times 3\text{--}5$ mm, acute; corolla *c.* 6 mm long, lobes 8, lanceolate; stamens 16, filaments very short, anthers oblong; ovary subconical, *c.* 1 mm across, 6–8-loculed, style filiform, glabrous. **Fruits** ellipsoid or obovoid, $2\text{--}2.5 \times 0.8\text{--}1.5$ cm, 1-seeded, obtuse; pericarp thin, glabrous. **Seeds** laterally compressed, ellipsoid, $1.5 \times 0.6\text{--}0.8$ cm; scar linear, *c.* 15×2 mm.

Vernacular names. Sarawak—*nyatoh padi* (Iban), *nyatoh putih* (Malay).

Distribution. Endemic to Borneo. Only known from Keningau district in Sabah (e.g., *SAN 32450*, *SAN 62914*, *SAN 109956*, and *SAN 118452*) and from Semengoh FR in Sarawak (e.g., *S 215*, *S 1024* and *S 15402*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 200 m.

Uses. The timber is used in heavy construction.

15. *Madhuca erythrophylla* (King & Gamble) H.J.Lam

(Greek, *erythro-* = red, *phullon* = leaves; the reddish or rusty-brown indumentum of the leaves)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 170, *l.c.* (1927) 453; Ridley *l.c.* (1925) 320; P. Royen *l.c.* (1960) 52; Ng *l.c.* 405; Turner *l.c.* 463. **Basionym:** *Bassia erythrophylla* King & Gamble *l.c.* 188, Ridley *l.c.* (1923) 272. **Type:** *Curtis 3652*, Peninsular Malaysia, Penang (holotype SING; isotype K).

Tree to 20 m tall, 30 cm diameter. **Bark** dark brown, smooth; inner bark reddish brown. **Twigs** stout, irregularly ridged, rusty-brown woolly-tomentose, glabrescent. **Terminal buds** to 10 mm long, densely rusty-brown tomentose. **Stipules** linear, *c.* 10 × 1 mm, rusty-brown tomentose, caducous. **Leaves** crowded at ends of twigs, coriaceous, rusty-brown tomentose on both surfaces, glabrescent, drying reddish brown; elliptic, oblong or obovate, 11–20 × 5–8 cm, base broadly cuneate, slightly oblique, margin plane, apex rounded or acuminate with an obtuse tip; midrib broadly grooved and crested above, round and prominent below; lateral veins 8–13 pairs, stout, ascending at an angle of 70–80° from midrib, diminishing and becoming inconspicuous toward leaf margin, prominent on both sides; intercostal venation densely reticulate, prominent on both sides; petiole 3.5–7 cm long, grooved on adaxial side, round on abaxial side, slightly thickened at base, hairy. **Inflorescences** axillary, 5–6-flowered. **Flowers:** pedicel stout, angular, 1.5–2.5 cm long, densely rusty-brown woolly-tomentose; sepals orbicular, 5–7 mm across, crested; corolla 8–9 mm long, lobes 8, lanceolate, obtuse at apex; stamens 16–18, filaments *c.* 4 mm long, subulate, anthers *c.* 4 mm long, sagittate; ovary *c.* 2 mm across, 8-loculed, hairy, style *c.* 2 mm long, glabrous. **Fruits** subglobose, *c.* 1.2 × 1 cm, 1-seeded, rounded at both ends; pericarp fleshy, densely yellowish-brown tomentose. **Seeds** ellipsoid, 0.9 × 0.5–0.7 cm, pointed at both ends; testa thin, glabrous; scar linear, *c.* 7 × 4 mm.

Distribution. Peninsular Malaysia, Sumatra (Lingga Is.) and Borneo. In Borneo, only known from the Semengoh FR in Sarawak (e.g., *S 8913*, *S 14991*, *S 15135*, *S 15191*, *S 44096*, and *Sinclair 10302*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 100 m.

16. *Madhuca fusca* (Engl.) Forman

(Latin, *fuscus* = very dark brown; the indumentum)

Fig. 8.

In Coode *et al.* (eds.), CLBD (1996) 439. **Basionym:** *Illipe fusca* Engl. *l.c.* 510. **Type:** *Beccari PB 3503*, Borneo, Sarawak, Kuching (holotype FI; isotypes L, S). **Synonym:** *Ganua fusca* (Engl.) Merr. *l.c.* (1921) 478, H.J. Lam *l.c.* (1925) 120, *l.c.* (1927) 424, Van den Assem *l.c.* 373.

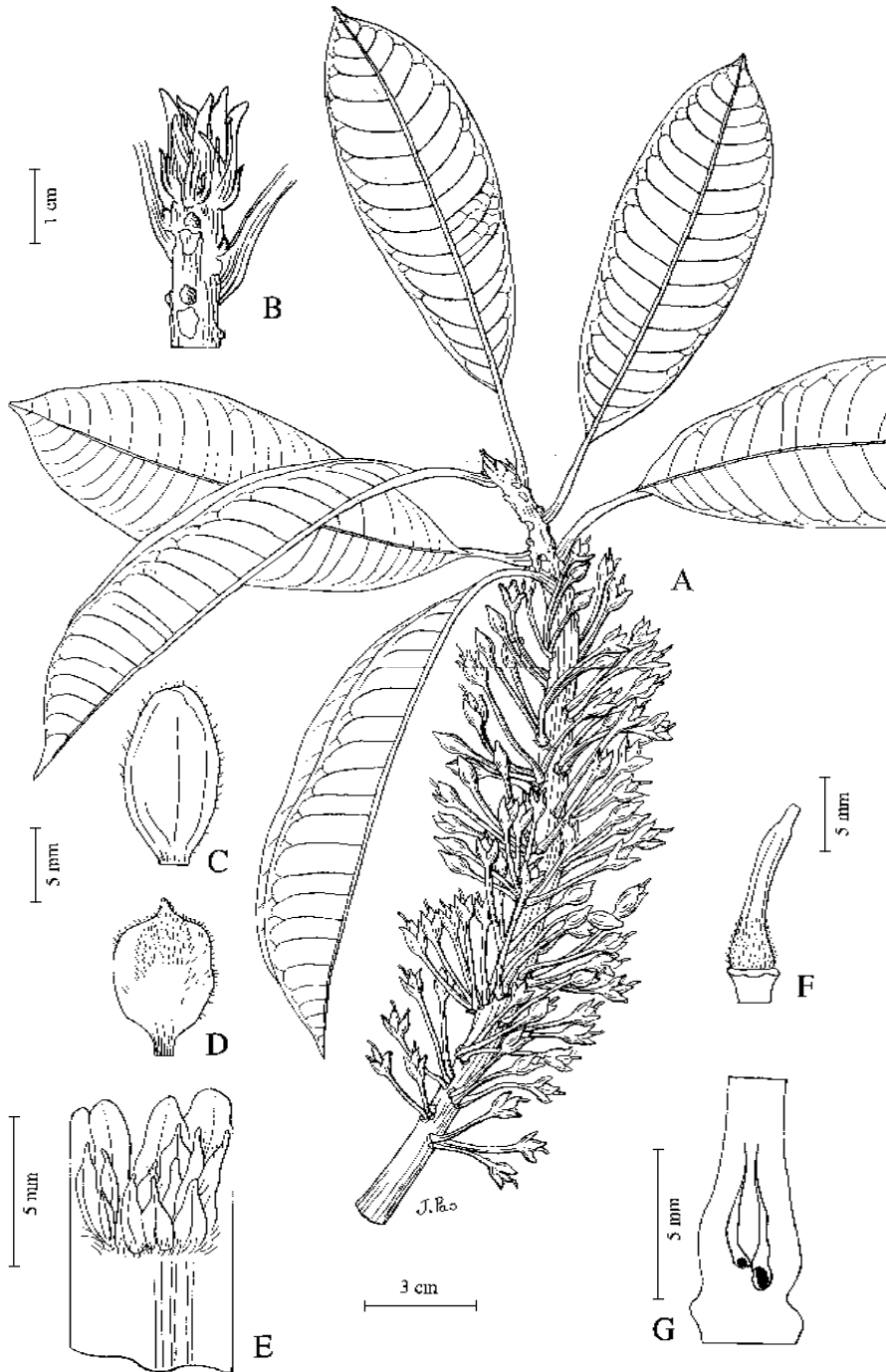


Fig. 8. *Madhuca fusca*. A, flowering leafy twig; B, terminal bud; C, outer sepal; D, inner sepal; E, perianth lobes and stamens; F, pistil; G, longitudinal section of ovary. (All from Beccari PB 3503.)

Tree. **Terminal buds** to 14×5 mm, with conspicuous bud-scales, sparsely tomentose, glabrescent. **Stipules** $5\text{--}7 \times 1$ mm. **Leaves** crowded at ends of twigs, coriaceous, glabrous above, densely rusty-brown tomentose below; elliptic to ovate, $11\text{--}15 \times 4.5\text{--}6$ cm, base broadly cuneate, margin plane, apex short-acuminate; midrib impressed above, prominent below; lateral veins 12–16 pairs, ascending at an angle of $70\text{--}80^\circ$ from midrib, arching and joining to form intramarginal vein-loops, prominent on both sides; intercostal venation descending from leaf margin and parallel to lateral veins, reticulate-tessellate near leaf margin, inconspicuous on both sides; petiole 2.5–3.5 cm long, adaxial side narrowly grooved at upper part and flat at lower part, base thickened, rusty-brown tomentose. **Inflorescences** axillary or in axils of leaf scars close to leafy parts of twigs, 2–11-flowered. **Flowers:** pedicel 2.2–2.7 cm long, densely rusty-brown tomentose; sepals ovate, *c.* 8×5 mm, apex acute; corolla tube funnel-shaped, glabrous inside, lobes 8, oblong, rounded at apex; stamens 16, filaments short, villous, anthers pilose, mucronate; ovary ovoid, densely rusty-brown hairy at base, 8-loculed, style blunt, glabrous. **Fruits** unknown.

Distribution. Endemic to Borneo. In Sarawak, uncommon, only known by the type collection from the vicinity of Kuching. Also occurs in Brunei (e.g., *BRUN* 462).

Ecology. In *kerangas* forest on sandstone ridge, at altitudes to 300 m.

17. *Madhuca glabrescens* H.J.Lam

(Latin, *glabrescens* = becoming glabrous; the leaves)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 180, *l.c.* (1927) 462; Masamune *l.c.* 591; P. Royen *l.c.* (1960) 34; Whitmore, Tantra & Sutisna *l.c.* 320. **Type:** *Nieuwenhuis* 652, Borneo, Kalimantan, Sg. Magne (holotype BO).

Tree to 20 m tall, 40 cm diameter. **Bark** reddish brown, scaly; inner bark dull orange. **Twigs** slender, terete, greyish tomentose, glabrescent. **Terminal buds** *c.* 1.5 mm long, greyish tomentose. **Stipules** broadly ovate, *c.* 1×0.5 mm, acute, greyish tomentose, caducous. **Leaves** crowded at ends of twigs, coriaceous, glabrous on both surfaces, waxy above; obovate or obovate-elliptic, $12\text{--}19 \times 4\text{--}7$ cm, base cuneate and slightly decurrent, margin plane, apex rounded or acuminate with an obtuse tip; midrib prominent and raised on both sides; lateral veins 12–16 pairs, ascending at an angle of $60\text{--}70^\circ$ from midrib, diminishing and becoming inconspicuous toward leaf margin, impressed above, prominent below; intercostal venation slender, laxly scalariform, distinct on both sides; petiole 1.5–3.0 cm long, grooved on adaxial side, rounded on abaxial side, thickened and rugose at base. **Inflorescences** axillary, 3–6-flowered. **Flowers:** pedicel slender, 0.7–1.5 cm long, villous; sepals broadly ovate, $4\text{--}5 \times 3\text{--}5$ mm, subacute, crested and villous; corolla *c.* 6 mm long, lobes 8–9, lanceolate, obtuse; stamens 18, filaments very short, densely woolly-tomentose, anthers *c.* 3 mm long, narrowly oblong-ovoid, villous; ovary globose, *c.* 1.5 mm across, 8-loculed, glabrous, style *c.* 5 mm long, glabrous. **Fruits** ellipsoid-oblong, $8\text{--}10 \times 2$ cm, laterally compressed, 1-seeded, acute at both ends; pericarp fleshy, densely yellowish-brown tomentose. **Seeds** laterally compressed, ellipsoid, $1.8 \times 0.5\text{--}0.8$ cm, pointed at both ends; testa thin, glabrous; scar broadly linear, *c.* 18×1.5 mm.

Vernacular names. Sarawak—*nyatoh daun licin* (Malay and Iban). Kalimantan—*maligalas* (Rongos).

Distribution. Endemic to Borneo. Common in Sabah (e.g., *SAN 3338*, *SAN 16009*, *SAN 27070*, *SAN 44684*, *SAN 71502*, *SAN 92354*, *SAN 118434*, and *SAN 129720*). Also occurs in Kalimantan.

Ecology. In primary lowland mixed dipterocarp forest.

18. *Madhuca hirtiflora* (Ridl.) H.J.Lam

(Latin, *hirtus* = hairy, *florus* = flower; with hairy flowers)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 160, in Ridley *l.c.* (1925) 319, *l.c.* (1927) 444; Ng *l.c.* 398; Turner *l.c.* 463. **Basionym:** *Bassia hirtiflora* Ridl. *l.c.* (1923) 266. **Type:** *Md. Haniff & Md. Nur 6949*, Peninsular Malaysia, Perak, Sg. Siput (holotype SING). **Synonym:** *Ganua hirtiflora* (Ridl.) P.Royen *l.c.* (1960) 112, Ng *l.c.* 398, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 317.

Tree to 15 m tall, 15 cm diameter. **Bark** greyish brown, smooth or scaly; inner bark dull orange. **Twigs** stout, *ridged or angular, densely woolly-tomentose on nodes*. **Terminal buds** 12–15 mm long, greyish woolly-pilose. **Stipules lanceolate**, *c. 12 × 5 mm*, acute, crested, greyish pilose. **Leaves crowded at ends of twigs**, coriaceous, *glabrous on both surfaces*, drying reddish brown; *broadly obovate*, 17–34 × 7.5–15 cm, base cuneate and slightly decurrent, *margin erose (gnawed)*, apex acuminate with an obtuse tip or rounded; midrib shallowly grooved and broadly crested above, stout and prominent below; *lateral veins 19–25 pairs*, ascending at an angle of 80–90° from midrib, *joined by thickened intercostal veins to form intramarginal vein-loops*, prominent on both sides; *intercostal venation densely reticulate-tessellate*, distinct above, prominent below; *petiole 5–8 cm long*, flat or broadly grooved on adaxial side, thickened and rugose at base, glabrous. **Inflorescences** in axils of leaf scars, 4–6-flowered. **Flowers:** pedicel stout, 0.5–1 cm long, densely greyish-tomentose; *sepals oblanceolate*, *c. 10 × 6 mm*, acute, crested, pilose; corolla *c. 12 mm long*, lobes 8, lanceolate, obtuse; stamens 15–18, filaments *c. 7 mm long*, anthers *c. 8 mm long*, oblong-ovoid; ovary globose, *c. 2 mm across*, 8-loculed, glabrous; style twice as long as corolla. **Fruits ellipsoid**, *c. 2.5 × 1 cm*, greyish pilose. **Seeds** unknown.

Vernacular name. Sarawak—*nyatoh kusta* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sarawak, uncommon and only known from the Semengoh FR (e.g., *S 3375*, *S 37978*, *S 40533*, and *Pennington 10264*). Also occurs in Kalimantan.

Ecology. In lowland mixed dipterocarp forest on sandy loam soils, at altitudes below 150 m.

19. *Madhuca kingiana* (Brace ex King & Gamble) H.J.Lam

(Sir George King, 1840–1909, British botanist and sometimes superintendent of the Calcutta Botanic Gardens, India)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 159; Ridley *l.c.* (1925) 319; Pennington *l.c.* 157; PROSEA *l.c.* 289; Kessler & Sidiyasa *l.c.* 213; Turner *l.c.* 463; Coode *et al.* (eds.) *l.c.* 306. **Basionym:** *Bassia kingiana* Brace ex King & Gamble *l.c.* 178, Ridley *l.c.* (1923) 267. **Lectotype** (P. Royen, 1960): *King's Collector 3314*, Peninsular Malaysia, Perak, Larut (hololectotype SING). **Synonyms:** *M. glaberrima* H.J.Lam *l.c.* (1925) 263, Merrill *l.c.* (1929) 239; *Ganua glaberrima* (H.J.Lam) H.J.Lam *l.c.* (1927) 428, Masamune *l.c.* 588;

G. kingiana (Brace ex King & Gamble) Van den Assem *l.c.* 373, P. Royen *l.c.* (1960) 112, Ng *l.c.* 399, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 316.

Tree to 20 m tall, 20 cm diameter. **Bark** greyish brown, smooth or scaly; inner bark brown. **Twigs** stout, subangular, rusty-brown hairy, glabrescent. **Terminal buds** *c.* 10 mm long. **Stipules** triangular, 5–10 × 4–8 mm, crested outside, rusty-brown hairy. **Leaves** crowded at ends of twigs, coriaceous, glabrous on both surfaces; oblong or oblanceolate, 18–33 × 6–13 cm, base broadly cuneate and slightly oblique, margin plane, apex short-acuminate; midrib grooved and narrowly crested above, round and prominent below; *lateral veins* 18–30 pairs, ascending at an angle of 75–85° from midrib, arching and joining into a smooth intramarginal vein, impressed above, prominent below; *intercostal venation* densely scalariform, prominent on both sides; petiole 3.5–5 cm long, grooved on adaxial side, thickened and rugose at base, glabrous. **Inflorescences** in axils of leaf scars, 3–6-flowered. **Flowers:** pedicel stout, 0.5–0.9 cm long, densely rusty-brown tomentose; sepals broadly ovate, *c.* 10 × 8 mm, subacute, crested; corolla *c.* 12 mm long, lobes 12–16, lanceolate, obtuse; stamens 24–36, filaments *c.* 7 mm long, anthers *c.* 8 mm long, oblong-ovoid; ovary globose, *c.* 2 mm across, 8–10-loculed, glabrous, style twice as long as corolla. **Fruits** subglobose or broadly ellipsoid, 2–2.5 × 1–1.5 cm, 1-seeded, rusty-brown tomentose; stalk to 3 cm long; pericarp fleshy. **Seeds** ellipsoid, *c.* 1.5 × 1 cm, pointed at both ends; testa glabrous, brown; scar oblanceolate, *c.* 15 × 1 mm, covering about one third of seed surface.

Vernacular name. Sabah—*nyatoh king* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, common and scattered throughout Sabah (e.g., *SAN 15375*, *SAN 16824*, *SAN 37922*, *SAN 76018*, *SAN 95187*, and *SAN 129720*) and Sarawak (e.g., *S 10298*, *S 14963*, *S 29460*, *S 37987*, and *S 46553*). Also occurs in Brunei (e.g., *BRUN 3317*) and Kalimantan.

Ecology. In lowland mixed dipterocarp forest, at altitudes below 150 m.

20. *Madhuca korthalsii* (Pierre ex Burck) H.J.Lam

(P.W. Korthals, 1807–1892, a Dutch botanist)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 168 & 264, *l.c.* (1927) 449; Ridley *l.c.* (1925) 320; Masamune *l.c.* 591; P. Royen *l.c.* (1960) 87; Burgess *l.c.* 449; Ng *l.c.* 406; Anderson *l.c.* 316; Whitmore, Tantra & Sutisna *l.c.* 320; Pennington *l.c.* 157; PROSEA *l.c.* 289; Turner *l.c.* 463; Argent *et al.* (eds.) *l.c.* 577. **Basionym:** *Bassia korthalsii* Pierre ex Burck, Ann. Jard. Bot. Buitenz. 5 (1885) 45. **Type:** *Korthals s.n.*, Sumatra (holotype L; isotype BO). **Synonyms:** *Illipe korthalsii* (Pierre ex Burck) Engl. *l.c.* 509; *Vidoricum korthalsii* (Pierre ex Burck) Kuntze, Revis. Gen. Pl. 2 (1891) 407; *Bassia braceana* King & Gamble *l.c.* 184, Ridley *l.c.* (1923) 270; *Kakosmanthus korthalsii* (Pierre ex Burck) Pierre ex Dubard, Rev. Gen. Bot. 20 (1908) 198.

Tree to 35 m tall, 50 cm diameter. **Bark** light to dark brown, scaly to flaky; inner bark reddish orange. **Twigs** slender, terete or subangular, greyish velvety-hairy, glabrescent. **Terminal buds** 1.5–2 mm long. **Stipules** triangular, *c.* 2 × 1 mm, acute and crested, velvety hairy, more or less persistent. **Leaves** well-spaced along twigs, coriaceous, glabrous on both surfaces, drying dull blackish-brown below; elliptic or elliptic-obovate, 9–24 × 6–10 cm, base cuneate, slightly decurrent and oblique, margin plane, apex rounded or acuminate with an obtuse tip; midrib flat or slightly raised above, rounded and prominent below; *lateral veins* 11–18 pairs, ascending at

an angle of 60–70° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, raised and prominent above, stronger below; *intercostal venation* slender, *laxly scalariform*, distinct on both sides; *petiole* 1.5–4 cm long, narrowly grooved on adaxial side, round on abaxial side, thickened, rugose and *puberulous at base*. **Inflorescences** axillary or on warts scattered along branchlets, 2–5-flowered. **Flowers:** pedicel slender, 0.6–1.5 cm long, greyish velvety; sepals ovate, *c.* 5 × 4 mm, greyish velvety; *corolla* white, *c.* 6 mm long, lobes 8, ovate; *stamens* 18, rusty-brown hirsute, filaments *c.* 1.5 mm long, *anthers oblong-ovoid*, *c.* 2 mm long; ovary ovoid, *c.* 1.5 mm across, 8-loculed; style *c.* 10 mm long, glabrous. **Fruits** ellipsoid, 2–3 × 1–2 cm, 1-seeded; pericarp fleshy and glabrous. **Seeds** laterally compressed, ellipsoid, 1.8 × 0.5–0.8 cm, pointed at both ends; testa thin, glabrous; scar linear, *c.* 18 × 1.5 mm.

Vernacular name. Sarawak—*kayu pak-peting* (Punan).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, common and scattered throughout Sabah (e.g., *SAN 20101*, *SAN 42567*, *SAN 55520*, *SAN 88748*, *SAN 118732*, and several others) and Sarawak (e.g., *S 3438* and *S 39493*). Also occurs in Kalimantan.

Ecology. In primary lowland mixed dipterocarp forest, at altitudes to 600 m.

21. *Madhuca kuchingensis* Yii & P.Chai

(of Kuching, Sarawak)

Gard. Bull. Sing. 53 (2001) 344. **Type:** *Beccari PB 2241*, Borneo, Sarawak, Kuching (holotype FI; isotype L). **Synonym:** *Ganua beccarii* Pierre ex Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 408, H.J. Lam *l.c.* (1925) 130, *l.c.* (1927) 429, Masamune *l.c.* 588, Van den Assem *l.c.* 380, Anderson *l.c.* 315.

Tree to 20 m tall, 30 cm diameter. **Bark** greyish brown, smooth to scaly; inner bark dull orange. **Twigs** slender, terete, *rusty-brown velvety-hairy*, glabrescent. **Terminal buds** *c.* 2 mm long, hairy. **Stipules** *c.* 2 × 1 mm, velvety hairy, caducous. **Leaves** crowded at ends of twigs, subcoriaceous, *glabrous on both surfaces*; *elliptic to oblong-elliptic*, 10–17 × 3–5 cm, base narrowly cuneate and slightly decurrent, margin plane, apex acuminate, acumen *c.* 10 mm long; midrib prominently raised on both sides; *lateral veins 11–13 pairs*, ascending at an angle of 60–70° from midrib, *arching and joined by thickened intercostal veins to form intramarginal vein-loops*, slender and faintly impressed above, prominent below; *intercostal venation* slender, *densely reticulate*, with few veins descending from leaf margin and parallel to lateral veins, faintly impressed above, distinct below; *petiole 2–3 cm long*, flat or slightly crested on adaxial side, round on abaxial side. **Inflorescences** axillary, *5–8-flowered*. **Flowers:** pedicel slender, 0.6–1 cm long, appressed hairy; sepals suborbicular, 4–5 mm across, subacute; *corolla* 3–4 mm long, lobes 8, lanceolate, obtuse; *stamens* 16, in two whorls, pilose, filaments very short, anthers *c.* 1 mm long, oblong; ovary globose, *c.* 1.5 mm across, 8-loculed, pilose; style *c.* 8 mm long, glabrous. **Fruits** laterally compressed, ellipsoid, 2 × 0.8–1 cm, 1-seeded, acute at both ends; pericarp thin, densely yellowish tomentose. **Seeds** laterally compressed, ellipsoid, 1.8 × 0.5–0.8 cm, pointed at both ends; testa thin and glabrous; scar linear, *c.* 18 × 1.5 mm.

Distribution. Endemic to Borneo and confined to the central and western parts of Sarawak (e.g., *S 3356*, *S 4307*, *S 14846*, *S 24344*, *S 27064*, and *S 32394*).

Ecology. In primary lowland *kerangas* and mixed dipterocarp forests, at altitudes to 100 m.

22. *Madhuca lancifolia* (Burck) H.J.Lam

(Latin, *lanci-* = lance-shaped, *folium* = leaf; with lanceolate leaves)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 158, *l.c.* (1927) 444; Ridley *l.c.* (1925) 319; Masamune *l.c.* 591; P. Royen *l.c.* (1960) 18; Whitmore, Tantra & Sutisna *l.c.* 320; Argent *et al.* (eds.) *l.c.* 578. **Basionym:** *Payena lancifolia* Burck, Med.'s Lands Pl. Buitenz. 3 (1886) 41. **Type:** *Teijsmann 8648*, Borneo, Kalimantan, Sintang (holotype BO; isotypes K, L).

Tree to 14 m tall, 15 cm diameter. **Bark** brown, slightly flaky; inner bark reddish brown, soft. **Twigs** stout, *subangular*, *densely rusty-brown tomentose*. **Terminal buds** to 10 mm long. **Stipules lanceolate**, *c.* 9 × 2 mm, pubescent, caducous. **Leaves well-spaced along twigs, coriaceous**, dark glossy green above, *densely golden-brown pubescent below*; lanceolate or elliptic-oblong, 15–55 × 5.5–15 cm, base broadly cuneate and decurrent, margin plane, apex obtuse or acuminate with pointed tip; midrib broadly grooved and narrowly crested above, prominent below; *lateral veins 22–50 pairs, ascending at an angle of 70–75° from midrib, arching and joining to form vein-loops near leaf margin, prominent on both sides*; *intercostal venation slender, scalariform*, with some veins descending from leaf margin and parallel to lateral veins, prominent above, stronger below; *petiole 3.5–7 cm long, broadly furrowed on adaxial side, round on abaxial side, thickened at base, pubescent, glabrescent*. **Inflorescences** axillary, 5–10-flowered. **Flowers:** pedicel angular, 1.2–1.6 cm long, densely tomentose; *sepals triangular, 5–7 mm long, acute; corolla c. 7 mm long, lobes 10–14, lanceolate; stamens 22–28, in 2 whorls, filaments subulate, c. 0.5 mm long, rusty-brown hirsute, anthers ovate-lanceolate, c. 2 mm long; ovary subconical, c. 3 mm long, 8–14-loculed, pilose, style clavate-subulate, 8–9 mm long*. **Fruits** unknown.

Vernacular names. Sarawak—*nyatoh beludu* (Iban). Brunei—*jangkar sakat* (Iban), *terkam balau* (Murut).

Distribution. Endemic to Borneo. Uncommon, only known by a few collections from Kinabatangan district in Sabah (e.g., *SAN 16864*), Semengoh FR in Sarawak (e.g., *Sinclair 10177*) and Brunei (e.g., *FMS 35476*).

Ecology. In lowland mixed dipterocarp forest, in marshy habitats along streams and gullies.

23. *Madhuca malaccensis* (C.B.Clarke) H.J.Lam

(of Malacca, Peninsular Malaysia)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 167, *l.c.* (1927) 449; Ridley *l.c.* (1925) 319; Merrill *l.c.* (1929) 239; Masamune *l.c.* 591; P. Royen *l.c.* (1960) 44; Ng *l.c.* 407; Whitmore, Tantra & Sutisna *l.c.* 320; PROSEA *l.c.* 291; Turner *l.c.* 464; Argent *et al.* (eds.) *l.c.* 578. **Basionym:** *Payena malaccensis* C.B.Clarke in Hooker *f.*, Fl. Brit. Ind. 3 (1882) 547. **Type:** *Griffith 3610*, Peninsular Malaysia, Malacca (holotype K). **Synonyms:** *Bassia malaccensis* (C.B.Clarke) King & Gamble *l.c.* 180, Ridley *l.c.* (1923) 268; *Dasyaulus malaccensis* (C.B.Clarke) Dubard, Rev. Gen. Bot. 20 (1908) 201.

Tree to 25 m tall, 45 cm diameter. **Bark** greyish brown, smooth to scaly; inner bark reddish brown. **Twigs** stout, subangular, rusty-brown velvety hairy at tips. **Terminal buds** to 5 mm long, velvety hairy. **Stipules** minute, lanceolate, caducous. **Leaves** well-spaced along twigs, coriaceous, glabrous on both surfaces; obovate to elliptic-obovate, 13–32 × 6.5–15 cm, base cuneate to broadly cuneate, margin plane, apex obtuse or acuminate with a sharp tip; midrib broad and prominent on both sides; lateral veins 11–17 pairs, ascending at an angle of c. 60° from midrib, diminishing and becoming inconspicuous toward leaf margin, prominent on both sides; intercostal venation slender, scalariform-tessellate, distinct on both side, stronger below; petiole 2–5 cm long, broadly grooved on adaxial side, round on abaxial side, distinctly thickened at base, glabrous. **Inflorescences** axillary, rarely in axils of leaf scars, 4–8-flowered. **Flowers:** pedicel angular, c. 1.5 cm long, hairy; sepals ovate, 6–7 × 4–6 mm, subobtusate; corolla c. 12 mm long, lobes 10–12, elliptic-lanceolate; stamens 22–25, filaments subulate, 1–1.5 mm long, anthers sagittate, c. 3 mm long; ovary subconical, 4–6 mm long, 8-loculed, glabrous, style subulate. **Fruits** oblong-obovoid, 2–2.7 × 1.2–1.5 cm, 1-seeded, rounded at apex and crowned with a persistent style, base cuneate; pericarp thin and glabrous. **Seeds** oblong, c. 1.5 × 0.8 cm, acute at both ends; scar linear, up to 5 mm broad.

Vernacular name. Sabah—nyatoh kemayan (Malay).

Distribution. S Thailand, Sumatra (Bangka), Peninsular Malaysia, Singapore, and Borneo. In Borneo, restricted to the east coast of Sabah (e.g., SAN 24749, SAN 34881, SAN 54606, SAN 60872, and SAN 99999).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 50 m.

24. *Madhuca markleeana* Yii & P.Chai

Fig. 9.

(Mark Lee Hua Seng, Deputy Director of the Forestry Department, Sarawak)

Gard. Bull. Sing. 53 (2001) 347. **Type:** *Yii S 72728*, Borneo, Sarawak, Bt. Meluku (holotype SAR; isotypes K, KEP, L, SAN).

Tree to 15 m tall, 25 cm diameter, with very low buttresses. **Bark** chocolate brown with greyish green mottles, smooth to finely fissured; inner bark c. 4 mm thick, dull orange, granular. **Twigs** terete, rusty-brown velvety hairy at tips, glabrescent. **Terminal buds** to 8 mm long; bud-scales elliptic, 10–14 × 9–11 mm. **Stipules** lanceolate, c. 10 × 3 mm, velvety hairy, caducous. **Leaves** well-spaced along twigs, coriaceous, glabrous on both surfaces; lanceolate or oblong, 25–35 × 7–8 cm, base broadly cuneate and slightly oblique, margin plane, apex obtuse or acuminate with a sharp tip; midrib broadly crested above, prominent below; lateral veins 28–35 pairs, ascending at an angle of 75–85° from midrib, straight at first and then arching and joining at tips to form vein-loops rather far from leaf margin, impressed above, prominent below; intercostal venation slender, scalariform, with some veins descending from leaf margin and parallel to lateral veins, faint above, distinct below; petiole 1.5–2.5 cm long, flat on adaxial side, round on abaxial side, velvety hairy, glabrescent. **Inflorescences** axillary, 3–5-flowered. **Flowers:** pedicel subangular, 5–6 cm long, pale green, sparsely pubescent; sepals suborbicular, c. 10 × 14 mm, outer pair with recurved margin, inner pair smaller, margin not recurved, pubescent; corolla white, c. 12 mm long, lobes 8, lanceolate, 7–8 mm long, apex acute, tube c. 4 mm long, slightly pubescent at the throat; stamens 19, in 2 whorls, filaments subulate, c. 5 mm long, anthers sagittate, yellowish, c. 5 mm long; ovary disciform, c. 3 × 5 mm, 8-loculed, pilose, style filiform, pale green, tapering

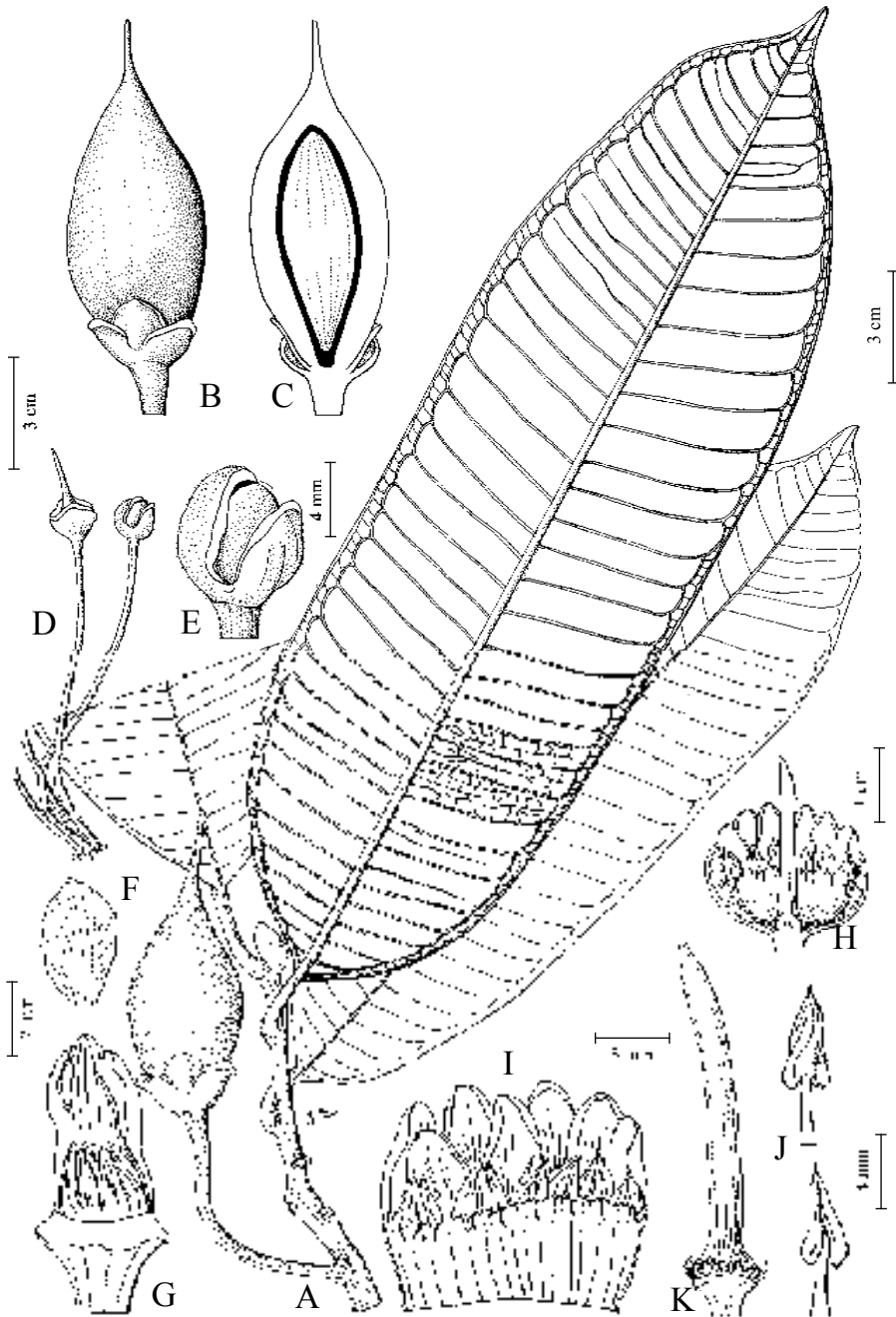


Fig. 9. *Madhuca markleeana*. A, fruiting leafy twig; B, fruit; C, longitudinal section of fruit; D, part of inflorescence; E, flower bud; F, petal; G, flower bud with sepals and a few petals removed; H, longitudinal section of flower bud; I, petals and stamens; J, stamens in different views; K, pistil. (A–C from *S* 72729, D–K from *S* 72728.)

towards stigma. **Fruits** ellipsoid, *c.* 7 × 4 cm, 1-seeded, tapering at both ends; pericarp thick and fleshy, green, densely brown tomentose; stalk 7–8 cm long. **Seeds** ellipsoid, 4.5 × 1.2–2 cm, pointed at both ends; testa thin and glabrous; scar narrowly linear, *c.* 43 × 3 mm.

Vernacular name. Sarawak—*nyatoh gasing* (Malay).

Distribution. Endemic to Borneo and confined to Sarawak; only known from the type collection and *S* 72729.

Ecology. Understorey tree on steep slopes of lowland mixed dipterocarp forest, at altitudes to 400 m.

25. *Madhuca mindanaensis* (Merr.) Merr.

(of Mindanao, the Philippines)

Enum. Philip. Fl. Pl. 3, 3 (1923) 277, *l.c.* (1929) 238; H.J. Lam *l.c.* (1925) 175, *l.c.* (1927) 455; Masamune *l.c.* 591; P. Royen *l.c.* (1960) 19; Burgess *l.c.* 449; Whitmore, Tantra & Sutisna *l.c.* 320. **Basionym:** *Bassia mindanaensis* Merr., Philip. J. Sci. Bot. 10 (1915) 58. **Type:** *Miranda* FB 17977, the Philippines, Mindanao (PNH†); **neotype** (P. Royen, 1960): *Elmer* 20596, Borneo, Sabah, Tawau, Elphinstone (holoneotype L; isoneotypes BM, K, P, SING, U).

Tree to 20 m tall, 25 cm diameter. **Bark** greyish brown, smooth to papery and scaly; inner bark dull orange. **Twigs** whitish, slender, terete or subangular, sparsely hairy, glabrescent. **Terminal buds** to 4 mm long. **Stipules** lanceolate or triangular, *c.* 8 mm long, hairy, caducous. **Leaves** well-spaced along twigs, chartaceous, glabrous on both surfaces; elliptic, obovate, or rarely oblanceolate, 14–28 × 3.5–10 cm, base cuneate and decurrent, margin plane, apex acuminate with a sharp tip; midrib grooved and broadly crested above, prominent and rounded below; lateral veins 9–17 pairs, ascending at an angle of 45–50° from midrib, arching and joining at tips to form vein-loops rather far from leaf margin, impressed above, stout and prominent below; intercostal venation slender, densely scalariform, faint above, distinct below; petiole 1–3 cm long, shallowly grooved on adaxial side, round on abaxial side, thickened and rugulose at base. **Inflorescences** axillary or on warts of leaf scars, 2–9-flowered. **Flowers:** pedicel slender, angular, 0.5–1.5 cm long, velvety hairy; sepals broadly ovate, 6–8 × 4–6 mm, greyish-yellow tomentose; corolla 9–11 mm long, lobes 8, oblanceolate, apex acute; stamens 15(–30), filaments subulate, *c.* 1.5 mm long, anthers sagittate *c.* 1 mm long; ovary disciform, *c.* 1 × 1.5 mm, 8-loculed, pilose, style filiform, 8–10 mm long. **Fruits** fusiform, 2–3.3 × 1–1.2 cm, 1-seeded, acute at both ends, drying black; pericarp thin and glabrous. **Seeds** ellipsoid, 2–2.7 × 0.6–0.8 cm, acute at both ends; testa thin, glabrous; scar narrowly linear, *c.* 10 × 3.5 mm.

Vernacular name. Sabah—*antagiras* (Dusun, Sandakan).

Distribution. Borneo and the Philippines. In Borneo, common in the east coast of Sabah (e.g., *SAN* 457, *SAN* 3426, *SAN* 19391, *SAN* 22666, and *SAN* 66689). Also occurs in Kalimantan (e.g., *Kostermans* 21702).

Ecology. Understorey trees of lowland mixed dipterocarp and riverine forest, at altitudes to 160 m.

26. *Madhuca montana* P.Royen(Latin, *montanus* = pertaining to mountain; confined to montane habitat)

Blumea 10 (1960) 76. **Type:** *Clemens 30861*, Borneo, Sabah, Mt. Kinabalu (holotype L; isotypes BM, K).

Tree to 33 m tall, 55 cm diameter. **Twigs** slender, brownish velvety, glabrescent. **Terminal buds** to 3 mm long. **Stipules** lanceolate-ovate, *c.* 2.5 × 1 mm, acute, velvety, caducous. **Leaves** well-spaced along twigs, coriaceous, densely hairy, glabrescent; elliptic or elliptic-obovate, 7–9 × 3–4 cm, base cuneate and decurrent, margin plane, apex obtuse; midrib broadly raised above, less prominent below; lateral veins 8–10 pairs, ascending at an angle of *c.* 60° from midrib, diminishing and becoming inconspicuous toward leaf margin, sometimes joined by thickened intercostal veins to form intramarginal vein-loops, obscure above, distinct below; intercostal venation laxly scalariform, usually more distinct above than below; petiole 0.8–1 cm long, flat on adaxial side, round on abaxial side, rugose. **Inflorescences** axillary, 1–3-flowered. **Flowers:** pedicel angular, 0.7–1.2 cm long, greyish hairy; sepals broadly ovate, *c.* 3 mm across, apex acute; corolla *c.* 3 mm long, lobes 8, oblong, apex rounded; stamens 16, villous, filaments subulate, *c.* 0.2 mm long, anthers oblong, *c.* 0.6 mm long; ovary disciform, *c.* 0.5 × 1 mm, glabrous, style stout and glabrous, *c.* 1 mm long. **Fruits** unknown.

Distribution. Endemic to Borneo. So far known only from Mt. Kinabalu in Sabah (e.g., *SAN 32317*, *SAN 33127* and *SAN 76524*) and G. Pueh in Sarawak (e.g., *S 46380*).

Ecology. In lower to upper montane forest, at altitudes to 4000 m.

27. *Madhuca monticola* (Merr.) Merr.(Latin, *monticolus* = mountain dweller; a species confined to montane habitat)

Enum. Philip. Fl. Pl. 3, 3 (1923) 227; H.J. Lam *l.c.* (1925) 180. **Basionym:** *Bassia monticola* Merr., Philip. J. Sci. Bot. 10 (1915) 56. **Type:** *Merrill 9622*, the Philippines, Palawan, Silanga (BM, L, NSW). **Synonym:** *Ganua monticola* (Merr.) H.J.Lam in Van den Assem *l.c.* 379.

Tree. **Twigs** glabrous, greyish, subangular, smooth or with warty inflorescence scars. **Terminal buds** *c.* 5 mm long. **Stipules** *c.* 2 mm long, caducous. **Leaves** crowded at ends of twigs, subcoriaceous, glabrous on both surfaces, drying reddish brown; oblong or oblong-lanceolate, 8.5–16 × 3–6.5 cm, base cuneate, margin plane, apex short-acuminate; midrib prominently raised on both sides; lateral veins slender, 13–18 pairs, ascending at an angle of 65–75° from midrib, arching and joining into a smooth vein near leaf margin, obscure above, distinct below; intercostal venation descending from leaf margin and parallel to lateral veins, laxly reticulate near leaf margin, obscure on both sides; petiole 1–3 cm long, broadly grooved on adaxial side, round on abaxial side, black and thickened towards base. **Inflorescences** in axils of leaf scars, 5–8-flowered. Fully developed flowers unknown; pedicel slender, 1.5–2.5 cm long, glabrous. **Fruits** ovoid to oblong-ovoid. **Seeds** unknown.

Distribution. Borneo and the Philippines. In Borneo, uncommon, only known by one collection (*Haviland & Hose 1261*) from the vicinity of Kuching in Sarawak.

28. *Madhuca motleyana* (de Vriese) J.F. Macbr.

(James D. Motley, ?–1859, engineer and plant collector, mainly in Borneo)

Contr. Gray Herb. Hav. Univ., NS. 53 (1918) 18; Ridley *l.c.* (1925) 320; Pennington *l.c.* 158; PROSEA *l.c.* 297; Kessler & Sidiyasa *l.c.* 213; Turner *l.c.* 464; Argent *et al.* (eds.) *l.c.* 578. **Basionym:** *Isonandra motleyana* de Vriese, Nat. Tijds. Ned. Ind. 21 (1860) 308. **Type:** Motley 857, Borneo, Kalimantan, Banjarmasin (holotype P; isotype L). **Synonyms:** *Sideroxylon glabrescens* Miq., Fl. Ind. Bat., Suppl. (1860) 44, King & Gamble *l.c.* 187, Ridley *l.c.* (1923) 271; *Bassia motleyana* (de Vriese) C.B. Clarke in Hooker *f.*, Fl. Brit. Ind. 3 (1882) 546; *Payena latifolia* Burck *l.c.* (1886) 58; *P. rubropedicellata* Burck *l.c.* 55; *P. bankensis* Burck *l.c.* 54; *Illipe motleyana* (de Vriese) Engl., Bot. Jahrb. 12 (1890) 509; *Ganua motleyana* (de Vriese) Pierre ex Dubard, Rev. Gen. Bot. 20 (1908) 202, Merrill *l.c.* (1921) 478, H.J. Lam *l.c.* (1925) 122, *l.c.* (1927) 424, Masamune *l.c.* 588, Van den Assem *l.c.* 382, Van den Assem & Kostermans *l.c.* 482, P. Royen *l.c.* (1960) 112, Ng *l.c.* 399, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 317.

Tree to 28 m tall, 50 cm diameter; sometimes with small buttresses or pneumatophores. **Bark** greyish brown, smooth to scaly; inner bark dull orange. **Twigs** stout, *terete*, *densely greyish-brown tomentose*. **Terminal buds** small, rusty-brown velvety hairy. **Stipules** *absent*. **Leaves** *well-spaced along twigs, thickly coriaceous*, glabrous above, *densely rusty-brown velvety tomentose below*, glabrescent; *ovate-elliptic*, rarely obovate, 6–11 × 3–6 cm, base broadly cuneate, margin plane, apex short-acuminate; midrib prominently raised on both sides; *lateral veins* 13–16 pairs, *ascending at an angle of c. 80° from midrib, arching and joining into vein-loops near leaf margin*, obscure above, distinct below; *intercostal venation descending from leaf margin and parallel to lateral veins*, reticulate-tessellate toward leaf margin, obscure above, prominent below; petiole subangular, 1.3–3 cm long, black at base. **Inflorescences** axillary, 3–12-flowered. **Flowers:** *pedicel* 0.8–1.5 cm long, *glabrous*; *sepals* *ovate, c. 4 mm long*, velvety hairy; *corolla* *c. 5 mm long, lobes* 8–10, *obovate*, velvety hairy; stamens 16–20, *filaments very short*, anthers shortly mucronate, *c. 1 mm long*; ovary elongated subconical, 6–8-loculed, style short, glabrous. **Fruits** *subglobose* or ellipsoid, *c. 2.5 × 1.5 cm, glabrous*, ripening yellow then reddish, 1-seeded. **Seeds** ellipsoid, 2 × 0.8–1 cm; testa glabrous; *scar* broadly lanceolate, *c. 18 × 4 mm*.

Vernacular name. Sabah and Sarawak—*ketiau paya* (Malay and Melanau).

Distribution. Peninsular Thailand, Sumatra (Riau, Belitung), Peninsular Malaysia and Borneo. Common and scattered throughout Sabah (e.g., SAN 354, SAN 26819, SAN 47858, SAN 66712, and SAN 80660) and Sarawak (e.g., S 22, S 3900, S 8402, S 13989, and S 34167). Also occurs in Brunei and Kalimantan.

Ecology. Widely distributed from coastal freshwater swamp and wet *kerangas* forests at sea level to hill mixed dipterocarp and sandstone *kerangas* forests at altitudes to 800 m.

Uses. *M. motleyana* produces moderately hard reddish *nyatoh* timber, suitable for making solid doors, cabinets and furniture. It also produces latex quite freely. The seeds produce *ketiau* fat, used by the local people for cooking and lighting.

29. *Madhuca multinervia* Yii & P. Chai

Fig. 10

(Latin, *multi-* = many, *nervis* = nerves; many-veined, the leaves)

Gard. Bull. Sing. 53 (2001) 349. **Type:** Dewol SAN 97008, Borneo, Sabah, Tongod, Bt. Pantagaluang (holotype SAR; isotypes BO, K, KEP, L, SAN, SING).

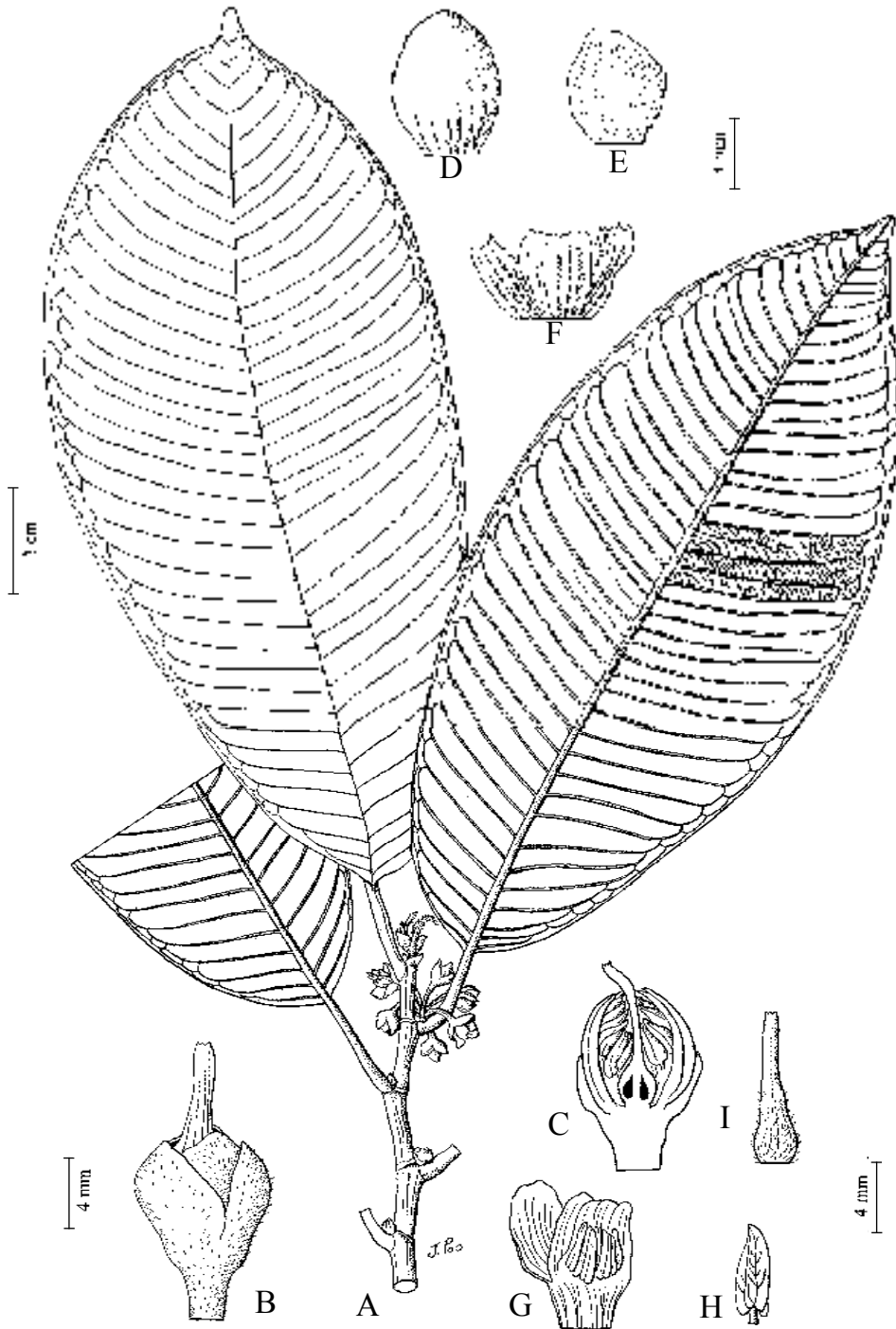


Fig. 10. *Madhuca multinervia*. A, flowering leafy twig; B, very young fruit; C, longitudinal section of flower bud; D, outer sepal; E, inner sepal; F, petals; G, part of flower with petals and stamens; H, stamen; I, pistil. (All from SAN 97008.)

Tree to 20 m tall, 40 cm diameter. **Bark** pale brown with greyish mottles, smooth; inner bark pale reddish. **Sapwood** white. **Twigs** slender, 2–4 mm diameter, subangular with distinct stipular scars, *rusty-brown velvety hairy at apex*, soon glabrescent and becoming blackish. **Terminal buds** c. 5 mm long. **Stipules** broadly ovate, c. 6×4 mm, truncate, rusty-brown velvety. **Leaves** well-spaced along ends of twigs, chartaceous to subcoriaceous, *glabrous on both surfaces or covered with remnants of scattered silvery hairs, especially on midrib below*; oblong-elliptic, 16.5–19 \times 5–12 cm, base obliquely cuneate to rounded, margin plane, apex obtuse; midrib impressed and slightly crested above, strongly prominent and rounded below; *lateral veins 28–45 pairs*, ascending at an angle of 65–80° from midrib, *arching and joining into vein-loops at 1–2 mm from leaf margin*, impressed above, prominent below; *intercostal venation scalariform*, faint; petiole 2–4 cm long, narrowly grooved on adaxial side, rounded on abaxial side, rugose and black at base, glabrous. **Inflorescences** axillary, 3–10-flowered. **Flowers**: pedicel 1–2 cm long, slender, velvety hairy; *sepals* in two whorls of 2, free, imbricate, *orbicular*, c. 6 mm across, velvety hairy, inner pair thinner, crested and hairy; corolla 8-lobed, 7–10 mm long, lobes elliptic or ovate, c. 3.5×1.5 mm, apex acute, densely hairy at the throat; stamens 16–24, in two or three whorls, filaments very short, anthers sagittate, c. 3.5 mm long; ovary subconical, c. 1 mm across, 8-loculed, glabrous or sparsely hairy, style c. 8 mm long, glabrous. **Fruits** ellipsoid, to 2.1 \times 1.2 cm, 1-seeded; *pericarp thin*, glabrous; stalk to 2 cm long. **Seeds** ellipsoid to obovoid, 1.8 \times 1.1 \times 0.8 cm, *obtuse at both ends*, testa glabrous; scar as long as seed, c. 5 mm wide.

Distribution. Endemic to Borneo. Scattered throughout the eastern part of Sabah (e.g., *SAN 88312*, *SAN 93874*, *SAN 96918*, *SAN 111764*, and *SAN 133478*).

Ecology. Usually on hillsides and ridges in primary lowland mixed dipterocarp forest.

30. *Madhuca oblongifolia* (Merr.) Merr.

Fig. 11.

(Latin, *oblongus* = much longer than broad, *folium* = leaf; with oblong leaves)

Enum. Philip. Fl. Pl. 3, 3 (1923) 277; H.J. Lam *l.c.* (1925) 166, *l.c.* (1927) 447; P. Royen *l.c.* (1960) 105. **Basionym:** *Bassia oblongifolia* Merr., Philip. J. Sci. 13 (1918) 323. **Type:** *Alambra FB 27101*, the Philippines, Luzon, Camarines Province (holotype PNH†; isotype K).

Tree to 19 m tall, 35 cm diameter. **Bark** greyish brown, flaky; inner bark dull orange. **Twigs** stout, angular, *greyish-brown velvety hairy*, glabrescent. **Terminal buds** greyish-brown velvety hairy, c. 5 mm long. **Stipules** lanceolate, c. 5×2 mm, rusty-brown velvety hairy. **Leaves** well-spaced along twigs, coriaceous, glabrous above, *densely covered with rusty-brown appressed tomentum beneath*; oblong to narrowly oblong-elliptic, (15–)20–30 \times (4–)6–13 cm, base cuneate, slightly decurrent, margin plane, apex short-acuminate; midrib slightly raised above, round and prominent below; *lateral veins 12–20 pairs*, ascending at an angle of 65–80° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, distinct on both sides; *intercostal venation scalariform*, or scalariform-tessellate near leaf base, obscure above, distinct below; petiole 1.2–4.5 cm long, flat or narrowly grooved on adaxial side, thickened at base. **Inflorescences** axillary, 3–10-flowered. **Flowers**: pedicel angular, 2–4 cm long; *sepals* broadly ovate, c. 9×7 mm, crested, acute; corolla c. 8–10 mm long, 8-lobed, lobes oblong, rounded at apex; stamens 16–22, filaments c. 1 mm long, anthers lanceolate, c. 4 mm long, hairy; ovary subconical, glabrous or puberulous, c. 2×1 mm, 8–9-loculed, style subulate, c. 6–7 mm long,

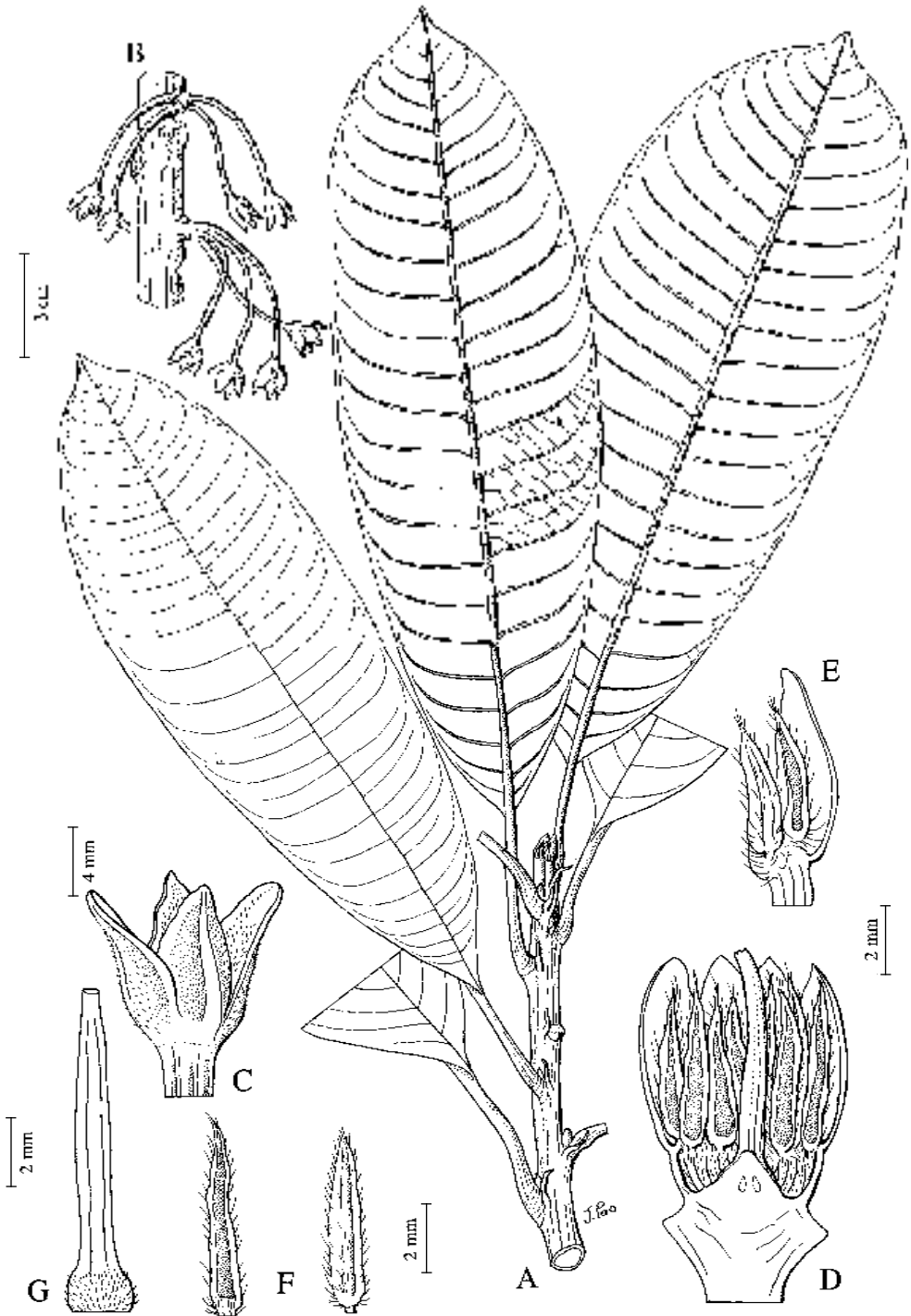


Fig. 11. *Madhuca oblongifolia*. A, leafy twig; B, inflorescences on leafless twig; C, nearly open flower; D, flower with sepals and a few petals removed; E, petal and stamens; F, stamens in different view; G, pistil. (All from S 43468.)

glabrous. **Fruits** ovoid-oblong, 1.8–2.4 × 0.8–1 cm, 1-seeded, acute at both ends; pericarp thin, sparsely hairy. **Seeds** ellipsoid, *c.* 1.5 × 0.6 cm; testa thin; scar linear.

Distribution. Borneo and the Philippines. In Borneo, known only by a few collections from Sarawak (e.g., *S* 25463, *S* 32448, *S* 43468, and *S* 49168).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 250 m.

31. *Madhuca ochracea* Yii & P.Chai

Fig. 12.

(Latin, *ochraceus* = pale yellowish brown; the indumentum)

Gard. Bull. Sing. 53 (2001) 350. **Type:** *Wright S* 29130, Borneo, Sarawak, Niah NP (holotype SAR; isotypes K, L, SAN, SING).

Tree to 25 m tall, 70 cm diameter. **Bark** greyish brown, scaly; inner bark dull orange. **Twigs** angular, glabrous. **Terminal buds** *c.* 5 mm long. **Stipules** broadly ovate, *c.* 5 × 4 mm, glabrous, persistent. **Leaves** crowded at ends of twigs, coriaceous, glabrous above, covered with persistent pale yellowish brown tomentum below; elliptic or elliptic-obovate, 8.5–19 × 3.5–8.2 cm, base cuneate, margin recurved, apex caudate or acuminate, acumen *c.* 1 cm long; midrib shallowly grooved and crested above, rounded and prominent below; lateral veins slender, 26–34 pairs, ascending at an angle of 80–85° from midrib, diminishing and becoming inconspicuous toward leaf margin, faint and impressed above, distinct below; intercostal venation slender, descending from leaf margin and parallel to lateral veins, laxly reticulate towards leaf margin, indistinct above, faint below; petiole 2–4.8 cm long, narrowly grooved on adaxial side, thickened and rugose at base. **Inflorescences** axillary, 2–7-flowered. **Flowers:** pedicel *c.* 1.2 cm long, glabrous, angular and enlarged at apex; sepals orbicular, *c.* 6 mm across, apex rounded, velvety hairy; corolla *c.* 8 mm long, 10-lobed, lobes obovate, *c.* 4 × 3 mm, apex rounded and ciliate; stamens 16, filaments *c.* 2.5 mm long, anthers sagittate, *c.* 2.5 mm long; ovary subconical, *c.* 2 mm across, 6–8-loculed, velvety hairy, style *c.* 7 mm long, subangular, glabrous. **Fruits** (immature) ovoid, *c.* 1 cm across, base rounded, apex flattened and topped by stout remnant of style, pale yellowish brown hairy. **Seeds** unknown.

Vernacular name. Sarawak—*nyatoh kelabu* (Iban).

Distribution. Endemic to Borneo. Known only from Sarawak by two collections from Niah NP (*S* 29130) and Mentagai hills (*S* 23100), Marudi, Miri division.

Ecology. In primary lowland mixed dipterocarp forest on clay loam soils, at altitudes to 100 m.

32. *Madhuca palembanica* (Miq.) Forman

(of Palembang, Sumatra)

In Coode *et al.* (eds.) *l.c.* 439; Argent *et al.* (eds.) *l.c.* 579. **Basionym:** *Podocarpus palembanicus* Miq., Fl. Ind. Bat., Suppl. (1861) 252 & 589. **Type:** *Teijsmann* 3891, Sumatra, Palembang, Muaradua (holotype U; isotype BO). **Synonym:** *Ganua palembanica* (Miq.) Van den Assem & Kostermans *l.c.* 482, H.J. Lam *l.c.* (1957) 512, Anderson *l.c.* 315.

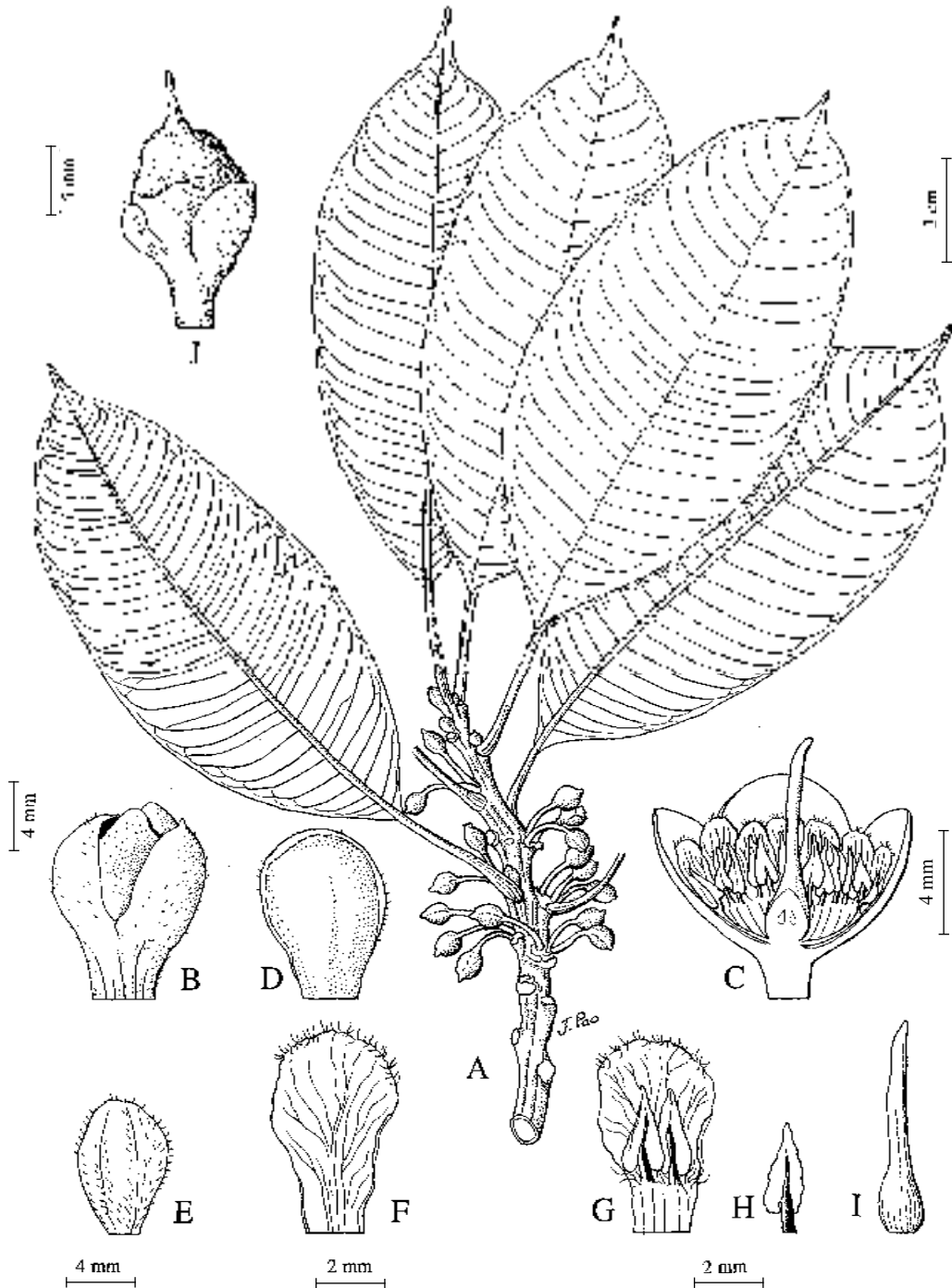


Fig. 12. *Madhuca ochracea*. A, flowering leafy twig; B, flower bud; C, longitudinal section of flower bud; D, outer sepal; E, inner sepal; F, petal; G, petal and stamens; H, stamen; I, pistil; J, young fruit. (A–I from S 29130, J from S 23100.)

Tree to 30 m tall, 45 cm diameter. **Bark** greyish brown or brown, scaly; inner bark dull orange. **Twigs** slender, subangular, rusty-brown hairy, glabrescent. **Terminal buds** 1–2 mm long, rusty-brown velvety hairy. **Stipules** filiform, 1–1.5 cm long, rusty-brown velvety hairy. **Leaves** well-spaced along twigs, chartaceous, glabrous on both surfaces; young leaves linear, *mature leaves elliptic-lanceolate*, 11–17 × 1.5–5 cm, base cuneate and decurrent, margin plane, apex acuminate, acumen *c.* 1 cm long; midrib narrowly grooved and finely crested above, round and prominent below; *lateral veins 15–23 pairs, ascending at an angle of c. 80° from midrib, arching and joining to form a smooth intramarginal vein*, obscure above, distinct below; *intercostal venation descending from leaf margin and parallel to lateral veins*, parallel-reticulate toward intramarginal veins, obscure above, prominent below; petiole slender, 3–4 cm long, narrowly grooved on adaxial side, round on abaxial side, thickened, rugulose and blackish at base. **Inflorescences** and **flowers** unknown. Infructescences axillary. **Fruits** in fascicles of 1–4, ovoid-globose, *c.* 1.5 × 1.2 cm (immature), pubescent, 1–2-seeded; pericarp thin, woody; stalk 1.2–1.7 cm long, terete and enlarged at distal part, glabrous. **Seeds** (immature) ellipsoid, 0.8 × 0.4–0.6 cm; scar linear.

Vernacular name. Sarawak—*nyatoh tangkai panjang* (Iban).

Distribution. Sumatra and Borneo. In Borneo, uncommon and known by a few collections from Sarawak (e.g., *S 28990*, *S 37490* and *S 40527*) and Brunei.

Ecology. Usually along ridges in hill mixed dipterocarp forest, at 500–800 m altitude.

33. *Madhuca pallida* (Burck) Baehni

(Latin, *pallidus* = pale in colour; the leaves)

Boissiera 11 (1965) 36; Pennington *l.c.* 158; Kessler & Sidiyasa *l.c.* 214. **Basionym:** *Bassia pallida* Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 44. **Type:** *Burck s.n.* (= *RHL Sheet Nos. 908225* and *908226*), Sumatra, Mt. Singgalang (holotype L). **Synonym:** *Illipe pallida* (Burck) Engl. *l.c.* 509; *Ganua pallida* (Burck) H.J.Lam *l.c.* (1925) 127, *l.c.* (1927) 427, *l.c.* (1957) 512, Van den Assem *l.c.* 377, Van den Assem & Kostermans *l.c.* 481, Anderson *l.c.* 315.

Tree to 16 m tall, 30 cm diameter, with low buttresses. **Bark** dark brown, smooth with vertical rows of reddish brown lenticels; inner bark pinkish, corky, fibrous or laminated. **Twigs** angular or ridged, glabrous. **Terminal buds** *c.* 10 × 3 mm, glabrous, with distinct narrow triangular bud-scales. **Stipules** subulate, 6 × 1–2 mm, persistent at base of petioles of uppermost leaves. **Leaves** in dense clusters of 6–10 on nodes; chartaceous to subcoriaceous, glabrous on both surfaces; obovate or oblanceolate, 14–28 × 4–8 cm, base cuneate to abruptly truncate or subcordate and slightly oblique, margin plane, apex acute to acuminate; midrib impressed above, broadly rounded and prominent below; *lateral veins 10–15 pairs, ascending at an angle of 70–80° from midrib, arching and joining to form intramarginal vein-loops, prominent on both sides; intercostal venation distinctly reticulate*, occasionally with a few veins descending from leaf margin and parallel to lateral veins, prominent on both sides; petiole stout, rugose, to 0.5 cm long. **Inflorescences** in axils of leaf scars, densely crowded below leafy parts of twigs, 4–8-flowered. **Flowers:** pedicel 1.5–2 cm long, sparsely hairy; sepals broadly ovate, 4–7 mm long, hairy; corolla bright yellowish green, lobes 8, lanceolate, *c.* 10 mm long, whitish at tips; stamens 16, in two whorls; ovary ovoid, 8-loculed, hairy; style subulate. **Fruits** globose, 1–2-seeded; pericarp thin, appressed tomentose. **Seeds** ellipsoid.

Vernacular name. Kalimantan—*majang ketapang* (Malay).

Distribution. Sumatra and Borneo. In Sabah and Sarawak, uncommon (e.g., *SAN 16238*, *SAN 35097*, *SAN 76055*, *SAN 100817*, and *S 226*). Also recorded from Brunei and Kalimantan.

Ecology. Lowland mixed dipterocarp forest, at altitudes to 300 m.

34. *Madhuca primoplagensis* Vink

Fig. 13.

(Latin, *primo-* = first; *plaga* = region; occurring only in the First Division of Sarawak)

Blumea 46 (2001) 195. **Type:** *Dania S 41015*, Borneo, Sarawak, Sabal FR, 74th mile Kuching-Simenggand Road (holotype L; isotypes K, KEP, SAN, SAR).

Tree or treelet to 20 m tall, 35 cm diameter. **Bark** dark brown, smooth; inner bark reddish brown. **Twigs** stout, with rounded ribs, densely rusty-brown woolly-hairy. **Terminal buds** to 12 mm long, woolly hairy. **Stipules** ovate-lanceolate or triangular-lanceolate, 12–16 × 3–8 mm, acute, woolly hairy. **Leaves** crowded at ends of twigs or spirally arranged and well-spaced along apical part of twigs, coriaceous, glabrous above except for midrib, sparsely yellowish-brown woolly-tomentose below; obovate or elliptic, 15–40 × 7–18 cm, base broadly cuneate, slightly oblique, margin plane, apex broadly rounded or acuminate with a blunt tip; midrib grooved and broadly crested above, rounded and prominent below; lateral veins 16–30 pairs, ascending at an angle of 55–70° from midrib, distinctly arching and joining to form intramarginal vein-loops, impressed above, prominent below; intercostal venation scalariform, impressed above, prominent and rusty-brown tomentose below; petiole 2–4 cm long, flat and keeled on adaxial side, densely woolly-tomentose. **Inflorescences** axillary or in axils of leaf scars, 3–7(–13)-flowered. **Flowers:** pedicel stout, angular, 0.5–1.7 cm long, woolly tomentose; sepals oblanceolate, 6–8 × 4–5 mm, subacute, strongly keeled, densely woolly-tomentose; corolla 8–9 mm long, 8-lobed, lobes lanceolate, obtuse; stamens 16–18, filaments c. 4 mm long, subulate, anthers c. 4 mm long, lanceolate; ovary ovoid, c. 2 mm across, 8–11-loculed, hairy, style 12–20 mm long, glabrous. **Fruits** ellipsoid, 2–3 × 1.4–1.6 cm, 1-seeded, rounded at both ends; pericarp fleshy, densely and persistently covered with yellowish-brown tomentum. **Seeds** ellipsoid, 1.6–1.8 × 0.8–1.1 cm, pointed at both ends; testa thin, glabrous; scar broadly linear, c. 15 × 5 mm.

Vernacular name. Sarawak—*nyatoh daun besar* (Malay and Iban).

Distribution. Endemic to Borneo. Known only from the First Division of Sarawak by a few collections (e.g., *S 41015*, *S 41119*, *S 42991*, and *S 69808*).

Ecology. In lowland *kerangas* and mixed dipterocarp forests on hill slopes, at altitudes to 300 m.

35. *Madhuca prolixa* (Pierre ex Dubard) Yii & P.Chai

(Latin, *prolixus* = expanded; the inflorescences)

Gard. Bull. Sing. 53 (2001) 345. **Basionym:** *Ganua prolixa* Pierre ex Dubard, Bull. Mus. Hist. Nat., Paris 14 (1908) 409, Merrill l.c. (1921) 478, H.J. Lam l.c. (1925) 130, l.c. (1927) 427, l.c. (1957) 513, Masamune

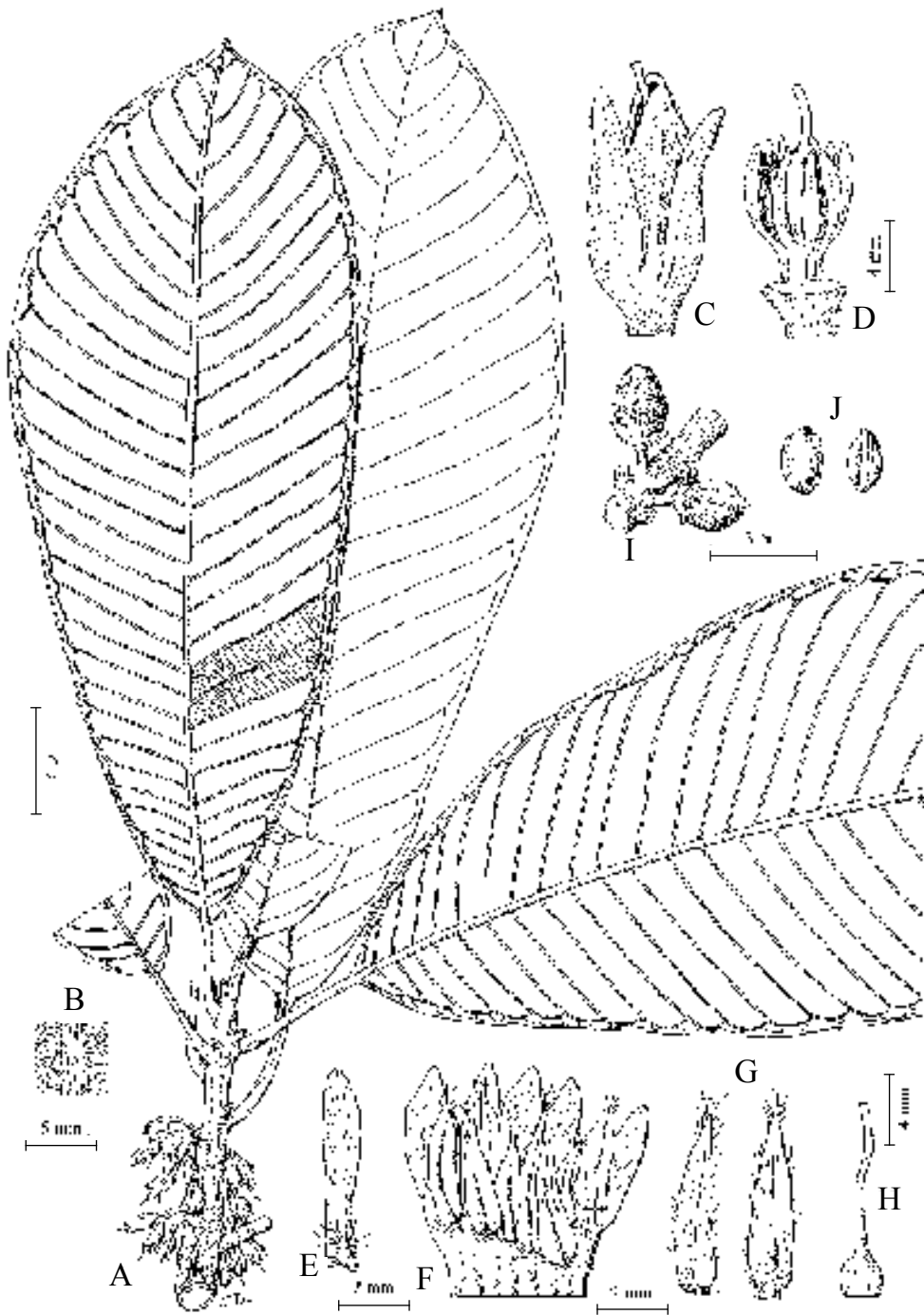


Fig. 13. *Madhuca primoplagensis*. A, flowering leafy twig; B, details of midrib and venation on lower leaf surface; C, flower bud; D, flower bud with sepals and petals removed; E, petal; F, petals and stamens; G, stamens in front and back views; H, pistil; I, infructescence; J, seeds in different views. (A–H from *S 41015*, I–J from *S 41119*.)

l.c. 589, Van den Assem *l.c.* 375, Anderson *l.c.* 315, Whitmore, Tantra & Sutisna *l.c.* 318. **Type:** *Beccari PB 2446*, Borneo, Sarawak, Kuching (holotype FI; isotype L).

Tree to 10 m tall, 15 cm diameter. **Bark** greyish brown, smooth; inner bark dull orange. **Twigs** stout, *terete*, *densely greyish tomentose all over*, glabrescent. **Terminal buds** to 10 mm long. **Stipules** *narrowly triangular*, *c.* 3×2 mm, caducous, greyish velvety hairy. **Leaves** *crowded at ends of twigs*, chartaceous, *glabrous on both surfaces*; *narrowly obovate*, $16\text{--}24 \times 6\text{--}9$ cm, base cuneate and decurrent; *margins plane*, apex acuminate, acumen *c.* 1 cm long with an obtuse tip; midrib flat or raised above, stout and prominent below; *lateral veins 15–20 pairs*, *ascending at an angle of 80–85° from midrib*, *arching and joined by thickened intercostal veins to form intramarginal vein-loops near leaf margin*, prominent on both sides; *intercostal venation reticulate-tessellate*, with a few veins descending from leaf margin and parallel to lateral veins, prominent on both sides; *petiole* stout, *2–3 cm long*, flat or grooved on adaxial side, thickened, rugose and greyish at base. **Inflorescences** axillary, rarely in axils of leaf scars, 5–8-flowered. **Flowers:** pedicel stout, densely greyish woolly-tomentose; 1.3–1.8 cm long, *terete* and enlarged at apex; *sepals oblong-ovate*, $10\text{--}12 \times 8\text{--}10$ mm, apex acute; corolla *c.* 12 mm long, *lobes 12*, oblanceolate; *stamens 24*, filaments *c.* 2 mm long, hairy, anthers oblong-ovoid, *c.* 3 mm long, densely villous; ovary subconical, *c.* 3×2 mm, hirsute, style *c.* 7 mm long, glabrous. **Fruits** *subglobose*, *c.* 2×1.7 cm, 1-seeded; *pericarp thin, smooth*, yellowish-grey tomentose. **Seeds** ellipsoid, $1.5 \times 0.3\text{--}0.5$ cm, acute at both ends; scar *c.* 15×3 mm.

Distribution. Peninsular Malaysia and Borneo. In Borneo, scattered throughout Sarawak (e.g., *S 4099*, *S 18771*, *S 25258*, and *S 29249*) and Brunei (e.g., *BRUN 2476* and *BRUN 3317*).

Ecology. In primary lowland mixed dipterocarp forest, at altitudes to 200 m.

36. *Madhuca pubicalyx* Ridl.

(Latin, *pubicalyx* = with soft-hairy calyx)

Kew Bull. (1934) 121; Masamune *l.c.* 591; P. Royen *l.c.* (1960) 35; Burgess *l.c.* 449; Anderson *l.c.* 316; Whitmore, Tantra & Sutisna *l.c.* 320; Pennington *l.c.* 158; Coode *et al.* (eds.) *l.c.* 306. **Type:** *Creagh s.n.*, Borneo, Sabah (holotype K).

Tree to 25 m tall, 30 cm diameter. **Bark** greyish brown to brown, smooth to finely fissured; inner bark reddish brown. **Twigs** *terete* or subangular, *woolly pubescent*, glabrescent. **Terminal buds** to 1.5 cm long. **Stipules** triangular or ovate, $7\text{--}12 \times 3\text{--}7$ mm, acuminate, crested, woolly puberulous outside. **Leaves** *well-spaced along twigs*, subcoriaceous, glabrous on both surfaces or greyish velvety hairy on midrib above and on whole surface below; elliptic-obovate or elliptic, rarely oblanceolate, $15\text{--}30 \times 4.5\text{--}12$ cm, base attenuate or cuneate and distinctly decurrent, margin plane, apex acuminate with obtuse tip; midrib impressed and narrowly crested above, rounded and prominent below; *lateral veins 13–19 pairs*, ascending at an angle of $45\text{--}55^\circ$ from midrib, *diminishing and becoming inconspicuous toward leaf margin*, prominent on both sides; *intercostal venation* slender, *scalariform*, distinct on both sides; *petiole* stout, $(2\text{--})3.5\text{--}6.5$ cm long, narrowly grooved on adaxial side, slightly thickened at base, glabrous on upper half, greyish puberulous on lower half. **Inflorescences** axillary or in axils of leaf scars, 2–8-flowered. **Flowers:** pedicel slender, angular, 2.5–5 cm long, greyish puberulous; sepals ovate-orbicular, 7–9.5 mm across, greyish puberulous; corolla 10–16 mm long, lobes 8–9, lanceolate; stamens 18–24, in two whorls, filaments subulate, *c.* 10 mm long, rusty-brown hairy, anthers oblong,

3–6.5 mm long; ovary obconical, 8–11-loculed, yellowish puberulous, style 10–17 mm long. **Fruits** ellipsoid-obovoid, 2–2.6 × 1.2–1.8 cm, 1-seeded, obtuse at both ends; pericarp thick, velvety hairy. **Seeds** flattened ellipsoid, 2.1 × 0.6–0.9 cm, acute at both ends; testa thin, glabrous; scar linear, 19 × 2 mm.

Vernacular name. Sabah—*nyatoh* (Kedayan).

Distribution. Endemic to Borneo. Common in Sabah (e.g., *SAN 15422*, *SAN 24734*, *SAN 53556*, *SAN 97126*, and *SAN 122759*), uncommon in Sarawak (e.g., *S 23017*). Also occurs in Brunei (e.g., *Dransfield JD 6879*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 50 m.

37. *Madhuca rufa* (King & Gamble) P.Royen (Latin, *rufus* = reddish; the indumentum)

Blumea 10 (1960) 55; Ng *l.c.* 409; Turner *l.c.* 464. **Basionym:** *Isonandra rufa* King & Gamble *l.c.* 166, Ridley *l.c.* (1923) 261, H.J. Lam *l.c.* (1925) 109, *l.c.* (1927) 421. **Type:** *King's Collector 4550*, Peninsular Malaysia, Perak, Gopeng (holotype CAL; isotype SING).

Tree to 6 m tall, 8 cm diameter. **Bark** greenish, smooth; inner bark brown. **Twigs** slender, *ridged, densely reddish-brown woolly hairy*. **Terminal buds** *c.* 4 mm long, reddish-brown woolly hairy. **Stipules lanceolate**, *c.* 4 × 1 mm, reddish-brown woolly hairy. **Leaves well-spaced along twigs, coriaceous**, upper surface glabrous, *lower surface glabrous except for the reddish-brown hairy midribs and lateral veins*; elliptic, 7–15 × 3–5 cm, base broadly cuneate and decurrent, margin plane, apex acuminate, acumen to 1.5 cm long, with sharp tip; midrib narrowly crested above, rounded and prominent below; *lateral veins 9–12 pairs, ascending at an angle of 70–75° from midrib, arching and joining to form vein-loops near leaf margin, impressed above, distinct below; intercostal venation laxly reticulate*, obscure above, distinct below; *petiole 0.5–1 cm long, grooved on adaxial side*, swollen and densely woolly hairy at base, glabrescent. **Inflorescences** axillary, 3–6 flowered. **Flowers:** pedicel slender, 0.3–1 cm long, densely reddish-brown woolly hairy; sepals ovate-lanceolate, *c.* 4 × 3 mm, apex acute; corolla (in buds) *c.* 4 mm long, 7-lobed; *stamens 12, filaments c. 1 mm long*, anthers lanceolate, *c.* 2 mm long; *ovary discoid, c. 0.5 × 1 mm, 5-loculed, glabrous*, style filiform, 4–6 mm long, glabrous. **Fruits fusiform**, 1.5–1.8 × 0.6–0.8 cm, pointed at both ends, 1-seeded; pericarp thin, *glabrous*. **Seeds** unknown.

Distribution. Peninsular Malaysia and Borneo. In Borneo, uncommon and recorded only from around Beaufort Hills in Sabah (e.g., *SAN 28096* and *SAN 35097*).

Ecology. In lowland mixed dipterocarp forest.

38. *Madhuca sandakanensis* P.Royen (of Sandakan, Sabah)

Blumea 10 (1960) 71. **Type:** *Wood SAN 16908*, Borneo, Sabah, Beaufort district, Pangi (holotype L; isotypes A, K, KEP, SAN, SING).

Tree to 17 m tall, 20 cm diameter. **Twigs** slender, *subangular*, pale yellowish green, *glabrous*. **Terminal buds** to 2.5 mm long. **Stipules** *lanceolate*, *c.* 2×0.5 mm, acute, velvety hairy, caducous. **Leaves** *well-spaced along twigs*, chartaceous to subcoriaceous, *glabrous* on both surfaces; obovate or elliptic-obovate, $11\text{--}23.5 \times 6\text{--}8.5$ cm, base cuneate and decurrent, margin plane, apex acuminate with an obtuse tip; midrib flat and narrowly crested above, prominent and rounded below; *lateral veins 6–11 pairs, ascending at an angle of c. 50° from midrib, diminishing and becoming inconspicuous toward leaf margin*, prominent on both sides; *intercostal venation slender, densely scalariform, distinct on both sides*; *petiole 1–3 cm long*, flat and narrowly crested on adaxial side, slightly thickened at base. **Inflorescences** axillary, 2–5-flowered. **Flowers:** pedicel angular, 0.8–1.2 cm long, greyish velvety hairy; sepals ovate, $5\text{--}6 \times 3\text{--}5$ mm, apex subobtusate, *glabrous*; *corolla c.* 8 mm long, 8-lobed, *lobes obovate-spathulate*, apex rounded; *stamens 12*, filaments filiform, 1–1.5 mm long, anthers oblong, *c.* 2.5 mm long; *ovary ovoid*, *c.* 3×1 mm, 8-loculed, *glabrous*, style stout, 7–12 mm long, *glabrous*. **Fruits** unknown.

Distribution. Endemic to Borneo. Scattered throughout Sabah (e.g., *SAN 16807*, *SAN 34865*, *SAN 41447*, *SAN 96705*, and *SAN 134083*) and Sarawak (e.g., *Hansen 817*).

Ecology. In lowland and hill mixed dipterocarp forests, at altitudes to 500 m.

39. *Madhuca sarawahensis* (Pierre ex Dubard) H.J.Lam (a misspelling of Sarawak)

Fig. 14.

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 180 (“*sarawakensis*”), *l.c.* (1927) 462; Masumune *l.c.* 592; P. Royen *l.c.* (1960) 26; Whitmore, Tantra & Sutisna *l.c.* 321. **Basionym:** *Kakosmanthus sarawahensis* Pierre ex Dubard, Rev. Gen. Bot. 20 (1908) 198, Bull. Mus. Hist. Nat., Paris 14 (1908) 407, Merrill *l.c.* (1921) 479. **Lectotype** (P. Royen, 1960): *Beccari PB 423*, Borneo, Sarawak, Kuching (hololectotype P; isolectotypes FI, L).

Tree to 25 m tall, 35 cm diameter. **Bark** greyish, smooth; inner bark dull orange. **Twigs** stout, *subangular*, *densely rusty-brown tomentose*. **Terminal buds** to 4 mm long. **Stipules** ovate-lanceolate, *c.* 10×4 mm, crested, rusty-brown tomentose. **Leaves** *well-spaced along twigs*, *coriaceous*, surface wrinkled, *glabrous on both surfaces except for the sparsely hairy midrib and lateral veins below*; *oblanceolate*, $16\text{--}51 \times 6\text{--}15$ cm, base broadly cuneate, slightly oblique and decurrent, margin plane, apex acuminate with sharp tip, or obtuse or rarely retuse; midrib impressed and broadly crested above, prominent and rounded below; *lateral veins 23–35 pairs, ascending at an angle of 60–70° from midrib, arching and joining to form vein-loops rather far from leaf margin, distinctly impressed above, prominent below*; *intercostal venation slender, scalariform*, prominent on both sides; *petiole 2.5–6 cm long, flat on adaxial side*, thickened and rugose at base. **Inflorescences** axillary, 7–10-flowered. **Flowers:** pedicel angular, 1–2 cm long, densely tomentose; *sepals ovate-lanceolate*, crested, $6\text{--}9 \times 3\text{--}5$ mm, apex subacute, inner pair thinner, puberulous and ciliate at margin; *corolla c.* 8 mm long, 8–9-lobed, lobes lanceolate; *stamens 13–16*, filaments subulate, *c.* 3 mm long, anthers narrowly sagittate, *c.* 4 mm long, sparsely hairy; *ovary ovoid*, puberulous, 9-loculed, *style filiform*, *c.* 3 mm long, *glabrous*. **Fruits** ellipsoid, *c.* 3.2×1.7 cm, 1-seeded, obtuse at both ends, puberulous, *glabrescent*; pericarp fleshy, green with numerous white dots; stalk to 1 cm long. **Seeds** ellipsoid, $2.6 \times 1\text{--}1.3$ cm, pointed at both ends; testa thin, *glabrous*, dark brown; scar *c.* 5 mm wide.

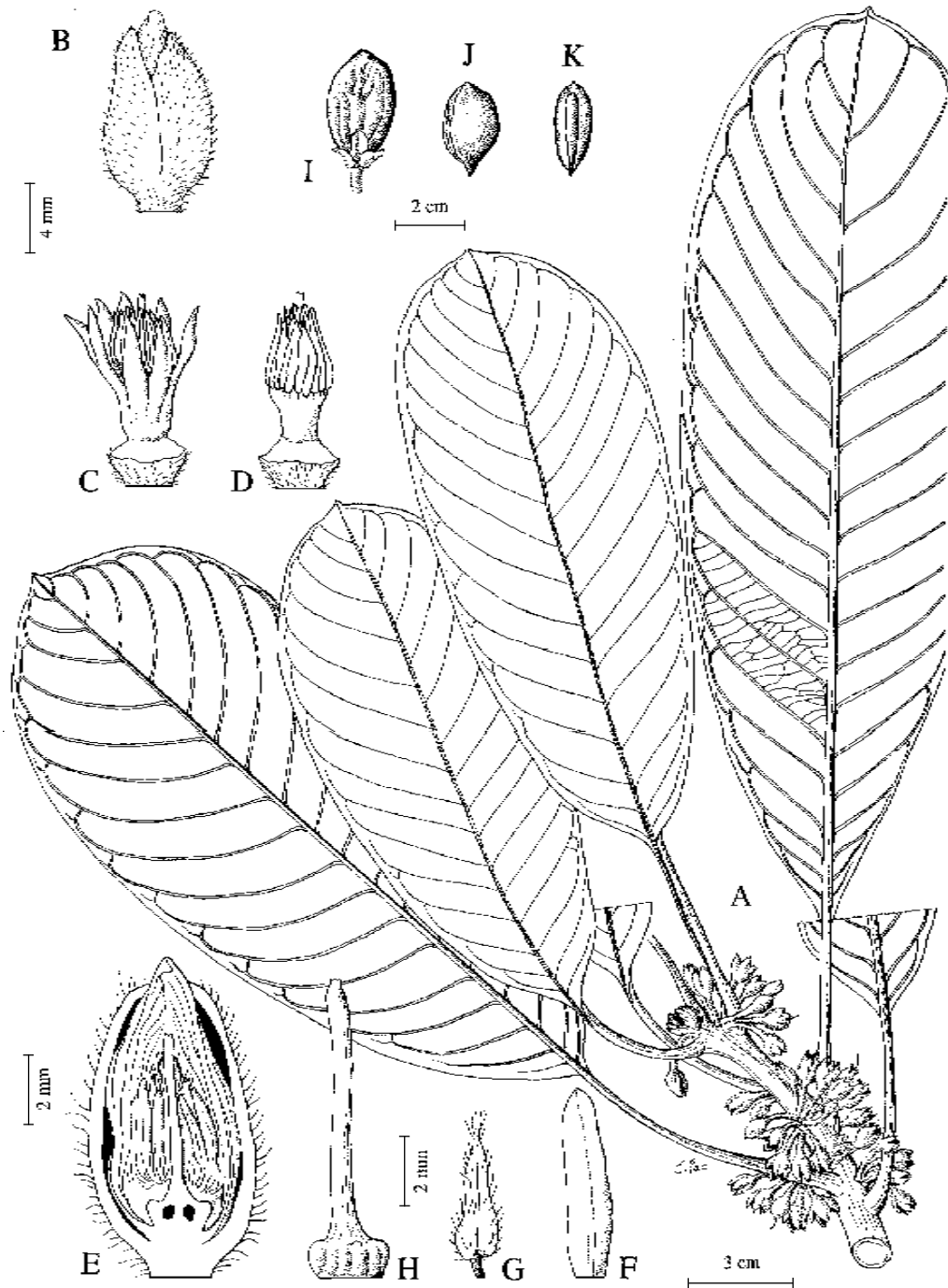


Fig. 14. *Madhuca sarawahensis*. A, flowering leafy twig; B, flower bud; C, flower bud with sepals removed; D, flower bud with sepals and petals removed; E, longitudinal section of flower bud; F, petal; G, stamen; H, pistil; I, fruit; J, side view of seed; K, adaxial view of seed. (A–H from S 25492, I–K from S 29474.)

Distribution. Endemic to Borneo. Restricted to Kuching Division in Sarawak (e.g., *S* 3388, *S* 8919, *S* 9379, *S* 15777, and *S* 48220).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 50 m.

40. *Madhuca sepilokensis* P.Royen

(of Sepilok, Sabah)

Blumea 10 (1960) 46. **Type:** *Wood SAN 16032*, Borneo, Sabah, Sandakan, Sepilok FR, compt. 7 (holotype L; isotypes A, K, SAN, SING).

Tree to 13 m tall, 15 cm diameter. **Twigs** slender, *subangular*, *glabrous*. **Terminal buds** to 2 mm long, greyish hairy. **Stipules** *ovate*, oblique, *c.* 1.5 × 0.5 mm, greyish hairy. **Leaves** *well-spaced along twigs*, chartaceous, glabrous on both surfaces, drying greenish brown; obovate, 19–27 × 6–10 cm, base narrowly cuneate and decurrent, margin plane, apex acuminate with obtuse tip; midrib flat or round above, round and prominent below; *lateral veins* 9–13 pairs, *ascending at an angle of 45–50° from midrib, diminishing and becoming inconspicuous toward leaf margin*, distinct on both sides; *intercostal venation* slender, *densely scalariform, faint above, distinct below*; *petiole* 3–3.5 cm long, flat on adaxial side, thickened at base. **Inflorescences** axillary, 3–6-flowered. **Flowers:** pedicel slender, angular, 0.9–1.3 cm long, sparsely greyish velvety-hairy; sepals ovate-lanceolate, 4–5 × 3–4 mm, apex obtuse with tufts of black hairs; *corolla* *c.* 9 mm long, 8-lobed, *lobes oblong*, apex obtuse; *stamens* 18, filaments subulate, *c.* 1 mm long, anthers oblong, *c.* 3 mm long; *ovary* *ovoid*, *c.* 2 × 1 mm, 8-loculed, *glabrous*, styles filiform, *c.* 12 mm long, glabrous. **Fruits** ellipsoid, *c.* 2.1 × 1 cm, 1-seeded, acute at both ends; pericarp thin, glabrous. **Seeds** ellipsoid, 1.6 × 0.6–1 cm, acute at both ends, testa thin, glabrous; scar *c.* 1.5 mm wide.

Distribution. Endemic to Borneo and confined to Sandakan district in Sabah (e.g., *SAN* 17725, *SAN* 21714, *SAN* 58685, *SAN* 63058, and *SAN* 99301).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 100 m.

41. *Madhuca sericea* (Miq.) H.J.Lam

(Latin, *sericeus* = silky with long straight closely pressed glossy hairs; the indumentum)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 163 & 264, *l.c.* (1927) 446; Ridley *l.c.* (1925) 319; Masamune *l.c.* 592; P. Royen *l.c.* (1960) 70; J. Sinclair, Gard. Bull. Sing. 22 (1965) 220; Ng *l.c.* 410; Whitmore, Tantra & Sutisna *l.c.* 321; PROSEA *l.c.* 293; Kessler & Sidiyasa *l.c.* 214; Turner *l.c.* 465; Argent *et al.* (eds.) *l.c.* 579. **Basionym:** *Payena sericea* Miq., Fl. Ind. Bat. 2 (1859) 1039. **Type:** *Horsfield s.n.*, Sumatra, Bangka (holotype BO; isotype K). **Synonyms:** *Bassia argentea auct. non de Vriese*: C.B. Clarke in Hooker *f. l.c.* 545, *nom. illeg.*, King & Gamble *l.c.* 184, Ridley *l.c.* (1923) 270; *Kakosmanthus argenteus* (C.B. Clarke) Pierre ex Dubard, Rev. Gen. Bot. (1908) 198; *P. ridleyi* Gaud., Bull. Soc. Bot. Fr. 65 (1918) 56, A. Bruggen, Blumea 9 (1958) 133; *M. sericea* var. *ridleyi* (Gaud.) Ng *l.c.* 410, PROSEA *l.c.* 293, Turner *l.c.* 464; *B. sericea* (Miq.) King, J. Bot. 63, Suppl. (1925) 61.

Tree to 33 m tall, 60 cm diameter. **Bark** vertically cracked, firm, greyish brown; inner bark red, with little white sap. **Twigs** *slender*, subangular, *persistently greyish sericeous*. **Terminal**

buds 2–4 mm long, sericeous. **Stipules** *minute*, sericeous, caducous. **Leaves** *well-spaced along twigs, coriaceous*, glabrous above, *golden or silvery-brown sericeous below*; elliptic, 6.5–18.5 × 3.5–8.7 cm, base cuneate and slightly oblique, margin plane, *apex acuminate*; midrib grooved and narrowly crested above, prominent below; *lateral veins 10–14 pairs, ascending at an angle of c. 60° from midrib, diminishing and becoming inconspicuous toward leaf margin, prominent on both sides; intercostal venation slender, scalariform, distinct on both sides; petiole 1.3–4.5 cm long, flat or shallowly furrowed on adaxial side, thickened at base.* **Inflorescences** axillary, 3–7-flowered. **Flowers**: pedicel subangular, 0.7–1.4 cm long, golden sericeous; sepals broadly ovate, *c. 5 × 4 mm, apex acute and ciliate with tufts of black hairs*; corolla *c. 6 mm long, 8–9-lobed, lobes spatulate, c. 4 × 1.5 mm, glabrous except for the sparsely hairy throat*; stamens 10–16, in two whorls, filaments 1–1.5 mm long, *anthers sagittate, c. 2.5 mm long*; ovary ovoid, *c. 1 mm across, 8-loculed, glabrous, style filiform, 7–9 mm long, glabrous.* **Fruits** ellipsoid, 2–3.5 × 1–1.5 cm, 1-seeded, acute at both ends; pericarp woody, greyish sericeous when young, glabrous when mature. **Seeds** ellipsoid, 1–1.5 × 0.5 cm; scar *c. 4 mm wide.*

Distribution. Sumatra (Lingga, Enggano and Bangka), Peninsular Malaysia, Singapore, and Borneo. Scattered throughout Sabah (e.g., *SAN 16647* and *SAN 16787*) and Sarawak (e.g., *S 25983*). Also known from Kalimantan.

Ecology. In lowland and hill mixed dipterocarp forests, at altitudes to 1000 m.

42. *Madhuca sessilis* (King & Gamble) Baehni

(Latin, *sessilis* = without stalk; the leaves)

Boissiera 11 (1965) 36; Turner *l.c.* 465; Argent *et al.* (eds.) *l.c.* 579. **Basionym:** *Payena sessilis* King & Gamble *l.c.* 174; Ridley *l.c.* (1923) 265. **Type:** *Ridley 5076*, Singapore (holotype SING). **Synonym:** *Ganua sessilis* (King & Gamble) H.J.Lam *l.c.* (1925) 120, *l.c.* (1927) 424, Van den Assem *l.c.* 387, Ng *l.c.* 399, Whitmore, Tantra & Sutisna *l.c.* 318.

Tree to 18 m tall, 35 cm diameter. **Bark** greyish brown, shallowly fissured or scaly. **Twigs** slender, subangular, *glabrous*. Bud-scales conspicuous, lanceolate to narrowly triangular, *c. 4.5 × 2 mm, glabrous.* **Stipules** *absent.* **Leaves** *crowded at end of twigs, subcoriaceous, glabrous on both surfaces, on drying dark green above, paler below; spatulate, rarely obovate, 2.5–5.5 × 1.5–2.5 cm, base narrowly cuneate, margin plane, apex blunt or rounded; midrib raised on both sides; lateral veins 7–9 pairs, ascending at an angle of 70–80° from midrib, arching and joining to form intramarginal vein-loops, obscure on both sides; intercostal venation laxly reticulate, with a few veins descending from leaf margin and parallel to lateral veins; petiole very short, leaves almost sessile.* **Inflorescences** axillary or in axils of leaf scars, 2–3-flowered. Fully developed flowers unknown; pedicel 0.8–1.2 cm long, slightly enlarged at both ends. **Fruits** globose, *c. 1 cm diameter, 1-seeded, flattened at both ends, with persistent style remnant; pericarp thin, purplish green, glabrous.* **Seeds** (immature) oblong, *c. 7 mm long.*

Distribution. Sumatra (Biliton), Singapore and Borneo. In Sarawak, very rare, represented by two collections (*S 37849* and *S 49951*) from the lower slopes of G. Pueh, Kuching Division. Also occurs in Kalimantan.

Ecology. In mixed dipterocarp forest on red-yellow igneous soils.

43. *Madhuca silamensis* Yii & P.Chai
(of Mt. Silam, Sabah)

Fig. 15.

Gard. Bull. Sing. 53 (2001) 354. **Type:** *Mujin SAN 37849*, Borneo, Sabah, Mt. Silam (holotype SAR; isotype SAN).

Tree to 9 m tall, 15 cm diameter. **Bark** shallowly fissured or scaly, greyish brown; inner bark brittle, with white latex. **Twigs** stout, subangular, glabrous. **Terminal buds** to 8 mm long. **Stipules** triangular, *c.* 4 × 4 mm, crested, glabrous. **Leaves** well-spaced along twigs, thickly coriaceous, silvery brown tomentose on both surfaces; elliptic to oblong-elliptic, 16–25 × 6–8 cm, base narrowly cuneate, margin plane, apex blunt or rounded; midrib raised on both sides, stronger below; lateral veins 15–19 pairs, ascending at an angle of 70–80° from midrib, diminishing and becoming inconspicuous toward leaf margin, distinctly raised on both sides; intercostal venation laxly reticulate; petiole 3–4 cm long, grooved on adaxial side, thickened at base, glabrous. **Inflorescences** axillary, 2–3-flowered. **Flowers:** pedicel 1–1.5 cm long, angular and slightly enlarged at both ends; sepals broadly ovate, *c.* 6 × 4 mm, rusty-brown tomentose (mature flowers unknown). **Fruits** unknown.

Distribution. Endemic to Sabah and known only from the type collection from Mt. Silam, Lahad Datu district and *SAN 51742* from Bt. Tawai, Kinabatangan district.

Ecology. In forest on ultrabasic soils, at altitude *c.* 850 m.

44. *Madhuca spectabilis* P.Royen

(Latin, *spectabilis* = spectacular, looking good; the impressive appearance of the tree)

Blumea 10 (1960) 24; Pennington *l.c.* 159; Kessler & Sidiyasa *l.c.* 214. **Type:** *NIFS bb 13911*, Borneo, Kalimantan, Balikpapan (holotype L; isotypes BO, SING).

Tree to 26 m tall, 40 cm diameter. **Twigs** stout, subangular, rusty-brown tomentose, glabrescent. **Terminal buds** to 25 mm long, hairy. **Stipules** lanceolate, *c.* 15 × 5 mm, glabrous except for the ciliate margin. **Leaves** well-spaced along twigs, subcoriaceous, glabrous on both surfaces; narrowly obovate, 25–40 × 6.5–11 cm, base narrowly cuneate, slightly decurrent, margins plane, apex long-acuminate, acumen *c.* 1.5 cm long; midrib slightly raised above, rounded and prominent below; lateral veins 26–30 pairs, ascending at an angle of *c.* 65° from midrib, strongly arching and joining into a smooth intramarginal vein; intercostal venation slender, scalariform, obscure above, distinct below; petiole 3.5–6 cm long, flat or slightly furrowed on adaxial side, rounded on abaxial side, thickened and rugose at base. **Inflorescences** on branchlets below leaves, 8–many-flowered. **Flowers:** pedicel slender, *c.* 1.5 cm long, subangular, hairy; sepals orbicular, 5–7 mm across, apex rounded; corolla *c.* 8 mm long, 8–9-lobed, lobes broadly elliptic, 5–6 × 1–2.5 mm, hairy; stamens *c.* 20, filaments *c.* 2 mm long, anthers sagittate, *c.* 3.5 mm long; ovary discoid, *c.* 2 mm across, 8-loculed, villous, styles filiform, *c.* 10 mm long, glabrous. **Fruits** unknown.

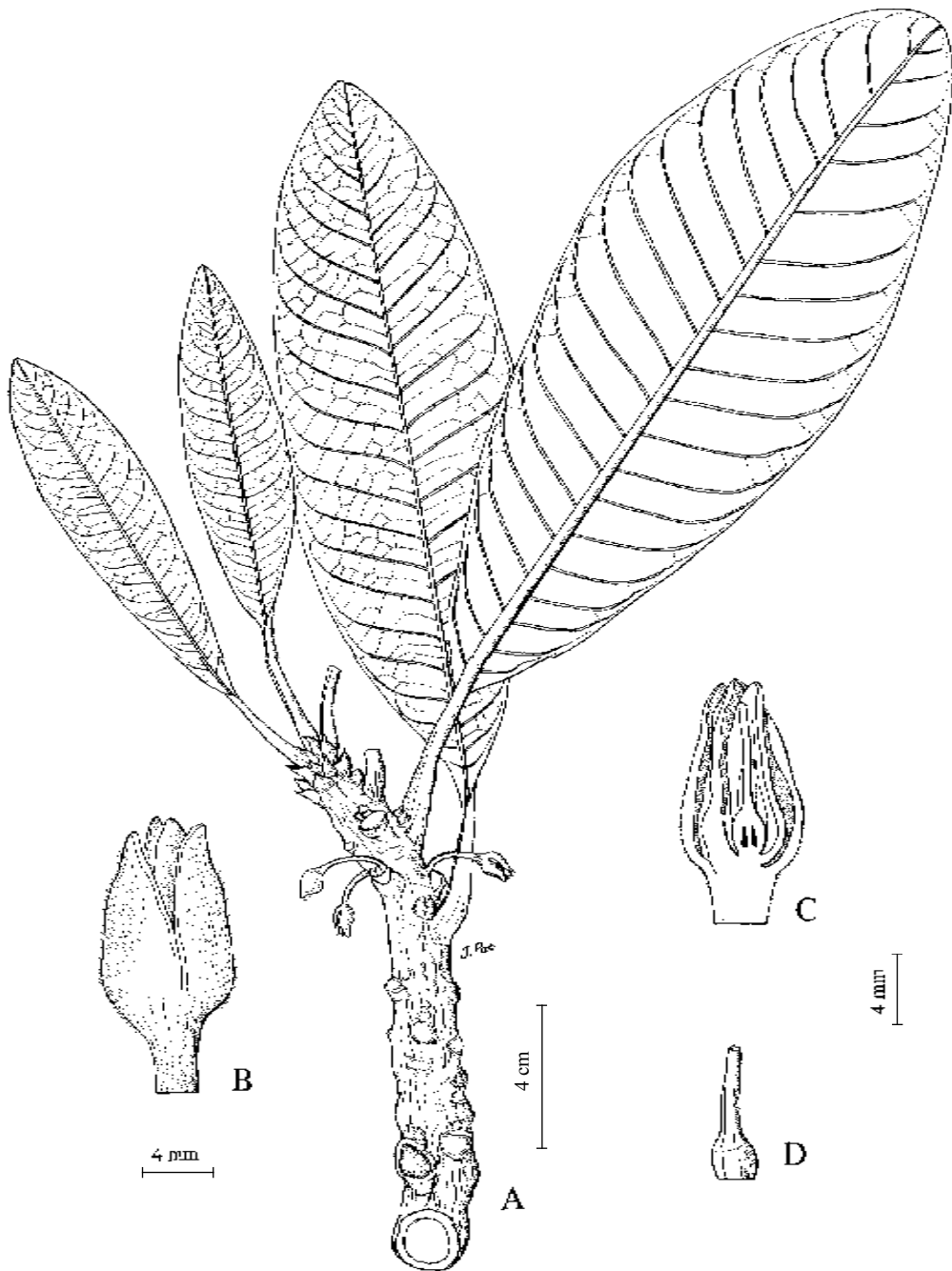


Fig. 15. *Madhuca silamensis*. A, flowering leafy twig; B, flower bud; C, longitudinal section of flower bud; D, pistil. (All from SAN 37849.)

Distribution. Endemic to Borneo. Uncommon and scattered around Sandakan, Sabah (e.g., *SAN 4382* and *SAN 4775*). Also occurs in Kalimantan.

Ecology. In lowland mixed dipterocarp forest, at altitudes to 200 m.

45. *Madhuca utilis* (Ridl.) H.J.Lam

(Latin, *utilis* = useful; the timber)

In Heyne, Nutt. Pl. Ned. Ind. 2 (1927) 1231, *l.c.* (1927) 460; Masamune *l.c.* 592; P. Royen *l.c.* (1960) 99; Ng *l.c.* 411; Whitmore, Tantra & Sutisna *l.c.* 321; Pennington *l.c.* 159; Turner *l.c.* 465. **Basionym:** *Payena utilis* Ridl., J. As. Soc. Str. Br. 79 (1918) 94, *l.c.* (1923) 265, H.J. Lam *l.c.* (1925) 150. **Type:** Hashim CF 477, Peninsular Malaysia, Ulu Selangor (holotype K; isotype KEP). **Synonyms:** *Madhuca stenophylla* H.J.Lam *l.c.* (1925) 179, Ridley *l.c.* (1925) 342; *Isonandra utilis* (Ridl.) Baehni *l.c.* 84.

Tree to 40 m tall, 70 cm diameter; buttresses usually steep, to 2.5 m high and 1 m wide. **Bark** greyish brown, smooth or shallowly fissured; inner bark reddish brown, laminated. **Twigs** slender, terete, sparsely rusty-brown tomentose, glabrescent. **Terminal buds** *c.* 2 mm long. **Stipules** linear, *c.* 3 × 1 mm, densely tomentose. **Leaves** crowded at ends of twigs, membranous to chartaceous, glabrous on both surfaces, not waxy above; obovate or spatulate, 5–8 × 2–3.5 cm (leaves of saplings to 18 × 6 cm), base narrowly cuneate and decurrent, margins plane, apex obtuse or rounded; midrib narrowly crested above, prominent below; lateral veins slender, 9–12 pairs, ascending at an angle of *c.* 60° from midrib, diminishing and becoming inconspicuous toward leaf margin, or rarely irregularly arching and joining into intramarginal vein-loops, obscure on both sides; intercostal venation slender, reticulate, obscure on both sides; petiole slender, less than 2 cm long, flat or broadly grooved on adaxial side, angular on abaxial side. **Inflorescences** in axils of young leaves and crowded at tips of twigs. **Flowers:** pedicel slender, angular, 0.9–1.8 cm long, silky hairy; sepals ovate-elliptic, *c.* 6 × 4 mm, silky hairy; corolla *c.* 8 mm long, 8–9-lobed, lobes oblong; stamens 10–16, filaments filiform, *c.* 5 mm long, anthers oblong; ovary globose, 8-loculed, glabrous, style 5–7 mm long, glabrous. **Fruits** ellipsoid, 3.5–5.5 × 1.5–2.5 cm, 1-seeded, rounded at apex, narrowed at base; pericarp thin, glabrous; stalk to 2.5 cm long. **Seeds** laterally compressed, ellipsoid, 3.5 × 1–1.8 cm; testa thin; scar 10–18 × 3–5 mm.

Vernacular names. Sarawak—*nyatoh batu*, *nyatoh jelutong* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sarawak, uncommon (e.g., *S 1436*, *S 14707* and *S 15992*). Also occurs in Kalimantan.

Ecology. In peat swamp and lowland wet *kerangas* forests.

Uses. Produces good quality *nyatoh* timber with decorative grains and good finishing, suitable for interior panelling, furniture and boat making.

46. *Madhuca vulpina* Vink

(Latin, *vulpinus* = resembling that of foxes; referring to the colour of the indumentum)

Blumea 46 (2001) 197. **Type:** *Sibat S 24613*, Borneo, Sarawak, Nyabau FR (holotype L; isotypes A, BO, FHO, K, MEL, SAN, SAR, SING).

Tree to 30 m tall, 45 cm diameter. **Bark** brown, flaky; inner bark reddish brown. **Twigs** slender, terete or with shallow rounded ribs, *rusty-brown velvety-hairy*, glabrescent. **Terminal buds** c. 3 mm long, hairy. **Stipules** lanceolate, c. 3×1.5 mm, hairy, caducous. **Leaves** mostly crowded at ends of twigs, subcoriaceous, *glabrous on both surfaces*; *oblanceolate, obovate or obovate-elliptic*, (5–)10–18 \times (2–)4–5.5 cm, base cuneate, margin plane, apex acute, obtuse to acuminate with an obtuse tip; midrib prominently raised on both sides; *lateral veins (9–)15–20 pairs*, ascending at an angle of 55–75° from midrib, *arching and joined by thickened intercostal veins to form vein-loops near leaf margin*, obscure above, prominent below; *intercostal venation slender, laxly to densely reticulate*, often with veins descending from leaf margin and parallel to lateral veins, obscure above, distinct below; *petiole (1–)2–3.5 cm long*, flat on adaxial side, round on abaxial side, thickened at base. **Inflorescences** axillary, 1–3 (rarely up to 8)-flowered. **Flowers:** pedicel slender, 0.8–1.5 cm long, densely woolly-tomentose; sepals suborbicular, 4–6 mm across; *corolla* c. 5 mm long, *lobes 8–16*, obovate or spatulate; *stamens 16–32, in two or three whorls*, filaments c. 1 mm long, anthers lanceolate, c. 1 mm long; ovary disciform to ovoid, c. 2 mm across, 8–10-loculed, pilose, style subulate and glabrous. **Fruits** ovoid-globose, 2–2.5 \times 1–1.5 cm, 1-seeded; pericarp thin, densely yellowish tomentose. **Seeds** laterally compressed, obovoid to ellipsoid, 1.8 \times 0.5–0.8 cm, rounded at both ends; testa thin and glabrous; scar linear, c. 18 \times 1.5 mm.

Distribution. Peninsular Malaysia and Borneo. In Borneo, confined to Kuching and Bintulu divisions in Sarawak (e.g., *S 3377, S 8910, S 12849, S 25376, and S 42108*).

Ecology. In primary *kerangas* and mixed dipterocarp forests, at altitudes below 100 m.

47. **Madhuca woodii** P.Royen

(G.H.S. Wood, 1927–1957, botanist at the Sandakan Herbarium)

Blumea 10 (1960) 36. **Type:** *Wood SAN 15215*, Borneo, Sabah, Beaufort district, Pangl (holotype L; isotypes A, BO, BRI, K, KEP, SING).

Tree to 20 m tall, 30 cm diameter. **Twigs** slender, *terete, glabrous*. **Terminal buds** to 3 mm long, pubescent. **Stipules** ovate, c. 2×1 mm, pubescent, caducous. **Leaves** *well-spaced along twigs*, chartaceous to subcoriaceous, glabrous on both surfaces, drying dark reddish brown below; elliptic or elliptic-obovate, 22–30 \times 7–11 cm, base cuneate, margin plane, apex long-acuminate, acumen to 1.5 cm long; midrib shallowly grooved and broadly crested above, prominent and round below; *lateral veins 13–20 pairs, ascending at an angle of 40–45° from midrib, diminishing and becoming inconspicuous toward leaf margin*, distinct on both sides; *intercostal venation slender, densely scalariform*, faint on both sides; *petiole 2–3.5 cm long*, flat on adaxial side, slightly thickened at base. **Inflorescences** axillary, 3–7-flowered. **Flowers:** pedicel angular, velvety hairy, 1.5–1.8 cm long; sepals ovate, glabrous, 4.5–6 \times 3–3.5 mm, apex round; *corolla* c. 8 mm long, lobes 8, oblong, apex round; *stamens 12*, filaments subulate, anthers lanceolate; *ovary ovoid, 2.5–3 \times 2 mm, 8-loculed, hairy*, style filiform, 10–15 mm long, glabrous. **Fruits** (immature) subconical, 1-seeded, with short style remnant, rusty-brown tomentose.

Distribution. Endemic to Borneo and restricted to Sandakan district in Sabah (e.g., *SAN 41273 and SAN 135405*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 300 m.

7. MIMUSOPS L.

(Greek, *mimos* = an ape, *opsis* = look alike; inference unknown)

L.C.J. Julaihi

Sp. Pl. 1 (1753) 349; Bentham & Hooker *f.*, Gen. Pl. 2 (1876) 661; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 199; Ridley, FMP 2 (1923) 277; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 234, *ibid.* 3, 8 (1927) 479; P. Royen, Blumea 6 (1952) 594; Backer & Bakhuizen *f.*, FJ 2 (1965) 191; Ng, TFM 1 (1972) 414; Chai, Some Ornamental & Roadside Plants of Sarawak (1984) 102; Corner, WSTM 3rd edition 2 (1988) 693; Pennington, Gen. Sapot. (1991) 120. **Synonyms:** *Imbricaria* Comm. *ex* Juss., Gen. Pl. (1789) 152; *Semicipium* Pierre, Not. Bot. Sapot. (1890) 10; *Kaukenia* Kuntze, Rev. Gen. Pl. 2 (1891) 406.

Shrubs or trees. **Stipules** often present, minute, caducous. **Leaves** spirally arranged, well-spaced along twigs or clustered at ends of twigs; blade with plane, wavy, or recurved margin; lateral veins arching and joining near leaf margin to form a smooth intramarginal vein or vein-loops; intercostal venation descending from leaf margin and parallel to lateral veins, or *reticulate*. **Inflorescences** 1–many-flowered fascicles, in axils of leaves or leaf scars. **Flowers** bisexual; *sepals* 8, in two whorls of 4, free, outer whorl valvate; corolla bell-shaped, hairy or glabrous, *lobes* 8, each lobe divided to base into 3 segments, median segments usually erect and clasping stamens, corolla tube much shorter than lobes; *stamens* 8, in a single whorl, inserted at throat of corolla tube; filaments free or partially fused to staminodes, anthers extrorse, hairy or glabrous; *staminodes* 8, well-developed, alternating with stamens, *hairy*; ovary 6–8-loculed, conoid, hairy, style subulate. **Fruit** a berry, 1–6-seeded; pericarp fleshy. **Seeds** laterally compressed; *scar* small, often circular or elliptic, *basal* or basi-ventral; cotyledons foliaceous; endosperm copious.

Distribution. About 30 species, distributed in the Old World tropics; 20 species in Africa, 15 in Madagascar, 4 in Mascarenes, 1 in Seychelles, and 1 in Asia and the Pacific Islands.

Taxonomy. *Mimusops* is closely allied to *Manilkara* Adans. but differs by having 8 sepals in two whorls of 4, 8 corolla lobes, 8 stamens and 8 well-developed staminodes. In *Manilkara*, the flowers have 6 sepals in two whorls of 3, 6 corolla lobes, 6 stamens and 6 staminodes.

Mimusops elengi L.

(after a Malabar plant name)

Fig. 16.

Sp. Pl. 1 (1753) 349; King & Gamble *l.c.* 199; Ridley *l.c.* 278; H.J. Lam *l.c.* (1925) 234, *l.c.* (1927) 479; Backer & Bakhuizen *f. l.c.* 191; Ng *l.c.* 414; Corner *l.c.* 694; Pennington *l.c.* 123; Turner, Gard. Bull. Sing. 47 (1995) 465. **Type:** unknown. **Synonyms:** *Mimusops parvifolia* R.Br., Prodr. (1810) 531; *M. obtusifolia* Blume, Bijdr. Fl. Ned. Ind. (1825) 673; *M. javensis* Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 63; *M. timorensis* Burck *l.c.* 63; *M. laterica* Elmer, Leaflet. Philip. Bot. 8 (1915) 2816; *M. elengi* L. var. *typica* (Blume *ex* Burck) H.J.Lam *l.c.* (1925) 235 (including forma *longepedunculata*); *M. elengi* L. var. *parvifolia* (R.Br.) H.J.Lam *l.c.* (1925) 236; *M. elengi* L. var. *brevifolia* H.J.Lam *l.c.* (1925) 236.

Tree to 20 m tall and 40 cm diameter. **Bark** finely fissured, greyish brown to dark brown; inner bark soft and fibrous, pinkish. **Sapwood** pink; heartwood reddish. **Twigs** slender, 1–3 mm thick, rusty-brown pubescent. **Stipules** lanceolate, *c.* 3 × 1 mm, rusty-brown pubescent. **Leaves** evenly scattered along twigs, chartaceous; elliptic, 4.5–9 × 1.8–5.4 cm, base cuneate, margin

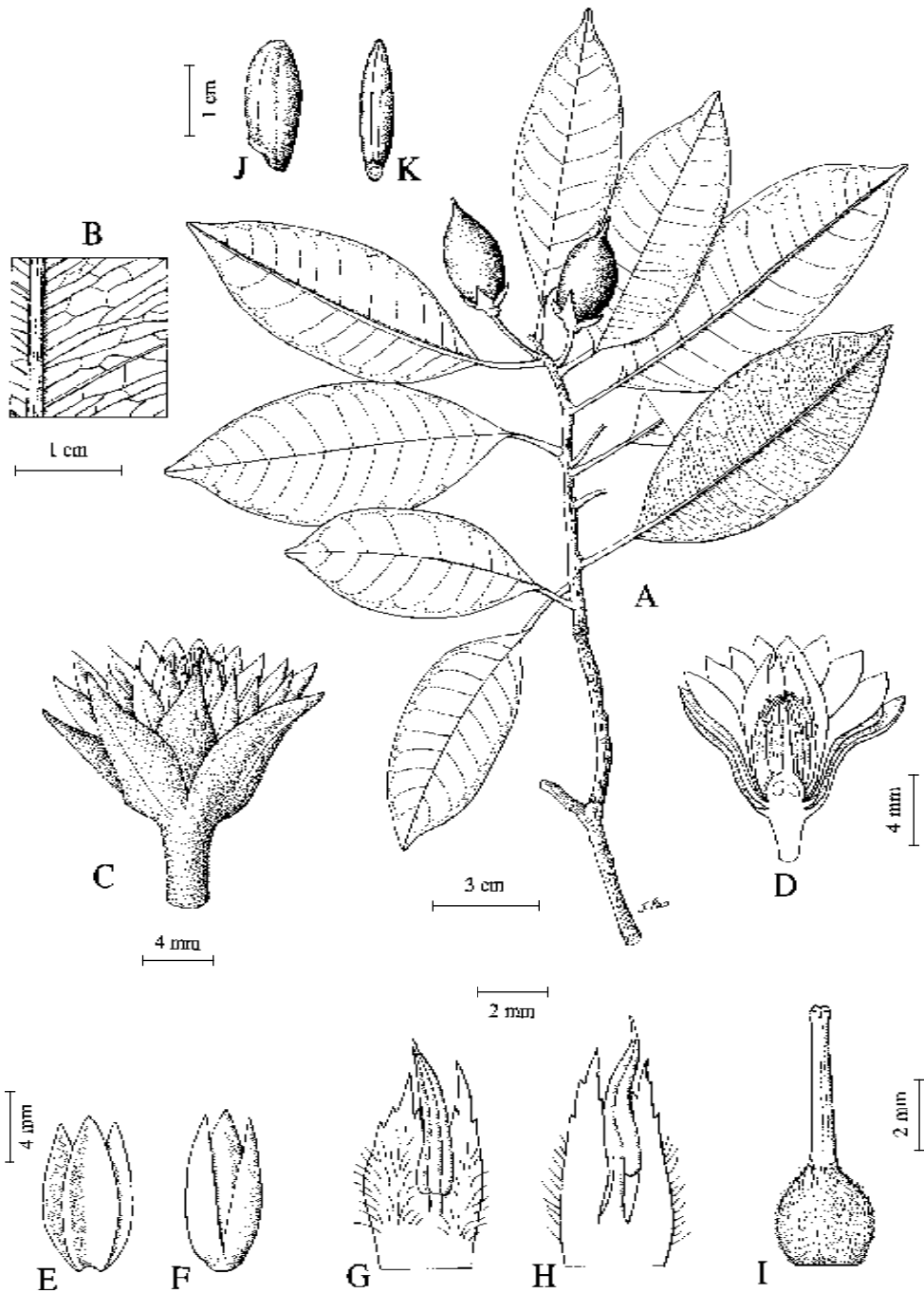


Fig. 16. *Mimusops elengi*. A, fruiting leafy twig; B, detail of leaf venation; C, open flower; D, longitudinal section of flower; E, adaxial side of petals; F, abaxial side of petals; G, frontal view of stamen; H, dorsal view of stamen; I, pistil; J, side view of seed; K, adaxial side of seed. (All from

wavy and recurved, apex short-acuminate; midrib slightly raised above, more prominent below; lateral veins 11–8 pairs, slender; petiole 0.6–2 cm long, grooved on adaxial side. **Inflorescences** axillary, 1–6-flowered. **Flowers** fragrant; pedicel 0.5–1 cm long, rusty-brown tomentose; sepals ovate-lanceolate, rusty-brown tomentose outside, glabrous within; corolla white, lobes linear lanceolate, inner lobes broader and shorter; filaments slender, *c.* 1.5 mm long, anthers sagittate; staminodes flat and hairy; ovary conoid, silky-brown tomentose, 6–8-loculed, style slender, *c.* 7 mm long. **Fruits** ovoid, *c.* 3 × 2 cm, 1–2-seeded, ripening orange; mesocarp (pulp) yellow. **Seeds** ellipsoid, *c.* 2 × 0.7 cm; scar *c.* 3 × 2 mm, basal.

Vernacular name. Sarawak—*bunga tanjong* (Malay).

Distribution. India, Sri Lanka, Myanmar, Thailand, Sumatra, Peninsular Malaysia, Borneo, Sulawesi, the Philippines, Maluku, Lesser Sunda Islands, Australia, and New Caledonia. In Borneo, scattered in littoral forest at Pulau Tiga, Beaufort and Sempurna in Sabah (e.g., *SAN 18473*, *SAN 34722*, *SAN 49140*, *SAN 84741*, and *SAN 93055*), and Semantan and Tg. Datu in Sarawak (e.g., *S 29943*, *S 32609* and *S 57560*).

Uses. *Bunga tanjong* is a popular village tree because of its fragrant flowers. It is also a good ornamental and roadside tree that adapts well in most sites. A decoction of the bark and flowers is used internally for fever and diarrhoea, and an infusion of the root is for treating sore throat. The leaves are boiled and applied to the head to relieve headache. Malay women use the flowers as a cosmetic.

8. PALAQUIUM Blanco

(After a Filipino name—*palak-palak*)

A.P. Abang Mohd. Mohtar

(elaborated by E. Soepadmo)

Fl. Filip. ed. 1 (1837) 403, *ibid.* ed. 2 (1845) 282; Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 22; Boerlage, Handl. Fl. Ned.-Indie 2, 1 (1891) 302; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 189; Dubard, Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 1, Bull. Mus. Hist. Nat., Paris 15 (1909) 379; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 14, *ibid.* 3, 8 (1927) 387; Ridley, FMP 2 (1923) 272, *ibid.* 5, Suppl. (1925) 319; Masamune, EPB (1942) 592; Browne, FTSB (1955) 155; P. Royen, Blumea 10 (1960) 433; Keng, OFMSP (1969) 224; Ng, TFM 1 (1972) 415; Anderson, CLTS (1980) 316; Corner, WSTM 3rd edition 2 (1988) 694; Whitmore, Tantra & Sutisna, CLK 2 (1990) 322; Pennington, Gen. Sapot. (1991) 148; Kessler & Sidiyasa, TBSA-EK (1994) 215; Coode *et al.* (eds.), CLBD (1996) 306; Argent *et al.* (eds.), MNDT-CK 2 (1997) 579; Kochummen, TFPF (1997) 412. **Synonyms:** *Bassia* sect. *Apobassia* A.DC., Prodr. 8 (1844) 198; *Dichopsis* Thwaites, Enum. Pl. Zeyl. (1864) 176; *Croixia* Pierre, Not. Bot. Sapot. (1890) 33; *Galactoxylon* Pierre, Not. Bot. Sapot. (1890) 6.

Trees. **Terminal buds** cone-like, glabrous to variously hairy. **Stipules** often present, commonly small and caducous. **Leaves** spirally arranged, well-spaced along twigs or more commonly clustered near ends of twigs, margin entire; lateral veins diminishing and becoming inconspicuous toward leaf margin, or arching and joining into intramarginal vein along leaf margin; intercostal venation scalariform or descending from leaf margin and parallel to lateral veins, or rarely reticulate. **Inflorescences** 1–many-flowered fascicles, axillary or borne in axils

of leaf scars. **Flowers** bisexual, rarely unisexual (plant dioecious), pedicellate; *sepals usually 6, in two whorls of 3*, free or slightly united, outer whorl more or less valvate; corolla lobes normally 6, each lobe not divided into segments, often contorted, rarely imbricate, at anthesis frequently spreading or reflexed, often longer than corolla tube, rarely only equalling it; corolla tube normally glabrous inside; *stamens (10–)12(–30)*, exserted, commonly in a single whorl, rarely in two or three alternating whorls, inserted near top of corolla tube or at base of corolla lobes, *filaments free* or sometimes partially united at base, anthers dehiscing extrorsely, introrsely or rarely laterally, frequently sagittate, large, hairy or glabrous; *staminodes absent*; disk (nectary) absent or rarely appears as a small swelling fused to ovary; ovary (5–)6(–10)-loculed, normally hairy, rarely glabrous, style long and tapering, exserted. **Fruits** 1–2(or rarely several)-seeded; pericarp thin or fleshy. **Seeds** usually broadly oblong or ellipsoid or laterally compressed; scar adaxial, broad or narrow; embryo with plano-convex or foliaceous cotyledons, without or with scanty endosperm.

Vernacular names. Sabah—*nyatoh* (preferred name). Sarawak—*njotu* (Bidayuh), *nyatoh* (preferred name), *nyatu* (Bidayuh, Kayan, Sadong), *pulut* (Murut).

Distribution. More than 110 species, ranging from India across SE Asia to the Pacific Islands. Most species are found in the Malesian region with the Philippines and Borneo being the centres of distribution with 32 species and 50 species respectively. In Sabah and Sarawak, 41 species are known.

Ecology. Common constituent of coastal, lowland mixed dipterocarp, freshwater swamp, and montane forests.

Uses. The timber produces a smooth planed surface which is non-durable under exposed conditions. It is suitable for medium construction if properly covered, hence widely used for interior finishing, panelling, partitioning, railings, furniture, mouldings and veneering. *Palaquium* was once known for its commercially prized latex, gutta-percha, which was widely used in the production of cable insulator and dental fillings.

Taxonomy. The genus *Palaquium* was first established in 1837 and typified by *Palaquium lanceolatum* Blanco from the Philippines. P. Royen (Blumea 10 (1960) 544) selected *Ramos 19483* as the neotype for the species due to the absence of Blanco's type specimen. In the past few decades, many species and infraspecific taxa were recognised, which has somehow perplexed the taxonomic position of the genus. The splitting into subspecies and varieties is deemed unnecessary for some species as the taxa involved are either justifiably new species or merely misidentified. Ng (*l.c.* 415) did not recognise any subspecies or varieties in the Malayan species. Likewise, infraspecific taxa reported for Sabah and Sarawak are not accepted in the present account.

Key to *Palaquium* species

1. Leaves well-spaced along twigs.....2
 Leaves clustered at ends of twigs.....24
2. Lateral veins arching and joining into intramarginal veins along leaf margin.....3
 Lateral veins diminishing and becoming inconspicuous toward leaf margin.....9

3. Intercostal venation scalariform.....4
 Intercostal venation descending from leaf margin and parallel to lateral veins or finely reticulate.....6
4. Leaves glabrous on both surfaces. Fruits oblong or fusiform.....
**41. P. xanthochymum** (in part)
 Leaves densely golden-tomentose or brownish woolly-pubescent below. Fruits globose or depressed ellipsoid or ellipsoid.....5
5. Twigs not covered with prominent leaf scars, densely brownish woolly-pubescent. Terminal buds to 10 mm long, densely woolly-pubescent. Stipules ovate. Leaves chartaceous; lateral veins 12–14 pairs. Stamens 18, anthers oblong....**19. P. majas**
 Twigs covered with prominent leaf scars, densely reddish-brown or golden tomentose. Terminal buds to 6 mm long, brownish tomentose. Stipules lanceolate. Leaves coriaceous; lateral veins 13–35 pairs. Stamens 12, anthers narrowly ovoid or sagittate.... **11. P. gutta** (in part)
6. Leaves coriaceous, glabrous above, brownish tomentose below.....
**20. P. microphyllum** (in part)
 Leaves chartaceous to subcoriaceous, glabrous on both surfaces.....7
7. Twigs reddish-brown tomentose. Stipules lanceolate, *c.* 1.5 × 0.5 mm. Inflorescences axillary or crowded along leafless parts of twigs; ovary discoid.....
**31. P. rostratum** (in part)
 Twigs glabrous. Stipules small, soon caducous. Inflorescences axillary; ovary ovoid.....
8
8. Leaf apex acuminate; petiole glabrous. Pedicel 7–12 mm long. Fruits 2–5 × 1.3–4 cm, 1-seeded. Seed obovoid, *c.* 1 × 0.8 cm.....**24. P. pseudocuneatum** (in part)
 Leaf apex rounded or obtuse; petiole brownish tomentose. Pedicel 3–4.5 mm long. Fruits 1–1.4 × 0.8–1.6 cm, 1–2-seeded. Seeds ellipsoid, *c.* 0.9 × 0.6 cm.....
**25. P. pseudorostratum**
9. Lateral veins more than 16 pairs.....10
 Lateral veins less than 16 pairs or rarely to 16 pairs.....14
10. Leaves thinly chartaceous. Stipules oblong.....**30. P. rivulare**
 Leaves subcoriaceous to coriaceous. Stipules lanceolate, triangular-lanceolate, linear-lanceolate or scale-like.....11
11. Twigs, lower leaf surface and pedicel brownish sericeous. Terminal buds to 5 mm long. Petiole 8–10 cm long, flat on adaxial side.....**33. P. sericeum**
 Twigs, lower leaf surface and pedicel otherwise. Terminal buds to 15 mm long. Petiole 1.5–4 cm long, grooved on adaxial side.....12
12. Terminal buds 7–8.5 mm long. Lateral veins 16–17 pairs.....**29. P. rioensis**
 Terminal buds to 15 mm long. Lateral veins 16–24 pairs.....13

13. Stipules scale-like, 4–10 × 3–5 mm. Leaves glabrous above, yellowish-brown tomentose below; lateral veins ascending at an angle of 50–60° from midrib. Stamens 19–27; anthers sagittate.....**35. P. stipulare**
 Stipules lanceolate, *c.* 5 × 1.5 mm. Leaves glabrous on both surfaces. Lateral veins ascending at an angle of 70–85° from midrib. Stamens 12; anthers oblong-ovoid.....**36. P. sumatranum**
14. Leaves glabrous on both surfaces.....15
 Leaves variously hairy below, at least on midrib and lateral veins.....17
15. Terminal buds to 10 mm long. Stipules lanceolate. Leaves chartaceous; lateral veins 12–14 pairs.....**38. P. tenuipetiolatum**
 Terminal buds to 4 mm long. Stipules triangular or triangular-lanceolate. Leaves subcoriaceous to coriaceous; lateral veins 5–12 pairs.....16
16. Leaves coriaceous; lateral veins 5–8 pairs, prominulous on both sides; intercostal venation inconspicuous below. Petiole greyish tomentose. Anthers sagittate, tomentose**21. P. multiflorum**
 Leaves subcoriaceous; lateral veins 7–12 pairs, impressed above, prominent below; intercostal venation prominulous below. Petiole glabrous. Anthers ellipsoid, glabrous**40. P. walsurifolium** (in part)
17. Twigs, lower leaf surface, petiole and pedicel shiny golden-sericeous. Stipules linear**2. P. calophyllum**
 Twigs, lower leaf surface, petiole and pedicel otherwise. Stipules not so.....18
18. Leaves larger, (8–)10–32 × (3.5–)4–8.5(–10) cm.....19
 Leaves smaller, 5–10(–12) × 1.8–4(–6 cm).....21
19. Terminal buds 3–4 mm long, reddish tomentose with woolly hairs. Intercostal venation inconspicuous on both sides. Anthers oblong, long-acuminate or bifid.....**6. P. dasyphyllum**
 Terminal buds to 10 mm long, brownish pubescent. Intercostal venation conspicuous on both sides. Anthers ovoid or sagittate.....20
20. Stipules lanceolate, *c.* 6 × 3 mm. Leaves chartaceous; lateral veins ascending at an angle of 55–65° from midrib. Petiole 1–1.2 cm long, flat and crested on adaxial side...**17. P. lisophyllum**
 Stipules linear-lanceolate, *c.* 10 × 2 mm. Leaves subcoriaceous; lateral veins ascending at an angle of 45–50° from midrib. Petiole 4–6 cm long, grooved on adaxial side.....**26. P. quercifolium**
21. Terminal buds to 5 mm long. Twigs subterete. Leaves sparsely tomentose below or brownish woolly-tomentose on midrib and lateral veins only; lateral veins 6–10 pairs. Petiole flat on adaxial side.....22
 Terminal buds to 10 mm long. Twigs angular. Leaves densely brownish-tomentose or sericeous below; lateral veins 8–15 pairs. Petiole grooved on adaxial side.....23

22. Twigs initially hairy, soon becoming glabrous. Leaves sparsely tomentose below; lateral veins prominulous above, prominent below. Sepals ovate; anthers cordate-ovate; ovary glabrous.....**4. P. crassifolium**
Twigs brownish pubescent with persistent long woolly-hairs. Leaves brownish woolly-tomentose on midrib and lateral veins only; lateral veins prominent on both sides. Sepals lanceolate; anthers sagittate; ovary densely brownish-hairy.....**5. P. cryptocariifolium**
23. Stipules lanceolate, *c.* 4 × 2.5 mm. Leaves coriaceous; lateral veins ascending at an angle of 30–40° from midrib. Inflorescences borne in axils of leaf scars; anthers ovoid-oblong, dehiscing laterally or subextrorsely.....**10. P. ferrugineum**
Stipules twisted and flag-shaped, to 8 mm long. Leaves chartaceous; lateral veins ascending at an angle of 60–65° from midrib. Inflorescences axillary; anthers sagittate, dehiscing extrorsely.....**39. P. vexillatum**
24. Lateral veins arching and joining into intramarginal vein along leaf margin.....25
Lateral veins diminishing and becoming inconspicuous toward leaf margin.....31
25. Twigs covered with prominent leaf scars.....26
Twigs otherwise.....29
26. Leaves coriaceous, densely dark reddish-brown woolly pubescent or golden tomentose below. Stipules lanceolate.....27
Leaves membranaceous, chartaceous to subcoriaceous, glabrous on both surfaces or pubescent on midrib only. Stipules ovate.....28
27. Leaves larger, 18–37.5 × 4–14 cm; lateral veins 27–35 pairs, ascending at an angle of *c.* 60°. Inflorescences borne on twigs below leaves or in axils of terminal leaves. Pedicel 4–6 mm long; corolla 8–10 mm long.....**1. P. beccarianum**
Leaves smaller, 9.5–13 × 3–8 cm; lateral veins 13–27 pairs, ascending at an angle of 75–85°. Inflorescences axillary. Pedicel 3–15 mm long; corolla to 2 mm long.....**11. P. gutta** (in part)
28. Terminal bud to 3 mm long. Leaves pubescent on midrib only; lateral veins 13–15 pairs; intercostal venation laxly reticulate. Inflorescences borne in axils of leaf scars; pedicel 8–12 mm long; anthers lanceolate; ovary brownish hirsute. Fruits globose, 1.2–1.5 cm diameter; pericarp thin. Seeds laterally compressed; scar covering *c.* one third of seed surface.....**32. P. rufolanigerum**
Terminal bud to 6 mm long. Leaves glabrous on both surfaces; lateral veins 14–20 pairs; intercostal venation scalariform or subreticulate. Inflorescences axillary; pedicel 3–9 mm long; anthers oblong; ovary glabrous. Fruits oblong or fusiform, *c.* 3.5 × 1.5 cm; pericarp fleshy. Seeds fusiform; scar covering about half of seed surface.....**41. P. xanthochymum** (in part)
29. Leaves coriaceous, glabrous above, brownish tomentose below. Fruits globose, *c.* 2.5 cm diameter.....**20. P. microphyllum** (in part)
Leaves chartaceous to subcoriaceous, glabrous on both surfaces. Fruits ellipsoid, 2–5 × 1.2–4 cm.....30

30. Twigs glabrous. Stipules small, caducous. Leaves subcoriaceous; lateral veins 12–14 pairs; petiole to 1.5 cm long, grooved on adaxial side.....
 **24. P. pseudocuneatum** (in part)
 Twigs reddish-brown tomentose. Stipules lanceolate, *c.* 1.5 × 0.5 mm. Leaves chartaceous; lateral veins 15–18 pairs; petiole to 4 cm long, flat on adaxial side.....
 **31. P. rostratum** (in part)
31. Leaves glabrous on both surfaces.....32
 Leaves variously hairy at least on lower surface and/or midrib and lateral veins only.....
 36
32. Twigs glabrous.....**3. P. cochlearifolium**
 Twigs variously hairy.....33
33. Leaves elliptic; lateral veins 17–20 pairs. Pedicel 18–21.5 mm long. Fruits ovoid..... **9. P. elegans**
 Leaves obovate; lateral veins 8–12(–17) pairs. Pedicel 7–17 mm long. Fruits globose, subglobose or obovoid.....34
34. Stipules triangular, *c.* 2.5 mm across. Pedicel 15–17 mm long; anthers ellipsoid. Fruits subglobose.....**40. P. walsurifolium** (in part)
 Stipules ovate or ovate-lanceolate, 2–2.5 × 1–2 mm. Pedicel 7–15 mm long; anthers oblong. Fruits globose or obovoid.....35
35. Stipules ovate-lanceolate, *c.* 2 × 1 mm. Leaves subcoriaceous to thickly coriaceous; lateral veins 8–10 pairs, ascending at an angle of *c.* 45° from midrib; petiole 0.8–2 cm long. Ovary ellipsoid, glabrous. Fruits obovoid, *c.* 1.5 × 1 cm.....**27. P. ridleyi**
 Stipules ovate, *c.* 2.5 × 2 mm. Leaves chartaceous; lateral veins 12–17 pairs, ascending at an angle of 65–75° from midrib; petiole 2–2.8 cm long. Ovary disc-like, brownish tomentose. Fruits globose, 8–10 cm diameter.....**28. P. rigidum**
36. Leaves sparsely greyish hairy on both surfaces or pubescent on midrib and lateral veins only..... 37
 Leaves variously densely hairy on lower side.....38
37. Leaves sparsely greyish-hairy on both surfaces; broadly obovate, 3–7.5 × 2–5 cm; lateral veins ascending at an angle of 40–45° from midrib; intercostal venation inconspicuous on both sides; petiole crested or flat on adaxial side. Ovary sparsely tomentose. Fruits ellipsoid, 1–1.4 × 0.7–1 cm, 1-seeded..... **12. P. herveyi**
 Leaves stellate-hairy on midrib and lateral veins only; elliptic to oblong, 9–13.5 × 3–5 cm; lateral veins ascending at an angle of *c.* 55° from midrib; intercostal venation conspicuous on both sides; petiole shallowly grooved on adaxial side. Ovary brownish hirsute. Fruits subglobose to globose, 2–2.5 cm across, 1–3-seeded.....**34. P. stellatum**
38. Leaves smaller, 5–11 × 2–4 cm; lateral veins 6–11 pairs.....39
 Leaves larger, (10–)14–25(–38) × 5–16.5 cm; lateral veins (10–)12–30 pairs...40

39. Leaves coriaceous; lateral veins ascending at an angle of 40–45° from midrib. Flowers in fascicles of 2–3. Fruits ellipsoid, *c.* 1.5 × 1 cm.....**8. *P. edeni***
 Leaves chartaceous to subcoriaceous; lateral veins ascending at an angle of 60–70° from midrib. Flowers in fascicles of to 18. Fruits globose or ovoid, 2–3 × 1.5–2 cm.....
**13. *P. hexandrum***
40. Leaves chartaceous to subcoriaceous.....41
 Leaves coriaceous.....42
41. Terminal buds to 12 mm long. Lateral veins 18–24 pairs. Anthers dehiscing laterally. Ovary subglobose, brownish pubescent. Fruits ellipsoid, 2–3 × 1.5–2 cm.....
**7. *P. decurrens***
 Terminal buds to 20 mm long. Lateral veins 10–18 pairs. Anthers dehiscing extrorsely. Ovary conical, glabrous. Fruits globose, 2.5–3 cm diameter.....**22. *P. obovatum***
42. Terminal buds 8–12 mm long.....43
 Terminal buds 14–20 mm long.....45
43. Stipules to 10 mm long. Intercostal venation prominent on both sides. Petiole *c.* 1.5 cm long. Pedicel *c.* 25 mm long; anthers ovoid.....**37. *P. supfianum***
 Stipules 5–7 × 3.5 mm. Intercostal venation prominulous or inconspicuous above. Petiole 1.5–5 cm long. Pedicel 4–18 mm long; anthers lanceolate-oblong or sagittate.....44
44. Leaves densely yellowish tomentose below, 12–24 × 6–15 cm; lateral veins 15–16 pairs. Pedicel to 4 mm long; anthers lanceolate-oblong; ovary glabrous. Fruits ovoid, *c.* 1 × 0.6 cm.....**15. *P. kinabaluense***
 Leaves densely rusty-brown tomentose below, 10–17 × 5.5–12 cm; lateral veins 13–23 pairs. Pedicel 8–18 mm long; anthers sagittate; ovary brownish tomentose. Fruits ellipsoid or globose, 1–3 × 1–2.5 cm.....**16. *P. leiocarpum***
45. Twigs brownish pubescent with hirsute hairs. Lateral veins 19–30 pairs, ascending at an angle to 50° from midrib; petiole to 0.5 cm long. Pedicel to 5 mm long. Fruits subglobose, 1.8–2.4 × 1.4–1.8 cm.....**14. *P. hispidum***
 Twigs brownish woolly-tomentose, glabrescent. Lateral veins 12–22 pairs, ascending at an angle of 50–65° from midrib; petiole 2–6 cm long. Pedicel 7–20 mm long. Fruits ellipsoid, globose or ovoid-oblong, 3.5–7 × 2.5–3 cm.....46
46. Leaves smaller, 16–24 × 8.5–15 cm; intercostal venation prominent on both sides; petiole brownish woolly-tomentose. Pedicel 7–11 mm long; corolla to 12 mm long; anthers sagittate; ovary discoid, glabrous. Fruits ellipsoid or globose, *c.* 3.5 × 2.5 cm.....**18. *P. maingayi***
 Leaves larger, 26–33 × 10.5–16.5 cm; intercostal venation inconspicuous above, prominent below; petiole glabrous. Pedicel 8–20 mm long; corolla 15–20 mm long, anthers oblong; ovary subglobose to ovoid, hirsute. Fruits ovoid-oblong, *c.* 7 × 3 cm.....**23. *P. ottolanderi***

1. *Palaquium beccarianum* (Pierre) P. Royen.

Fig. 17.

(After Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Blumea 8 (1957) 424, *ibid.* 10 (1960) 461; Anderson *l.c.* (1980) 316; Whitmore, Tantra & Sutisna *l.c.* 322. Argent *et al.* (eds.) *l.c.* 581; Kessler & Sidiyasa *l.c.* 216. **Basionym:** *Croixia beccariana* Pierre, Not. Bot. Sapot. (1890) 33. **Type:** *Beccari PB 4069*, Borneo, Sarawak, Kuching, Matang (holotype P; isotypes FI, L). **Synonyms:** *Planchonella beccariana* (Pierre) H.J. Lam *l.c.* (1925) 216, *l.c.* (1927) 382, 475; *Planchonella pierreana* Dubard, Ann. Mus. Col. Mars. 20 (1912) 60; *Palaquium ferox* H.J. Lam *l.c.* (1925) 70, 256, *l.c.* (1927) 401, *p.p.*, *excl. specim. Hamid 10582*.

Tree to 20 m tall. **Bark** reddish brown, deeply regularly fissured; inner bark pinkish. **Twigs** stout, 8–17 mm diameter, covered with prominent leaf scars, densely dark reddish-brown woolly pubescent. **Terminal buds** to 5 mm long, densely dark reddish-brown woolly pubescent. **Stipules lanceolate**, *c.* 10 × 5 mm, apex obtuse, densely tomentose outside, glabrous inside, caducous. **Leaves clustered at ends of twigs, coriaceous**, glabrous above, densely dark reddish-brown woolly pubescent below; oblanceolate or obovate to obovate-oblong, 18–37.5 × 4–14 cm, base narrowly acute, apex acute to rounded; midrib impressed and crested above, prominent below; lateral veins 27–35 pairs, ascending at an angle of *c.* 60° from midrib, arching and joining into intramarginal vein along leaf margin; intercostal venation scalariform; petiole 2–4 cm long, grooved on adaxial side, densely dark reddish-brown woolly pubescent. **Inflorescences borne on twigs below leaves or in axils of terminal leaves**; fascicles 3–5-flowered. **Flowers:** pedicel angular, 4–6 mm long, reddish-brown pubescent; sepals ovate to lanceolate, 3–5 × 2–2.5 mm, apex of outer sepals obtuse, that of inner sepals acute, pubescent outside, glabrous inside; corolla 8–10 mm long, lobes ovate to elliptic, apex obtuse; stamens 12, filaments slender, *c.* 8 mm long, anthers narrowly ovoid, 2–2.5 mm long; ovary discoid-conoid, *c.* 1.5 × 2 mm, 6-loculed, glabrous, style subulate, 14–18 mm long, glabrous. **Fruits** ellipsoid, 2.5–3.5 × 1.5–2 cm, apex obtuse, 1-seeded, with persistent sepals; pericarp fleshy, glabrous. **Seeds** ellipsoid, 2–2.6 × 1–1.7 cm, apex mucronate, base acuminate; scar covering about half of seed surface.

Vernacular name. Sabah—*nyatoh bulu* (Malay).

Distribution. Endemic to Borneo. In Sarawak, mainly found in Kuching Division (e.g., *Beccari PB 4069*), and particularly common in the Semengoh FR. In Sabah, mostly recorded from Sandakan district (e.g., *KEP 70519*, *SAN 17670*, *SAN 92727*, and *Sinclair 9319*). Also occurs in Kalimantan (e.g., *bb. 10410*, *bb. 15849*, *bb. 29316*, *Kostermans 5401* and *Kostermans 6714*).

Ecology. Mostly in lowland mixed dipterocarp forest on fertile loamy soils; occasionally also in limestone forest.

2. *Palaquium calophyllum* (Teijsm. & Binn.) Pierre

Fig. 18.

(Greek, *calophyllum* = with beautiful leaves)

In Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 28; Merrill, Enum. Philip. Fl. Pl. 3 (1923) 279; H.J. Lam *l.c.* (1925) 52, *l.c.* (1927) 398; Masamune *l.c.* 592; P. Royen *l.c.* (1960) 558; Anderson *l.c.* 316; Whitmore, Tantra & Sutisna *l.c.* 322; Pennington *l.c.* 150; Coode *et al.* (eds.) *l.c.* 306; Argent *et al.* (eds.) *l.c.* 581. **Basionym:** *Isonandra calophylla* Teijsm. & Binn., Nat. Tijdschr. Ned.-Indie 27 (1864) 35. **Type:** *Teijsmann s.n.*, Borneo, Kalimantan (holotype BO). **Synonyms:** *Dichopsis calophylla* (Teijsm. & Binn.) Benth. & Hook.f., Gen. Pl. 2. (1876) 658; *Croixia calophylla* (Teijsm. & Binn.) Baehni, Boissiera 11 (1965) 109.

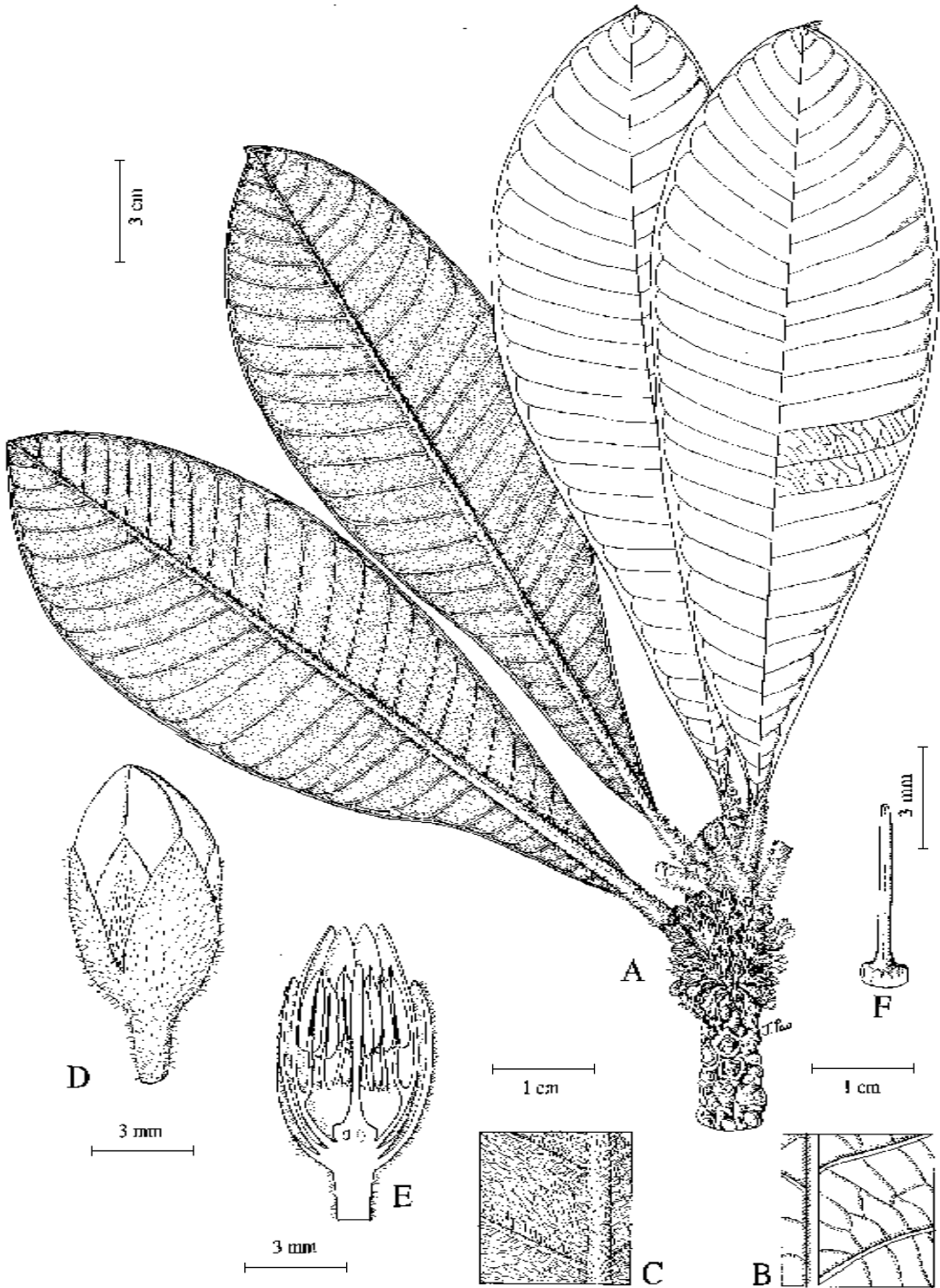


Fig. 17. *Palaquium beccarianum*. A, flowering leafy twig; B, detail of leaf venation; C, indumentum on lower leaf surface; D, flower bud; E, longitudinal section of flower bud; F, pistil. (All from SAN 92727.)

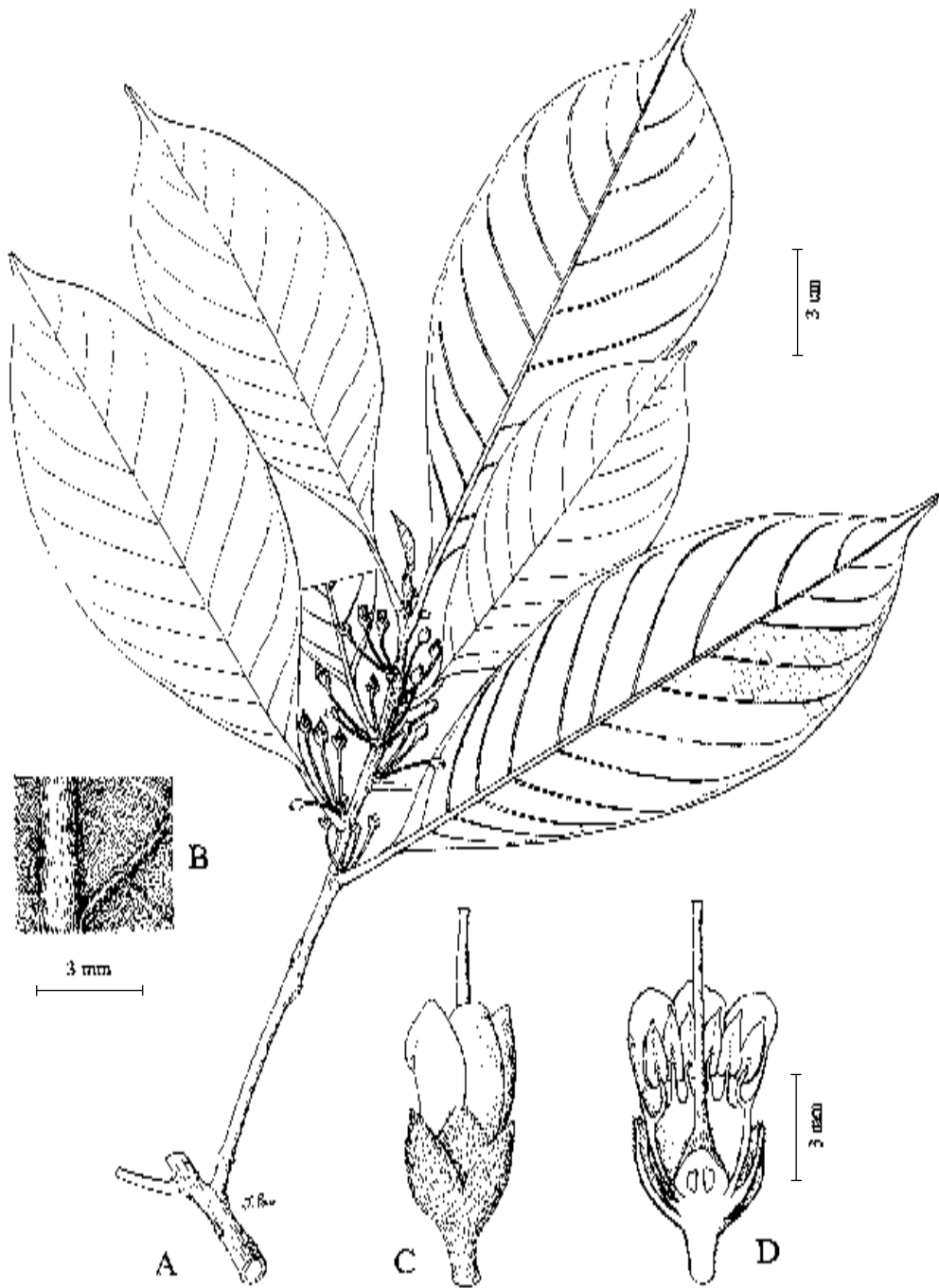


Fig. 18. *Palaquium calophyllum*. A, flowering leafy twig; B, indumentum on lower leaf surface; C, flower; D, longitudinal section of flower. (All from *S 18487*.)

Tree to 20 m tall. **Bark** brownish grey, smooth to slightly cracked, inner bark light brown to cream. **Twigs** subterete to angular, slender, 2–5 mm diameter, *shiny golden-sericeous*, older twigs brownish. **Terminal buds** 5–7 mm long. **Stipules** linear, 3.5–4 × 1.5–2 mm, brownish tomentose outside, glabrous inside. **Leaves** *well-spaced along twigs*, chartaceous or coriaceous, glabrous above, *shiny golden-sericeous below*; elliptic to obovate, 9–23.5 × 3.5–11 cm, base cuneate, decurrent, apex acute to acuminate; midrib impressed above, prominent below; *lateral veins 8–16 pairs*, ascending at an angle of 40–45° from midrib, straight and parallel, arching, *diminishing and becoming inconspicuous toward leaf margin*, inconspicuous above, prominent below; intercostal venation scalariform, inconspicuous above, fine but distinct below; *petiole* 1.5–2.5 cm long, grooved on adaxial side, swollen at base, *shiny golden-sericeous*. **Inflorescences** axillary or in axils of leaf scars, fascicles 2–12-flowered. **Flowers:** *pedicel* angular, 10–30 mm long, *shiny golden-sericeous*; sepals triangular or ovate, 3–4 × 2.5–3.5 mm, golden tomentose outside, glabrous inside; corolla 5–6 mm long, sparingly hairy especially in the middle of lobes, lobes lanceolate, obtuse at apex, at anthesis reflexed; stamens 12, filaments 2–3.5 mm long, subulate, angular, glabrous, anthers sagittate to ovoid (sometimes bifid), dehiscing laterally, brownish tomentose; ovary conical, 2.5–3 mm long, 6-loculed, 6-lobed, sericeous, style slender, sericeous at base. **Fruits** globose, 1.5–2 cm diameter, 1–2-seeded; pericarp hard, densely tomentose. **Seeds** almost globose, *c.* 1 × 0.8 cm; scar covering to one third of seed surface.

Vernacular name. Sarawak—*nyatu dien* (Bidayuh).

Distribution. Sumatra, Borneo, the Philippines, Maluku, and New Guinea. Recorded throughout Sabah and Sarawak. Particularly common in Bako NP in the southwestern part of Sarawak (e.g., *Clemens 22200, S 18487, S 37838, S 43583, and S 49883*) and in the southwestern part of Sabah (e.g., *SAN 16778, SAN 16985, SAN 23067, SAN 88368, and SAN 117537*). Also occurs in the eastern part of Kalimantan (e.g., *bb. 15242, bb. 29707, Kostermans 6668, Kostermans 7030, Tuke P2 336, and Tuke P2 488*), and in Brunei (e.g., *BRUN 894 and BRUN 3398*).

Ecology. Mostly in mixed dipterocarp forest at altitudes to 800 m; also in alluvial forest and *kerangas* forest.

3. *Palaquium cochlearifolium* P.Royen

Fig. 19.

(Latin, *cochlearis* = spoon-shaped, *folium* = leaf; the spoon-shaped leaves)

Blumea 10 (1960) 545; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 322; Pennington *l.c.* 150; Coode *et al.* (eds.) *l.c.* 306; Argent *et al.* (eds.) *l.c.* 581. **Type:** *Buwalda 7810*, Borneo, Kalimantan, Sampit (holotype L; isotypes BO, PNH, SING).

Tree to 30 m tall, 45 cm diameter. **Bark** dark brown, shallowly cracked to irregularly fissured, sometimes with soft lenticels between fissures; inner bark pinkish to red, fibrous. **Twigs** stout, terete, 4–8 mm diameter, with numerous leaf scars, *glabrous*. **Terminal buds** to 5 mm long, glabrous. **Stipules** triangular, *c.* 1 × 1 mm, glabrous, caducous. **Leaves** *clustered at ends of twigs*, coriaceous, *glabrous on both surfaces*; cochleate or obovate, 9.5–17 × 4–7.5 cm; base cuneate to rounded, apex rounded, subobtuse, acute or obtusely short-acuminate; midrib flat and crested above, prominent below; *lateral veins 6–10 pairs*, ascending at an angle of 75–85° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, faint to distinct on both sides; intercostal venation scalariform, faint to prominent on both sides; *petiole* 1.5–5 cm long, grooved

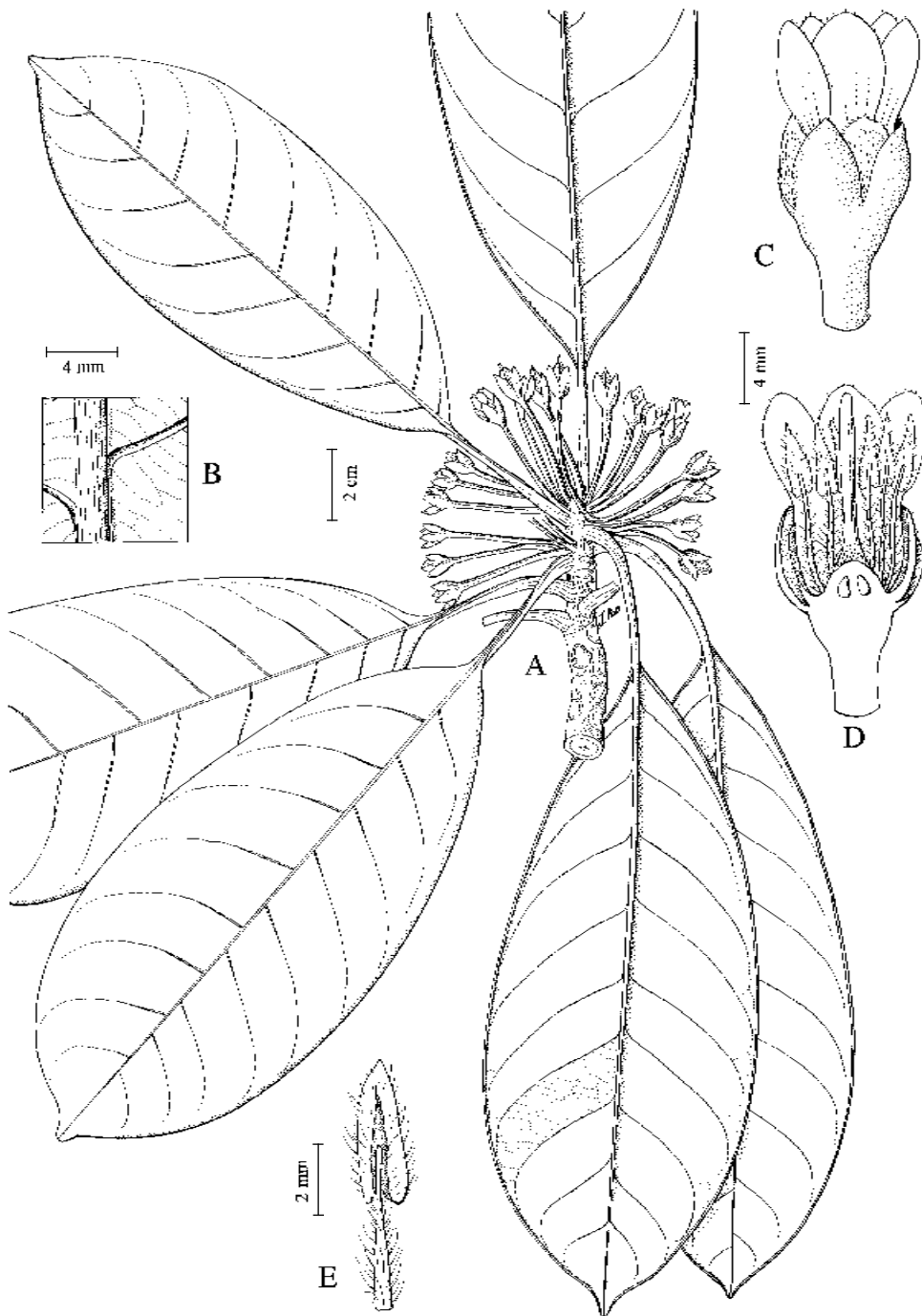


Fig. 19. *Palaquium cochlearifolium*. A, flowering leafy twig; B, detail of venation on lower leaf surface; C, flower; D, longitudinal section of flower; E, stamen. (All from S 8697.)

and crested on adaxial side, thickened at base, glabrous. **Inflorescences** axillary or terminal, fascicles 3–14-flowered. **Flowers:** pedicel angular, 20–35 mm long, glabrous; sepals ovate, 5–8 × 4–5 mm, outer ones glabrous on both sides, inner ones pubescent with short hairs outside, glabrous inside; corolla lobes elliptic, to 10 mm long; stamens 12, filaments linear, 3–10 mm long, anthers oblong, 2–3 mm long, hairy, dehiscent extrorsely; ovary conical, 6-loculed, hairy at base, style 4–9 mm long, sparsely hairy. **Fruits** ellipsoid, *c.* 2.5 × 2 cm, 1-seeded; pericarp fleshy, glabrous. **Seeds** *c.* 1.5 × 1 cm; scar covering to half of seed surface.

Vernacular names. Sabah—*paga* (Kadazan). Sarawak—*nyatoh jelutong*, *nyatoh temiang* (Iban).

Distribution. Endemic to Borneo. Locally common in Sabah (e.g., *KEP 48496* and *SANA 1731*) and Sarawak (e.g., *S 653*, *S 1418*, *S 2867*, *S 8697*, and *S 57113*). Also occurs in Brunei (e.g., *BRUN 978*, *BRUN 3248*, *S 5860*, and *SAN 17443*) and Kalimantan (e.g., *bb. 13476*, *bb. 15688*, *bb. 33043*, and *Buwalda 7810*).

Ecology. Exclusively a swamp forest species, particularly common in the *Dacrydium-Casuarina* association of peat swamp forest in Lawas, Sarawak. Also occurs in *kerangas* forest throughout Sabah and Sarawak.

4. *Palaquium crassifolium* Pierre ex Dubard

(Latin, *crassus* = thick; *folium* = leaf; having thick leaves)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 23; H.J. Lam *l.c.* (1925) 35, *l.c.* (1927) 391; Masamune *l.c.* 593; P. Royen *l.c.* (1960) 490; Whitmore, Tantra & Sutisna *l.c.* 322; Pennington *l.c.* 152 (as a doubtful species). **Type:** *Beccari PB 2099*, Borneo, Sarawak (holotype P; isotypes FI, L).

Tree. **Twigs** *subterete*, slender, *c.* 2.5 mm diameter, *initially hairy, soon becoming glabrous*. **Terminal buds** *to 5 mm long*. **Stipules** *lanceolate*, *c.* 4 × 2 mm, apex acute, light brown tomentose outside, brownish hairy inside, caducous. **Leaves** *well-spaced along twigs*, subcoriaceous, glabrous above, *sparsely tomentose below*; obovate, 8–10 × 2.6–5 cm, base cuneate, apex obtuse or nearly so; midrib impressed above, prominent below; *lateral veins 6–7 pairs*, ascending at an angle of *c.* 45° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, *prominulous above, prominent below*; intercostal venation laxly scalariform, inconspicuous on both sides; *petiole 1–1.6 cm long, flat on adaxial side*, slightly thickened at base, *brownish tomentose*, glabrescent. **Inflorescences** axillary, fascicles 2–3-flowered. **Flowers:** *pedicel brownish tomentose*; *sepals 4 or 6, ovate, 2–2.5 × 1.8–2.2 mm*, brownish tomentose outside, glabrous inside, inner sepals with hairy margin; corolla lobes spatulate, 4 or 6, *c.* 4.2 × 2.2 mm; stamens 12, sometimes 9, inserted at base of corolla lobes, filaments subulate, 2–2.5 mm long, *anthers cordate-ovate, 2–2.5 mm long, apex apiculate, sparsely hairy*; *ovary ovoid, c. 2 × 1 mm, 6-loculed, glabrous*, style slender, 6–8 mm long, glabrous. **Fruits and seeds** unknown.

Vernacular name. Sarawak—*nyatoh temiang* (Iban).

Distribution. Endemic to Borneo. Rare, known only by a few collections from Sarawak (e.g., *Beccari PB 2099*, *Egon 934* and *S 68746*).

Ecology. In mixed dipterocarp forest.

5. *Palaquium cryptocariifolium* P.Royen

(Latin, with leaves resembling those of the genus *Cryptocarya*, Lauraceae)

Blumea 10 (1960) 504, *p.p.*, *excl.* fig. 8 (= *P. reginamontium* Ng); Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 322. **Type:** *Forest Service Sarawak 1*, Borneo, Sarawak, Semengoh FR (holotype E; isotype L).

Tree to 35 m tall. **Bark** finely fissured, brownish grey, inner bark laminated, reddish brown. **Twigs** *subterete*, slender, *c.* 3 mm diameter, *brownish pubescent with persistent long woolly-hairs*. **Terminal buds** to 4 mm long, brownish tomentose. **Stipules** *ovate-lanceolate*, *c.* 5 × 3 mm, brownish tomentose. **Leaves** *mostly well-spaced along twigs*, rarely clustered at ends of twigs, subcoriaceous, *brownish woolly-tomentose on midrib and lateral veins on both surfaces*; obovate to obovate-elliptic, 6–12 × 3–6 cm, base cuneate, apex obtuse to acuminate; *lateral veins 6–10 pairs*, ascending at an angle of 45–50° from midrib, *diminishing and becoming inconspicuous toward leaf margin, prominent on both sides*; intercostal venation scalariform, fine, obscure on both sides; *petiole 1–3 cm long, flat on adaxial side, rounded on abaxial side, densely brown-hairy*. **Inflorescences** axillary, densely crowded along apical portion of shoots. **Flowers:** *pedicel* angular, 3–8 mm long, *densely brownish-hairy*; *sepals 6, lanceolate, c.* 4.5 × 2 mm, apex obtuse, brownish hairy outside, glabrous inside, inner sepals glabrous; corolla 4–5.5 mm long, sparsely hairy, petals 6, narrowly ovate, apex truncate, fimbriate; stamens 12, filaments subulate, *c.* 1 mm long, glabrous, *anthers sagittate*, 1–1.5 mm long, sparsely brownish-hairy, dehiscent extrorsely; *ovary* conical, *c.* 2.5 × 1.5 mm, 6–7-loculed, *densely brownish-hairy*, style subulate, *c.* 2.5 mm long, glabrous. **Fruits** ellipsoid, 1–2 × 1–1.5 cm, glabrous, normally 1-seeded. **Seeds** *c.* 1.4 × 1 cm.

Distribution. Endemic to Borneo. Recorded from the southwestern and northernmost parts of Sarawak (e.g., *Caroll 1166, S 0168, S 17891, S 37011, and S 38342*). Also occurs in C Kalimantan.

Ecology. In mixed dipterocarp forest and *kerangas* forest.

6. *Palaquium dasyphyllum* Pierre *ex* Dubard

(Greek, *dasus* = thickly hairy, *phullon* = leaf; alluding the lower surface of leaves)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 8; H.J. Lam *l.c.* (1925) 73, *l.c.* (1927) 405; Masamune, *l.c.* 593; P. Royen *l.c.* (1960) 497; Anderson *l.c.* 317, Whitmore, Tantra & Sutisna *l.c.* 323; Pennington *l.c.* 150; Argent *et al.* (eds.) *l.c.* 583. **Type:** *Teijsmann s.n.*, Borneo, Kalimantan, Bandjarmasin (holotype BO; isotype L). **Synonyms:** *Isonandra dasyphylla auct. non* Miq.: de Vriese, *Nat. Tijdschr. Ned.-Indie* 21 (1860) 307; *Palaquium stenophyllum* H.J.Lam *l.c.* (1925) 97, *l.c.* (1927) 411, Merrill, PEB (1929) 238.

Tree to 36 m tall, 65 cm diameter. **Bark** smooth, dark brown, inner bark chocolate brown. **Twigs** *terete*, slender, 2–4 mm diameter, *densely brownish-tomentose towards terminal bud*. **Terminal buds** 3–4 mm long, *reddish tomentose with woolly hairs*. **Stipules** *linear-lanceolate*, *c.* 9 × 2 mm, densely reddish to brownish tomentose, caducous. **Leaves** *well-spaced along twigs*, subcoriaceous, glabrous above except for the orange-red hairy basal part of midrib, *appressed hairy below*; oblong to elliptic, 10–23 × 4–7.5 cm, base cuneate, apex obtuse to rounded or obtusely acuminate; midrib impressed above, rounded and prominent below; *lateral veins 9–12*

pairs, ascending at an angle of 40–75° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, slightly conspicuous and impressed above, prominent below; *intercostal venation* scalariform, *inconspicuous on both sides*; *petiole* 1.3–2 cm long, grooved on adaxial side, thickened towards base, *brownish woolly-tomentose* or partly glabrescent. **Inflorescences** axillary, fascicles 2–10-flowered. **Flowers:** *pedicel* angular, *brownish pubescent with hirsute hairs*; sepals ovate-oblong to linear-lanceolate, 3.5–5 × 1.5–3 mm, tomentose outside, glabrous inside, inner sepals glabrous; corolla lobes lanceolate, 6.5–12 mm long, glabrous except for some part outside corolla tube which is brownish sericeous; stamens 12, filaments linear, 1–3 mm long, *anthers oblong*, 3–4 mm long, *long-acuminate* or *bifid*, dehiscing extrorsely or laterally, brownish sericeous; ovary ovoid, 2.5 × 2–2.5 mm, 6-loculed, appressed hairy, style slender, 10–15 mm long, glabrous but pubescent at base. **Fruits** ovoid, obovoid to ellipsoid, 1–2.4 × 0.8–1.5 cm, 1-seeded; pericarp fleshy, glabrous. **Seeds** spindle-shaped, *c.* 1.2 × 0.5 cm; scar covering about half of seed surface.

Vernacular name. Sabah—*nyatoh sidang* (Dusun).

Distribution. Sumatra and Borneo. In Borneo, common especially in Sandakan and Tawau districts in Sabah (e.g., *SAN 30356*, *SAN 30973*, *SAN 31384*, *SAN 35851*, and *SAN 88152*), and in Kapit and Marudi districts in Sarawak (e.g., *Haviland 508*, *S 21820*, *S 23028*, *S 23084*, and *S 33559*). Also known in Kalimantan (e.g., *bb. 6823*, *bb. 13755*, *Kostermans 4271*, and *Kostermans 6823*) and possibly in Brunei.

Ecology. In hill mixed dipterocarp to montane forests, at altitudes above 950 m, rarely in *kerangas* and limestone forest.

7. *Palaquium decurrens* H.J.Lam

(Latin, *decurrens* = running down; referring to the leaf base)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 51, *l.c.* (1927) 398; Masamune *l.c.* 593; P. Royen *l.c.* (1960) 487; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 323; Argent *et al.* (eds.) *l.c.* 583. **Type:** *Hallier 357*, Borneo, Kalimantan, Lumukutan (holotype BO; isotypes L, NY).

Trees to 34 m tall, 50 cm diameter. **Bark** dark brown, finely fissured to finely flaky, inner bark pink and grey-mottled. **Twigs** stout, subterete to angular, 8–12 mm diameter, brownish sericeous, glabrescent. **Terminal buds** to 12 mm long, brownish sericeous. **Stipules** lanceolate, 5 × 3–4 mm, brownish sericeous, caducous. **Leaves** clustered at ends of twigs, chartaceous, glabrous above, densely brownish-sericeous below; obovate, 25–38 × 10.5–16.5 cm, base cuneate, decurrent, apex acuminate, rounded or emarginate; midrib impressed above, prominent below; *lateral veins* 18–24 pairs, ascending at an angle of 55–60° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, slightly impressed above, rounded and prominent below; *intercostal venation* scalariform, prominulous on both sides; *petiole* 2.5–3.5 cm long, adaxial side grooved on upper part, flat at base. **Inflorescences** axillary, fascicles 3–8-flowered. **Flowers:** *pedicel* angular, 5–23 mm long, pubescent; sepals lanceolate, *c.* 5 × 2.5 mm, brownish sericeous; corolla lobes 6, lanceolate, 3.5–4 mm long; stamens 12, filaments subulate, *c.* 1 mm long, *anthers* ovoid, 3–4 mm long, *dehiscing laterally*; *ovary subglobose*, *c.* 2 × 1.5 mm, *brownish pubescent*, style subulate, 7–8 mm long, glabrous. **Fruits** ellipsoid, 2–3 × 1.5–2 cm; pericarp fleshy, glabrous. **Seeds** ellipsoid, *c.* 2 × 1.5 cm; scar covering about half of seed surface.

Distribution. Endemic to Borneo. Found in Kuching, Sri Aman, Kapit and Bintulu divisions in Sarawak (e.g., *S 28973*, *S 33131* and *S 49918*) and in C Kalimantan (e.g., *Hallier 357*). Possibly also occurring in Brunei.

Ecology. In lowland mixed dipterocarp forest.

8. *Palaquium edenii* Pierre *ex* Dubard

(Probably named after F.W. van Eeden, 1829–1901, the first Director of the Haarlem Colonial Museum, the Netherlands)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 22; H.J. Lam *l.c.* (1925) 50, *l.c.* (1927) 398; Masamune *l.c.* 593; P. Royen *l.c.* (1960) 499; Whitmore, Tantra & Sutisna *l.c.* 323; Pennington *l.c.* 150. **Type:** *Beccari PB 361*, Borneo, Sarawak (holotype FI; isotypes G, P).

Tree. **Twigs** subterete, slender, 2–4 mm diameter, brownish hairy. **Terminal buds** to 8 mm long, brownish hairy. **Stipules** lanceolate, 2–3 mm long, brownish pubescent outside, glabrous inside, caducous. **Leaves** clustered at ends of twigs, coriaceous, glabrous above, densely brownish-tomentose below, especially along midrib; elliptic, 5.5–8 × 2.2–3 cm, base cuneate, shortly decurrent, apex shortly acuminate with obtuse tip; midrib impressed above, prominent below; lateral veins 9–10 pairs, ascending at an angle of 40–45° from midrib, diminishing and becoming inconspicuous toward leaf margin, impressed above, prominent below; intercostal venation scalariform, distinct below, inconspicuous above; petiole 1.7–2.2 cm long, grooved on adaxial side, round on abaxial side, brownish to greyish tomentose. **Inflorescences** axillary, fascicles 2–3-flowered. **Flowers:** pedicel angular, to 10 mm long, brownish tomentose; sepals ovate, c. 2.5 × 2 mm, brownish tomentose outside, glabrous inside, basal part of inner sepals with fimbriate margin; corolla lobes 6, 7–10 mm long, narrowly elliptic, glabrous; stamens 10–12, filaments slender, c. 5 mm long, anthers oblong or cordate, 1.5–2.5 mm long, brownish hairy on both sides; ovary ovoid, c. 2 × 1.5 mm long, 6-loculed, 6-lobed, glabrous, style slender, 1–1.5 mm long, glabrous. **Fruits** ellipsoid, c. 1.5 × 1 cm, apex with short remnant of style, 1-seeded; pericarp fleshy, glabrous.

Distribution. Endemic to Borneo. Known only by the type collection from Sarawak (*Beccari PB 361*).

Ecology. In mixed dipterocarp forest.

9. *Palaquium elegans* Griffioen & H.J.Lam

(Latin, *elegans* = elegant; the habit)

In P. Royen *l.c.* (1960) 465; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 323. **Type:** *Haviland 898/801*, Borneo, Sarawak, Rejang, Sibuloh (holotype L; isotype SAR).

Tree to 24 m tall. **Twigs** slender, c. 2.5 mm diameter, brownish pubescent, glabrescent. **Terminal buds** c. 3.5 mm long, brownish puberulous. **Stipules** lanceolate, c. 2.5 × 0.5 mm, pubescent on both sides, caducous. **Leaves** clustered at ends of twigs, thinly coriaceous, glabrous on both surfaces; elliptic, 14–17.5 × 4.5–6 cm, base rounded-acute, apex acuminate; midrib impressed above, prominent below; lateral veins 17–20 pairs, ascending at an angle of 45–55° from midrib, diminishing and becoming inconspicuous toward leaf margin, indistinct above, prominent below;

intercostal venation scalariform, inconspicuous on both sides; petiole thick, 0.4–0.7 cm long, flat on adaxial side, brownish tomentose. **Inflorescences** axillary, fascicles *c.* 10-flowered. **Flowers:** *pedicel* angular, 18–21.5 mm long, brownish tomentose; sepals ovate, *c.* 4.5 × 2 mm, brownish tomentose outside, glabrous inside, inner sepals with irregular margin; corolla lobes 6, ovate-lanceolate, 8.5–10 mm long; stamens 12, filament subulate, *c.* 1 mm long, anthers ovoid-oblong, *c.* 3 mm long, glabrous, outer ones dehiscing extrorsely, inner ones introrsely; ovary globose, *c.* 1.5 mm diameter, brownish tomentose, style, slender, *c.* 10 mm long, glabrous. **Fruits** ovoid, 1.4–1.8 × 0.9–1.3 cm; pericarp thin, glabrous. **Seeds** unknown.

Distribution. Endemic to Borneo. Known from Sarawak by few collections from Rejang in Sibul (the type), Bt. Mersing in Bintulu Division and Lambir NP in Miri Division.

Ecology. In mixed dipterocarp forest.

10. *Palaquium ferrugineum* Pierre *ex* Dubard

(Latin, *ferrugineus* = rusty coloured; the indumentum)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 11; H.J. Lam *l.c.* (1925) 71, *l.c.* (1927) 402; Masamune *l.c.* 593; P. Royen *l.c.* (1960) 561; Whitmore, Tantra & Sutisna *l.c.* 323. **Type:** *Beccari PB 2283*, Borneo, Sarawak, near Matang (holotype P; isotypes FI, G, L).

Large tree. **Twigs** slender, 1.5–5 mm diameter, *angular, reddish-brown tomentose*, glabrescent. **Terminal buds** 8–10 mm long, brownish tomentose. **Stipules** lanceolate, *c.* 4 × 2.5 mm, brownish tomentose outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs, coriaceous*, sparsely brownish-tomentose above, *densely reddish-brown tomentose below*; elliptic, 5–9.5 × 2.5–4 cm, base narrowly cuneate, decurrent, apex obtusely acuminate; midrib impressed above, prominent below; *lateral veins 12–15 pairs, ascending at an angle of 30–40° from midrib, diminishing and becoming inconspicuous toward leaf margin*, impressed but rather inconspicuous above, prominent below; intercostal venation scalariform, inconspicuous on both sides; *petiole grooved on adaxial side, reddish-brown tomentose*. **Inflorescences** borne in axils of leaf scars, fascicles 2–6-flowered. **Flowers:** *pedicel* angular, *c.* 5 mm long, brownish tomentose; sepals ovate, *c.* 2 × 1.5 mm, brownish tomentose outside, glabrous inside, inner sepals smaller; corolla lobes elliptic-lanceolate, glabrous, reflexed at anthesis; stamens 12, filaments slender, 2.5–3.5 mm long, glabrous, *anthers ovoid-oblong*, brownish hairy, *dehiscing laterally or subextrorsely*; ovary discoid, *c.* 1.5 × 1 mm, 6-loculed, brownish tomentose, style subulate, *c.* 7 mm long, glabrous. **Fruits** unknown.

Distribution. Endemic to Borneo and known only by the type specimen from Matang, Sarawak (*Beccari PB 2283*).

Ecology. In mixed dipterocarp forest.

11. *Palaquium gutta* (Hook.f.) Baill.

(Englishised Malay word—*getah* = sap or latex; referring to the tree as a source of gutta-percha latex)

Tr. Bot. Méd, Phan. (1884) 1500; Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 24; King & Gamble *l.c.* 192; Merrill *l.c.* (1921) 480; Ridley *l.c.* (1923) 274; H.J. Lam *l.c.* (1925) 27, *l.c.* (1927) 387; P. Royen

l.c. (1960) 553; Ng *l.c.* 420; Anderson *l.c.* 317; Corner *l.c.* 695; Whitmore, Tantra & Sutisna *l.c.* 323; Pennington *l.c.* 150; Turner, Gard. Bull. Sing. 47 (1995) 465; Argent *et al.* (eds.) *l.c.* 583. **Basionym:** *Isonandra gutta* Hook.f., Lond. J. Bot. 6 (1847) 463. **Lectotype** (P. Royen, 1960): *Lobb 290*, Singapore (holotype K; isotype SING). **Synonyms:** *Dichopsis gutta* (Hook.f.) Benth. & Hook.f., Gen. Pl. 2 (1876) 658; *Croixia gutta* (Hook.f.) Baehni *l.c.* 110; *Palaquium borneense* Pierre, Bull. Soc. Lin., Paris 1 (1883) 496; *P. gutta* (Hook.f.) Baill. forma *borneense* (Pierre) H.J.Lam *l.c.* (1925) 28; *P. oblongifolium* Burck *l.c.* 25; *P. fulvosericeum* Engl., Bot. Jahrb. Syst. 12 (1890) 511; *P. ellipsoideum* Becc., Nelle For. Born. ed. 1 (1902) 560; *P. magnoliaefolium* Becc. *l.c.* 560; *P. optimum* Becc. *l.c.* 559; *P. tammedak* Becc. *l.c.* 559; *P. sambasense* Pierre ex Dubard *l.c.* 11.

Tree to 40 m tall. **Bark** reddish brown, cracked or fissured, inner bark greenish white to yellowish green. **Twigs** slender, 2–5 mm diameter, subterete or angular, covered with prominent leaf scars, usually golden tomentose or glabrescent. **Terminal buds** to 6 mm long, brownish tomentose. **Stipules** lanceolate, to 3 mm long, brownish tomentose outside, glabrous inside, caducous. **Leaves** well-spaced along twigs or clustered near ends of twigs, coriaceous, puberulous to glabrous above, densely golden tomentose below; elliptic-oblong, broadly oblong or obovate, 9.5–13 × 3–8 cm, base broadly or narrowly cuneate, decurrent, apex rounded to acuminate; midrib impressed above, prominent below; lateral veins 13–27 pairs, ascending at an angle of 75–85° from midrib, arching and joining into intramarginal veins along leaf margin, prominulous or almost inconspicuous above, prominent below; intercostal venation scalariform, subparallel or sometimes reticulate, prominent or inconspicuous on both sides, or more prominent below; petiole 1–4 cm long, grooved on adaxial side, golden to brownish tomentose. **Inflorescences** axillary, fascicles 2–12-flowered. **Flowers:** pedicel angular, 3–15 mm long, sericeous to golden tomentose; outer sepals ovate, 2–3 × 3–7 mm, inner sepals ovate-oblong, golden tomentose outside, glabrous inside; corolla to 2 mm long, lobes elliptic-ovate; stamens 12, filaments lanceolate, to 6 mm long, glabrous, anthers narrowly ovoid or sagittate, 2–2.5 mm long, glabrous, dehiscing extrorsely; ovary ovoid, c. 1.5 mm across, 6-loculed, brownish tomentose, style slender, 6–9 mm long, pubescent. **Fruits** globose or depressed ellipsoid, 1–2.5 × 2–2.5 cm, 1–2-seeded; pericarp thin or fleshy, brownish tomentose or glabrescent. **Seeds** ovoid to ellipsoid, c. 2 × 1 cm; scar covering about half of seed surface.

Vernacular names. Sabah—nyatoh taban merah (Malay). Sarawak—nyatoh rian (Iban, Malay). Brunei—jangkar (Iban), jangkar merah (Iban).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. Fairly common throughout Sabah (e.g., *Clemens 21232*, *Clemens 50695*, *SAN 10230*, *SAN 55176*, and *SAN A 16816*) and Sarawak (*Beccari PB 2269*, *Danyut A 1274*, *Egon 612*, *S 32262*, and *S 33480*). Also widespread in Brunei and Kalimantan (e.g., *bb. 12644*, *bb. 20444*, *bb. 21211*, and *bb. 29676*).

Ecology. Frequent in mixed dipterocarp forest, *kerangas* and limestone forests.

Taxonomy. *P. gutta* is a highly variable species. However, H.J. Lam's contention (*l.c.* 1925) to recognise 4 distinct forms, viz. *f. gutta*, *f. borneense*, *f. selendit*, and *f. vrieseanum*, is not endorsed in the present account.

Uses. Well known for its commercial gutta-percha latex.

12. *Palaquium herveyi* King & Gamble

(D.F.A. Hervey, 1849–1911, former Resident of Malacca, Peninsular Malaysia)

J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 197; Ridley *l.c.* (1923) 276; H.J. Lam *l.c.* (1925) 38, *l.c.* (1927) 395; Wyatt-Smith, FRI Res. Pamphl. 4 (1954) 35; P. Royen *l.c.* (1960) 489; Ng *l.c.* 420; Coode *et al.* (eds.) *l.c.* 307; Turner *l.c.* 465. **Type:** *Hervey s.n.*, Peninsular Malaysia, Malacca (holotype K).

Tree to 45 m tall. **Bark** reddish brown, flaky; inner bark laminated, reddish to orange-brown. **Twigs** slender, *c.* 2.5 mm diameter, angular, brownish to greyish pubescent, glabrescent. **Terminal buds** to 4 mm long, puberulous. **Stipules** lanceolate, *c.* 4 × 2 mm, brownish tomentose outside, glabrous inside, caducous. **Leaves** clustered at ends of twigs, subcoriaceous, sparsely greyish-hairy on both surfaces, glabrescent below; broadly obovate, 3–7.5 × 2–5 cm, base cuneate, apex acuminate; midrib crested or impressed above, angular to round below; lateral veins 5–10 pairs, ascending at an angle of 40–45° from midrib, diminishing and becoming inconspicuous toward leaf margin, impressed above, rounded below; intercostal venation fine, scalariform, inconspicuous on both sides; petiole 0.8–1.5 cm long, crested or flat on adaxial side, rounded on abaxial side, brownish or greyish pubescent. **Inflorescences** axillary, fascicles 2–6-flowered. **Flowers:** pedicel angular, brownish tomentose; outer sepals ovate, *c.* 2.5 × 2 mm, apex subobtusate, brownish tomentose outside, glabrous inside, inner sepals lanceolate, margin pubescent with stiff hairs; corolla 4–5 mm long, brownish hairy, lobes oblong-ovate, apex rounded; stamens 12, filaments slender, 1–2 mm long, glabrous, anthers ovoid-oblong, *c.* 1.5 mm long, brownish hairy, dehiscing extrorsely; ovary subglobose, *c.* 1 × 0.7 mm, sparsely tomentose, style subulate, 5–8 mm long, glabrous. **Fruits** ellipsoid, 1–1.4 × 0.7–1 cm, 1-seeded, glabrous. **Seeds** fusiform, *c.* 0.8 × 0.3 cm; scar covering more than half of seed surface.

Distribution. Peninsular Malaysia and Borneo. In Borneo, known from the southwestern part of Sabah (e.g., SAN 16775, SAN 21071 and SAN 28333) and from Brunei (e.g., Aziz 363, BRUN 2607 and SAN 17076).

Ecology. In mixed dipterocarp forest.

13. *Palaquium hexandrum* (Griff.) Baill.

(Latin, *hexandrum* = with six stamens; the flowers)

Tr. Bot. Méd. Phan. (1884) 1500; King & Gamble *l.c.* 197; Ridley *l.c.* (1923) 277; H.J. Lam *l.c.* (1927) 409; Wyatt-Smith *l.c.* (1954) 34; P. Royen *l.c.* (1960) 501; Ng *l.c.* 421; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 323; Pennington *l.c.* 151; Turner *l.c.* 466; Argent *et al.* (eds.) *l.c.* 584. **Basionym:** *Isonandra hexandra* Griff., Not. Pl. As. 4 (1851) 292. **Type:** Griffith 3609, Peninsular Malaysia, Malacca, Nanguli (holotype K; isotype L). **Synonyms:** *Dichopsis hexandra* (Griff.) C.B. Clarke in Hooker *f.*, Fl. Brit. Ind. 3 (1882) 543; *Croixia hexandra* (Griff.) Baehni *l.c.* 111; *Palaquium pisang* Burck *l.c.* (1886) 41.

Tree to 50 m tall, 120 cm diameter; buttresses to 3 m high. **Bark** dark brown; inner bark reddish brown. **Twigs** slender, 2–3.5 mm diameter, angular or subterete, brownish puberulous, glabrescent. **Terminal buds** 5–8 mm long, puberulous. **Stipules** lanceolate or ovate, *c.* 2.5 × 1 mm, puberulous outside, glabrous inside, persistent or caducous. **Leaves** clustered at ends of twigs, chartaceous to subcoriaceous, glabrous above, densely brownish-puberulous below; ovate to oblong-ovate, 7–11 × 2.5–4 cm, base broadly to narrowly cuneate, apex acute or

acuminate; midrib impressed above, rounded below; *lateral veins 6–11 pairs, ascending at an angle of 60–70° from midrib, diminishing and becoming inconspicuous toward leaf margin*, prominulous to inconspicuous on both sides; intercostal venation finely scalariform, conspicuous to inconspicuous on both sides; petiole slender, 0.5–2.5 cm long, grooved on adaxial side, rounded on abaxial side, brownish puberulous, glabrescent. **Inflorescences** axillary, *fascicles to 18-flowered*. **Flowers:** pedicel angular, to 12 mm long, brownish sericeous; outer sepals triangular to deltoid, *c. 2.5 × 2 mm*, brownish puberulous outside, glabrous inside, inner sepals with hairy margin; corolla lobes elliptic-oblong or lanceolate, *c. 7 mm long*, with hairy margin; stamens 12, filaments subulate, 2–2.5 mm long, anthers elliptic-oblong, 2–2.5 mm long, bifid at apex, glabrous, dehiscing extrorsely; ovary ovoid, *c. 1 × 0.5 mm*, 6-loculed, glabrous, style slender, 6–12 mm long, glabrous. **Fruits** *globose or ovoid, 2–3 × 1.5–2 cm*, 1–2-seeded; pericarp fleshy, glabrous. **Seeds** ovoid, *c. 2.5 × 1.5 cm*; scar covering about half of seed surface.

Distribution. Sumatra, Peninsular Malaysia and Borneo. Rare in Sabah (e.g., *SAN 16812*) and Sarawak (e.g., *S 0676* and *S 0877*), more common in E Kalimantan (e.g., *bb. 26431, bb. 31623, bb. 34706, Kostermans 5309*, and *Kostermans 5509*). Also occurs in Brunei.

Ecology. In lowland forest. In Kalimantan, frequent in alluvial forest along riverbanks.

Uses. One of the large species which is useful for its light-weight timber. The sour fruit is said to be edible and the seeds produce a fat which is considered one of the most important sources of vegetable fat in Siak, Sumatra.

14. *Palaquium hispidum* H.J.Lam

(Latin, *hispidus* = covered with coarse rigid erect hairs; the twigs, terminal buds, under side of leaves and inflorescences)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 63, *l.c.* (1927) 400; Masamune *l.c.* 594; P. Royen *l.c.* (1960) 460; Ng *l.c.* 421; Whitmore, Tantra & Sutisna *l.c.* 323; Turner *l.c.* 466. **Type:** *van Delden s.n.*, Peninsular Malaysia, Pahang, Kuala Lipis (holotype L; isotype BO). **Synonyms:** *Palaquium hispidum* H.J.Lam var. *typicum* and var. *grandiflorum* H.J.Lam *l.c.* (1925) 64; *Croixia hispida* (H.J.Lam) Baehni *l.c.* 111.

Tree to 50 m tall. **Bark** greyish white, inner bark reddish. **Twigs** stout, 5–8 mm diameter, subterete, *brownish pubescent with hirsute hairs*, glabrescent. **Terminal buds**, *c. 15 mm long*, hirsute pubescent. **Stipules** lanceolate, *c. 13 × 5 mm*, brownish hirsute-pubescent outside. **Leaves** *clustered at ends of twigs, coriaceous*, glabrous above, *densely brownish or yellowish hirsute-pubescent below*; ovate or ovate-oblong, *14–25 × 6–10 cm*, base cuneate or rounded, apex acuminate; midrib impressed above, rounded and prominent below; *lateral veins 19–30 pairs, ascending at an angle of to 50° from midrib, diminishing and becoming inconspicuous toward leaf margin*, impressed above, prominent below; intercostal venation finely scalariform, indistinct above, slightly distinct below; *petiole to 0.5 cm long*, grooved on adaxial side. **Inflorescences** axillary, fascicles 3–8-flowered. **Flowers:** *pedicel to 5 mm long*, densely hirsute-pubescent; outer sepals ovate or triangular, *5–8 × 3–10 mm*, apex obtuse or rounded, brownish pubescent outside, glabrous inside, inner sepals with filmy and fimbriate margins; corolla 10–15 mm long, glabrous except for the hairy base, 6-lobed; stamens 12, glabrous, filaments slender, 2–3 mm long, angular; anthers oblong, 3–3.5 mm long, apex bifid, dehiscing extrorsely; ovary ovoid, *c. 2.5 × 2 mm*, 6-loculed, hirsute, style slender, to 10 mm long, angular, glabrous. **Fruits** *subglobose*,

1.8–2.4 × 1.4–1.8 cm, usually 1-seeded, with remnant of style, glabrous. **Seeds** ovoid, *c.* 1.4 × 1 cm; scar covering about one third of seed surface.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo rare, recorded from Baram, Bintulu, and Pelagus districts in Sarawak (e.g., *S 41325*) and from Kalimantan (e.g., *Church & Mahyar 2005*).

Ecology. In lowland mixed dipterocarp forest.

15. *Palaquium kinabaluense* P.Royen

(of Mt. Kinabalu, Sabah)

Blumea 10 (1960) 475; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna *l.c.* 324. **Type:** *Clemens 27635*, Borneo, Sabah, Mt. Kinabalu, Dallas (holotype L; isotypes BM, CAL, G, SING). **Synonym:** *Palaquium macrocarpum auct. non* Burck: Anderson *l.c.* 317.

Tree to 20 m tall. **Bark** pinkish green; inner bark whitish. **Twigs** stout, 5–7 mm diameter, woolly tomentose. **Terminal buds** to 10 mm long, woolly tomentose. **Stipules** oblong-ovate, *c.* 7 × 3.5 mm, brownish tomentose outside, glabrous inside, caducous. **Leaves** clustered at end of twigs, coriaceous, whitish tomentose above, densely yellowish-tomentose below, glabrescent; obovate, 12–34 × 6–15 cm, base broadly cuneate, apex rounded or acuminate; midrib slightly impressed above, flattened or rounded and prominent below; lateral veins 15–16 pairs, ascending at an angle of 50–60° from midrib, diminishing and becoming inconspicuous toward leaf margin, prominent on both sides; intercostal venation finely scalariform, prominulous on both sides; petiole 1.5–3.5 cm long, grooved on adaxial side, rounded on abaxial side, brownish tomentose. **Inflorescences** axillary, fascicles 2–8-flowered. **Flowers:** pedicel terete, to 4 mm long, brownish woolly-tomentose; outer sepals triangular, 2–4 × 1.5–2 mm, woolly tomentose outside, glabrous inside, inner sepals with glabrous and membranous margin; corolla lobes ovate-lanceolate, to 8 mm long; stamens 12, filaments subulate, *c.* 1 mm long, anthers lanceolate-oblong, *c.* 2.5 mm long, dehiscing extrorsely; ovary obovoid, *c.* 1 × 1.5 mm, 6-loculed, glabrous except for the slightly hairy apex, style stout, conoid, *c.* 5 mm long, glabrous. **Fruit** ovoid, *c.* 1 × 0.6 cm, 1-seeded, glabrous. **Seeds** unknown.

Distribution. Endemic to Borneo. Recorded from Mt. Kinabalu and Sandakan district in Sabah (e.g., *Clemens 27635*) and G. Mulu NP, Miri division and Rejang River in Sibu division in Sarawak (e.g., *Clemens 21532* and *Clemens 21824*).

Ecology. In lowland and hill mixed dipterocarp forests, including limestone forest, at altitudes to 1000 m.

16. *Palaquium leiocarpum* Boerlage

(Greek, *leios* = smooth to the touch, *karpos* = fruit; with smooth fruit)

Bull. Inst. Bot. Buitenz. 5 (1900) 24; Merrill *l.c.* (1921) 480; H.J. Lam *l.c.* (1925) 27, *l.c.* (1927) 387; Masamune *l.c.* 594; P. Royen *l.c.* (1960) 514; Ng *l.c.* 422; Anderson *l.c.* 317; Whitmore, Tantra & Sutisna

l.c. 324; Pennington *l.c.* 151; Turner *l.c.* 466; Coode *et al.* (eds.) *l.c.* 307; Argent *et al.* (eds.) *l.c.* 584. **Lectotype** (P. Royen, 1960): *Romburgh 2*, Borneo, Kalimantan (holotype BO). **Synonym:** *Palaquium molle* Pierre in Beccari, *Nelle For. Born.* ed. 1 (1902) 559, H.J. Lam *l.c.* (1925) 105, *l.c.* (1927) 413.

Tree to 30 m tall. **Bark** brownish to reddish grey, finely fissured; inner bark light brown, soft. **Twigs** 2–8 mm diameter, terete, brownish tomentose, with scattered leaf scars. **Terminal buds** to 8 mm long. **Stipules** ovate or lanceolate, *c.* 5 × 3.5 mm, tomentose outside, glabrous inside, caducous. **Leaves** clustered at ends of twigs, coriaceous, glabrous above, usually dark brown when dry, densely rusty-brown tomentose below; oblong or obovate, 10–17 × 5.5–12 cm, base cuneate, margin revolute, apex rounded or acuminate; midrib impressed and faintly crested above; lateral veins 13–23 pairs, ascending at an angle of 45–65° from midrib, mostly diminishing and becoming inconspicuous toward leaf margin or rarely arching and joining into intramarginal veins along leaf margin; intercostal venation scalariform or reticulate, inconspicuous above, prominent below; petiole 1.5–5 cm long, slightly thickened at base, brownish tomentose. **Inflorescences** axillary, fascicles 3–6-flowered. **Flowers:** pedicel 8–18 mm long, tomentose; outer sepals triangular or ovate, 5.5–8 × 4–4.5 mm, apex acute or obtuse, brownish tomentose, inner sepals smaller, apex almost rounded, glabrous; corolla to 10 mm long, lobes lanceolate, sparsely hairy; stamens 12, filaments slender, *c.* 3.5 mm long, anthers sagittate, *c.* 4 mm long, tomentose, dehiscing introrsely; ovary ovoid, *c.* 1 × 1 mm, 6-lobed, 6-loculed, brownish tomentose, style slender, *c.* 12 mm long. **Fruits** ellipsoid or globose, 1–3 × 1–2.5 cm, with persistent style or its remnant. **Seed** ellipsoid, 1–1.4 × 0.8–1.2 cm; scar covering about half of seed surface.

Vernacular name. Sarawak—nyatoh tembaga (Iban).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and Sulawesi. Common in most parts of Sabah (e.g., *SAN A 4565* and *SAN 16694*) and Sarawak (e.g., *Egon A 0925*, *Nooteboom & Chai 2230*, *S 24579*, *S 38170*, and *S 64091*) as well as in Brunei (e.g., *BRUN 149*, *KEP 32571* and *Wong WKM 1910*), and in Kalimantan (e.g., *van Balgooy & van Setten 5574*).

Ecology. In mixed swamp forest, mixed dipterocarp forest and *kerangas* forest.

Uses. The latex is inferior to gutta-percha, and has consequently been used as an adulterant.

17. *Palaquium lisophyllum* Pierre ex Dubard

(Greek, *lisos* = smooth, *phullon* = leaf; with smooth leaves)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 7; Merrill *l.c.* (1921) 480; H.J. Lam, *l.c.* (1925) 73, *l.c.* (1927) 403; Masamune *l.c.* 594; P. Royen *l.c.* (1960) 496; Anderson *l.c.* 317; Whitmore, *Tantra & Sutisna l.c.* 324. **Type:** Beccari *PB 3286*, Borneo, Sarawak, Marop (holotype FI; isotype L).

Tree to 20 m tall. **Twigs** slender, 2–4 mm diameter, subterete, brownish pubescent, glabrescent. **Terminal buds** to 10 mm long, brownish pubescent. **Stipules** lanceolate, *c.* 6 × 3 mm, brownish pubescent, caducous. **Leaves** well-spaced along twigs, chartaceous, glabrous above, brownish tomentose below; oblong-elliptic, 15–19 × 6.5–8.5 cm, base cuneate or rounded, apex acuminate; midrib slightly raised above, rounded and prominent below, densely tomentose; lateral veins 12–14 pairs, ascending at an angle of 55–65° from midrib, diminishing and becoming inconspicuous toward leaf margin, prominulous above, prominent below; intercostal venation finely scalariform,

fairly conspicuous on both sides; petiole 1–1.2 cm long, flat and crested on adaxial side, brownish puberulous. **Inflorescences** axillary, fascicles 2–4-flowered. **Flowers:** pedicel 2–3.5 mm long, brownish puberulous; outer sepals ovate, *c.* 5 × 3 mm, brownish puberulous outside, glabrous inside, inner sepals with hairy margin; corolla lobes elliptic, *c.* 5 mm long; stamens 12, filaments stout, *c.* 0.5 mm long, *anthers sagittate*, *c.* 2 mm long, acute or bifid, brownish tomentose, dehiscing extrorsely; ovary obovoid, *c.* 1.5 × 1 mm, 6-loculed, glabrous except at apex, style subulate, *c.* 4 mm long, brownish puberulous. **Fruit** unknown.

Distribution. Endemic to Borneo. Uncommon, known only by a single collection (*Beccari PB 3286*) from Matang in southwestern part of Sarawak, and by another collection (*SAN 73554*) from Lahad Datu district in Sabah.

Ecology. In mixed dipterocarp forest.

18. *Palaquium maingayi* (C.B. Clarke) Engl.

(A.C. Maingay, 1836–1869, British physician and botanist, sometime jail-warden in Malacca)

Bot. Jahrb. Syst. 12 (1890) 511; King & Gamble *l.c.* 191; Dubard *l.c.* (1909) 7; Ridley *l.c.* (1923) 273; H.J. Lam *l.c.* (1925) 72, *l.c.* (1927) 402; Wyatt-Smith *l.c.* (1954) 36; P. Royen *l.c.* (1960) 482; Ng *l.c.* 423; Pennington *l.c.* 151; Turner *l.c.* 466. **Basionym:** *Dichopsis maingayi* C.B. Clarke in Hooker *f.*, Fl. Brit. Ind. 3 (1882) 543. **Type:** *Maingay 996/2*, Peninsular Malaysia, Malacca (holotype K; isotype L).

Tree to 24 m tall. **Twigs** stout, 6–10 mm diameter, subterete, brownish woolly-tomentose, glabrescent. **Terminal buds** to 20 mm long, densely tomentose. **Stipules** lanceolate, *c.* 10 × 3.5 mm, densely tomentose outside, glabrous inside, caducous. **Leaves** clustered at ends of twigs, coriaceous, glabrous above, densely reddish to dark-brownish tomentose below; obovate to spatulate, 16–24 × 8.5–15 cm, base acute to rounded, decurrent; midrib impressed above, prominent and rounded below; lateral veins 12–22 pairs, ascending at an angle of 50–60° from midrib, diminishing and becoming inconspicuous toward leaf margin, impressed above, prominent below; intercostal venation finely scalariform, prominent on both sides; petiole to 5 cm long, grooved on adaxial side especially at upper part, thickened at base, brownish woolly-tomentose. **Inflorescences** axillary, fascicles 5–10-flowered. **Flowers:** pedicel angular, 7–11 mm long, densely tomentose; outer sepals ovate, 2.5–4 × 2.5–4.5 mm, apex acute, brownish tomentose outside, glabrous inside, inner sepals with rounded apex, margin entire and membranaceous; corolla to 12 mm long, glabrous; stamens 12, glabrous, filaments slender, 3–3.5 mm long, *anthers sagittate*, 3–3.5 mm long, dehiscing extrorsely; ovary discoid, *c.* 1 × 2 mm, 6-loculed, glabrous, style slender, 6–8 mm long, glabrous. **Fruits** ellipsoid or globose, *c.* 3.5 × 2.5 cm, 1-seeded, glabrous. **Seeds** obovoid, *c.* 2 × 0.5 cm; scar covering about half of seed surface.

Distribution. Peninsular Malaysia and Borneo. A new record for Borneo (Sarawak, e.g., *S 39972*).

Ecology. Riparian and *kerangas* forests.

Uses. The latex was once used as an adulterant to gutta-percha. The heavy dark brown timber is used in house building.

19. *Palaquium majas* H.J.Lam

(Dayak, *majas* = the Bornean *orang utan*; referring to the brownish indumentum)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 66, *l.c.* (1927) 401; Masamune *l.c.* 595; P. Royen *l.c.* (1960) 470; Whitmore, Tantra & Sutisna *l.c.* 324; Argent *et al.* (eds.) *l.c.* 584. **Type:** *Jaheri 1085*, Borneo, Kalimantan, Sg. Brunei (holotype BO; isotype L). **Synonym:** *Croixia majas* (H.J.Lam) Baehni *l.c.* 110.

Tree to 24 m. **Bark** brown, flaky. **Twigs** slender, 3–5 mm diameter, terete, *densely brownish woolly-pubescent*, glabrescent, *not covered with prominent leaf scars*. **Terminal buds** to 10 mm long, *densely woolly-pubescent*. **Stipules** ovate, 5 × 2–4 mm, brownish woolly-pubescent outside, glabrous inside. **Leaves** *well-spaced along twigs, chartaceous*, glabrous above, *densely brownish woolly-pubescent below* especially along midrib and veins; obovate, 14–25.5 × 7.5–12.5 cm; midrib impressed above, round and prominent below; *lateral veins 12–14 pairs*, ascending at an angle of 60–65° from midrib, *arching and joining into intramarginal vein along leaf margin*, impressed above, prominent below; *intercostal venation scalariform*, prominent on both sides; petiole 1–2 cm long, thickened, brownish woolly-pubescent. **Inflorescences** axillary, fascicles to 8-flowered. **Flowers:** pedicels angular, 5–12 mm long, brownish woolly-pubescent; outer sepals lanceolate, 4.5–5.5 × 2–3 mm, brownish woolly-pubescent outside, glabrous inside, inner sepals with membranaceous margin; corolla lobes elliptic-oblong, to 10 mm long, glabrous; *stamens 18*, glabrous, filaments slender, 1.5–2 mm long, *anthers oblong*, 3–3.5 mm long, apex bifid, dehiscing laterally; ovary depressed ovoid, *c.* 1.5 × 2 mm, brownish pubescent, 6-loculed, 6-lobed, style slender, *c.* 10 mm long, glabrous. **Fruits** *globose or ellipsoid*, 1.5–2 × 1.5–2 cm, 1-seeded; pericarp fleshy, glabrous. **Seeds** ellipsoid *c.* 1.5 × 1.2 cm; scar covering about half of seed surface.

Distribution. Endemic to Borneo. Recorded from Engkilili, Sri Aman division and a few localities in Kapit Division in Sarawak (e.g., *S 40541* and *S 48673*). Also found in Kalimantan (e.g., *Jaheri 1054*).

Ecology. In lowland mixed dipterocarp forest on rich yellow soils, at altitudes to 550 m.

20. *Palaquium microphyllum* King & Gamble

(Greek, *mikro* = small, *phullon* = leaf; with small leaves)

J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 196; Ridley *l.c.* (1923) 276; H.J. Lam *l.c.* (1925) 36, *l.c.* (1927) 395; Masamune *l.c.* 595; Wyatt-Smith *l.c.* (1954) 37; P. Royen *l.c.* (1960) 578; Ng *l.c.* 423; Whitmore, Tantra & Sutisna *l.c.* 324; Pennington *l.c.* 151; Turner *l.c.* 466; Coode *et al.* (eds.) *l.c.* 307. **Type:** *Ridley 10840*, Singapore, Bt. Timah (holotype SING).

Tree to 30 m tall. **Bark** dark reddish brown, cracked, slightly flaky. **Twigs** slender, 2.5–5 mm diameter, *reddish woolly-tomentose*, glabrescent, *not covered with prominent leaf scars*. **Terminal buds** to 9 mm long, reddish woolly-tomentose. **Stipules** absent. **Leaves** *well-spaced along twigs or clustered at ends of twigs, coriaceous*, glabrous above, *brownish tomentose below*; spatulate, 3–7 × 2–3.5 cm, base cuneate, apex acuminate; midrib crested and angular above, prominent below; *lateral veins 8–18 pairs*, ascending at an angle of 65–70° from midrib, *arching and joining into intramarginal vein along leaf margin*, conspicuous on both sides; *intercostal venation finely reticulate or descending from leaf margin and parallel to lateral veins*; petiole 1–2 cm long, flat or grooved and crested on adaxial side, reddish or greyish woolly-tomentose. **Inflorescences**

axillary, fascicles to 4-flowered. **Flowers:** pedicel *c.* 6 mm long, brownish tomentose; outer sepals ovate, *c.* 2.5 × 2 mm, brownish tomentose outside, glabrous inside, with entire margin; corolla lobes elliptic, 4.5–6 mm long, apex obtuse; stamens 12, filaments slender, 2–2.5 mm long, anthers ovoid, 1.5–2 mm long, apex mucronate, glabrous, dehiscent introrsely; ovary conical, *c.* 2 mm across, 6-loculed, 6-lobed, brownish tomentose, style slender, to 8 mm long, glabrous. **Fruits** globose, *c.* 2.5 cm diameter, glabrous, with remnant of style. **Seeds** ellipsoid *c.* 2 × 1.5 cm; scar covering about half of seed surface.

Vernacular name. Peninsular Malaysia—*nyatoh pipit* (Malay).

Distribution. Sumatra (including Lingga, Riau, Bangka), Peninsular Malaysia, Singapore, and Borneo. In Sabah, known by several collections from Sandakan district (e.g., *SAN 10676* and *SAN 50358*). In Sarawak, found in Ulu Balleh, Kapit. Also occurs in Seria, Brunei (e.g., *S 5886*).

Ecology. In lowland mixed dipterocarp, swamp, and *kerangas* forests.

Uses. The hard timber is used for planks, posts and other parts of traditional Malay wooden houses.

21. *Palaquium multiflorum* Pierre ex Dubard

(Latin, *multi-* = many; *florum* = flower; with many flowers, the inflorescences)

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 23; Merrill *l.c.* (1921) 480; H.J. Lam *l.c.* (1925) 91, *l.c.* (1927) 410; Masamune *l.c.* 595; Jeuken, Blumea 6 (1952) 579; P. Royen *l.c.* (1960) 491; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 324; Pennington *l.c.* 152 (as a doubtful species). **Type:** *Beccari PB 1439*, Borneo, Sarawak, Matang (holotype P; isotypes FI, G, L, NY, SING). **Synonym:** *Isonandra emarginata* H.J. Lam *l.c.* (1927) 420, Jeuken *l.c.* 578.

Small tree to 8 m tall. **Bark** finely fissured, reddish brown; inner bark light brown, laminated. **Twigs** slender, 1.5–3 mm diameter, angular, brownish tomentose, glabrescent. **Terminal buds** to 4 mm long, brownish tomentose. **Stipules** triangular-lanceolate, *c.* 1.5 × 1 mm, apex acute, tomentose outside, glabrous inside. **Leaves** well-spaced along twigs, coriaceous, glabrous on both surfaces; elliptic to obovate, 3–6.5 × 1.8–4.5 cm, base broadly cuneate, apex rounded; midrib crested above, rounded and prominent below; lateral veins 5–8 pairs, ascending at an angle of 60–70° from midrib, diminishing and becoming inconspicuous toward leaf margin, prominent on both sides; intercostal venation finely scalariform, inconspicuous below; petiole slender, 0.3–0.4 cm long, flat or grooved on adaxial side, greyish tomentose, glabrescent. **Inflorescences** terminal or axillary, fascicles 3–7-flowered. **Flowers:** pedicel angular, 5–14 mm long, brownish tomentose; outer sepals 5–6, ovate, *c.* 2.5 × 2 mm, brownish tomentose outside, whitish tomentose inside, inner sepals with membranaceous margin, nearly glabrous; corolla lobes ovate-elliptic, *c.* 4 mm long, glabrous on both sides; stamens 9–13, filament subulate, *c.* 1 mm long, anthers sagittate, *c.* 0.6 mm long, apex rounded or truncate, tomentose; ovary ellipsoid, *c.* 1.5 × 1 mm, 11–13-loculed, tomentose, style subulate, 1–1.5 mm long, glabrous. **Fruits** unknown.

Distribution. Endemic to Borneo and confined to the southwestern part of Sarawak (e.g., *Beccari PB 1439* and *Haviland 1890*).

Ecology. Mostly in *kerangas* forest, rarely in mixed dipterocarp forest.

22. *Palaquium obovatum* (Griff.) Engl.

(Latin, *obovatum* = obovate; shape of the leaves)

Bot. Jahrb. Syst. 12 (1890) 511; King & Gamble *l.c.* (1906) 190; Dubard, Bull. Bot. Soc. Fr. 56, Mém. 16 (1909) 5, Bull. Mus. Hist. Nat., Paris 15 (1909) 380; Ridley *l.c.* (1923) 273; H.J. Lam *l.c.* (1925) 83; *l.c.* (1927) 408; Masamune *l.c.* 595; Wyatt-Smith *l.c.* (1954) 38; P. Royen *l.c.* (1960) 453; Ng *l.c.* 423; Anderson *l.c.* 318; Corner *l.c.* 695; Pennington *l.c.* 151; Turner *l.c.* 466. **Basionym:** *Isonandra obovata* Griff., Not. Pl. As. 4 (1854) 293. **Type:** *Griffith 3606*, Peninsular Malaysia, Malacca (holotype K). **Synonyms:** *Dichopsis obovata* (Griff.) C.B. Clarke in Hooker *f.*, Fl. Brit. Ind. 3 (1882) 542; *Palaquium theoideum* Elmer, Leaf. Philip. Bot. 3 (1910) 868; *P. punctatum* Fletcher, Kew Bull. (1937) 375.

Tree to 40 m tall. **Bark** red-brown, fissured and scaly, inner bark red to pale yellow. **Twigs** slender, 3–6 mm diameter, angular, generally brownish tomentose, glabrescent. **Terminal buds** to 20 mm long, tomentose. **Stipules** lanceolate to linear, *c.* 4.5 × 1.5 mm, pubescent outside, glabrous inside, caducous. **Leaves** clustered at ends of twigs, chartaceous to subcoriaceous, glabrous above, densely tomentose below; obovate, obovate-oblong, or oblong, 14–30 × 8–12 cm, base cuneate, apex obtuse or rounded to obtusely acuminate; midrib impressed and crested above, rounded and prominent below, characteristically dark brown in dried specimens; lateral veins 10–18 pairs, ascending at an angle of 45–70° from midrib, diminishing and becoming inconspicuous toward leaf margin, conspicuous above, rounded and prominent below; intercostal venation finely scalariform, distinct on both sides; petiole 1–4.5 cm long, grooved or flat on adaxial side, tomentose to glabrous. **Inflorescences** axillary, fascicles 7–10-flowered. **Flowers:** pedicel angular, 10–20 mm long, brownish tomentose; outer sepals triangular, *c.* 3 × 2.5 mm, brownish tomentose outside, glabrous inside, inner sepals with membranaceous margin; corolla lobes lanceolate-oblong, 6–15 × 2.5–3.5 mm long, tomentose, soon becoming glabrous; stamens 12, filaments slender, 4–5 mm long, glabrous, *anthers* ovoid, *c.* 2.5 mm long, brownish tomentose, *dehiscing extrorsely*; *ovary* conical, *c.* 3 × 2 mm, glabrous, style, slender, 2–2.5 mm long, glabrous. **Fruits** globose, *c.* 2.5–3 cm diameter, glabrous, 1–2-seeded; pericarp fleshy, glabrous. **Seeds** compressed ellipsoid, *c.* 2 × 1.8 cm; scar narrow, *c.* 20 × 7 mm.

Distribution. From India to Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, recorded from Bau, Mulu NP and Lambir NP in Sarawak, Penampang district in Sabah and from Kalimantan.

Ecology. Mostly found in limestone forest but also occurs in other types of lowland forest.

Uses. The latex was formerly used as a low quality gutta-percha. Its timber is durable under water and thus useful in boat-planking and house building.

23. *Palaquium ottolanderi* Koord. & Valetton

(T. Ottolander, 1854–1935, Dutch planter in Java)

Bijdr. Booms. Java 1 (1894) 146; H.J. Lam *l.c.* (1925) 64, *l.c.* (1927) 401; P. Royen *l.c.* (1960) 481; Ng *l.c.* 424; Pennington *l.c.* 151; Turner *l.c.* 466. **Type:** *Koorders 10158β*, Java, Banjumas, Pelabuhan Ratu (holotype L; isotype BO). **Synonym:** *Croixia ottolanderi* (Koord. & Valetton) Baehni *l.c.* 110.

Tree to 30 m tall. **Twigs** stout, 9–15 mm diameter, covered with numerous leaf scars, *brownish woolly-tomentose, glabrescent*. **Terminal buds** 14–18 mm long. **Stipules** lanceolate, *c.* 15 × 5 mm, acute to acuminate, hairy outside, glabrous inside, caducous. **Leaves** clustered at ends of twigs, *coriaceous*, glabrous above except for the hirsute midrib, *densely hirsute-pubescent below*, denser along midrib and veins; elliptic, obovate, or oblong, 26–33 × 10.5–16.5 cm, base broadly cuneate, slightly decurrent, apex rounded or broadly acuminate; midrib impressed above, rounded and prominent below; *lateral veins* 14–20 pairs, ascending at an angle of 55–65° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, rarely arching and joining into intramarginal vein along leaf margin, impressed above, prominent below; *intercostal venation* scalariform, *inconspicuous above, prominent below*; *petiole* 2–6 cm long, flat or shallowly grooved on adaxial side, *glabrous*. **Inflorescences** axillary, fascicles 7–16-flowered. **Flowers:** *pedicel* angular, 8–20 mm long, brownish hirsute; outer sepals ovate or obovate, 4–7 mm across, brownish hirsute outside, glabrous inside; *corolla* 15–20 mm long, lobes elliptic-oblong, apex obtuse; stamens 12, filaments slender, 3.5–5 mm long, *anthers* oblong, 2–3 mm long, apex mucronate, dehiscing introrsely; *ovary* *subglobose* to *ovoid*, *c.* 2.5 mm diameter, 6-loculed, 6-lobed, *hirsute*. **Fruits** *ovoid-oblong*, *c.* 7 × 3 cm. **Seeds** fusiform, *c.* 3.5 × 1.5 cm; scar covering about half of seed surface.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Java, and Borneo. In Borneo, recorded from Sandakan district in Sabah and from C Kutei in Kalimantan.

Ecology. In lowland mixed dipterocarp forest.

Notes. Very close to *Palaquium majas* but differs by its larger leaves.

24. *Palaquium pseudocuneatum* H.J.Lam

(Latin, *pseudo-* = false, somewhat; *cuneatum* = wedge-shaped; the somewhat wedge-shaped leaf base)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 391; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 588; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 324; Coode *et al.* (eds.) *l.c.* 307. **Type:** *Egon* 340, Borneo, Sarawak (holotype BO; isotype SAR). **Synonym:** *Croixia pseudocuneata* (H.J.Lam) Baehni *l.c.* 110.

Tree to 35 m tall. **Bark** reddish to light greyish brown, cracked or narrowly fissured, sometimes flaky, inner bark red or pink, laminated, fibrous. **Twigs** slender, 2–3 mm diameter, terete or angular, *glabrous*, *not covered with prominent leaf scars*. **Terminal buds** 3–6 mm long, tomentose. **Stipules** *small, caducous*. **Leaves** *well-spaced along twigs* or *clustered at ends of twigs*, *subcoriaceous*, *glabrous on both surfaces*; obovate or spatulate, 4–9.5 × 2–3.8 cm, base cuneate, *apex acuminate*; midrib impressed above, angular and prominent below; *lateral veins* 12–14 pairs, ascending at an angle of 60–75° from midrib, *arching and joining into intramarginal veins along leaf margin*, prominulous on both sides; *intercostal venation* *descending from leaf margin and parallel to lateral veins* or *finely reticulate*, slightly conspicuous above, more distinct below; *petiole* 0.9–1.5 cm long, *grooved on adaxial side*, angular on abaxial side, *glabrous*. **Inflorescences** *axillary*, fascicles 2–3-flowered. **Flowers:** *pedicel* angular, 7–12 mm long, brownish tomentose; outer sepals ovate, *c.* 3 × 2 mm, brownish tomentose outside, glabrous inside, inner sepals smaller; corolla lobes elliptic-oblong, to 4 mm long, brownish woolly-pubescent at

base; stamens 12, filaments slender, 1.5–2.5 mm long, densely brownish hairy, anthers ovoid, 1–2 mm long, glabrous, dehiscing extrorsely; *ovary ovoid*, c. 2 mm across, brownish hirsute, style slender, 6–10 mm long, glabrous. **Fruits ellipsoid**, 2–5 × 1.3–4 cm, 1-seeded; pericarp fleshy, glabrous. **Seeds obovoid**, c. 1 × 0.8 cm; scar covering about half of seed surface.

Vernacular name. Sarawak—*nyatoh babi kecil* (Iban).

Distribution. Endemic to Borneo and recorded from Kuching and Miri divisions in Sarawak (e.g., *Egon A 0937*, *S 4954*, *S 9246*, and *S 9256*), Brunei (e.g., *KEP 35707* and *van Niel 3814*) and Kalimantan (e.g., *bb. 12400* and *bb. 14246*).

Ecology. Mainly in seasonal freshwater swamp forest but also occurs in hill forests.

25. *Palaquium pseudorostratum* H.J.Lam

(Latin, somewhat similar to *P. rostratum*)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 393; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 586; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 151; Argent *et al.* (eds.) *l.c.* 585. **Type:** *bb. 9449*, Borneo, Kalimantan, Tuwanan, Lower Dajak (holotype BO; isotype L). **Synonym:** *Croixia pseudorostrata* (H.J.Lam) Baehni *l.c.* 108.

Tree to 30 m tall. **Bark** reddish brown, shallowly fissured to smooth; inner bark thin, pinkish to reddish brown. **Twigs** stout, 3–7 mm diameter, subterete or angular, *glabrous*. **Terminal buds** 3–6 mm long, brownish sericeous. **Stipules** *small, caducous*. **Leaves** *well-spaced along twigs, chartaceous to subcoriaceous, glabrous on both surfaces*; spatulate to obovate, 6.5–14 × 3–6 cm, base narrowly cuneate, *apex rounded or obtuse*; midrib impressed and crested above, angular and prominent below; *lateral veins* 12–16(–20) pairs, ascending at an angle of 70–80° from midrib, *arching and joining into intramarginal vein along leaf margin*, prominulous to inconspicuous above, prominulous below; *intercostal venation descending from leaf margin and parallel to lateral veins*, fine, slightly distinct above, prominent to inconspicuous below; *petiole* 0.5–4 cm long, flat or grooved on adaxial side, angular on abaxial side, *brownish tomentose*, glabrescent. **Inflorescences** *axillary*, fascicles 2–4-flowered. **Flowers:** *pedicel* angular, 3–4.5 mm long, brownish sericeous; outer sepals ovate, 3–5 × 2–3.5 mm, brownish puberulous outside, glabrous inside, inner sepals membranaceous along margin; corolla lobes elliptic-oblong, to 5 mm long; stamens 12, in two whorls, filaments slender, 2–4 mm long, anthers ovoid, 1.5–2.5 mm long, glabrous, dehiscing extrorsely; *ovary ovoid*, c. 1.5 × 1 mm, 6-loculed, brownish sericeous, glabrous at base, style slender, 6–10 mm long, glabrous. **Fruits** globose, ellipsoid or depressed subglobose, 1–1.4 × 0.8–1.6 cm, 1–2-seeded; pericarp fleshy, glabrous. **Seeds ellipsoid**, c. 0.9 × 0.6 cm; scar covering about half of seed surface.

Vernacular name. Sarawak—*nyatoh babi* (Iban).

Distribution. Borneo and the Philippines. In Borneo, known from Sandakan, Sipitang and Tawau districts in Sabah (e.g., *SAN 15249*, *SAN 16731*, *SAN 24320*, and *SAN A 488*), Kuching, Limbang and Sibul districts in Sarawak (e.g., *S 0402*, *S 2678*, *S 19433*, *S 36132*, and *S 57118*), E, SE and SW Kalimantan (e.g., *bb. 33045* and *Kostermans 5685*), and Badas FR in Brunei.

Ecology. Frequent in freshwater and peat swamp forests. Also occurs in *kerangas* forest.

26. *Palaquium quercifolium* (de Vriese) Burck

(Latin, *quercifolium* = with leaves resembling those of *Quercus*, Fagaceae)

Ann. Jard. Bot. Buitenz. 5 (1886) 41; Merrill *l.c.* (1921) 481; H.J. Lam *l.c.* (1925) 53; *l.c.* (1927) 399; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 562; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 151; Kessler & Sidiyasa *l.c.* 216; Coode *et al.* (eds.) *l.c.* 307; Argent *et al.* (eds.) *l.c.* 585.

Basionym: *Isonandra quercifolia* de Vriese, Nat. Tijdschr. Ned.-Indie 21 (1860) 311. **Type:** *Motley VII* (= *de Vriese 1367*), Borneo, Kalimantan, Bandjarmasin (holotype BO; isotype L). **Synonyms:** *Isonandra argentata* Teijsm. & Binn., Nat. Tijdschr. Ned.-Indie 25 (1863) 415; *Dichopsis argentata* (Teijsm. & Binn.) Benth. & Hook.f., Gen. Pl. 2, 2 (1876) 658; *Palaquium argentatum* (Teijsm. & Binn.) Pierre in Burck *l.c.* (1886) 30; *I. macrophylla* de Vriese *l.c.* 311; *P. macrophyllum* (de Vriese) Pierre ex Dubard, Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 9; *Croixia quercifolia* (de Vriese) Baehni *l.c.* 108.

Tree to 30 m tall. **Bark** red-brown, inner bark pale reddish. **Twigs** stout, 3–10 mm diameter, *brownish tomentose*, glabrescent. **Terminal buds** 4–8 mm long, *brownish tomentose*. **Stipules** linear-lanceolate, *c.* 10 × 2 mm, brownish sericeous outside, glabrous inside, caducous. **Leaves** well-spaced along twigs, *subcoriaceous*, glabrous above, *brownish to reddish tomentose* below; obovate-oblong or elliptic, (8–)12–32 × (3.5–)5–10 cm, base cuneate, apex acuminate; midrib impressed above, rounded and prominent below; *lateral veins* 14–16 pairs, *ascending at an angle of 45–50° from midrib, diminishing and becoming inconspicuous toward leaf margin* or partly arching and joining into intramarginal vein along leaf margin, impressed above, prominent below; *intercostal venation* finely scalariform, *conspicuous on both sides*; *petiole* 4–6 cm long, *grooved on adaxial side, brownish tomentose to glabrous*. **Inflorescences** axillary, fascicles 4–5-flowered. **Flowers:** *pedicel* 8–10 mm long, *brownish tomentose*; sepals lanceolate, 4–5 × 2–3 mm, brownish tomentose outside, almost glabrous inside; corolla lobes ovate-lanceolate, 13–15 mm long, brownish tomentose; stamens 12, filaments slender, to 9 mm long, glabrous, *anthers* ovoid or *sagittate*, 2.5–3.5 mm long, glabrous; ovary discoid, *c.* 1.5 × 1 mm, 5–6-loculed, glabrous except for the brownish tomentose apex, style slender, 15–22 mm long, glabrous. **Fruits** globose, *c.* 2 cm diameter, 1-seeded; pericarp thin, glabrous. **Seeds** ellipsoid, *c.* 1.4 × 1.2 cm; scar broadly elliptic, *c.* 1.2 × 1 cm.

Distribution. Sumatra, Borneo, Sulawesi, and Ambon. In Sabah, recorded from Kinabatangan district, and in Sarawak from Anap, Bintulu and Lundu districts (e.g., *S 23707* and *S 36699*). Also occurs in C and S Kalimantan (e.g., *Kostermans 11169*) and in Brunei (e.g., *BRUN 34*).

Ecology. In lowland mixed dipterocarp forest and alluvial swamp forest.

27. *Palaquium ridleyi* King & Gamble

(H.N. Ridley, 1855–1956, former Director of the Singapore Botanic Gardens)

J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 196; Ridley *l.c.* (1923) 276; H.J. Lam *l.c.* (1925) 92 & 257, *l.c.* (1927) 410; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 506; Ng *l.c.* 426; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 152; Turner *l.c.* 466; Coode *et al.* (eds.) *l.c.* 307; Argent *et al.* (eds.) *l.c.* 585. **Type:** *Ridley 3591a*, Singapore, Kranji (holotype K). **Synonyms:** *Palaquium ledermannii* Krause, Engl. Bot. Jahrb. 58 (1923) 552; *P. poilanei* Lecomte, Fl. Gen. Indo-Chine 3, 7 (1930) 900.

Tree to 30 m tall. **Bark** brownish grey, smooth to shallowly cracked; inner bark pinkish to light brown. **Twigs** slender, 2–5 mm diameter, subterete or angular especially towards apex, *covered*

with short brownish hairs, glabrescent. **Terminal buds** 2–3 mm long, glabrous. **Stipules** ovate-lanceolate, *c.* 2 × 1 mm, apex acute, short-hairy outside, glabrous inside. **Leaves** clustered at end of twigs, glabrous on both surfaces, subcoriaceous to thickly coriaceous; usually obovate, 6–14.4 × 2.7–5.4 cm, base cuneate to attenuate, decurrent, apex obtuse or acute or with a narrow notch; midrib raised and crested above, angular or rounded below; lateral veins 8–10 pairs, ascending at an angle of *c.* 45° from midrib, diminishing and becoming inconspicuous toward leaf margin, impressed and almost inconspicuous above, prominent below; petiole 0.8–2 cm long, flat on adaxial side, angular or rounded on abaxial side. **Inflorescences** mostly axillary amongst terminal leaves, fascicles 5–11-flowered. **Flowers:** pedicel slender, to 15 mm long, tomentose; sepals 6, ovate, *c.* 2 mm across, brownish tomentose outside, glabrous inside; corolla to 3 mm long, almost glabrous; stamens 10–12, filaments slender, 2–2.5 mm long, glabrous, anthers oblong, *c.* 1 mm long, sparsely hairy, dehiscing extrorsely; ovary ellipsoid, *c.* 1.5 × 1 mm, 5–6-loculed, glabrous, style stout, 1.5–2.5 mm long, glabrous. **Fruits** obovoid, *c.* 1.5 × 1 cm, 1–2-seeded, with short style remnant, glabrous. **Seeds** obovoid, *c.* 1 × 0.5 cm; scar narrow, *c.* 2 mm wide.

Vernacular name. Sarawak—nyatoh terong (Iban).

Distribution. Indo-China, Sumatra, Peninsular Malaysia, Singapore, Borneo, the Philippines, and New Guinea. In Borneo, common in Sarawak (e.g., *S* 0472, *S* 0680, *S* 7921, *S* 8040, and *S* 9013), Sabah (e.g., *SAN* 16775 and *SAN* 16812), Brunei (e.g., *BRUN* 416 and *BRUN* 1007), and Kalimantan (e.g., *bb.* 10706 and *bb.* 16803).

Ecology. In peat swamp and kerangas forests.

Uses. The timber is strong and resistant to attack by insects. Used for making shingles in Sumatra.

28. *Palaquium rigidum* Pierre ex Dubard (Latin, *rigidum* = rigid; the stiff leaves)

Bull. Soc. Bot. Fr. 56, Mém 16 (1909) 18; Merrill *l.c.* (1921) 481; H.J. Lam *l.c.* (1925) 27, *l.c.* (1927) 387; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 564; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325. **Type:** Beccari PB 2284, Borneo, Sarawak, Matang (holotype FI; isotypes G, L).

Tree to 25 m tall. **Bark** reddish grey. **Twigs** stout, *c.* 6 mm diameter, subterete, brownish tomentose, glabrescent. **Terminal buds** *c.* 4 mm long, brownish tomentose. **Stipules** ovate, *c.* 2.5 × 2 mm, brownish tomentose on both sides, caducous. **Leaves** clustered at ends of twigs, chartaceous, glabrous on both surfaces; obovate, 13–15.5 × 4–6.5 cm, base cuneate, decurrent, apex obtusely acuminate; midrib impressed above, prominent and rounded below; lateral veins 12–17 pairs, ascending at an angle of 65–75° from midrib, diminishing and becoming inconspicuous toward leaf margin, prominent on both sides; intercostal venation scalariform, almost parallel to lateral veins, prominent on both sides; petiole 2–2.8 cm long, flat on adaxial side, brownish tomentose at base. **Inflorescences** axillary, fascicles 3–4-flowered. **Flowers:** pedicel 7–15 mm long, angular, brownish tomentose; outer sepals ovate-lanceolate, *c.* 6 × 4 mm, brownish tomentose outside, glabrous inside, inner sepals with membranaceous margin; corolla lobes oblong, *c.* 6 × 4 mm; stamens 12, in two whorls, filaments slender, 2.5–4 mm long, anthers oblong, 3–4 mm long, glabrous, dehiscing extrorsely; ovary disc-like, *c.* 1.5 × 1.5 mm,

6-loculed, *brownish tomentose*, style slender, 10–12 mm long, cylindrical. **Fruits** *globose*, 8–10 cm diameter, 1-seeded; pericarp thin, finely tomentose. **Seeds** unknown.

Distribution. Endemic to Borneo. Confined to Sarawak and recorded from Matang (e.g., *Beccari PB 2284*), Semengoh FR and Baram area.

Ecology. In lowland mixed dipterocarp forest.

29. *Palaquium rioense* H.J.Lam (of Riau province, Sumatra)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 89, *l.c.* (1927) 409; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 538; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 152. **Type:** *Hort. Bog. IV. C. 23*, Sumatra, Riau, cultivated at the Bogor Botanic Gardens (holotype BO; isotype NY).

Tree, 20–40 m tall. **Bark** brown, inner bark pinkish. **Twigs** slender, 2–5 mm in diameter, terete, *brownish hairy*, glabrescent. **Terminal buds** 7–8.5 mm long, tomentose. **Stipules** lanceolate, *c.* 6.5 × 3 mm, tomentose outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs*, coriaceous, glabrous above, *brownish tomentose below*; ovate to obovate, 14.5–17.5 × 2.5–3.5 cm, base cuneate, apex acuminate; midrib impressed above, round and prominent below; *lateral veins 16–17 pairs*, ascending at an angle of 50–65° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, slightly impressed above, prominent below; intercostal venation finely scalariform, prominulous above, slightly more prominent below; *petiole 1.5–2 cm long, grooved on adaxial side*, brownish tomentose. **Inflorescences** axillary, fascicles few-flowered. **Flowers:** *pedicel* angular, to 10 mm long, *dark brownish tomentose*; outer sepals lanceolate, *c.* 3 × 1.5 mm, apex acute, brownish tomentose outside, glabrous inside, inner sepals with membranaceous glabrous margin; corolla lobes ovate-lanceolate, to 7.5 mm long, brownish sericeous outside along tube and base, brownish hirsute inside between stamens; stamens 12, filaments slender, 3–4 mm long, sparsely hairy at base, anthers ovoid-oblong, *c.* 2 mm long, apex apiculate, sparsely hairy at base, dehiscing extrorsely; ovary ovoid, *c.* 1.5 × 1 mm, brownish sericeous, style slender, 9–12 mm long, glabrous. **Fruits** obovoid, *c.* 2 × 1.5 cm, 1-seeded, glabrous; pericarp thin. **Seeds** slightly smaller than fruits; scar covering about one third of seed surface.

Distribution. Sumatra (Riau) and Borneo. In Borneo, found in Mt. Kinabalu area and SW part of Sabah (e.g., *Clemens 29022*, *Clemens 32080*, *Clemens 40605*, and *Clemens 50445*), C and N parts of Sarawak, Brunei and E Kalimantan (e.g., *Endert 3620* and *Endert 3643*).

Ecology. Mostly in hill and lower montane forests, at altitudes 300–1500 m.

30. *Palaquium rivulare* H.J.Lam (Latin, *rivularis* = growing by watercourses)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 403; Masamune *l.c.* 596; P. Royen *l.c.* (1960) 474; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 152. **Type:** *Endert 3021*, Borneo, Kalimantan, W Kutai (holotype BO; isotype L).

Tree to 20 m tall. **Bark** pale brown, smooth. **Twigs** stout, 3–7 mm diameter, subterete, brownish tomentose to glabrous. **Terminal buds** c. 10 mm long, sparsely tomentose. **Stipules** *oblong*, c. 12 × 5 mm, subchartaceous, sparsely tomentose outside, glabrous inside. **Leaves** *well-spaced along twigs, thinly chartaceous*, glabrous above, sparsely hairy below; oblong, 17–23 × 7.5–10 cm, base rounded, asymmetrical, apex obtusely acuminate; midrib impressed and crested above, prominent below; *lateral veins 18–22 pairs*, ascending at an angle of 55–70° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, almost inconspicuous above, prominent below; intercostal venation thin, scalariform, conspicuous on both sides; petiole stout, 0.9–2.6 cm long, flat on adaxial side, rounded on abaxial side, sparsely tomentose, glabrescent. **Inflorescences** axillary, fascicles 4–10-flowered. **Flowers:** pedicel angular, 5–10 mm long, brownish, almost glabrous; outer sepals triangular or ovate, 2.5–3 × 2 mm, apex obtuse, brownish tomentose outside, glabrous inside; inner sepals thin, glabrous, hairy along margin; corolla lobes ovate-oblong, 5–8 mm long, brownish, sparsely hairy; stamens 18–21, in two or three whorls, filaments short, subulate, 0.5–1.5 mm long, brownish hairy, anthers ovoid, 3–4 mm long, apex acuminate, brownish hairy, dehiscing extrorsely; ovary conical, c. 2 × 1 mm, 6-loculed, 6-lobed, brownish hairy, style cylindrical, stout, 3–4 mm long, glabrous. **Fruits** unknown.

Distribution. Endemic to Borneo. Found throughout Sarawak (e.g., *S 37358* and *S 37464*) and NE Kalimantan (e.g., *Endert 3021* and *Kostermans 9701*).

Ecology. In mixed dipterocarp forest and limestone forest. Occasionally also in riparian forest.

31. *Palaquium rostratum* (Miq.) Burck

(Latin, *rostratus* = with a beak, narrowed into a slender tip; probably referring to the fruit)

Ann. Jard. Bot. Buitenz. 5 (1886) 39; H.J. Lam *l.c.* (1925) 40, *l.c.* (1927) 396; Masamune *l.c.* 597; P. Royen *l.c.* (1960) 568; Ng *l.c.* 426; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 152; Turner *l.c.* 466; Coode *et al.* (eds.) *l.c.* 307; Argent *et al.* (eds.) *l.c.* 586. **Basionym:** *Isonandra ?rostrata* Miq., Fl. Ned.-Indie, Suppl. (1861) 581. **Type:** *Teijsmann HB 3276*, Sumatra, Bangka, Djebus (holotype BO; isotype L). **Synonyms:** *Croixia rostrata* (Miq.) Baehni *l.c.* 109; *Palaquium verstegei* Burck *l.c.* 35; *P. membranaceum* Burck *l.c.* 42; *P. parvifolium* Burck *l.c.* 36; *P. bancanum* Burck *l.c.* 43.

Tree to 45 m tall. **Bark** greyish brown, shallowly fissured, sometimes flaky; inner bark yellowish brown. **Twigs** 2–8 mm diameter, subterete to angular, *reddish-brown tomentose, not covered with prominent leaf scars*. **Stipules** *lanceolate*, c. 1.5 × 0.5 mm, apex acute, puberulous outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs or clustered at ends of twigs, glabrous on both surfaces, chartaceous*; obovate or spatulate, rarely elliptic, 7–14.5 × 3.5–6.5 cm, base cuneate, decurrent, apex rounded or obtusely acuminate; midrib flat or slightly impressed and faintly crested above, prominent and angular below; *lateral veins 15–18 pairs*, ascending at an angle of 75–90° from midrib, *arching and joining into intramarginal vein along leaf margin*; *intercostal venation descending from leaf margin and almost parallel to lateral veins*; petiole 1.2–4 cm long, flat on adaxial side, angular on abaxial side, glabrous. **Inflorescences** axillary or crowded along leafless part of twigs; fascicles 1–2-flowered. **Flowers:** pedicel to 6 mm long, brownish tomentose; sepals ovate, 4 × 2–3 mm, apex obtuse, brown tomentose outside, glabrous inside; corolla to 3 mm long, brownish tomentose to glabrous, densely brownish pubescent on corolla tube, lobes ovate, apex obtuse; stamens 12, filaments subulate, c. 0.7 mm long, brownish tomentose, soon becoming glabrous, anthers ovoid, c. 1 mm long, flattened,

glabrous; *ovary discoid*, *c.* 1.5×1 mm, 6-loculed, brownish tomentose, style conoid, 1.5–3.5 mm long, glabrous. **Fruits** *ellipsoid*, $2\text{--}3.5 \times 1.2\text{--}1.4$ cm, 1-seeded, apex rounded, with short remnant of style; pericarp fleshy, glabrous. **Seeds** ovoid $1\text{--}2.3 \times 0.5\text{--}0.9$ cm; scar covering about half of seed surface.

Distribution. Thailand, Sumatra (including Lingga, Riau, Bangka, and Biliton), Peninsular Malaysia, Java, Borneo (throughout; e.g., *BRUN 742*, *BRUN 5245*, *FD-F.M.S. 35433*, *Kostermans 6107*, *S 32873*, *S 38505*, *S 39709*, *SAN 16786*, *SAN 33805*, and *SAN A 3867*), Sulawesi, and Ambon.

Ecology. In *kerangas* and mixed dipterocarp forests on sandy soils, from sea level to about 1200 m altitude.

Uses. The timber is attractive and widely used for furniture-making and panelling. The fruits are edible.

32. *Palaquium rufolanigerum* P.Royen

Fig. 20.

(Latin, *rufus* = reddish, *lanigerum* = wool-bearing; the reddish-brown woolly indumentum)

Blumea 10 (1960) 580; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 152. **Type:** *Rambli 1754* (= *S 48*), Borneo, Sarawak, Kuching, Semengoh FR (holotype SAR; isotype KEP).

Tree, 20–30 m tall. **Bark** reddish brown, finely and shallowly fissured; inner bark rosy pink to reddish, soft. **Twigs** slender, *c.* 4 mm diameter, subterete, covered with prominent leaf scars, densely reddish-brown woolly-tomentose. **Terminal buds** to 3 mm long, densely reddish-brown woolly-tomentose. **Stipules** tomentose, *ovate*, *c.* 3×2 mm. **Leaves** clustered at ends of twigs, chartaceous to subcoriaceous, initially densely reddish-brown woolly tomentose, later glabrous except for midrib; spatulate, $6.7\text{--}9.5 \times 2\text{--}3.3$ cm, base narrowly cuneate, decurrent, apex rounded; midrib crested and sparsely hairy above, angular, prominent and densely reddish-brown woolly-tomentose below; lateral veins 13–15 pairs, arching and joining into intramarginal vein along leaf margin, almost inconspicuous above, fairly conspicuous below; intercostal venation laxly reticulate; petiole 0.8–1.3 cm long, densely reddish-brown woolly-tomentose. **Inflorescences** borne in axils of leaf scars, fascicles 2–3-flowered. **Flowers:** pedicel angular, 8–12 mm long, densely reddish-brown woolly-tomentose; outer sepals triangular, $2\text{--}3 \times 2\text{--}5$ mm, brownish tomentose outside, glabrous inside, inner sepals with membranaceous glabrous margin; corolla lobes 4–5 mm long, brownish sericeous; stamens 12, glabrous, filaments slender, *c.* 3 mm long, anthers lanceolate, *c.* 2 mm long, apex bifid, dehiscing extrorsely; ovary globose, *c.* 2.5 mm diameter, 6-loculed, brownish hirsute, style slender, to 10 mm long, base hirsute. **Fruits** globose, 1.2–1.5 cm diameter, smooth, 1-seeded; pericarp thin. **Seeds** laterally compressed; scar covering about one third of seed surface.

Distribution. Endemic to Borneo. In Sabah, known by several collections from Beaufort district. In Sarawak, recorded from Kuching Division particularly in Semengoh FR, Bako NP, Kapit and Sri Aman Divisions (e.g., *S 048*, *S 24652*, *S 37630*, *S 44920*, and *S 47084*). Also occurs in Brunei and Kalimantan.

Ecology. In coastal to lower montane forests.

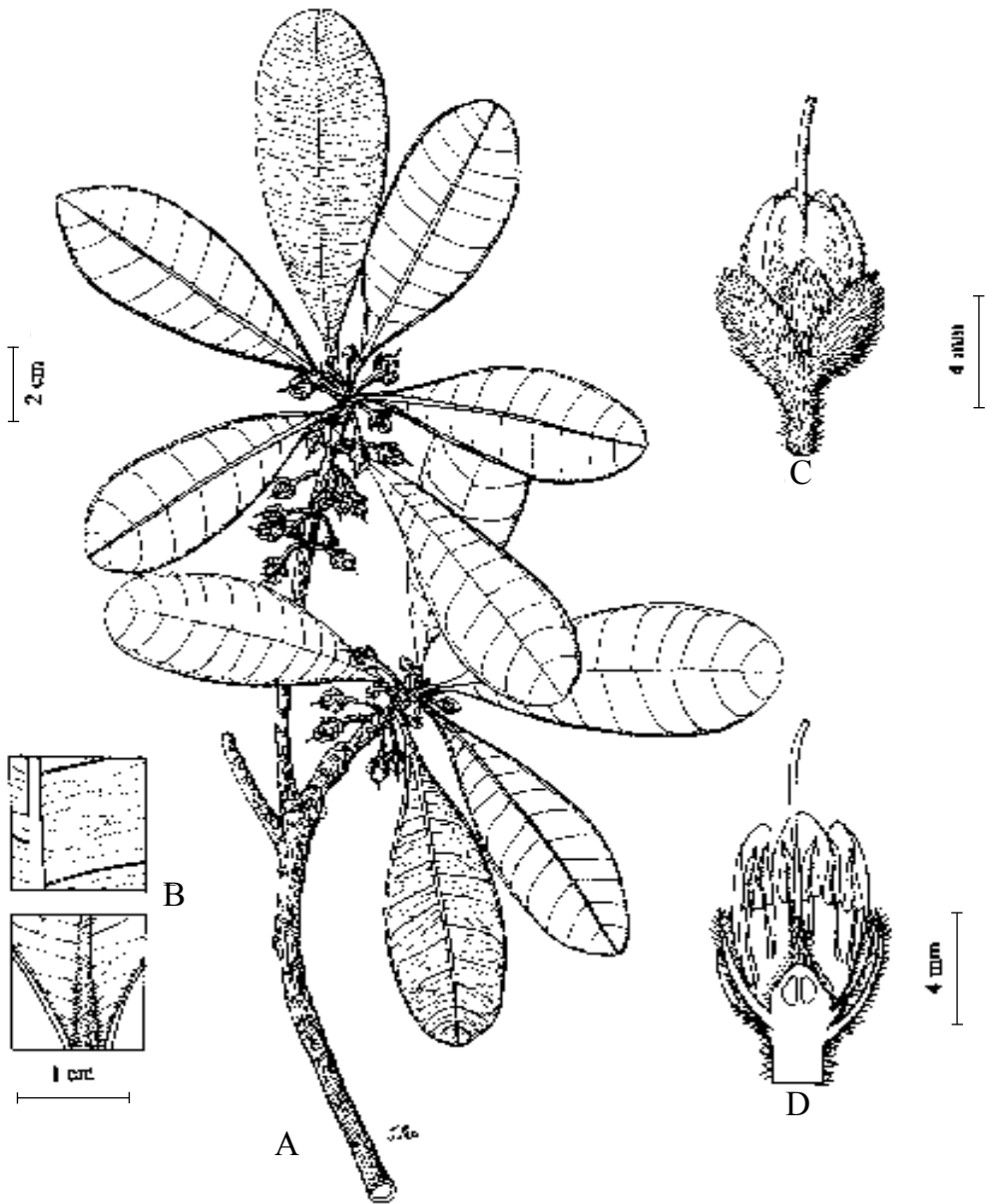


Fig. 20. *Palaquium rufolanigerum*. A, flowering leafy twig; B, detailed venation of leaf; C, flower; D, longitudinal section of flower. (All from S 32502.)

Notes. A very distinct species, easily recognised by its small, spatulate leaves and reddish-brown woolly indumentum.

33. *Palaquium sericeum* H.J.Lam

(Latin, *sericeus* = silky with long straight closely pressed glossy hairs; the indumentum)

Bull. Jard. Bot. Buitenz. 3, 7 (1925) 53, *l.c.* (1927) 399; Masamune *l.c.* 597; P. Royen *l.c.* (1960) 463; Anderson *l.c.* 318; Whitmore, Tantra & Sutisna *l.c.* 325; Pennington *l.c.* 152; Kessler & Sidiyasa *l.c.* 216; Coode *et al.* (eds.) *l.c.* 307; Argent *et al.* (eds.) *l.c.* 586. **Type:** *Jaheri 716*, Borneo, Kalimantan, Blulu (holotype BO).

Tree to 22 m tall. **Bark** reddish brown, smooth, sometimes scaly; inner bark brown. **Twigs** slender, 1–3 mm diameter, *brownish sericeous*. **Terminal buds** to 5 mm long, woolly tomentose. **Stipules** linear-lanceolate, 2.5 × 1–1.5 mm, brownish sericeous outside, glabrous inside, persistent. **Leaves** well-spaced along twigs, *subcoriaceous*, glabrous above, *brownish sericeous below*; oblong to obovate, 15–38.5 × 7.5–10.5 cm, base rounded, sometimes oblique, apex acutely acuminate to emarginate; midrib impressed above, angular or rounded and prominent below; *lateral veins* 23–25 pairs, ascending at an angle of *c.* 55° from midrib, *diminishing and becoming inconspicuous toward leaf margin*, impressed above, prominent below; intercostal venation scalariform, inconspicuous on both sides; *petiole* stout, 8–10 cm long, *flat on adaxial side*, brownish sericeous. **Inflorescences** axillary, fascicles 12–20-flowered. **Flowers:** *pedicel* 10–25 mm long, angular, *brownish sericeous*; outer sepals ovate-lanceolate, 2–8 × 2 mm, brownish sericeous outside, glabrous inside, apex acute, inner sepals acute to rounded, glabrous, margin membranaceous; corolla to 10 mm long, glabrous, lobes ovate-lanceolate, apex subobtuse; stamens 12, filaments subulate, to 1 mm long, glabrous, anthers sagittate, 2–3 mm long, apex acuminate, glabrous, those of outer stamens dehiscing extrorsely, and those of inner ones introrsely; ovary conical, *c.* 2 × 1 mm, brownish sericeous, style slender, to 8 mm long, glabrous. **Fruits** globose or ellipsoid, 1.5–2.7 × 0.7–1.7 cm, sparsely hairy to almost glabrous. **Seeds** laterally compressed, ellipsoid, *c.* 1.5 × 1 cm; scar covering about one third of seed surface.

Distribution. Endemic to Borneo. In Sabah, confined to the eastern coastal areas (e.g., *SAN 16640*, *SAN 37023*, *SAN 88273*, *SAN 97137*, and *SAN 128234*). In Sarawak, recorded mainly from the central and northern parts (e.g., *S 22457*, *S 23343*, *S 24637*, *S 39815*, and *S 40202*). Also occurs in Brunei (e.g., *Dransfield JD 6555*, *Kirkup 360* and *Wong WKM 1568*) and C Kalimantan (e.g., *Mogea 4326*).

Ecology. In a wide range of forest types but more abundant in the lowland mixed dipterocarp forest and alluvial forest; occasionally also in limestone forest.

34. *Palaquium stellatum* King & Gamble

(Latin, *stellatum* = star-like; hairs of indumentum of the midrib and lateral veins)

J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 198; Ridley *l.c.* (1923) 277; H.J. Lam *l.c.* (1925) 71, *l.c.* (1927) 402; Wyatt-Smith *l.c.* 43; P. Royen *l.c.* (1960) 533; Ng *l.c.* 427; Whitmore, Tantra & Sutisna *l.c.* 326; Pennington *l.c.* 152; Turner *l.c.* 466; Argent *et al.* (eds.) *l.c.* 586; Kochummen, TFPF (1997) 413. **Type:** *Scortechini 1855*, Peninsular Malaysia, Perak (holotype SING). **Synonyms:** *Bassia watsoni* Ridl. *l.c.* (1923) 267; *Madhuca watsoni* (Ridl.) H.J.Lam *l.c.* (1925) 179, *l.c.* (1927) 462.

Tree to 40 m tall. **Bark** brownish, peeling off; inner bark reddish brown. **Twigs** slender, 3–5 mm diameter, irregularly ridged, brownish hirsute, glabrescent. **Terminal buds** to 5 mm long, hirsute. **Stipules** lanceolate, *c.* 3 × 1.5 mm, brownish hirsute outside, glabrous inside, caducous. **Leaves** clustered at ends of twigs, subcoriaceous to chartaceous, glabrous except for the stellate-hairy midrib and veins; elliptic to oblong, 9–13.5 × 3–5 cm, base cuneate, apex obtusely acuminate; midrib crested above, prominent and crested below; lateral veins 8–10 pairs, rusty stellate-tomentose on both sides, ascending at an angle of *c.* 55° from midrib, diminishing and becoming inconspicuous toward leaf margin, conspicuous on both sides; intercostal venation finely scalariform, conspicuous on both sides; petiole to 2.2 cm long, shallowly grooved on adaxial side, brownish hirsute. **Inflorescences** axillary, fascicles to 5-flowered. **Flowers:** pedicels terete or angular, to 20 mm long, brownish hirsute; outer sepals ovate, *c.* 7 × 3 mm, inner sepals with membranaceous margin, dark brownish hirsute on both sides; corolla lobes elliptic-oblong, to 10 mm long; stamens 12, filaments lanceolate, angular, 3–4 mm long, glabrous, anthers oblong-lanceolate, *c.* 2 mm long, apex pointed, brownish tomentose, dehiscing extrorsely; ovary subglobose, *c.* 2 × 1.5 mm, brownish hirsute, style slender, 6–10 mm long, glabrous. **Fruits** subglobose to globose, 2–2.5 cm diameter, 1–3-seeded; pericarp fleshy, glabrous. **Seeds** spindle-shaped, *c.* 1.5 × 0.5 cm; scar narrow, 2–4 mm wide.

Distribution. Sumatra (Riau), Peninsular Malaysia and Borneo. In Sabah, known by one collection from Beaufort district, and in Sarawak known by a single record from Lambir NP. Also occurs in Kalimantan (e.g., *Kostermans 7951*).

Ecology. In lowland mixed dipterocarp forest especially on sandy loam soils.

Uses. The timber is very heavy, hard and durable.

35. *Palaquium stipulare* Pierre ex Dubard (Latin, *stipularis* = with prominent stipules)

Fig. 21.

Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 21; Merrill *l.c.* (1921) 481; H.J. Lam *l.c.* (1925) 57, *l.c.* (1927) 399; Masamune *l.c.* 597; P. Royen *l.c.* (1960) 488; Anderson *l.c.* 319; Whitmore, Tantra & Sutisna *l.c.* 326; Pennington *l.c.* 152. **Type:** *Beccari PB 1549*, Borneo, Sarawak, Matang (holotype P; isotype FI). **Synonym:** *Palaquium richardsii* Griffioen & H.J.Lam, Kew Bull. (1927) 17.

Tree to 30 m tall. **Bark** brownish grey, smooth to rough, powdery or cracked in older trees; inner bark reddish brown to pinkish. **Twigs** stout, 5–12 mm diameter, covered with prominent leaf scars, brownish tomentose. **Terminal buds** to 15 mm long, glabrescent. **Stipules** scale-like, 4–10 × 3–5 mm, tomentose outside, glabrous inside. **Leaves** well-spaced along twigs, subcoriaceous, glabrous above, yellowish-brown tomentose below; obovate, 10–20.5 × 6–14 cm, base cuneate, apex rounded; midrib impressed above, round and prominent below; lateral veins 16–21 pairs, ascending at an angle of 50–60° from midrib, diminishing and becoming inconspicuous toward leaf margin, prominent below, inconspicuous above; intercostal venation scalariform, inconspicuous on both sides; petiole 1.5–3 cm long, grooved on adaxial side, tomentose. **Inflorescences** axillary, fascicles 2–4-flowered. **Flowers:** pedicel subterete, 12–45 mm long, brownish tomentose; outer sepals ovate-elliptic, 7–10 × 5–7 mm, brownish tomentose outside, glabrous inside, inner sepals ovate, with membranaceous margin; corolla lobes elliptic-oblong, to 20 mm long; stamens 19–27, filaments lanceolate, 2–3.5 mm long, anthers sagittate,

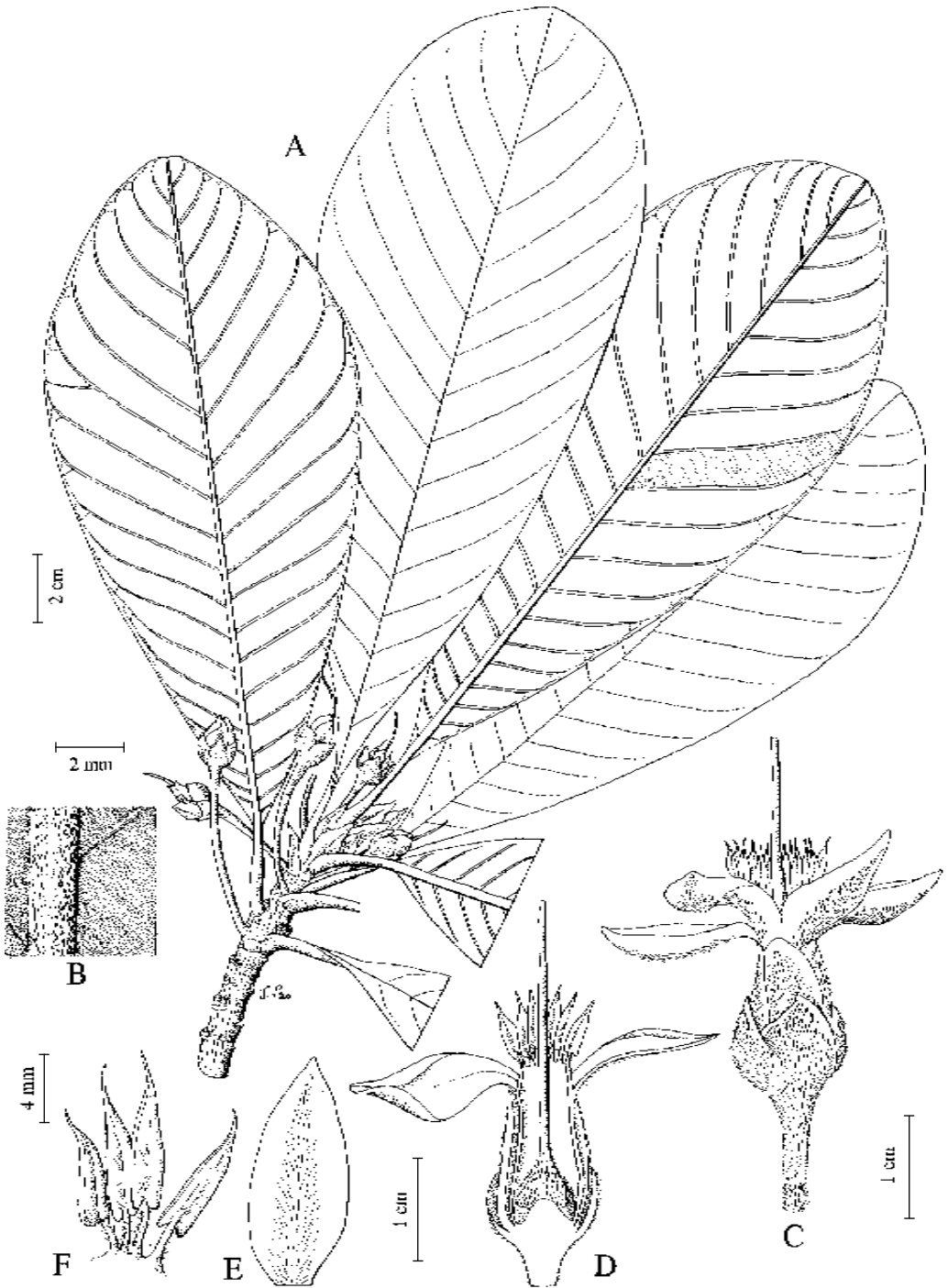


Fig. 21. *Palaquium stipulare*. A, flowering leafy twig; B, indumentum on lower leaf surface; C, open flower; D, longitudinal section of flower; E, petal; F, stamens. (All from S 39251.)

5–7 mm long, brownish tomentose; ovary ovoid, *c.* 2 × 1.5 mm, brownish tomentose, style slender, to 20 mm long, glabrous. **Fruits** globose, 2–2.7 cm diameter, 1-seeded, almost glabrous.

Seeds unknown.

Distribution. Endemic to Borneo and recorded from Kuching, Miri, Kapit, and Bintulu districts in Sarawak (e.g., *Beccari PB 1549*).

Ecology. In lowland mixed dipterocarp forest on yellow clayey soils.

36. *Palaquium sumatranum* Burck

(of Sumatra)

Ann. Jard. Bot. Buitenz. 5 (1886) 34; Dubard, Bull. Soc. Bot. Fr. 56, Mém. 16 (1909) 18; H.J. Lam *l.c.* (1925) 39, 254, *l.c.* (1927) 396; Masamune *l.c.* 326; P. Royen *l.c.* (1960) 595; Whitmore, Tantra & Sutisna *l.c.* 326. **Type:** *Teijsmann s.n.*, Sumatra (holotype BO). **Synonyms:** *Palaquium teysmannianum* Burck *l.c.* 38; *P. beauvisagei* Burck *l.c.* 38.

Tree to 45 m tall. **Bark** rusty brown, inner bark pale brown. **Twigs** stout, 4–7 mm diameter, brownish puberulous to glabrous. **Terminal buds** to 12 mm long, puberulous. **Stipules lanceolate**, *c.* 5 × 1.5 mm, puberulous outside, glabrous inside, caducous. **Leaves well-spaced along twigs, coriaceous, glabrous on both surfaces;** elliptic to obovate-oblong, 13–19 × 6–9.5 cm, base cuneate, apex rounded; midrib impressed above, angular and prominent below; *lateral veins 19–24 pairs, ascending at an angle of 70–85° from midrib, diminishing and becoming inconspicuous toward leaf margin*, prominulous above, prominent below; intercostal venation reticulate; *petiole 2.5–4 cm long, grooved on adaxial side*, slightly thickened at base, reddish puberulous, glabrescent. **Inflorescences** axillary, fascicles 1–3-flowered. **Flowers:** *pedicel* angular, 5–8 mm long, brownish tomentose; outer sepals ovate, 5–6 × 2–5 mm, brownish tomentose outside, glabrous inside, inner sepals with membranaceous margin; corolla lobes elliptic or ovate, to 8.5 mm long; *stamens 12*, filament linear, 2–3 mm long, glabrous, *anthers oblong-obovoid*, 2–3 mm long, glabrous, dehiscing extrorsely; ovary discoid, 1–1.5 mm long, brownish puberulous, 6-loculed, style subulate, 8–14 mm long, stigma 5-lobed. **Fruits** ovoid to obovoid, *c.* 2.5 × 1.5 cm, 1-seeded; pericarp very thin, glabrous. **Seeds** only slightly smaller than fruit; scar covering about one fourth of seed surface.

Distribution. Thailand, Sumatra (Biliton and Riau), Borneo, and Java. In Borneo, known from Ranau district in Sabah (e.g., *Clemens 40574*), southwestern part of Sarawak, and S and E Kalimantan (e.g., *bb. 14845*, *bb. 14878* and *bb. 19788*).

Ecology. In mixed dipterocarp forest.

37. *Palaquium supfianum* Schltr.

(K. Supf, German manufacturer)

Tropenpfl. 7 (1903) 469; H.J. Lam *l.c.* (1925) 60, *l.c.* (1927) 400; P. Royen *l.c.* (1960) 480. **Type:** *Schlechter 13921*, New Guinea, Bismarck Mts. (holotype B†; isotype P). **Synonym:** *P. inutile* Schltr. ex Krause, Engl. Bot. Jahrb. 58 (1923) 469.

Tree to 35 m tall. **Twigs** stout, subterete, brownish tomentose, glabrescent. **Terminal buds** 10–12 mm long. **Stipules** lanceolate, to 10 mm long, pubescent on both sides, caducous. **Leaves** clustered at ends of twigs, coriaceous, glabrous above, densely brownish-tomentose below; obovate, 10–25 × 5–8 cm, base cuneate, decurrent, apex acute or obtusely acuminate or sometimes rounded; midrib impressed above, prominent below; lateral veins 12–15 pairs, ascending at an angle of 45–60° from midrib, diminishing and becoming inconspicuous toward leaf margin, prominulous above, prominent below; intercostal venation scalariform, prominent on both sides; petiole thickened, c. 1.5 cm long, grooved on adaxial side, wrinkled on abaxial side. **Inflorescences** axillary, fascicles to 5-flowered. **Flowers:** pedicel angular, c. 25 mm long, brownish tomentose; outer sepals ovate or triangular, c. 5 mm across, brownish tomentose outside, glabrous inside, inner sepals glabrous, with membranaceous margin; corolla lobes to 10 mm long, apex acuminate, curled outwards at anthesis; stamens 12, filaments slender, 3–4 mm long, glabrous, anthers ovoid, c. 3 mm long, apex acuminate, sparsely hairy, dehiscing extrorsely; ovary globose, c. 2 mm diameter, 6-loculed, brownish tomentose, style stout, angular, 5–12 mm long, pubescent. **Fruits** globose, brownish sericeous, glabrescent. **Seeds** unknown.

Distribution. Borneo and New Guinea. In Borneo, uncommon, known by one collection (S 39972) from Sg. Jelini, Belaga district, Sarawak.

Ecology. In lowland mixed dipterocarp forest at about 800 m altitude.

Notes. The disjunct distribution is somewhat unusual, and therefore, the correct identity of the specimen cited above and the occurrence of the species in Sarawak is doubtful (Editors).

38. *Palaquium tenuipetiolatum* Merr.

(Latin, *tenuis* = thin, *petiolum* = leaf stalk; the slender petiole)

Bur. Govt. Lab. Publ. 17 (1904) 45, Phil. J. Sc. 1, Suppl. (1906) 144, Enum. Phil. Fl. Pl. 3, 3 (1923) 283; H.J. Lam l.c. (1925) 95, l.c. (1927) 410; P. Royen l.c. (1960) 529. **Type:** *Barnes 154*, the Philippines, Luzon, Lamao R. (holotype PNH; isotypes NY, SING). **Synonym:** *Croixia tenuipetiolata* (Merr.) Baehni l.c. 109.

Tree to 30 m tall. **Twigs** slender, 3–4 mm diameter, brownish tomentose at apex, glabrescent. **Terminal buds** to 10 mm long, tomentose. **Stipules** lanceolate, c. 2 × 1 mm, tomentose outside, glabrous inside, caducous. **Leaves** well-spaced along twigs, chartaceous, glabrous on both surfaces; elliptic, 5–7 × 2–2.5 cm, base cuneate, decurrent, apex acuminate or caudate; midrib slightly impressed and crested above, round and prominent below; lateral veins 12–14 pairs, diminishing and becoming inconspicuous toward leaf margin, ascending at angle of 60–70° from midrib, prominulous on both sides; intercostal venation scalariform, inconspicuous on both sides; petiole 1.5–2 cm long, grooved on adaxial side, wrinkled on abaxial side, brownish tomentose. **Inflorescences** axillary, fascicles 1–3-flowered. **Flowers:** pedicel 3–10 mm long, angular, brownish pubescent; sepals ovate-triangular, c. 3 mm across, outer ones smaller and thicker than inner ones, apex obtuse, inner ones with membranaceous margin, brownish tomentose outside, glabrous inside; corolla to 6 mm long, glabrous, lobes elliptic, obtuse at apex, reflexed when fully open; stamens 12, filaments slender, c. 3.5 mm long, glabrous, anthers ovoid to ellipsoid, c. 2 mm long, apex bifid, dehiscing extrorsely, brownish tomentose; ovary discoid, c. 3 × 2 mm, 6-loculed, 12-lobed, style subulate, 7–10 mm long, glabrous except for the brownish hirsute base. **Fruits** ovoid or fusiform, oblique, c. 2.5 × 1.5 cm, 1-seeded, obtusely acuminate at apex;

pericarp thin, glabrous. **Seeds** almost as big as fruit; scar covering about half of seed surface.

Distribution. Borneo and the Philippines. In Borneo, rare, known by a single collection (S 39644) from G. Mulu NP in Sarawak.

Ecology. In mixed dipterocarp forest.

39. *Palaquium vexillatum* P. Royen

(Latin, *vexillatus* = flag-like; the stipules)

Blumea 10 (1960) 494; Whitmore, Tantra & Sutisna *l.c.* 326. **Type:** *Kostermans 7325*, Borneo, Kalimantan, Balikpapan (holotype L; isotype BO).

Tree to 38 m tall. **Bark** light brown, fissured; inner bark whitish to tinged reddish. **Twigs** slender, 2–4 mm diameter, *angular, brownish tomentose*, glabrescent. **Terminal buds** 6–8 mm long, brownish sericeous. **Stipules** slender, *twisted and protruding from terminal bud like small flags, to 8 mm long*, brownish hairy outside, glabrous inside. **Leaves** *well-spaced along twigs, chartaceous*, glabrous above, *densely brownish-tomentose below*; ovate to elliptic, 5–9 × 1.8–4.5 cm, base cuneate, apex acuminate; midrib impressed and crested above, rounded and prominent below; *lateral veins 8–12 pairs, ascending at an angle of 60–65° from midrib, diminishing and becoming inconspicuous toward leaf margin*, prominulous on both sides; intercostal venation finely scalariform, fairly conspicuous on both sides; *petiole 0.8–2.4 cm long, grooved on adaxial side, rounded on abaxial side, brownish tomentose*. **Inflorescences** *axillary*, fascicles to 5-flowered. **Flowers:** *pedicel 2–5 mm long, subterete, brownish tomentose*; outer sepals triangular, ovate or elliptic, *c. 2.5 × 2 mm*, brownish tomentose outside, glabrous inside, inner sepals with membranaceous and hairy margin; corolla lobes elliptic, to 2 mm long, glabrous outside, brownish tomentose inside; stamens 12, in two whorls, filaments subulate, *c. 0.2 mm long*, glabrous, *anthers sagittate, c. 0.8 mm long*, apex bifid, brownish hairy, *dehiscing extrorsely*; ovary obovoid, *c. 1.5 mm across*, 6-loculed, glabrous at base, puberulous at apex, style clavate, *c. 1 mm long*, glabrous. **Fruits** unknown.

Distribution. Endemic to Borneo and recorded from Ranau district in Sabah and from Balikpapan in Kalimantan (e.g., *Kostermans 7325*).

Ecology. Locally common in secondary forest on brownish sandy soils.

40. *Palaquium walsurifolium* Pierre ex Dubard

(Latin, with leaves like those of *Walsura*, Meliaceae)

Bull. Soc. Bot. Fr. 56, Mém 16 (1909) 22; Merrill *l.c.* (1921) 481; H.J. Lam *l.c.* (1925) 77, 256, *l.c.* (1927) 407; Masamune *l.c.* 597; P. Royen *l.c.* (1960) 492; Anderson *l.c.* 319; Whitmore, Tantra & Sutisna *l.c.* 326; Pennington *l.c.* 152. **Type:** *Beccari PB 557*, Borneo, Sarawak, Kuching (holotype P; isotypes FI, G, L, NY, S).

Tree to 30 m tall, with stilt roots. **Bark** rusty brown, pock-marked, inner bark rusty brown. **Twigs** slender, 2–3 mm diameter, *brownish tomentose*, glabrescent. **Terminal buds** *to 3 mm*

long, brownish tomentose. **Stipules** *triangular*, *c.* 2.5 mm across, tomentose outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs or clustered at ends of twigs, subcoriaceous, glabrous on both surfaces; obovate*, 6–9 × 3–4.5 cm, apex acuminate; midrib slightly impressed above, rounded and prominent below, sometimes distinctly dark brown; *lateral veins 7–12 pairs*, ascending at an angle of 60–70° from midrib, *diminishing and becoming inconspicuous toward leaf margin, impressed above, prominent below; intercostal venation* scalariform, inconspicuous above, *prominulous below; petiole* 1.2–2.2 cm long, grooved or flat on adaxial side, *glabrous*. **Inflorescences** axillary, fascicles to 5-flowered. **Flowers:** *pedicel 15–17 mm long*, terete, brownish tomentose; sepals ovate, 2.5–4 × 2 mm, brownish puberulous outside, glabrous inside and along margin; corolla lobes ovate-elliptic, to 5 mm long; stamens 12, filaments slender, *c.* 2.5 mm long, glabrous, *anthers ellipsoid*, *c.* 1.5 mm long, *glabrous*, dehiscing laterally or extrorsely; ovary globose, *c.* 1 × 1 mm, 6-loculed, brownish tomentose, style slender, 5–8 mm long, glabrous. **Fruits** *subglobose*, 1.2–1.8 × 1–1.5 cm, 1-seeded; pericarp fleshy, glabrous. **Seeds** ellipsoid, slightly smaller than fruit; scar covering about one third of seed surface.

Vernacular name. Sarawak—*nyatoh jangkar* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known only by a few collections from Sarawak (Kuching and Sibu districts; e.g., *Beccari 557, Carroll 7172, Haviland 1875*, and *S 4773*) and SW Kalimantan (e.g., *bb. 12888*).

Ecology. In peat swamp, lowland mixed dipterocarp and alluvial forests.

41. *Palaquium xanthochymum* (de Vriese) Pierre

(Greek, *xantho-* = yellow, *chymum* = latex; with yellow latex)

In Burck, *Ann. Jard. Bot. Buitenz.* 5 (1886) 30; King & Gamble *l.c.* 194; Dubard, *Bull. Soc. Bot. Fr.* 56, *Mém.* 16 (1909) 11; Ridley *l.c.* (1923) 275; H.J. Lam *l.c.* (1925) 77, 256, *l.c.* (1927) 407; Masamune *l.c.* 598; P. Royen *l.c.* (1960) 576; Ng *l.c.* 428; Anderson *l.c.* 319; Whitmore, Tantra & Sutisna *l.c.* 326; Turner *l.c.* 467; Argent *et al.* (eds.) *l.c.* 587. **Basionym:** *Isonandra xanthochyma* de Vriese, *Nat. Tijdschr. Ned.-Indie* 21 (1860) 311. **Type:** *Motley VI (= de Vriese 1366)*, Borneo, Kalimantan, Bandjarmasin (holotype BO; isotypes BM, L). **Synonyms:** ?*Dichopsis rubens* C.B. Clarke in Hooker *f.*, *Fl. Brit. Ind.* 3 (1882) 543; *Palaquium rubens* (C.B. Clarke) Engl., *Bot. Jahrb.* 12 (1890) 511; *P. lanceolatum auct. non* Blanco: Burck *l.c.* (1886) 43; *Croixia xanthochyma* (de Vriese) Baehni *l.c.* 109.

Tree to 40 m tall. **Bark** smooth to shallowly fissured. **Twigs** stout, 3–10 mm diameter, subterete, becoming more or less angular towards apex, *covered with prominent leaf scars*, brownish pubescent near terminal buds. **Terminal buds** to 6 mm long, acute, brownish pubescent. **Stipules** *ovate*, 2.5 × 1.5 mm, acute at apex, brownish pubescent outside, glabrous inside, caducous. **Leaves** *well-spaced along twigs or clustered at ends of twigs, membranaceous to subcoriaceous, glabrous on both surfaces*, rarely puberulous below; obovate, elliptic or spatulate, 8–11.5 × 3.5–5 cm, base decurrent, apex rounded to acuminate; midrib impressed and crested above; *lateral veins 14–20 pairs*, ascending at an angle of *c.* 70° from midrib, *arching and joining into intramarginal vein along leaf margin*, prominulous above, prominent below; *intercostal venation scanty, mostly scalariform* or sometimes *subreticulate*; petiole 1–1.5 cm long, grooved on adaxial side, rounded or angular on abaxial side, glabrous or brownish puberulous. **Inflorescences** axillary, fascicles 4–5-flowered. **Flowers:** *pedicel 3–9 mm long*, angular, sparsely brownish sericeous; sepals ovate-triangular, brownish tomentose outside, glabrous inside; corolla to 10 mm long,

glabrous; stamens 12, glabrous, filaments subulate, 1–2 mm long, *anthers oblong*, 2–3 mm long, dehiscent extrorsely; *ovary* ovoid, *c.* 1 mm across, 6-loculed, *glabrous*, style slender, 9–14 mm long, glabrous. **Fruits** *oblong* or *fusiform*, *c.* 3.5 × 1.5 cm; *pericarp fleshy*, tomentose. **Seeds** *fusiform*, *c.* 2.5 × 0.5 cm; *scar covering about half of seed surface*.

Distribution. Sumatra (Riau, Lingga and Bangka), Peninsular Malaysia, Java, and Borneo. In Borneo, uncommon, known by three collections from Kuching district in Sarawak, and by one specimen from Banjarmasin area in SE Kalimantan (e.g., *Motley VI = de Vriese 1366*).

Ecology. In mixed swamp and mixed dipterocarp forests, at altitudes to 400 m.

Uses. The timber is moderately heavy, hard and not easily split. It is particularly suitable for making boats.

9. PAYENA A.DC.

(A. Payen, 1795–1871, French chemist)

J.T. Pereira

Prodr. 8 (1844) 196; Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 47; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 167; Merrill, EB (1921) 476; Ridley, FMP 2 (1923) 261; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 130, *ibid.* 3, 8 (1927) 430; Masamune, EPB (1942) 598; Browne, FTSB (1955) 322; A. Bruggen, Blumea 9 (1958) 95; Backer & Bakhuizen *f.*, FJ 2 (1965) 192; Smythies, CST (1965) 126; Burgess, TS (1966) 447; Ng, TFM 1 (1972) 428; Anderson, CLTS (1980) 319; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 326; Pennington, Gen. Sapot. (1991) 159; PROSEA 5, 1 (1993) 333; Kessler & Sidiyasa, TBSA-EK (1994) 217; Coode *et al.* (eds.), CLBD (1996) 308; Pereira, Kew Bull. 52, 4 (1997) 903; Argent *et al.* (eds.), MNDT-CK 2 (1997) 587. **Synonyms:** *Keratophorus* Hassk., Flora Bot. Zeit. 38 (1855) 578; *Ceratophorus* de Vriese, Pl. Ind. Bat. Or. (1856) 60; *Hapaloceras* Hassk., Flora Bot. Zeit. 42 (1859) 639.

Trees with buttresses. **Stipules** present, caducous. **Leaves** *alternate and distichous on horizontal shoots*, sometimes somewhat spiral on upright shoots; blades with entire and plane margin; lateral veins arching and joining near leaf margin to form intramarginal vein-loops; *intercostal venation descending from leaf margin and branching out towards midrib and parallel to lateral veins*, rarely with intervening veins arising from midrib. **Inflorescences** 1–many-flowered fascicles, axillary or borne on leafless nodes, sometimes crowded at distal end of twigs (e.g., *P. leerii*). **Flowers** bisexual; *sepals 4, more or less free, arranged in two whorls of two*, outer sepals valvate, densely to sparsely hairy, thick and fleshy, inner sepals imbricate, thin, margin ciliate; corolla easily detached, lobes 7–9, not divided into segments, imbricate, equal or exceeding corolla tube; stamens (13–)14–18(–30), arranged in one or two whorls, inserted at top of corolla tube, filaments free or partially or completely fused in pairs or bundles, anthers extrose or laterally dehiscent, apex acuminate, or bifid to lacerate; staminodes absent; disk (nectary) absent or a poorly developed annulus around base of ovary; *ovary (4–)8(–9)-loculed, globose or conoidal, style subulate, exserted; ovules one per locule*. **Fruits** indehiscent with persistent calyx and style, 1–2-seeded. **Seeds** slightly to strongly compressed; scar adaxial, long and narrow; cotyledons foliaceous; endosperm copious.

Distribution. About 19 species, distributed in Myanmar, Thailand, Andamans, Sumatra (including Simalur, Riau and Bangka), Peninsular Malaysia, Java, Borneo and southern part of the Philippines. Twelve species are recorded for Borneo, including 8 endemic species.

Ecology. Common main canopy or emergent trees in primary mixed dipterocarp forest, occasionally in secondary forest and forest edges along rivers, and in lower montane and montane forest, at altitudes to 3000 m (e.g., Mt. Kinabalu), on various types of soils. Some species are restricted to a certain habitat, e.g., *P. leerii* is recorded along coastal areas in mixed swamp forest and *kerangas* forest in Borneo.

Uses. The wood of *Payena* is normally traded as *nyatoh*, which is a light-weight to medium-heavy hardwood, e.g., *P. acuminata*. It is also traded as *bitis* (*nyatoh batu*), a heavy hardwood, e.g., *P. leerii*. The timber is usually marketed with that of other Sapotaceae genera. *Nyatoh* is frequently used for the manufacture of fine furniture, decorative doors and panelling whereas *nyatoh batu* is more durable and used in constructional work, paving blocks, heavy-duty flooring and window frames. Some species, e.g., *P. leerii*, produce gutta-percha, a purified coagulated latex. It was formerly used to insulate submarine cables, as a tooth filler in dentistry, in manufacturing surgical instruments, and also as an ingredient of chewing gum. Fruits of some species are reported to be edible. A decoction of the roots of *P. lucida* was used in traditional medicine where it was given to women after childbirth (Burkill, EPMP 2 (1935) 1678).

Taxonomy. Since A.C. de Candolle first described the genus in 1844, its division into various subgroups has undergone many changes. De Candolle (*l.c.* 196) recognised *Payena* as having twice as many corolla lobes as sepals and the stamens all fertile, opposite the corolla lobes. A. Bruggen (*l.c.* 98) treated the genus for the Malesian region and subdivided it into two sections based on flower colour and the type of indumentum on the various parts of the plant. These are section *Purpureopayena*, represented by *P. dasyphylla*, and section *Payena*, where the rest of the species are grouped. According to Pennington (*l.c.* 160), *Payena* is closely allied to *Madhuca* (both in the tribe *Isonandreae*) in having similar flower structure. It differs from *Madhuca* by the alternate and distichous leaves (nearly always spiral in *Madhuca*), intercostal venation parallel to lateral veins and descending from the leaf margin (mostly oblique or reticulate venation in *Madhuca*) and embryo with foliaceous cotyledons and copious endosperm (cotyledons usually thick and flat, endosperm absent or very thin in *Madhuca*).

Key to *Payena* species

1. Lower surface of mature leaves densely golden-yellow appressed hairy.....
.....**1. P. acuminata**
Lower surface of mature leaves glabrous and/or sparsely brown appressed or patent hairy.....2
2. Leaves of flowering or fruiting branch larger, (20–)25–35 × 8–12(–14) cm.....3
Leaves of flowering or fruiting branch smaller, 4.5–16(–20) × 2–7 cm.....4
3. Stipules narrowly triangular, 6–10 × 1.5–2.5 mm, caducous. Lateral veins arching and joining to form vein-loops near leaf margin. Fruits glabrous; stalk 5–6 cm long.....
.....**3. P. gigas**

- Stipules large, ovate to suborbicular, 15–25 × 10–15 mm, persistent. Lateral veins joining to form a distinct smooth vein parallel to leaf margin. Fruits brown velvety-hairy; stalk 8–10 cm long..... **4. P. grandistipula**
4. Leaf acumen 2–3 cm long. Pedicel 2–3 mm long. Corolla lobes hairy along the longitudinal median parts. Filaments densely hairy..... **8. P. lamii**
 Leaf acumen typically shorter than 2 cm. Pedicel longer than 5 mm. Corolla lobes glabrous. Filaments glabrous..... 5
5. Young twigs, petiole, or midrib on lower leaf surface tomentose..... 6
 Young twigs, petiole, or midrib on lower leaf surface glabrous, subglabrous to densely sericeous..... 8
6. Lateral veins faint on lower leaf surface, joining to form a smooth vein parallel to leaf margin. Ovary 3–4 mm across, hairy; style hairy at its basal half... **5. P. kapitensis**
 Lateral veins prominent on lower leaf surface, arching and joining to form vein-loops near leaf margin. Ovary 1–2 mm across, glabrous; style glabrous..... 7
7. Leaves chartaceous to thinly coriaceous, intercostal venation prominent beneath. Outer sepals densely rusty-tomentose. Stamens in two whorls. Young fruits ovoid to ellipsoid, abruptly terminated by a slender style..... **2. P. ferruginea**
 Leaves thickly coriaceous, intercostal venation obscure on both sides. Outer sepals sparsely sericeous. Stamens in one whorl. Young fruits very narrowly ovoid, gradually tapering to a sharp point..... **6. P. khoonmengiana**
8. Leaf upper surface white-waxy. Inflorescences axillary, mostly at distal ends of twigs. Fruits conical..... **9. P. leerii**
 Leaf upper surface not white-waxy. Inflorescences axillary or on leafless nodes. Fruits ovoid, narrowly ovoid to ovoid-ellipsoid..... 9
9. Lateral veins joining to form a smooth vein parallel to leaf margin. Stipules 0.5–1 mm wide. Pedicel 5–20 mm long. Fruit stalk 0.5–2 cm long; persistent inner sepals 3.5–4 mm long..... **11. P. microphylla**
 Lateral veins arching and joining to form vein-loops near leaf margin. Stipules 1–2 mm wide. Pedicel (20–)25–35(–45) mm long. Fruit stalk 2.5–6 cm long; persistent inner sepals 5–10 mm long..... 10
10. Stipules triangular, 1–1.5 mm wide. Outer sepals of flowers 7–12 mm long, inner sepals 8–13 mm long. Corolla lobes 8–12 mm long. Stamens in two whorls, anthers hairy..... **10. P. longipedicellata**
 Stipules ovate, 1.5–2 mm wide. Outer sepals of flowers 4–7 mm long, inner sepals 4–7.5 mm long. Corolla lobes 5–9 mm long. Stamens in one whorl, anthers glabrous..... 11
11. Young twigs subglabrous. Petiole 2–3 mm thick. Pedicel 1–1.5 mm thick. Corolla tube 0.5–1 mm long. Style 6–10 mm long. Fruits 2.5–3 × 1–1.5 cm; stalk 5–6 cm long. Seed 1–1.5 × 0.7 cm..... **7. P. kinabaluensis**
 Young twigs sericeous. Petiole (1–)1.5–2 mm thick. Pedicel 0.5–1 mm thick. Corolla

tube 3–6 mm long. Style 12–20 mm long. Fruits 4–5 × 1.5–2.5 cm; stalk 2.5–4 cm long. Seed 2–3 × 1–1.5 cm..... **12. P. obscura**

1. *Payena acuminata* (Blume) Pierre

(Latin, *acuminatus* = tapering into a narrow point; the leaf apex)

Bull. Mens. Soc. Linn., Paris 1 (1885) 528; Merrill, PEB (1929) 238; Masamune *l.c.* 598; A. Bruggen *l.c.* 100; Backer & Bakhuizen *f. l.c.* 192; Burgess *l.c.* 448; Ng *l.c.* 429; Anderson *l.c.* 319; Whitmore, Tantra & Sutisna *l.c.* 326; Pennington *l.c.* 160; PROSEA *l.c.* 338; Turner, Gard. Bull. Sing. 47 (1995) 467; Pereira *l.c.* 917; Argent *et al.* (eds.) *l.c.* 588. **Basionym:** *Mimusops acuminata* Blume, Bijdr. Fl. Ned. Ind. (1825) 672. **Lectotype** (A. Bruggen, 1958): *Blume 239*, Java (hololectotype L). **Synonyms:** *Bassia sericea* Blume *l.c.* 674; *Isonandra pulchra* Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 21; *Payena sericea* (Blume) H.J.Lam var. *typica* *l.c.* (1925) 140, *l.c.* (1927) 441; *P. sericea* (Blume) H.J.Lam var. *pulchra* (Burck) H.J.Lam *l.c.* (1925) 142, *l.c.* (1927) 441; *P. acuminata* (Blume) Pierre var. *acuminata*, A. Bruggen *l.c.* 101; *P. acuminata* (Blume) Pierre var. *pulchra* (Burck) A. Bruggen *l.c.* 103; *Madhuca acuminata* (Blume) Baehni, Boissiera 11 (1965) 36.

Tree to 30 m tall, 75 cm diameter. **Bark** brown, smooth to flaky; inner bark brownish yellow to brownish red. **Sapwood** pale yellow to white. **Twigs** (young) slender, terete, golden-yellow appressed hairy. **Stipules** narrowly triangular, 4–5 × 1.5 mm, golden hairy. **Leaves** subcoriaceous to chartaceous, glabrous above, *densely golden-yellow appressed hairy beneath*; broadly to narrowly elliptic, 10–22 × 3.5–8 cm, base rounded to cuneate, apex acuminate, acumen 0.5–1.5 cm long; midrib flat to slightly raised and glabrous above, slightly raised and sericeous beneath; lateral veins 14–25 pairs, at an angle of 70–80° with midrib, obscure above, faint and golden appressed-hairy beneath, joining and arching to form vein-loops near leaf margin; intercostal venation faint on both sides; petiole 1–3 cm long, 1.5–2.0 mm thick, sparsely golden appressed-hairy, soon-glabrescent. **Inflorescences** axillary or borne on leafless nodes, 5–20-flowered. **Flowers:** pedicel 10–20 mm long, *c.* 1 mm thick, golden hairy; outer sepals triangular, 5–7 × 4–5(–6) mm, densely golden-hairy, inner sepals narrowly triangular, 5–6.5 × 3.5–5 mm, densely golden-hairy; corolla lobes ovate, (3–)4–6 × 1.5–2 mm wide, glabrous, corolla tube 2–2.5 mm long, glabrous; stamens 16, in one whorl, filaments 0.5–1.5 mm long, glabrous, anthers 2–3 mm long, glabrous; ovary conical, 1.5–2 mm across, golden-yellowish hairy, style 6–9 mm long, glabrous. **Fruits** drying ridged, ellipsoid, 3–4 × 1.5–2 cm, abruptly terminated by a slender style, golden appressed-hairy; persistent outer sepals 5–9 × 4–5 mm, persistent inner sepals 5–7 × 4–5 mm; persistent style to 0.8 cm long; stalk 1.5–2.5 cm long, 1.5–2.5 mm thick, golden appressed-hairy. **Seeds** ellipsoid, 2.5 × 1.5 cm; scar 0.2–0.4 cm wide.

Vernacular names. Sabah—*natu*, *nyatoh merah* (Malay). Sarawak—*bee-taul* (Murut), *nyatoh rian* (Malay). Kalimantan—*malau pedara* (Bassap).

Distribution. A widespread species ranging from Thailand, Sumatra (Riau and Simalur), Peninsular Malaysia, Java to Borneo (Sabah, Sarawak and Kalimantan). In Sabah, occurs mainly in the east coast (e.g., *Elmer 21236*, *SAN 21302*, *SAN 57091*, and *SAN 109594*). In Sarawak, recorded from the 1st, 3rd and 5th Divisions (e.g., *S 235*, *S 23658*, *S 31578*, and *S 32676*).

Ecology. In primary and secondary mixed dipterocarp forests, common on slopes or ridges, at altitudes to 400 m; sometimes occurring on limestone.

Uses. The timber is of commercial value. It also produces gutta percha and the fruits are edible.

2. *Payena ferruginea* J.T.Pereira

Fig. 22.

(Latin, *ferrugineus* = rusty brown; the indumentum)

Kew Bull. 52 (1997) 905. **Type:** *Ahmad SAN 47698*, Borneo, Sabah, Lahad Datu, Silam Road (holotype KEP; isotypes K, L, SAN, SAR). **Synonyms:** *Payena longipedicellata auct. non* King & Gamble: A. Bruggen, *Blumea* 9 (1958) 115, *p.p.*; *P. lucida auct. non* (Wall. ex G.Don) A.DC.: A. Bruggen *l.c.* 111, *p.p.* (specimens from Borneo); *P. lowiana auct. non* Pierre: A. Bruggen *l.c.* 126, *p.p.* (specimens from Borneo).

Tree to 35 m tall, 75 cm diameter, buttresses to 3 m high. **Bark** dark brown to grey, fissured to smooth; inner bark red-brown. **Sapwood** pale yellow to pink. **Twigs** (young) *densely rusty-tomentose*. **Stipules** narrowly triangular, 1.5–3 × 1–2 mm, densely rusty-tomentose. **Leaves** chartaceous to thinly coriaceous, glabrous above, *sparsely brown-tomentose beneath*; ovate, elliptic to lanceolate, 8–15 × 3–6.5 cm, base cuneate to slightly rounded, sometimes oblique, apex acuminate, *acumen 0.3–1.7 cm long*; midrib flat, glabrous to tomentose above, prominent and *tomentose beneath*; lateral veins 8–16 pairs, at an angle of 60–70° with midrib, obscure and glabrous above, *prominent and rusty tomentose to glabrous beneath, arching and joining to form vein-loops near leaf margin*; intercostal venation faint above, *prominent beneath*; petiole (1–)2–3.5 cm long, 1–2 mm thick, *rusty tomentose*. **Inflorescences** axillary or borne on leafless nodes, 2–9-flowered. **Flowers:** pedicel (10–)20–30 mm long, 0.5–1 mm thick, rusty tomentose; outer sepals ovate, rounded or acute at apex, 4–6 × 4–6 mm, *densely rusty-tomentose*, inner sepals broadly ovate, 4–6 × 5–8 mm, rusty tomentose; corolla lobes broadly ovate with wavy margin, 3–5 × 3–5 mm, *glabrous*, corolla tube 3.5–5 mm long, glabrous; stamens in two whorls, filaments with two lengths, 0.5–1 mm and 2–2.5 mm long, *glabrous*, anthers 2–3 mm long, glabrous; ovary 1.5–2 mm across, *glabrous*, style 9.5–15 mm long, *glabrous*. **Fruits** (young) drying black, *ovoid to ellipsoid, 2–3.5 × 1.5–2 cm, abruptly terminated by a slender style*, glabrous; persistent outer and inner sepals recurved, 4–6 × 4–7 mm; persistent style to 1 cm long; stalk 1.5–3.5 cm long, 1.5–2 mm thick, subglabrous. **Seeds** ellipsoid, 2–2.5 × 1–1.5 cm.

Vernacular names. Kalimantan—*nato hitam* (Malay), *natu hitam* (Bandjar).

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, distributed mainly in the east coast districts (Lahad Datu and Kinabatangan, e.g., *SAN 22890*, *SAN 29390*, *SAN 100432*, and *SAN 121974*). In Sarawak, recorded from the 4th Division (Bintulu and Tubau R., e.g., *S 15913* and *S 18375*).

Ecology. In primary lowland and hill mixed dipterocarp forests on sandy loam or clay-rich soils, at altitudes to 450 m. Sometimes also occur in fresh water swamp forest.

Uses. The timber is of commercial value. The fruits are edible.

3. *Payena gigas* A.Bruggen(Latin, *gigas* = a giant; the large-sized tree)

Blumea 9 (1958) 108; Burgess *l.c.* 449; Whitmore, Tantra & Sutisna *l.c.* 327. **Type:** *Clemens 27452*, Borneo, Sabah, Mt. Kinabalu (holotype L; isotypes BM, BO, G, K).

Tree to 40 m tall, 105 cm diameter. **Bark** greyish to brown, finely fissured; inner bark red-brown. **Sapwood** yellow to whitish. **Twigs** (young) slender, terete, densely tomentose. **Stipules**

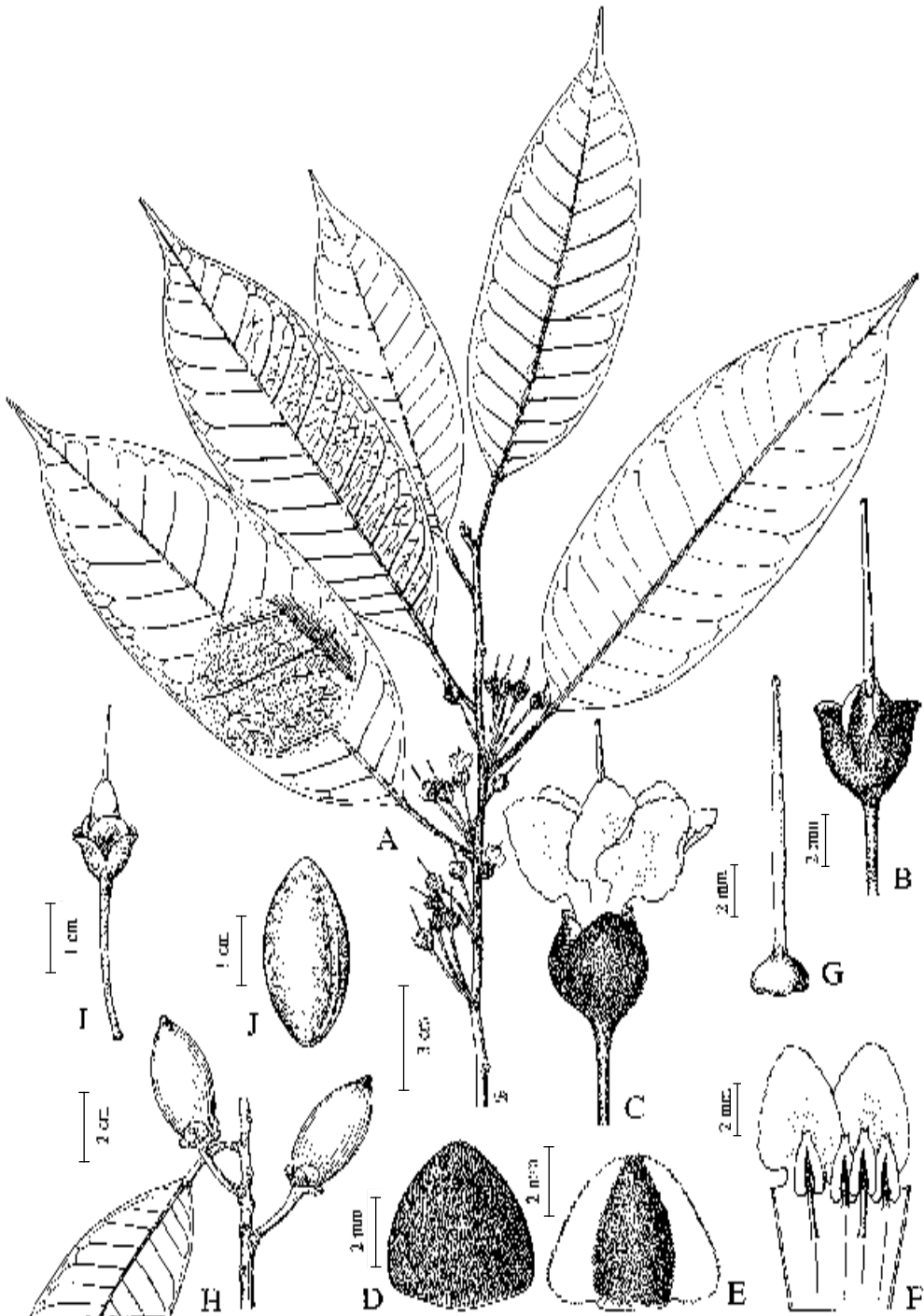


Fig. 22. *Payena ferruginea*. A, flowering leafy twig; B, flower bud; C, mature flower with petals protruding from the calyx; D, outer sepal; E, inner sepals; F, a section of corolla with four stamens attached; G, pistil; H, fruiting leafy twig; I, young fruit; J, seed. (A–G from SAN 47698, H and J from SAN 31640, I from SAN 22890.)

caducous, narrowly triangular, 6–10 × 1.5–2.5 mm, densely tomentose. **Leaves** chartaceous to coriaceous, *glabrous on both surfaces*; broadly elliptic, 20–35 × 8–14 cm, base rounded to oblique, apex acuminate, acumen 1–1.5 cm long; midrib sunken and glabrous above, prominent and tomentose beneath; *lateral veins* 30–32 pairs, at an angle of 70–80° with midrib, flat or sunken and glabrous above, raised, prominent and sparsely tomentose beneath, *arching and joining to form vein-loops near leaf margin*; intercostal venation faint on both sides; petiole 4–5.5 cm long, 3–4 mm thick, densely tomentose to subglabrous. **Inflorescences** axillary, 3–8-flowered. **Flowers:** pedicel 30–60 mm long, 1.5–2 mm thick, minutely hairy; outer sepals broadly ovate, 7–8 × 6–7 mm, tomentose, inner sepals broadly ovate, 5–7 × 8–9 mm, tomentose; corolla lobes broadly ovate, 5–6 × 4–5 mm, glabrous, corolla tube 4–5 mm long, glabrous; stamens 16, in one whorl, filaments *c.* 0.5 mm long, glabrous, anthers *c.* 3 mm long, glabrous; ovary *c.* 3 mm across, glabrous, style *c.* 15 mm long, glabrous. **Fruits** drying black, ovoid, 4–4.5 × 2–3 cm, *glabrous*; persistent outer sepals 8–10 × 9–10 mm, persistent inner sepals 7–8 × 9–10 mm; persistent style to 15 mm long; *stalk 5–6 cm long, c. 1.5–2 mm thick, subglabrous*. **Seeds** ellipsoid with a broad base, 3.5–4.5 × 2–2.5 cm; scar 0.3–1.3 cm wide.

Distribution. Endemic to Borneo and known only from Sabah (Ranau area including Mt. Kinabalu and Trus Madi in the Tambunan district, e.g., *Clemens 26330, Clemens 27316, Clemens 51322, and SAN 61874*).

Ecology. In hill mixed dipterocarp to lower montane forest, at 850–1220 m above sea level.

Uses. The fruits are reported to be edible.

4. *Payena grandistipula* J.T.Pereira

Fig. 23.

(Latin, *grandis* = large, *stipula* = stipules; with large stipules)

Kew Bull. 52 (1997) 908. **Type:** *Ismawi et al. S 43621*, Borneo, Sarawak, 7th Division, Ulu Belaga, Semawat R. (holotype SAR; isotypes K, KEP, L, SAN).

Tree to 20 m tall, 30 cm diameter. **Bark** shallowly fissured. **Twigs** (young) hairy. **Stipules** *large, persistent, ovate to suborbicular, 15–25 × 10–15 mm, hairy*. **Leaves** coriaceous, *glabrous on both surfaces or sparsely brown-hairy beneath*; broadly elliptic or oblong, 22–32 × 8–12 cm, base rounded to shortly attenuate, apex acuminate, acumen 0.5–1 cm long; midrib slightly raised and glabrous above, prominent and sparsely hairy beneath; *lateral veins* 30–35 pairs, at an angle of 75–85° with midrib, obscure and glabrous above, prominently raised and hairy beneath, *joining to form a distinct smooth vein parallel to leaf margin*; intercostal venation faint above, prominent beneath; petiole 2–3 cm long, 3–3.5 mm thick, sparsely hairy. **Flowers** unknown. **Fruits** ovoid, 3.5–4 × 1.6–2.5 cm, apex gradually tapering to a sharp point, *brown velvety-hairy*; persistent outer sepals 9–10 × 10–12 mm, persistent inner sepals 9–10 × 10–11 mm; persistent style to 20 mm long; *stalk 8–10 cm long, 2.5–3 mm thick, subglabrous*. **Seeds** ellipsoid, *c. 2 × 0.7 cm*.

Distribution. Endemic to Borneo (Sarawak only). Known only from the locality of the type specimen.

Ecology. In riparian forest.

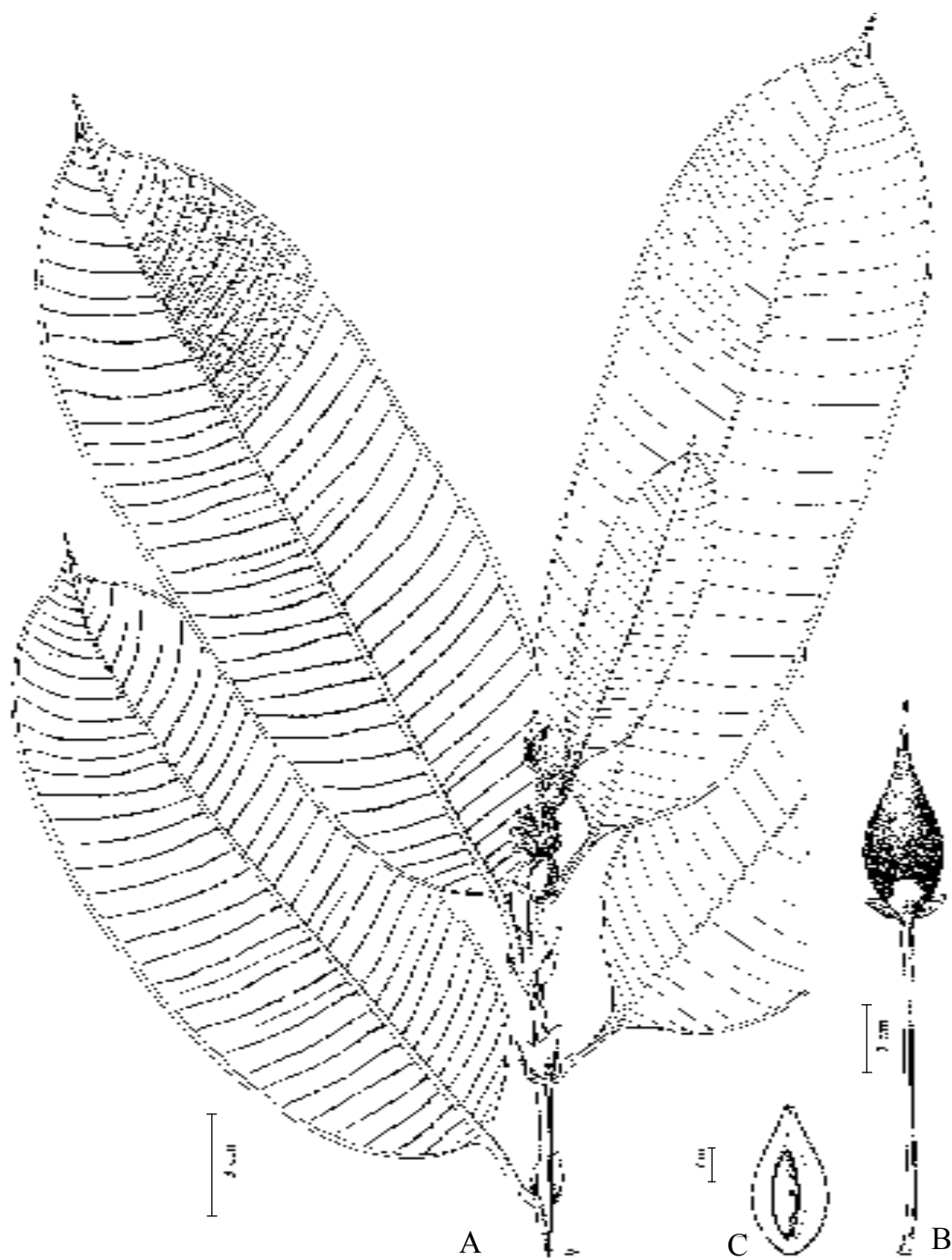


Fig. 23. *Payena grandistipula*. A, leafy twig with prominent stipules; B, fruit; C, longitudinal section of fruit. (All from *S* 43621.)

5. *Payena kapitensis* J.T.Pereira
(of Kapit, Sarawak)

Fig. 24.

Kew Bull. 52 (1997) 910. **Type:** *Gary S 37211*, Borneo, Sarawak, 7th Division, Kapit, Balleh, Ulu Melinau R. (holotype SAN; isotypes K, KEP, L, SAR).

Tree to 35 m tall, 45 cm diameter. **Bark** dark brown, flaky. **Twigs** (young) *rusty-tomentose*. **Stipules** ovate, 2–3 × 2–3 mm, densely tomentose. **Leaves** subcoriaceous, *glabrous on both surfaces*; narrowly elliptic, 10–15 × 3.5–5 cm, base slightly rounded or oblique, apex acuminate, *acumen 0.5–1 cm long*; *midrib* flat and glabrous to tomentose above, prominent and *sparsely tomentose beneath*; *lateral veins* 12–18 pairs, at an angle of 70–80° with midrib, glabrous on both sides, *faint beneath, joining to form a smooth vein parallel to leaf margin*; intercostal venation obscure on both sides; *petiole* 2–3 cm long, 1.5–2 mm thick, *tomentose*. **Inflorescences** axillary or borne on leafless nodes, 2–4-flowered. **Flowers:** *pedicel 20–30 mm long, c. 1 mm thick, densely rusty-tomentose*; outer sepals broadly ovate, 7–9 × 6–7 mm, densely rusty-tomentose, inner sepals narrowly ovate, 8–10 × 5–6 mm, densely rusty-tomentose; *corolla lobes* narrowly ovate, tapering at apex, 6–7 × 2–3 mm, *glabrous*, corolla tube 6–7 mm long, glabrous; stamens in one whorl, *filaments c. 0.5 mm long, glabrous*, anthers 2–3 mm long, glabrous; *ovary 3–4 mm across, hairy, style 18–20 mm long, hairy at its basal half*. **Fruits** unknown.

Distribution. Endemic to Borneo (Sarawak). Known from the type collection only.

Ecology. In mixed dipterocarp forest, on ridge top.

6. *Payena khoonmengiana* J.T.Pereira
(Wong Khoon Meng, former forest botanist at Kepong, Brunei and Sandakan)

Fig. 25.

Kew Bull. 52 (1997) 912. **Type:** *Mat-Salleh KMS 3313*, Borneo, Sabah, Kinabatangan district, Bt. Tawai FR (holotype SAN; isotypes A, BO, K, KEP, L, SAR, SING).

Tree to 15 m tall, 13 cm diameter. **Bark** reddish brown, fissured to smooth; inner bark brown. **Sapwood** cream. **Twigs** (young) *tomentose*. **Stipules** caducous. **Leaves** *thickly coriaceous*, glabrous above, *sparsely brown tomentose or glabrous beneath*; ovate to elliptic, 7–10 × 3.5–5 cm, base rounded, apex acuminate, *acumen 1–1.5 cm long*; *midrib* flat to slightly raised and glabrous to tomentose above, raised, prominent and *tomentose beneath*; *lateral veins* 10–14 pairs, at an angle of 60–70° with midrib, obscure and glabrous above, *prominent and tomentose beneath, arching and joining to form vein-loops near leaf margin*; intercostal venation obscure on both sides; *petiole* 1.5–2.5 cm long, 1.5–2 mm thick, *tomentose*. **Inflorescences** axillary or borne on leafless nodes, 1–2-flowered. **Flowers** (immature): *pedicel 25–30 mm long, c. 1 mm thick, subglabrous*; *outer sepals* thick, broadly ovate, 6–7 × 6–7 mm, *sparsely sericeous*, inner sepals ovate, *c. 7 × 8–9 mm, sparsely sericeous*; *corolla lobes* broadly elliptic or oblong, 4–5 × 1–2.5 mm, *glabrous*, corolla tube 1–1.5 mm long, glabrous; *stamens in one whorl*, glabrous, *filaments c. 0.5 mm long, glabrous*, anthers 2.5–3 mm long; *ovary 1.5–2 mm across, glabrous, style 6–14 mm long, glabrous*. **Fruits** (young) *very narrowly ovoid, 3–4 × 0.7–0.8 cm, gradually tapering to a sharp point*, glabrous; persistent outer sepals, 6–7 × 6–8 mm, persistent inner sepals 6–7 × 8–10 mm; persistent style to 1 cm long; stalk slender, 3.5–4 cm long, 1–1.5 mm thick, glabrous. **Seeds** unknown.

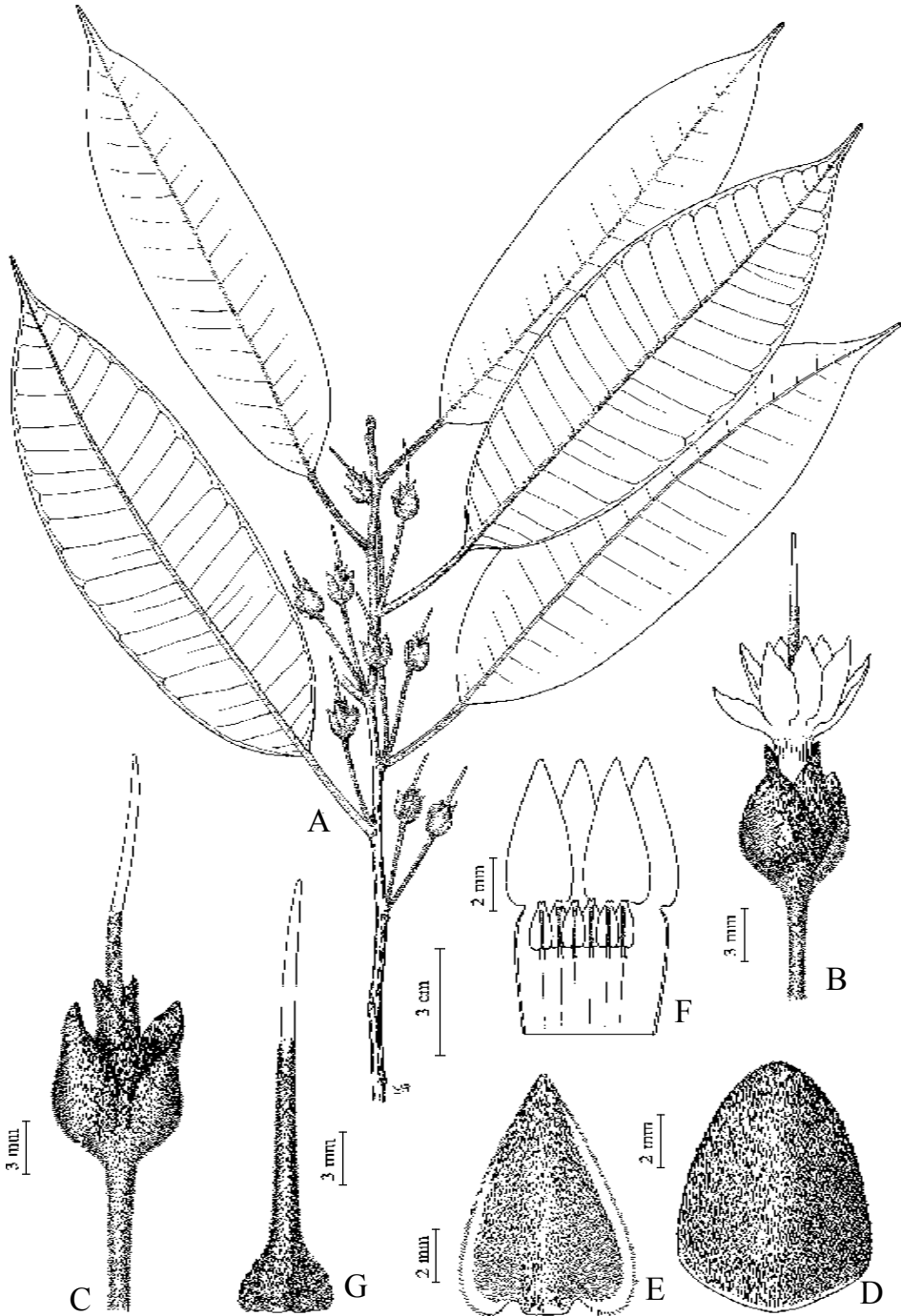


Fig. 24. *Payena kapitensis*. A, flowering leafy twig; B, mature flower with petals protruding from the calyx; C, mature flower with petals removed; D, outer sepal; E, inner sepal; F, a section of corolla with six stamens attached; G, pistil. (All from S 37211.)

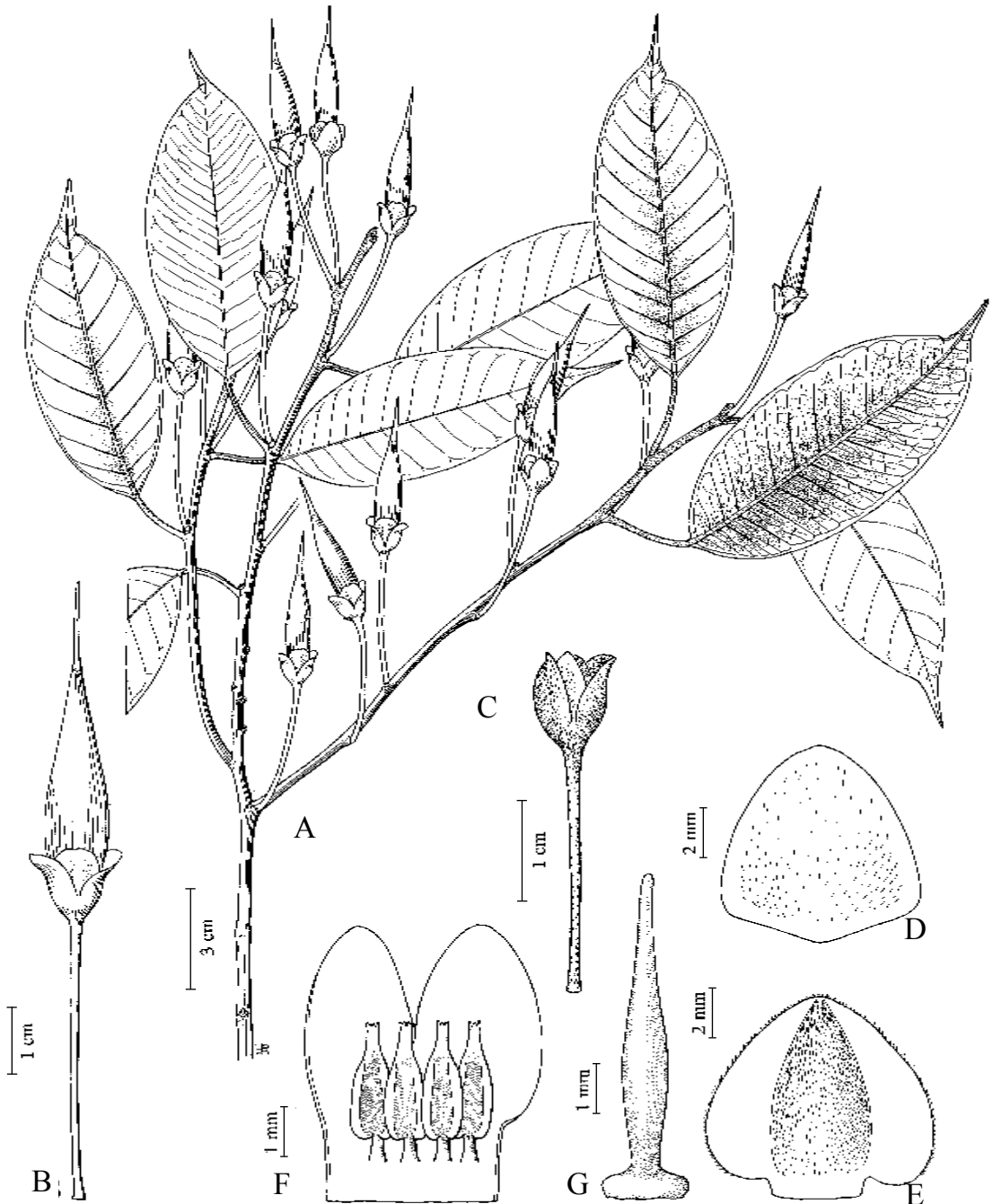


Fig. 25. *Payena khoonmengiana*. A, fruiting leafy twig; B, young fruit; C, flower bud; D, outer sepal; E, inner sepal; F, a section of corolla showing four stamens attached; G, pistil. (A–B from Mat-Salleh KMS 3313, C–G from Zainuddin AZ 5048.)

Distribution. Endemic to Borneo (Sabah), so far only known from two collections (*Mat-Salleh KMS 3313* and *Zainuddin AZ 5048*) from Bt. Tawai, Kinabatangan district.

Ecology. In lowland forest on ultramafic soils, near waterfalls, at about 480 m altitude.

7. *Payena kinabaluensis* J.T.Pereira
(of Mt. Kinabalu, Sabah)

Fig. 26.

Kew Bull. 52 (1997) 914. **Type:** *Clemens 26329*, Borneo, Sabah, Mt. Kinabalu, Dallas (holotype K; isotypes L, SING).

Tree to 20 m tall. **Twigs** (young) *subglabrous*. **Stipules** *ovate*, *c.* $2 \times 1.5\text{--}2$ mm, *subglabrous*. **Leaves** *subcoriaceous* to *chartaceous*, *glabrous* to *appressed hairy* and *not white-waxy above*, *sparsely appressed brown-hairy beneath*; narrowly to broadly *elliptic-oblong*, $12\text{--}20 \times 3.5\text{--}7$ cm, base slightly rounded to *oblique*, apex *acuminate*, *acumen* $1\text{--}1.5$ cm long; *midrib* slightly raised and *glabrous* to *sericeous* above, *distinct* and *subglabrous* to *sericeous* beneath; *lateral veins* 15–20 pairs, at an angle of $60\text{--}70^\circ$ with *midrib*, *obscure* and *glabrous* on both sides, *arching and joining to form vein-loops near leaf margin*; *intercostal venation* *obscure* on both sides; *petiole* 2–3 cm long, 2–3 mm thick, *subglabrous*. **Inflorescences** *axillary* or *borne on leafless nodes*, 2–7-flowered. **Flowers** (immature); *pedicel* 30–35 mm long, 1–1.5 mm thick, *sparsely sericeous*; *outer sepals* broadly *ovate*, $5\text{--}7 \times 7\text{--}8$ mm, *sparsely hairy*, *inner sepals* broadly *ovate*, $5\text{--}6 \times 8\text{--}8.5$ mm, *sericeous*; *corolla lobes* *ovate*, $6\text{--}7 \times 4.5\text{--}5$ mm, *glabrous*, *corolla tube* 0.5–1 mm long, *glabrous*; *stamens* in *one whorl*, *filaments* 0.5–1 mm long, *glabrous*, *anthers* 3.5–4 mm long, *glabrous*; *ovary* *c.* 2 mm across, *glabrous*, *style* 6–10 mm long, *glabrous*. **Fruits** *ovoid*, $2.5\text{--}3 \times 1\text{--}1.5$ cm, *gradually tapering to a sharp point at apex*, *glabrous*; *persistent outer sepals* $7\text{--}9 \times 8\text{--}10$ mm, *persistent inner sepals* $6\text{--}7 \times 9\text{--}10$ mm; *persistent style* to 20 mm long; *stalk* $5\text{--}6$ cm long, *c.* 1.5 mm thick, *glabrous*. **Seeds** *ellipsoid*, $1\text{--}1.5 \times 0.7$ cm.

Distribution. Endemic to Borneo (Sabah). Only known from the type collection.

Ecology. In primary mixed dipterocarp forest, at about 900 m altitude.

8. *Payena lamii* A.Bruggen
(H.J. Lam, 1892–1977, Dutch botanist)

Blumea 9 (1958) 127; Anderson *l.c.* 319; Whitmore, Tantra & Sutisna *l.c.* 327. **Type:** *Everett s.n.*, Borneo, Sarawak, Bintulu (holotype SAR; isotype L).

Tree to 15 m tall, 20 cm diameter. **Bark** smooth, *lenticellate*. **Twigs** (young) slender, *terete*, *appressed rusty-hairy*. **Leaves** *subcoriaceous* to *coriaceous*, *glabrous on both surfaces*; *ovate-oblong*, $12\text{--}19 \times 4.5\text{--}7$ cm, base *cuneate* to *subequal rounded*, apex *acuminate*, *acumen* 2–3 cm long; *midrib* raised and *glabrous* above, *prominently raised and hairy* to *glabrous* beneath; *lateral veins* 20–32 pairs, at an angle of $60\text{--}80^\circ$ with *midrib*, *glabrous*, *flat* and *obscure* above, *prominently raised* beneath, *joining to form a smooth vein parallel to leaf margin*; *intercostal venation* *invisible* above, *faint* beneath; *petiole* 2.5–4.5 cm long, 1.5–2 mm thick, *glabrous*. **Inflorescences** *axillary* or *borne on leafless nodes*, 7–10-flowered. **Flowers:** *pedicel* 2–3 mm

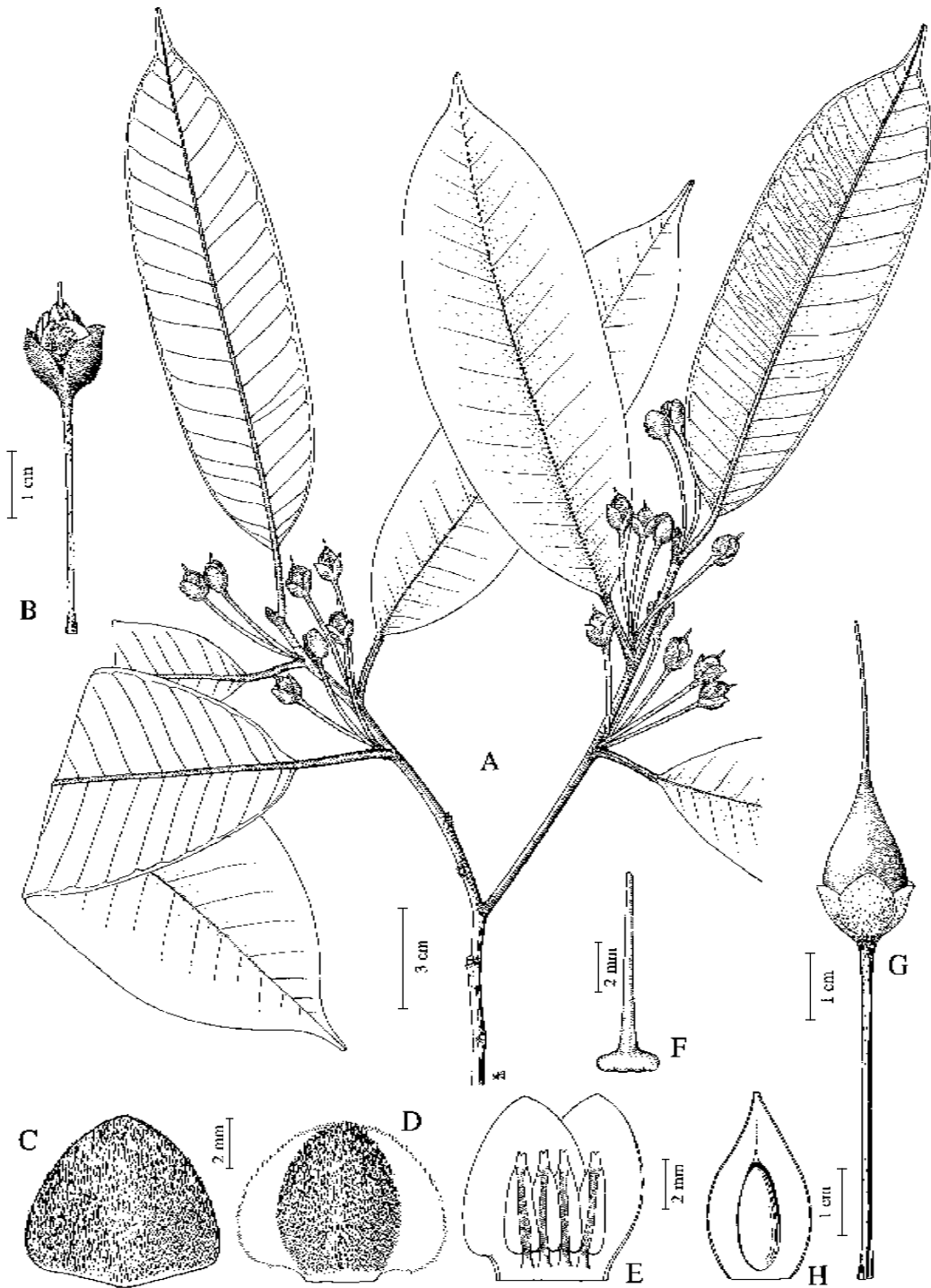


Fig. 26. *Payena kinabaluensis*. A, flowering leafy twig; B, flower bud; C, outer sepal; D, inner sepal; E, a section of corolla showing four stamens attached; F, pistil; G, fruit; H, longitudinal section of fruit. (All from Clemens 26329.)

long, *c.* 1 mm thick, hairy; outer sepals ovate, 4–4.5 × 3–4 mm, pubescent, inner sepals ovate, 4–4.5 × 3.5–4 mm, appressed yellowish brown hairy; *corolla lobes* ovate-oblong, 2.5–3 × 1–1.5 mm, *hairy along longitudinal median parts*, corolla tube 2–2.5 mm long, hairy; stamens 16, in one whorl, *filaments c.* 1 mm long, *densely hairy*, anthers 1.5–2 mm long, hairy; ovary *c.* 1 mm across, hairy, style 7–10 mm long, glabrous. **Fruits** broadly ellipsoid, *c.* 3 × 2–2.5 cm, abruptly terminated by a slender style, sparsely hairy; persistent outer sepals 5–6 × 4–5 mm, persistent inner sepals 6–7 × 4–5 mm; persistent style *c.* 15 mm long; stalk 1.8–2 cm long, 1–1.5 mm thick, glabrous to sparsely hairy. **Seeds** ellipsoid, 2–2.5 × 1.2–1.5 cm.

Vernacular names. Sarawak—*nyato berlali* (Bintulu area), *nyatoh padang* (Sibu area).

Distribution. Endemic to Borneo (Sarawak). Uncommon, so far only known from four collections, i.e. *S 25695* from Bt. Sejarak, Lundu district, *S 2722* and *S 2768* from Sibu district, and *Everett s.n.* (type) from Bintulu district.

Ecology. In peat swamp and *kerangas* forests, at altitudes to 250 m.

9. *Payena leerii* (Teijsm. & Binn.) Kurz

(J.M. van Leer, 1812–?, Dutch physician)

J. As. Soc. Beng. 40, 2 (1871) 69; Merrill *l.c.* (1921) 477; Ridley *l.c.* 263; H.J. Lam *l.c.* (1925) 137, 261, *l.c.* (1927) 437; Burkill *l.c.* 1678; Masamune *l.c.* 599; Browne *l.c.* 322; Backer & Bakhuizen *f. l.c.* 192; Smythies *l.c.* 126; Burgess *l.c.* 448; A. Bruggen *l.c.* 121; Ng *l.c.* 432; Anderson, *Trees of Peat Swamp Forests of Sarawak* (1972) 174, *l.c.* (1980) 319; Whitmore, *Tantra & Sutisna l.c.* 327; PROSEA *l.c.* 340; Turner *l.c.* 467; Argent *et al.* (eds.) *l.c.* 588. **Basionym:** *Azaola leerii* Teijsm. & Binn., *Nat. Tijdschr. Ned.-Indie* 6 (1854) 116. **Neotype** (A. Bruggen, 1958): *Teijsmann, s.n.* (= *Herbarium Hance 13935*), Sumatra (holoneotype BM). **Synonyms:** *Keratophorus leerii* (Teijsm. & Binn.) Hassk. *l.c.* 579; *Hapaloceras leerii* (Teijsm. & Binn.) Hassk. *l.c.* 639; *Madhuca leerii* (Teijsm. & Binn.) Merr., *Enum. Phil. Fl. Pl.* 3 (1923) 277; *Isonandra ?benjamina* de Vriese, *Nat. Tijdschr. Ned.-Indie* 21 (1860) 310; *Payena benjamina* (de Vriese) Pierre, *Bull. Mens. Soc. Linn., Paris* 1 (1885) 524; *P. beccarii* Pierre *l.c.* 525; *P. parvifolia auct. non Engl.*: Merrill *l.c.* (1921) 477.

Tree to 30 m tall, 60 cm diameter, buttresses low and spreading. **Bark** greyish brown, slightly fissured to finely cracked; inner bark reddish brown. **Sapwood** pale orange to white. **Twigs** (young) slender, terete, *densely rusty-sericeous*. **Stipules** triangular, *c.* 1.5 × 0.5–1 mm, densely rusty-sericeous. **Leaves** chartaceous to coriaceous, *glabrous on both surfaces, white-waxy above*; ovate to narrowly elliptic, 4.5–10 × 2–5 cm, base rounded, apex short-acuminate, *acumen* (0.5–)1–2 cm long; *midrib* slightly raised and glabrous to rusty appressed-hairy above, raised and *rusty sericeous beneath*; lateral veins 10–16 pairs, at an angle of 65–75° with midrib, obscure and glabrous on both sides, joining to form a smooth vein parallel to leaf margin; intercostal venation invisible above, faint beneath; *petiole* 0.5–1.5 cm long, 0.5–1 mm thick, *rusty sericeous*. **Inflorescences** *axillary, mostly on distal end of twigs*, 1–8-flowered. **Flowers:** *pedicel* 5–20 mm long, 0.5–1 mm thick, rusty appressed-hairy; outer sepals triangular to ovate, 3–5 × 3–4 mm, rusty hairy, inner sepals narrowly ovate, 3–5 × 3–5 mm, densely rusty-hairy; *corolla lobes* narrowly to broadly ovate, 3–5 × 1–2 mm, *glabrous*, corolla tube 1–2 mm long, sometimes with hairs at outer base; stamens 16, in one whorl, *filaments c.* 0.5 mm long, *glabrous*, anthers 1.5–3 mm long, hairy; ovary 1.5–2 mm across, densely hairy, style 6–8.5 mm long, glabrous. **Fruits** *conical*, (2–)3–4 × 1–1.5 cm, sparsely appressed rusty-hairy to glabrous; persistent outer sepals

4–5 × 4–5 mm, persistent inner sepals 4–5 × 3.5–5 mm; persistent style to 10 mm long; stalk 1–2 cm long, c. 1 mm thick, subglabrous to glabrous. **Seeds** ellipsoid, 2–2.5 × 0.8–1 cm; scar 0.1–0.2 cm wide.

Vernacular names. Sarawak—*nyatoh burung*, *nyatoh cabi*, *nyatoh kabang*, *nyatoh pipit* (Kuching area).

Distribution. A widespread species in W Malesia, extending from Sumatra, Peninsular Malaysia, Borneo (Sabah, Sarawak, Brunei and Kalimantan) to the Philippines. In Sabah, restricted to the west coast (e.g., *Cuadra 2436*, *SAN 57538*, *SAN 60558*, and *SAN 102976*), whereas in Sarawak mainly occurring in the 1st Division, rarely in 2nd and 4th Divisions (e.g., *S 10129*, *S 13484*, *S 29910*, *S 42179*, and *S 48702*).

Ecology. In coastal lowland forest, typically in mixed swamp forest and *kerangas* forest, on sandy podsolic soils, at altitudes to 650 m.

Uses. *P. leerii* has been grouped under *nyatoh batu* (Burgess *l.c.* 449, 453). It produces good quality gutta percha. The fruits are edible.

10. *Payena longipedicellata* Brace ex King & Gamble

(Latin, *longipedicellatus* = with a long pedicel; the flower)

J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 169; Merrill *l.c.* (1921) 477; Ridley *l.c.* 262; H.J. Lam *l.c.* (1925) 148; Masamune *l.c.* 599; A. Bruggen *l.c.* 115; Ng *l.c.* 432; Anderson *l.c.* (1980) 319; Whitmore, Tantra & Sutisna *l.c.* 327; Turner *l.c.* 467; Coode *et al.* (eds.) *l.c.* 308. **Lectotype** (A. Bruggen, 1958): *King's Collector 2940*, Peninsular Malaysia, Perak, Larut (K).

Tree to 30 m tall, 60 cm diameter. **Bark** black, cracked. **Sapwood** yellow. **Twigs** (young) slender, terete, *glabrous* to *sericeous*. **Stipules** *triangular*, 2–2.5 × 1–1.5 mm, appressed hairy. **Leaves** subcoriaceous, *glabrous on both surfaces, not white-waxy above*; ovate to narrowly elliptic, 7.5–13 × 3–5 cm, base unequally rounded, apex short-acuminate, *acumen 0.3–0.7(–1.5) cm long*; midrib flat and *glabrous above, prominently raised and glabrous to subglabrous beneath*; lateral veins 10–18 pairs, at an angle of 60–70° with midrib, *glabrous and obscure above, glabrous and prominent beneath, arching and joining to form vein-loops near leaf margin*; intercostal venation invisible above, faint beneath; *petiole 1.5–3.5 cm long, 1–1.5 mm thick, glabrous*. **Inflorescences** *axillary or borne on leafless nodes, 1–3-flowered*. **Flowers:** *pedicel 25–45 mm long, c. 1 mm thick, minutely hairy*; *outer sepals* broadly ovate, apex acute to obtuse, 7–12 × 7–10 mm, sparsely hairy, *inner sepals* broadly ovate, 8–13 × 7–12 mm, apex acuminate, sparsely hairy; *corolla lobes 8–12 × 2.5–4 mm, glabrous*, corolla tube c. 8 mm long, *glabrous*; *stamens 16, in two whorls, alternate ones covered by the others, filaments c. 0.5–1 mm long, glabrous, anthers 3–4 mm long, hairy, bifid at apex*; ovary c. 3 mm across, hairy, style 14–30 mm long, hairy to its basal half. **Fruits** *ovoid, 2.5–3 × 2–2.5 cm, gradually tapering to a sharp point, subglabrous*; *persistent inner sepals c. 10 × 5 mm*; persistent style to 15 mm long; *stalk c. 3.5 cm long, 1–1.5 mm thick, subglabrous*. **Seeds** ellipsoid, c. 1.5 × 0.5 cm.

Distribution. Peninsular Malaysia (one collection, *King's Collector 2940*) and Borneo (Sabah and Sarawak), uncommon. In Sabah, recorded only from Beaufort district (e.g., *SAN 31812*) whereas in Sarawak occurs in Kuching Division (e.g., *Haviland 3035*).

Ecology. In lowland mixed dipterocarp forest on hilly areas.

11. *Payena microphylla* (de Vriese) Pierre

(Greek, *mikro* = small, *phullon* = leaf; small-leaved)

Bull. Mens. Soc. Linn., Paris 1 (1885) 531; Burck *l.c.* 60; Merrill *l.c.* (1921) 477; H.J. Lam *l.c.* (1925) 136; A. Bruggen *l.c.* 120; Anderson *l.c.* (1980) 319; Whitmore, Tantra & Sutisna *l.c.* 327; Pennington *l.c.* 160; Coode *et al.* (eds.) *l.c.* 308; Pereira *l.c.* 918; Argent *et al.* (eds.) *l.c.* 589. **Basionym:** *Isonandra microphylla* de Vriese, Nat. Tijdschr. Ned.-Indie 21 (1860) 312. **Type:** *Motley 203*, Borneo, Kalimantan, Banjarmasin (BO, K, L, P). **Synonyms:** *P. endertii* auct. non H.J.Lam: A. Bruggen *l.c.* 124, *p.p.* (specimens of Borneo); *P. obscura* auct. non Burck: A. Bruggen *l.c.* 117, *p.p.* (specimens of Borneo); *P. leerii* auct. non (Teijsm. & Binn.) Kurz: A. Bruggen *l.c.* 121, *p.p.* (specimens of Borneo); *P. lucida* auct. non (Wall. ex G.Don) A.DC.: A. Bruggen *l.c.* 111, *p.p.* (specimens of Borneo).

Tree to 45 m tall, 160 cm diameter, buttresses to 5 m high. **Bark** black to reddish brown, deeply fissured to scaly; inner bark reddish brown. **Sapwood** yellow to white. **Twigs** (young) slender, terete, *sericeous*. **Stipules** narrowly triangular to linear, 2.5–8 × 0.5–1 mm, appressed hairy. **Leaves** subcoriaceous to chartaceous, glabrous and *not white-waxy above*, *glabrous to sparsely sericeous beneath*; ovate or elliptic-oblong, 5–15 × 2–6 cm, base cuneate to rounded, sometimes oblique, apex acuminate, *acumen 0.2–1.5 cm long*; *midrib* slightly raised and glabrous above, distinct and *glabrous to sericeous beneath*; *lateral veins* 10–25 pairs, at an angle of 50–70° with midrib, glabrous, faint, above, prominent to obscure beneath, *joining to form a smooth vein parallel to leaf margin*; intercostal venation obscure above, prominent to obscure beneath; *petiole* 0.5–2 cm long, 1–2 mm thick, *glabrous to subglabrous*. **Inflorescences** *axillary or borne on leafless nodes*, 2–15-flowered. **Flowers:** *pedicel 5–20 mm long*, 0.2–1 cm thick, appressed hairy; outer sepals broadly ovate, 2–5 × 3–6 mm, appressed hairy, inner sepals broadly ovate, 2.5–5 × 3–6 mm, appressed hairy; *corolla lobes* elliptic, 2–6 × 1.5–3 mm, *glabrous*, corolla tube 2–6 mm long, glabrous; stamens 16, in one whorl, *filaments* in bundles, 0.5–2 mm long, *glabrous*, anthers 1–3 mm long, glabrous; ovary 1.5–2.5 mm across, glabrous to hairy, style 6–18 mm long, glabrous. **Fruits** *ovoid to ovoid-ellipsoid*, 2–4 × 1–2 cm, drying black, glabrous; persistent outer sepals recurved, 2.5–3.5 × 2.5–4 mm, *persistent inner sepals 3.5–4 × 3.5–5 mm*; persistent style to 15 mm long; *stalk 0.5–2 cm long*, 1.5–2 mm thick, subglabrous. **Seeds** ellipsoid, *c.* 2 × 1 cm.

Vernacular names. Sarawak—*pulut badan* (Kelabit). Kalimantan—*nato mergatakan* (Pleihari area).

Distribution. Endemic to Borneo (Sabah, Sarawak, Brunei and Kalimantan). Common and widespread in Sabah (e.g., *Clemens 26715*, *Beaman 7634*, *RSNB 4323*, *SAN 42880*, and *SAN 132813*) and Sarawak (e.g., *S 17734*, *S 22374*, *S 33765*, and *S 38842*).

Ecology. In lowland mixed dipterocarp forest on various types of soils to montane forest, at altitudes to 2000 m.

12. *Payena obscura* Burck

(Latin, *obscurus* = indistinct, obscure; the leaf with obscure veins)

Ann. Jard. Bot. Buitenz. 5 (1886) 60; Merrill *l.c.* (1921) 477; Ridley *l.c.* 263; H.J. Lam *l.c.* (1925) 150, *l.c.* (1927) 435; Masamune *l.c.* 598; Wyatt-Smith, FRI Res. Pamphl. 4 (1954) 51; A. Bruggen *l.c.* 117; Ng *l.c.*

433; Anderson *l.c.* (1980) 319; Whitmore, Tantra & Sutisna *l.c.* 327; PROSEA *l.c.* 338; Pennington *l.c.* 160; Turner *l.c.* 467; Coode *et al.* (eds.) *l.c.* 308; Pereira *l.c.* 916. **Type:** *Burck s.n.* (= *Herbarium Bogoriense No. 151344*), Sumatra, Pangkalan (BO).

Tree to 30 m tall, 90 cm diameter, buttresses concave to 1.5 m high. **Bark** dark brown to greyish brown, fissured to flaky; inner bark brown. **Sapwood** yellow to white. **Twigs** (young) slender, terete, *sericeous*. **Stipules** *ovate*, 1.5–2.5 × 1.5–2 mm, golden-brown hairy. **Leaves** coriaceous to chartaceous, glabrous and *not white-waxy above, sparsely appressed brown-hairy to glabrous beneath*; *ovate, obovate to narrowly elliptic or oblong, 6–16 × 2.5–7 cm*, base cuneate, rounded to attenuate, apex short-acuminate, *acumen 0.3–2 cm long*; *midrib flat and glabrous above, prominent and sericeous to glabrous beneath; lateral veins 12–20 pairs, at an angle of 60–70° with midrib, glabrous, obscure above, faint below, arching and joining to form vein-loops near leaf margin*; *intercostal venation faint on both sides; petiole 1–3.5 cm long, (1–)1.5–2 mm thick, subglabrous*. **Inflorescences** *axillary or borne on leafless nodes, 1–9-flowered*. **Flowers:** *pedicel 20–35 mm long, 0.5–1 mm thick, hairy; outer sepals broadly ovate, 4–7 × 5–8 mm, appressed hairy, inner sepals broadly ovate, 4–7.5 × 5–8 mm, appressed hairy; corolla lobes oblong to ovate, 5–9 × 2–5 mm, glabrous, corolla tube 3–6 mm long, glabrous; stamens 16, in one whorl, filaments 0.5–2 mm long, glabrous, anthers 2–3.5 mm long, glabrous, lacerate to acuminate at apex; ovary 1.5–3 mm across, glabrous to hairy, style 12–20 mm long, glabrous or hairy to one third from base only*. **Fruits** *ovoid to narrowly ovoid, 4–5 × 1.5–2.5 cm, gradually tapering into a sharp point, glabrous to subglabrous; persistent outer sepals 5–8 × 5–10 mm, persistent inner sepals 5–8 × 6–10 mm; persistent style to 20 mm long; stalk 2.5–4 cm long, 1.5–4 mm thick, glabrous*. **Seeds** *ellipsoid, 2–3 × 1–1.5 cm; scar 0.3–0.4 cm wide*.

Uses. The latex produces gutta percha.

Key to varieties

Outer sepals 4–5 mm long. Ovary glabrous. Fruit stalk 1.5–1.8 mm thick. Persistent outer sepals 5–7 mm wide.....

var. **havilandii** (King & Gamble) J.T.Pereira

(J.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Kew Bull. 52 (1997) 916. Basionym: *Payena havilandii* King & Gamble *l.c.* 169, *p.p.* (specimens from Borneo), Ridley *l.c.* 263, H.J. Lam *l.c.* (1925) 136. Lectotype (Pereira, 1997): *Haviland 2320*, Borneo, Sarawak, near Kuching (K).

Endemic to Borneo (Sabah, Sarawak and Brunei). In Sarawak, collected from the 1st and 2nd Divisions (e.g., *S 13386, S 37844, S 37918, and S 43975*). In Sabah, only known from one collection, *Clemens 11258*, from Tuaran. In lowland mixed dipterocarp forest, on sandy-clay soils, at altitudes to 850 m.

Outer sepals 5–7.5 mm long. Ovary hairy. Fruits stalk 2–3.5 mm thick. Persistent outer sepals 7–10 mm wide.....

var. **obscura**

Synonym: *Payena havilandii* King & Gamble *l.c.* 169, *p.p.* (specimens from Peninsular Malaysia and Singapore).

Widespread. Sumatra, Peninsular Malaysia, Singapore, and Borneo (Sabah, Sarawak and Brunei). In Sabah, mainly collected from the west coast (Papar, Beaufort and Sipitang districts; e.g., *SAN 16832, SAN 34530, SAN 35099, SAN 66731, and SAN 108534*), rarely in the east coast (two collections from Labuk-Sugut district, *SAN 73879 and SAN 139024*). In

Sarawak, recorded from the 4th Division (Lambir Hills NP; e.g., *S 38423*, *S 38432*). From lowland to ridge *kerangas* forest, at altitudes to 1200 m. Vernacular names: Sabah—*nyatoh taban putih* (Sipitang). Brunei—*nyato* (Dusun, Iban), *nyatoh jangkar* (Dusun).

10. POUTERIA Aublet

(from a South American plant name)

Stephen P. Teo

Hist. Pl. Guiane 1 (1775) 85; Baehni, Candollea 9 (1942) 149; Herrmann-Erlee & P. Royen, Blumea 8 (1957) 453; Ng, TFM 1 (1972) 437; Anderson CLTS (1980) 320; Whitmore & Tantra, CLS (1986) 224; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 328; Pennington, Gen. Sapot. (1991) 184; PROSEA 5, 1 (1993) 362; Coode *et al.* (eds.), CLBD (1996) 308; Argent *et al.* (eds.), MNMT-CK 2 (1997) 589; Teo, Sar. Mus. J. 51 (1997) 211. **Synonyms:** *Lucuma* Molina, Saggio Chili (1782) 186, H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 219, *ibid.* 3, 8 (1927) 476; *Planchonella* Pierre, Not. Bot. Sapot. (1890) 34, H.J. Lam *l.c.* (1925) 193, *l.c.* (1927) 467, P. Royen, Blumea 8 (1957) 236, Backer & Bakhuizen *f.*, FJ 2 (1965) 189, Ng, TFM 1 (1972) 437, Anderson, CLTS (1980) 319, Whitmore & Tantra *l.c.* 224, Whitmore, Tantra & Sutisna *l.c.* 328.

Trees or shrubs. **Stipules** absent. **Leaves** spirally arranged, rarely subopposite, well-spaced along twigs or crowded at ends of twigs; *lateral veins well-spaced*, diminishing and becoming inconspicuous toward leaf margin or arching and joining to form intramarginal vein-loops; *intercostal venation reticulate* or *scalariform*. **Inflorescences** few-flowered fascicles, axillary or borne on leafless older twigs; fascicles solitary or occasionally clustered on leafless short shoots. **Flowers** unisexual (plant dioecious) or bisexual; *sepals (4–)5(–6), in a single whorl*, overlapping or free but joined at base; corolla cup-shaped or tubular, rarely rotate, lobes (4–)5(–6), not divided into segments, erect or rarely spreading, ciliate or papillose, tube shorter, equal or rarely longer than corolla lobes; stamens (4–)5(–6), in a single whorl, inserted on lower or upper half of corolla tube, or rarely at base of corolla lobes, included or rarely exerted, filaments short, anthers extrorsely or laterally dehiscent; *staminodes (4–) 5(–6), rarely absent*, inserted in corolla lobes' sinuses or inside corolla tube; disk (nectary) present or absent; ovary 1–6-loculed, style stout, included or exerted, ovule placentation axile. **Fruit** a berry, 1–several-seeded. **Seeds** broadly ellipsoid, plano-convex; testa smooth, wrinkled or pitted; scar adaxial; cotyledons plano-convex or thin-foliaceous; endosperm present or absent.

Distribution. About 200 species, distributed in tropical America, C Africa, Asia, Malesia, Australia and the Pacific Islands. Ten including one incompletely known species are recorded from Sabah and Sarawak.

Ecology. Occurs in wide range of habitats, from coastal fringe forest to lower montane forest, at altitudes to 1700 m.

Taxonomy. Baehni (*l.c.* (1942) 149) united *Planchonella* and *Pouteria* into a single genus, and pointed out that the proportion between the amount of endosperm and the thickness of cotyledons was insufficient to separate the two genera. Subsequently, several authors (P. Royen *l.c.* 236, Herrman-Erlee & P. Royen *l.c.* 453, Ng *l.c.* 437, and Whitmore, Tantra & Sutisna *l.c.* 328) reinstated *Planchonella* as a distinct genus, differing from *Pouteria* by its thin foliaceous

cotyledons, copious endosperm, and narrow linear seed scar. In *Pouteria* the cotyledons are thick, the endosperm is thin or lacking and the seed scar is broad. In addition, *Planchonella* has an Asiatic centre of distribution, whereas *Pouteria* has its centre of distribution in S America. Pennington (*l.c.* 184) made detailed comparative studies of all genera in the Sapotaceae and concluded that, based on the presence of many intermediate floral and other morphological characters, the two genera should be combined. Pennington's conclusion is accepted in the present account.

Key to *Pouteria* species

1. Leaves crowded near end of twigs..... **5. *P. maclayana***
 Leaves well-spaced along twigs.....2
2. Lateral veins arching and diminishing toward leaf margin.....3
 Lateral veins straight or curved, arching and joining near leaf margin to form intramarginal vein-loops.....5
3. Leaves glaucous below. Fruits densely rusty-brown appressed tomentose. Seed scar oblong..... **7. *P. malaccensis***
 Leaves not glaucous below. Fruits glabrous or sparsely rusty-brown tomentose. Seed scar linear.....4
4. Leaf margin undulate and recurved; lateral veins closely spaced, 14–19 pairs, straight and parallel, arching and diminishing only near leaf margin; intercostal venation densely scalariform; petiole broadly but shallowly grooved on adaxial side. Inflorescences 2–5-flowered. Fruits 0.8–2.5 × 0.3–1.6 cm..... **2. *P. firma***
 Leaf margin not undulate, plane; lateral veins well-spaced, 5–7(–11) pairs, subparallel, arching and diminishing toward leaf margin; intercostal venation laxly scalariform; petiole flat on adaxial side. Inflorescences up to 15-flowered. Fruits 2.5–4 × 2–3.5cm..... **6. *P. maingayi***
5. Intercostal venation reticulate.....6
 Intercostal venation scalariform.....8
6. Leaves lanceolate to narrowly elliptic; margin undulate and slightly recurved; petiole 0.4–1.2 cm long. Fruits with a ring of hirsute hairs at base; pericarp fleshy to slightly woody..... **4. *P. linggensis***
 Leaves obovate, obovate-elliptic to obovate-oblong; margin not undulate; petiole 1.5–2.5 cm long. Fruits glabrous; pericarp membranaceous.....7
7. Leaves glabrous on both surfaces, not shining above; apex broadly acute to shortly acuminate; intercostal venation laxly reticulate, without any vein descending from leaf margin and parallel to lateral veins. Sepals obovate; corolla lobes thick and fleshy, membranaceous around margin. Fruits ovoid-globose to ellipsoid-globose, 3–3.5 × 2–2.5 cm..... **3. *P. glabra***
 Leaves glabrous and shining above, initially densely reddish-brown tomentose below,

- late-glabrescent, apex rounded; intercostal venation densely reticulate, with a few veins descending from leaf margin and parallel to lateral veins. Sepals broadly ovate to suborbicular; corolla lobes membranaceous throughout. Fruits obovoid or subglobose, 1–1.5 cm across.....**9. P. obovata**
8. Leaves membranaceous to chartaceous, on drying shining black on both surfaces; margin undulate. Inflorescences fascicled, borne on leafless to almost leafless axillary shoots to 12 cm long. Fruits obliquely fusiform or obovoid-globose.....**1. P. duclitan**
Leaves thickly coriaceous, drying yellowish brown, not shining; margin not undulate. Inflorescences axillary. Fruits ovoid.....**8. P. mindanaensis**

1. *Pouteria duclitan* (Blanco) Baehni

(after a Philippines plant name)

Candollea 9 (1942) 283. **Basionym:** *Sideroxylon duclitan* Blanco, Fl. Filip. ed. 1 (1837) 129; Merrill, Spec. Blancoan. (1918) 301. **Neotype** (Merrill, 1918): *Merrill Spec. Blancoan. 1*, the Philippines, Luzon, Manila (isoneotype NSW). **Synonyms:** *Sideroxylon balitbitan* Blanco l.c. 130; *S. nitidum* Blume, Bijdr. Fl. Ned. Ind. (1826) 675, Merrill l.c. (1921) 482; *Planchonella nitida* (Blume) Dubard, Ann. Mus. Colon. Marseille 20 (1912) 62, H.J. Lam l.c. (1925) 205, 245, 246, 266, l.c. (1927) 472, P. Royen l.c. (1957) 362; *Pouteria nitida* (Blume) S.P.Teo l.c. 217, *comb. inval., non* (A.DC.) Radlk., Sitzb. Math.-Phys. Akad. Muench. 12 (1882) 333.

Tree to 50 m tall; bole fluted. **Bark** scaly; inner bark pale yellow. **Twigs** terete or sub-angular, 4–10 mm diameter. **Leaves** well-spaced along twigs, membranaceous to chartaceous, on drying shining black on both surfaces, initially reddish-brown tomentose, glabrescent; elliptic, ovate or obovate, 12.5–30 × 5–12 cm (leaves of saplings much larger up to 87 × 30 cm), base cuneate, margin undulate, apex acute or obtuse; midrib shallowly impressed above, prominently raised below; lateral veins 8–18(–30) pairs, ascending at an angle of 50–80° from midrib, straight, arching and joining to form vein-loops near leaf margin, raised on both sides; intercostal venation distinctly scalariform, reticulate near leaf margin, slightly distinct on both sides; petiole 3–7 cm long, shallowly grooved on adaxial side, glabrous. **Inflorescences** fascicled along leafless or nearly leafless axillary shoots to 12 cm long. **Flowers** whitish green; pedicel filiform, 2–9 mm long, reddish-brown sericeous, glabrescent; sepals ovate to obovate, 1–1.5 × 1–2 mm, sparsely sericeous outside, glabrous inside; corolla lobes spatulate to obovate, 1.5–2.5 × 1.5–2 mm; stamens 1.5–2.5 mm long, filaments subulate, 1–1.5 mm long, anthers ovoid, 0.5–1 mm across; staminodes subulate, 0.5–1 mm long; ovary conoid, 1–2 × 1 mm, 5-loculed, densely hirsute at base, style 5-ribbed, apex hirsute. **Fruits** obliquely fusiform and 1-seeded, or obovoid-globose and 2–5-seeded, 3.5 × 1.5–2.5 cm, rusty-brown tomentose. **Seeds** 1–5, oblong-obovoid, 1–2 × 0.6–1.2 cm; scar as long as seed, 4–5 mm broad; endosperm copious; cotyledons foliaceous.

Distribution. Sumatra, Christmas Island, Java, Borneo, the Philippines, Sulawesi, Lesser Sunda Islands, Maluku and Papua New Guinea. In Sabah, recorded from Beaufort (e.g., SAN 44544) and Ranau districts (e.g., SAN 28290 and SFN 27210). Also occurs in Kalimantan (e.g., bb. 19075 and Kostermans 5865).

Ecology. In lowland mixed dipterocarp to lower montane forest, at altitudes to 1400 m.

2. *Pouteria firma* (Miq.) Baehni

Fig. 27.

(Latin, *firmus* = stiff; probably referring to the texture of the leaf)

Candollea 9 (1942) 284; Pennington *l.c.* 198; PROSEA *l.c.* 368; Turner, Gard. Bull. Sing. 47 (1995) 467; Coode *et al.* (eds.) *l.c.* 308. **Basionym:** *Chrysophyllum firmum* Miq., Fl. Ind. Bat., Suppl. (1861) 579. **Type:** *Teijsmann s.n.*, Sumatra, Bangka, Plangas (holotype BO). **Synonyms:** *Sideroxylon firmum* (Miq.) Pierre ex Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 17, King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 164, Ridley, FMP 2 (1923) 260; *Beccariella firma* (Miq.) Pierre *l.c.* (1890) 30; *Planchonella firma* (Miq) Dubard, Ann. Mus. Colon. Marseille 20 (1912) 59, Masamune, PEB (1942) 600, P. Royen *l.c.* (1957) 316, Ng *l.c.* 434, Anderson *l.c.* 320, Whitmore, Tantra & Sutisna *l.c.* 328.

Tree to 24 m tall; buttresses to 1.5 m tall or absent. **Bark** smooth to slightly fissured, greyish brown; inner bark soft, reddish brown. **Twigs** terete, 3–10 mm diameter, yellowish to rusty-brown sericeous, glabrescent. **Leaves** *well-spaced along twigs*, thickly coriaceous, initially yellowish or reddish-brown villose on both surfaces, ultimately becoming glabrous above except on midrib, *not glaucous below*, bullate; elliptic-oblong to obovate-oblong, 8–14 × 4–6 cm, base cuneate to rounded and shortly decurrent, *margin undulate* and *recurved*, apex acuminate; midrib impressed to flat above, prominently raised below; *lateral veins 14–19 pairs, closely spaced*, ascending at an angle of 40–70° from midrib, *straight and parallel, arching and diminishing only near leaf margin*, slightly impressed above, prominent below; *intercostal venation densely scalariform*, faint above, distinct below; *petiole* (0.8–)2–4.5(–6.2) cm long, *broadly but shallowly grooved on adaxial side*, yellowish or rusty-brown velutinous, glabrescent. **Inflorescences** 2–5-flowered, axillary or in axils of leaf scars. **Flowers:** pedicel angular, 5–6 mm long; sepals triangular to broadly ovate, 2–4.5 × 2–3 mm, thick and fleshy, apex acute, minutely hairy on both sides; corolla lobes oblanceolate, *c.* 2.5 × 1–1.5 mm, membranaceous, glabrous; stamens 2–3 mm long, filaments subulate, *c.* 1 mm long, anthers ovoid, *c.* 1.5 × 1 mm; staminodes filiform or spatulate, 1–1.5 mm long, rarely absent; ovary globose, 1–2 mm diameter, 5-loculed, rusty-brown sericeous, style 1–1.5 mm long, sparsely hairy; stigma obliquely lobed. **Fruits** obovoid to ellipsoid, 0.8–2.5 × 0.3–1.6 cm, ripening black, *glabrous except at base*. **Seeds** 1–4, compressed ellipsoid, 0.6–2.3 × 0.3–0.6 cm; *scar linear*; endosperm copious; cotyledons foliaceous.

Vernacular name. Sarawak—*perluak* (Kelabit).

Distribution. Throughout Malesia and the Solomon Islands. In Borneo, scattered throughout Sabah (e.g., *SAN 21021* and *SAN 37840*) and Sarawak (e.g., *S 25839*, *S 34430* and *S 35949*). Also occurs in Kalimantan.

Ecology. In hill mixed dipterocarp to lower montane forest, at 850–1700 m altitudes.

Uses. The timber is used for making furniture, flooring, joinery, plywood and hardboard.

3. *Pouteria glabra* (Ridl.) I.M. Turner(Latin, *glaber* = devoid of indumentum; the leaf and fruit)

Gard. Bull. Sing. 47 (1995) 467; Teo *l.c.* 215. **Basionym:** *Sideroxylon glabrum* Ridl., J. Roy. As. Soc. Str. Br. (1912) 476, *l.c.* (1923) 259. **Type:** *Ridley 15770*, Peninsular Malaysia, Selangor, Sepang Mines (holotype SING; isotype K). **Synonym:** *Planchonella glabra* (Ridl.) H.J.Lam *l.c.* (1925) 217, Ng *l.c.* 435.

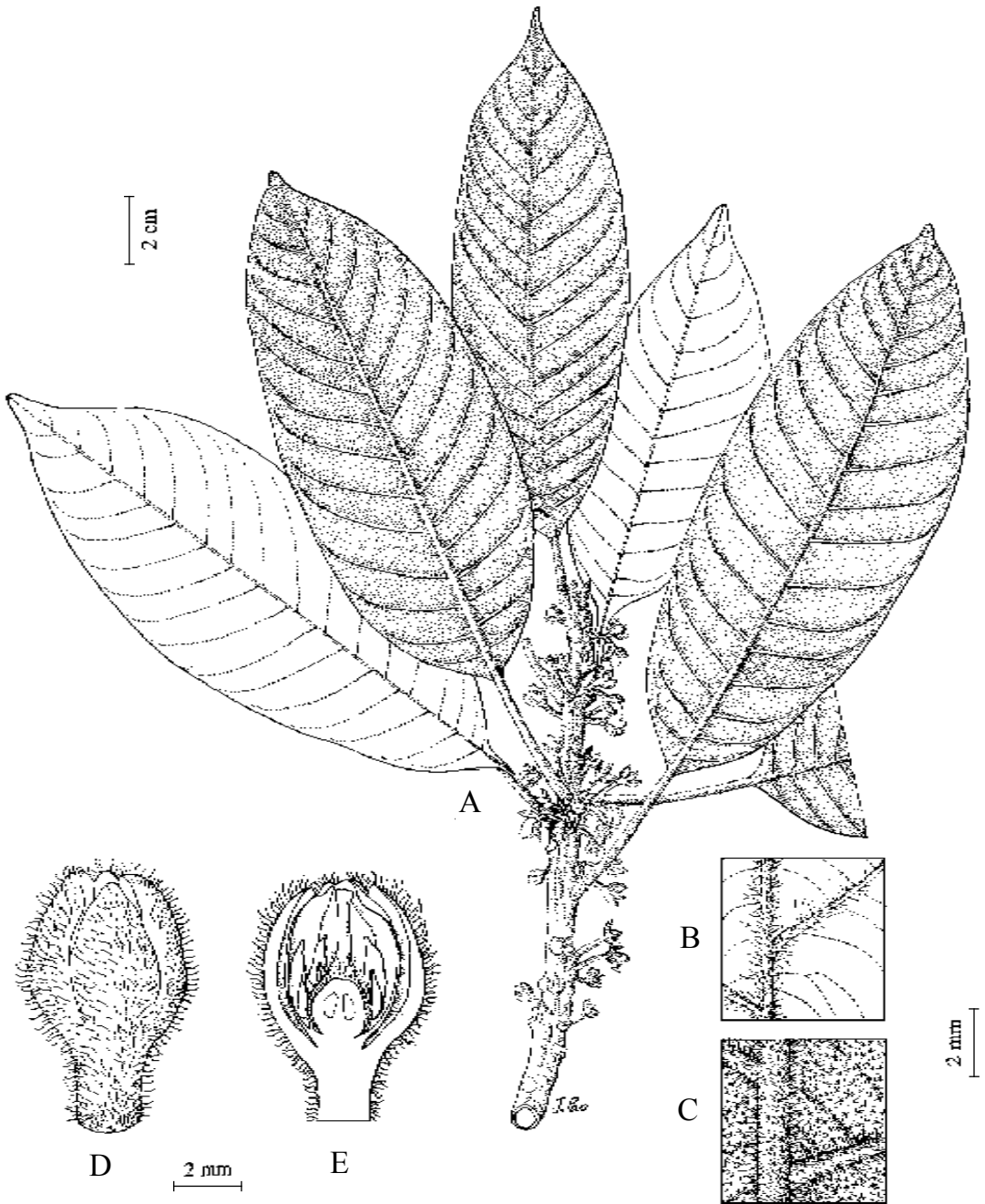


Fig. 27. *Pouteria firma*. A, flowering leafy twig; B, venation on lower leaf surface; C, indumentum of lower leaf surface; D, flower bud; E, longitudinal section of flower bud. (All from *Nooteboom 2122*.)

Tree to 15 m tall, 20 cm diameter. **Twigs** smooth, terete or angular, c. 4 mm diameter, initially tomentose, glabrescent. **Leaves** well-spaced along twigs, coriaceous, glabrous on both surfaces, drying yellowish brown, not shining above; obovate to obovate-elliptic, (8–)10–15(–22) × (3.5–)5–7.5(–10) cm, base narrowly cuneate, margin not undulate, recurved, apex broadly acute to shortly acuminate; midrib flat or raised above, prominently raised below; lateral veins 6–12 pairs, ascending at an angle of 50–80° from midrib, straight, strongly arching and joining to form intramarginal vein-loops near leaf margin, slightly raised above, prominently raised below; intercostal venation laxly reticulate, without any vein descending from leaf margin and parallel to lateral veins, faintly visible on both sides; petiole 1.5–2 cm long, flat on adaxial side, initially tomentose, glabrescent. **Inflorescences** axillary or in axils of leaf scars, 1–8-flowered. **Flowers** c. 3.5 × 3 mm; pedicel to 5 mm long; sepals obovate, c. 3 × 2 mm, ciliate, glabrous inside, minutely hairy outside, apex rounded; corolla lobes c. 2 × 1.5 mm, thick and fleshy, membranaceous around margin, glabrous; stamens 2.5–3.5 mm long, filaments c. 2 mm long, anthers c. 1 mm long; ovary globose, 1–1.5 mm diameter, style 1–1.5 mm long, glabrous, stigma 5-lobed; staminodes 5, slightly longer than stamens. **Fruits** ovoid-globose to ellipsoid-globose, 3–3.5 × 2–2.5 cm, smooth, glabrous; pericarp membranaceous. **Seeds** obliquely fusiform 0.8–1.2 × 0.2–0.4 cm.

Distribution. Peninsular Malaysia and Borneo. In Borneo, known from Bt. Sarang, Tatau, Bintulu district (S 20959), G. Api, Baram district (S 4279) and Sebuaran, Bau district (Jacobs 5479) in Sarawak.

Ecology. Uncommon and localised on slopes and summits of limestone hills.

4. *Pouteria linggensis* (Burck) Baehni (of Lingga Is., Sumatra)

Fig. 28.

Boissiera 11 (1965) 57; Pennington l.c. 199; PROSEA l.c. 369; Turner l.c. 468. **Basionym:** *Sideroxylon linggensis* Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 15; Merrill, EB (1921) 482. **Type:** Teijsmann s.n. (1899), Sumatra, Lingga Is., Bt. Besar (holotype BO; isotype L). **Synonyms:** *Planchonella linggensis* (Burck) Pierre, Not. Bot. Sapot. (1890) 35, P. Royen l.c. (1957) 384, Ng l.c. 436, Backer & Bakhuizen f. l.c. 189, Whitmore, Tantra & Sutisna l.c. 328; *Lucuma ?discolor* Baill., Bull. Soc. Linn., Paris 2 (1891) 935; *Pouteria discolor* (Baill.) Baehni l.c. (1942) 337; *Sideroxylon pittosporifolium* Elmer, Leaf. Philip. Bot. 3 (1910) 872; *S. littorale* Ridl. l.c. (1923) 259; *Planchonella littoralis* (Ridl.) H.J.Lam l.c. (1925) 216; *Chrysophyllum curtisii* King & Gamble l.c. 159.

Tree to 12 m tall, 20 cm diameter. **Bark** greyish, smooth; inner bark yellowish. **Twigs** smooth, terete, 2–4 mm diameter, initially tomentose, glabrescent. **Leaves** well-spaced along twigs, chartaceous, minutely hairy below, glabrescent, often drying greyish green above and yellowish brown below; lanceolate to narrowly elliptic, (4–)6–10(–16) × (1.5–)2.5–4(–5) cm, base cuneate, margin undulate, slightly recurved, apex broadly acute or acuminate; midrib flat to shallowly impressed above, raised below; lateral veins 9–10 pairs, ascending at an angle of 50–60° from midrib, straight, arching and joining to form vein-loops near leaf margin, faintly visible on both sides; intercostal venation laxly reticulate, with a few veins descending from leaf margin and parallel to lateral veins, obscure on both sides; petiole 0.4–1.2 cm long. **Inflorescences** axillary, 1–5-flowered. **Flowers** greenish yellow; pedicel c. 2.5 mm long, minutely hairy; sepals ovate, c. 2.5 × 2 mm, thick, minutely hairy outside and glabrous inside, margin membranaceous and ciliate; corolla lobes oblanceolate, 1.5 × 0.5–1 mm, membranaceous, glabrous; stamens included,

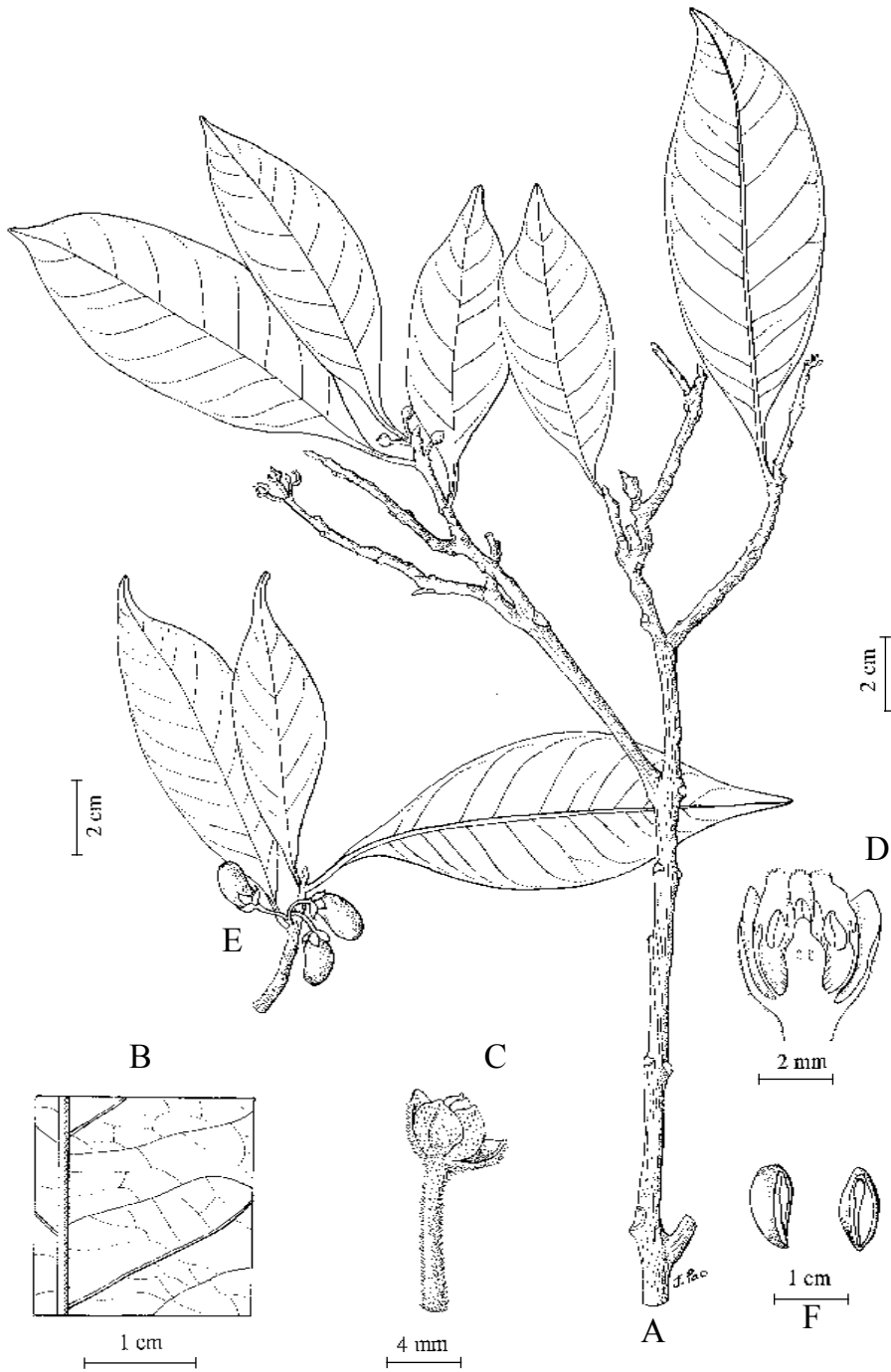


Fig. 28. *Pouteria linggensis*. A, flowering leafy twig; B, detailed venation of leaf; C, flower bud; D, longitudinal section of flower bud; E, fruiting leafy twig; F, seeds. (A–D from *SAN 42022*, E–F from *SAN 23860*.)

c. 1.5 mm long, filaments *c.* 1 mm long, anthers 0.8–1 mm long; staminodes 5; ovary globose, 1–1.5 mm diameter, style *c.* 0.5 mm long, stigma 5-lobed. **Fruits** ovoid-globose to obovoid, 1–2 × 0.5–1.3 cm, rounded-angular, *with a ring of hirsute hairs at base*, ripening purplish; *pericarp fleshy to slightly woody*. **Seeds** 1–5, obovoid, 0.7–1.5 × 0.4–0.6 cm, endosperm; scar linear; endosperm thick; cotyledons foliaceous.

Distribution. Sumatra (Lingga Is.), Peninsular Malaysia, Singapore, Borneo, the Philippines, Sulawesi, Papua New Guinea, N Australia, and the Pacific Islands. In Borneo, uncommon, recorded from Gaya (e.g., *SAN 42022*) and Sepanggar islands (e.g., *SAN 23860*) in Sabah, and from Bintulu (e.g., *S 24644*), Baram (e.g., *Hose 567*) and Datu Protected Forest (e.g., *S 41932*) in Sarawak. Also occurs in Brunei (e.g., *BRUN 3279*) and Kalimantan.

Ecology. In coastal lowland mixed dipterocarp forest, at altitudes to 400 m.

Uses. Produces good quality, durable *nyatoh* timber, used for indoor construction, furniture and tool handles.

5. *Pouteria maclayana* (F.Muell.) Baehni

(N.N. Miklucho-Maclay, 1846–1888, Russian geographer and ethnologist)

Candollea 9 (1942) 307; White, J. Arn. Arb. 31 (1950) 109; Herrmann-Erlee & P. Royen *l.c.* 475; Pennington *l.c.* 199; Coode *et al.* (eds.) *l.c.* 308; Teo *l.c.* 217. **Basionym:** *Illipe maclayana* F.Muell., Descr. Not. Pap. Pl. (1885) 12. **Type:** *Miklucho-Maclay s.n.*, SE New Guinea, Western division, Oriomo R., Wuroi (holotype MEL; isotype P). **Synonyms:** *Bureavella maclayana* (F.Muell.) Pierre, Not. Bot. Sapot. (1890) 16; *Lucuma maclayana* (F.Muell.) H.J.Lam *l.c.* (1925) 221, *l.c.* (1927) 476.

Tree to 18 m tall, 25 cm diameter. **Bark** smooth, brown. **Twigs** angular and striate, *c.* 4 mm diameter, initially tomentose, glabrescent. **Leaves** crowded near ends of twigs, chartaceous, initially tomentose, ultimately glabrous, drying greyish green to blackish above, yellowish brown below; elliptic-obovate, (11–)16(–28) × (7–)9(–13) cm, base cuneate, margin plane, apex acuminate; midribs flat or sunken above, prominently raised below; lateral veins 10–17 pairs, ascending at an angle of 70–80° from midrib, strongly arching and joining into intramarginal loops, prominent on both sides; intercostal venation reticulate, obscure on both sides; petiole 0.7–1.5 cm long, terete, initially tomentose, ultimately glabrous. **Inflorescences** axillary, to 6-flowered. **Flowers:** pedicel 2–3 mm long, glabrescent; sepals suborbicular, *c.* 2 mm across, minutely hairy outside, glabrous inside; corolla lobes lanceolate, *c.* 3 × 1 mm, glabrous; stamens included, filaments very short, anthers subglobose; staminodes short, subulate; ovary conoid, style short. **Fruits** obovoid to depressed globose, 0.8–1 × 1–1.3 cm, glabrous. **Seeds** 3, obovoid *c.* 5.5 × 3 cm; scar ovate.

Distribution. Sumatra (Lingga Is.), Talaud, Borneo, Maluku, Papua New Guinea and Solomon Islands. In Borneo, uncommon, only known by 5 collections from the eastern shoulder of Mt. Kinabalu (*RSNB 204*), Mt. Kinabalu Park (*Stevens et al. 224* and *Stevens et al. 654*) in Sabah, and from Jebong Limestone hill near Bau (*S 37396*), and Sampadai Hill, Melinau, Kapit district (*S 40737*) in Sarawak.

Ecology. In hill mixed dipterocarp forest on clay soils, limestone forest, and lower montane forest, at altitudes to 1500 m.

6. *Pouteria maingayi* (C.B.Clarke) Baehni

(A.C. Maingay, 1836–1869, British physician and botanist, sometime jail-warden in Malacca, Peninsular Malaysia)

Candollea 9 (1942) 343; Pennington *l.c.* 199; PROSEA *l.c.* 370; Turner *l.c.* 468. **Basionym:** *Sideroxylon maingayi* C.B.Clarke in Hooker *f.*, Fl. Brit. Ind. 3 (1882) 536; Ridley *l.c.* (1923) 258; King & Gamble *l.c.* 161. **Type:** *Maingay 993*, Peninsular Malaysia, Malacca, Sg. Udang (holotype K). **Synonyms:** *Sideroxylon borneense* Burck, Ann. Jard. Bot. Buitenz. 5 (1886) 15; *Lucuma maingayi* (C.B.Clarke) Dubard, Ann. Mus. Colon. Marseille, 20 (1912) 19, H.J. Lam *l.c.* (1925) 230, Masamune *l.c.* 589; *Planchonella maingayi* (C.B.Clarke) P.Royen *l.c.* (1957) 413, Ng *l.c.* 436, Anderson *l.c.* 320, Whitmore, Tantra & Sutisna *l.c.* 328.

Tree to 40 m tall, 80 cm diameter; bole columnar, with prominent symmetrical or steep plank-buttresses. **Bark** yellowish grey, smooth to shallowly fissured; inner bark granular, mottled yellow or white. **Sapwood** pale yellow. **Twigs** terete, 2.4–4 mm diameter, initially brownish tomentose, glabrescent. **Leaves** *well-spaced along twigs*, coriaceous, rusty-brown sericeous on both surfaces, ultimately glabrous and shining above, *not glaucous below*; obovate to obovate-elliptic or oblong, 7–25 × 3–7 cm, base cuneate and decurrent, *margin not undulate, plane*, apex acuminate with an obtuse tip, acumen 2–12 mm long; midrib flat or slightly impressed above, prominent below; *lateral veins 5–7(–11) pairs, well-spaced, subparallel*, ascending at an angle of 50–60° from midrib, *arching and diminishing toward leaf margin; intercostal venation laxly scalariform*, obscure on both sides; *petiole 1.5–3.0 cm long, flat on adaxial side*, angular below, rusty-brown pubescent, glabrescent. **Inflorescences** axillary, *to 15-flowered*. **Flowers** whitish; pedicel angular, 2–4 mm long, pubescent; sepals broadly ovate to orbicular, often unequal, 1.5–2.5 mm across, apex obtuse; corolla lobes suborbicular, *c.* 1 mm across, apex truncate; stamens *c.* 2 mm long, filaments *c.* 1.5 mm long, anthers *c.* 0.5 mm long, ovoid, laterally dehiscent; staminodes lanceolate, *c.* 1 mm long, apex subulate; ovary ovoid, *c.* 1 mm across, apex truncate, 5-loculed, densely pubescent, style cylindrical, *c.* 1 mm long, stigma 5-lobed. **Fruits** ellipsoid-globose, 2.5–4 × 2–3.5 cm; pericarp thick, *sparsely rusty-brown tomentose*. **Seeds** 5, laterally compressed, ovoid, *c.* 1.5 × 0.8 cm, obtuse or subacute at both ends; *scar linear*; endosperm thick; cotyledons foliaceous.

Vernacular name. Sarawak—*nyatoh* (Iban, Malay).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. Uncommon in Sabah (e.g., *Clemens 51202*, *Clemens 56300* and *SAN 33794*) and Sarawak (e.g., *S 0025*, *S 3205*, *S 8049*, and *Haviland 2799/2321*). Also occurs in Kalimantan (e.g., *Winkler 2410*).

Ecology. In lowland mixed dipterocarp forest.

7. *Pouteria malaccensis* (C.B.Clarke) Baehni

(of Malacca, Peninsular Malaysia)

Candollea 9 (1942) 302; Hermann-Erlee & P. Royen *l.c.* 463; Ng *l.c.* 438; Anderson *l.c.* 320; Whitmore, Tantra & Sutisna *l.c.* 328; Pennington *l.c.* 199; PROSEA *l.c.* 371; Turner *l.c.* 468. **Basionym:** *Sideroxylon malaccense* C.B.Clarke in Hooker *f. l.c.* (1882) 537, King & Gamble *l.c.* 161, Gamble, Kew Bull. (1907) 109, Ridley *l.c.* (1923) 258. **Type:** *Maingay 994*, Peninsular Malaysia, Malacca (holotype SING; isotypes L, P).

Synonyms: *Fontbrunea malaccensis* (C.B. Clarke) Pierre *l.c.* (1890) 32; *Lucuma malaccensis* (C.B. Clarke) Dubard *l.c.* (1912) 19, Masamune *l.c.* 590; *Xantolis malaccensis* (C.B. Clarke) Baehni *l.c.* (1965) 23.

Tree to 30 m tall, 70 cm diameter; buttresses to 2.5 m tall. **Bark** greyish brown, smooth becoming shallowly fissured; inner bark pale brown. **Sapwood** pale yellow. **Twigs** smooth, terete, 4–8 mm diameter, densely appressed rusty-brown tomentose at tips. **Leaves** *well-spaced along twigs*, coriaceous, initially densely appressed rusty-brown tomentose on both surfaces, soon becoming glabrous except on midrib and occasionally on lateral veins, *glaucous below*; broadly obovate, oblanceolate to elliptic-oblong, (8–)10–18(–23) × (4–)7–9(–11) cm, base cuneate, margin revolute, apex obtuse to rounded; midrib flat to slightly raised above, prominently raised below; *lateral veins* (6–)9–14(–18) pairs, ascending at an angle of 50–65° from midrib, straight or curved, *arching and diminishing and becoming inconspicuous near leaf margin*, impressed above, prominent below; intercostal venation scalariform, distinct below; petiole (1.8–)3–4(–5.5) cm long, shallowly grooved on adaxial side, densely appressed rusty-brown tomentose. **Inflorescences** axillary, 5–11-flowered. **Flowers** greenish white, sweet-scented; pedicel 4–6 mm long, pubescent; sepals 3–4 × 2.5–4.5 mm, base connate, apex rounded, rusty-brown sericeous outside, glabrous inside; corolla lobes ovate, *c.* 4 × 3.5 mm, apex obtuse; stamens *c.* 1.5 mm long, filaments subulate, *c.* 1 mm long, anthers ovoid, *c.* 0.5 mm across; staminodes poorly developed or absent; ovary subglobose, *c.* 1 mm across, densely appressed rusty-brown tomentose, style cylindrical, *c.* 1 mm long, sparsely hairy, stigma minutely ribbed. **Fruits** ellipsoid-oblong to almost globose, 2.3–3.8 × 1.8–2.8 cm, smooth, topped by persistent style, *densely rusty-brown appressed tomentose*. **Seeds** 2–5, ovoid, 2–2.5 × 1 × 0.8–1 cm; *scar oblong*, plane, subconvex, to flat and keeled; cotyledons thick; endosperm absent.

Vernacular names. Sarawak—*nyatoh batu*, *nyatoh putih*, *nyatoh sulit* (Iban), *perdulan* (Kelabit), *sundip* (Malay); Brunei—*nyatoh batu* (Malay).

Distribution. Thailand, Sumatra (Riau Archipelago, Lingga Is.), Peninsular Malaysia, Borneo, and Sulawesi. In Sabah, recorded from Ranau district (e.g., *SAN 49217*), and in Sarawak from Kelabit Highlands and Semengoh FR (e.g., *S 0154*, *S 3369*, *S 11052*, *S 32430*, and *S 47697*). Also occurs in Brunei and Kalimantan.

Ecology. Common in lowland and hill mixed dipterocarp on leached yellow sandy and clay soils to lower montane forest, at altitudes to 1400 m.

Uses. The timber is used by local people for making furniture.

8. *Pouteria mindanaensis* (H.J.Lam) Baehni (of Mindanao, the Philippines)

Fig. 29.

Candollea 9 (1942) 326; Teo *l.c.* 217. **Basionym:** *Planchonella mindanaensis* H.J.Lam *l.c.* (1925) 207, *l.c.* (1927) 473, P. Royen *l.c.* (1957) 414. **Type:** *Clemens 1126*, the Philippines, Mindanao (holotype PNH†?; isotypes BO, G, K, L). **Synonym:** *Xantolis mindanaensis* (H.J.Lam) Baehni *l.c.* (1965) 23.

Tree to 16 m tall, 25 cm diameter. **Twigs** stout, terete to angular, to 10 mm diameter, appressed yellowish-hairy at tips, glabrescent. **Leaves** *well-spaced along twigs*, *thickly coriaceous*, initially

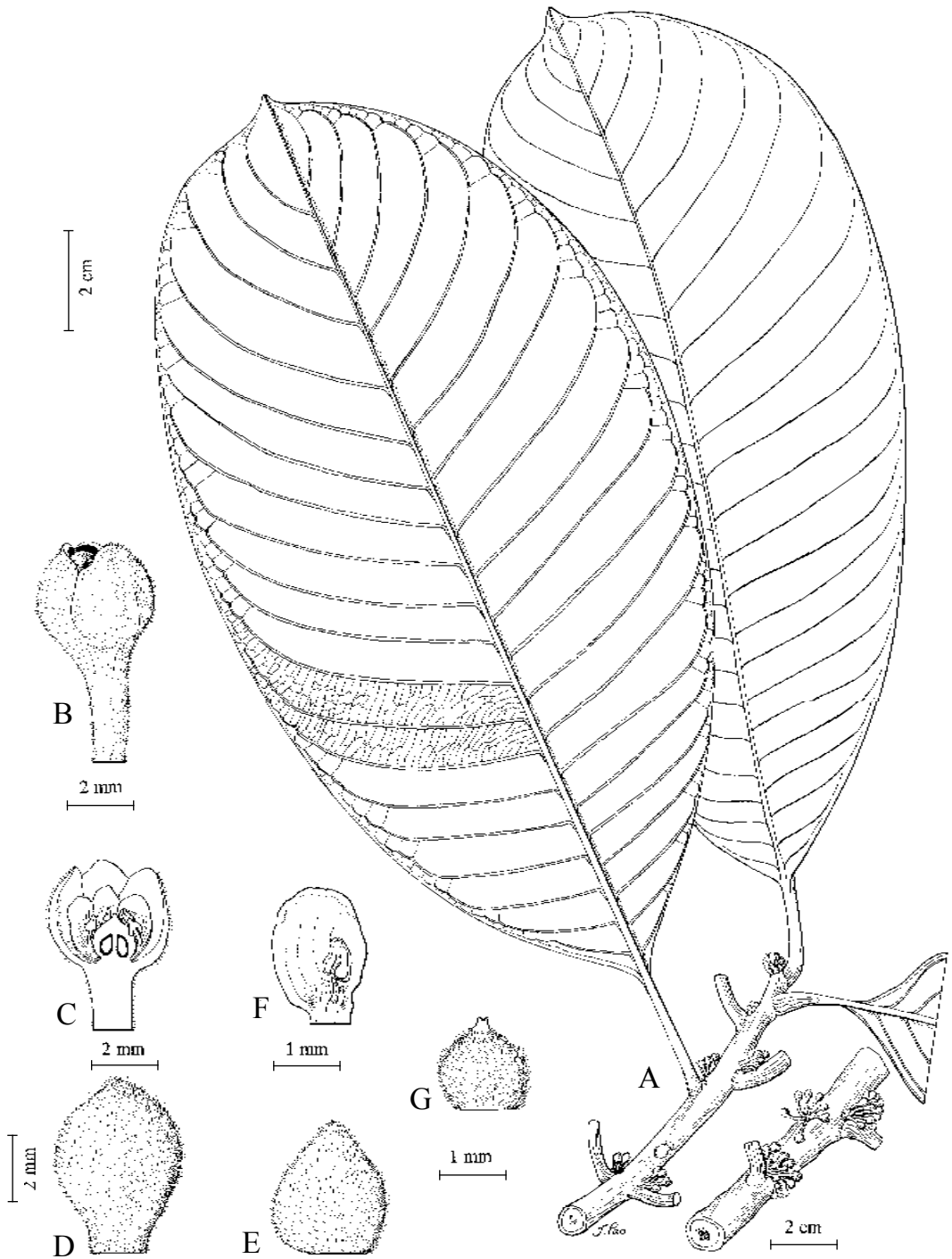


Fig. 29. *Pouteria mindanaensis*. A, flowering leafy twigs; B, flower bud; C, longitudinal section of flower bud; D, outer sepal; E, inner sepal; F, petal with attached stamen; G, pistil. (All from S 46953.)

pale yellow appressed-pubescent on both surfaces, ultimately glabrous, *drying yellowish brown, not shining above*; obovate to oblong, 7–38 × 3.5–21 cm, base attenuate, decurrent, *margin not undulate*, apex broadly acuminate to acute; midrib flat to slightly impressed above, prominently raised below; *lateral veins* 13–21 pairs, ascending at an angle of 50–70° from midrib, *straight, arching and joining to form vein-loops near leaf margin*, obscure above, prominent below; *intercostal venation scalariform*, sometimes laxly reticulate near leaf margin, obscure on both sides; petiole 2–5 cm long, flat on adaxial side, initially tomentose, glabrescent. **Inflorescence axillary**, 8–15-flowered. **Flowers** unisexual or bisexual; pedicel 5–12 mm long, appressed yellowish-pubescent; sepals broadly ovate or orbicular, 2.5–5 × 2–4 mm, ciliate, appressed yellowish-sericeous outside, glabrous inside; corolla glabrous, lobes suborbicular, 1–2 mm across; stamens *c.* 2 mm long, filaments *c.* 1 mm long, anthers ovoid, *c.* 1 mm long, laterally dehiscent; staminodes lanceolate, about half as long as corolla lobes; ovary conoid, 0.5–1 mm long, 5-loculed, pubescent, style stout. **Fruits** ovoid, 1–2 × 0.8–1.5 cm; pericarp membranaceous, smooth, glabrous. **Seeds** 1–4, laterally compressed, ellipsoid, *c.* 1.5 × 0.6 cm, obtuse at both ends; scars linear, *c.* 15 × 1.5 mm; endosperm copious; *cotyledons foliaceous*.

Distribution. Borneo and the Philippines. In Sarawak, recorded by a single collection (*S 46953*) from Lundu district. Also occurs in Kalimantan.

Ecology. In lowland mixed dipterocarp forest, at altitude about 150 m.

9. *Pouteria obovata* (R.Br.) Baehni

Fig. 30.

(Latin, *ob* = inverted, *ovatus* = egg-shaped; the leaf shape)

Candollea 9 (1942) 324; Pennington *l.c.* 199; PROSEA *l.c.* 371; Turner *l.c.* 468; Coode *et al.* (eds.) *l.c.* 308; Argent *et al.* (eds.) *l.c.* 590. **Basionym:** *Sersalisia obovata* R.Br., Prodr. (1810) 530. **Type:** *Banks s.n.*, Australia (holotype K). **Synonyms:** *Achras obovata* (R.Br.) Benth. & F.Muell., Fl. Austr. 4 (1869) 283; *Planchonella obovata* (R.Br.) Pierre, Not. Bot. Sapot. (1890) 36, H.J. Lam *l.c.* (1925) 202, *l.c.* (1927) 473, Masamune *l.c.* 600, P. Royen *l.c.* (1957) 368, Ng *l.c.* 437, Anderson *l.c.* 320, Whitmore, Tantra & Sutisna *l.c.* 328.

Tree to 20 m tall, 35 cm diameter; bole straight with irregular, conical or round coppery brown crown. **Bark** greenish to reddish brown, with grey mottles, shallowly fissured; inner bark reddish. **Sapwood** yellow. **Twigs** terete, 4–6 mm diameter, densely appressed reddish-brown tomentose, glabrescent. **Leaves** *well-spaced along twigs*, chartaceous to thinly coriaceous, *glabrous and shining above, densely reddish-brown appressed-tomentose below, late-glabrescent*; obovate, obovate-elliptic or obovate-oblong, (6–)10–12(–17) × (2.5–)5–7(–9) cm, base narrowly to broadly cuneate, *margin not undulate*, recurved, *apex rounded*; midrib and lateral veins slightly raised on both sides; *lateral veins* (5–)9(–11) pairs, ascending at an angle of 40–60° from midrib, *straight, arching and joining to form vein-loops near leaf margin*, faintly visible on both sides; *intercostal venation densely reticulate, with a few veins descending from leaf margin and parallel to lateral veins*, obscure on both sides; *petiole* 1.5–2.5 cm long, shallowly grooved on adaxial side, minutely tomentose, glabrescent. **Inflorescences** axillary or in axils of leaf scars, 1–20-flowered. **Flowers** greenish white; pedicel stout, 2.5–6 mm long; *sepals broadly ovate to suborbicular*, 1.5–2 mm across, apex rounded, ciliate, tomentose outside, glabrous inside; *corolla lobes* broadly ovate to oblong, 1.5–2 × 1.5–2.5 mm, *membranaceous throughout*; stamens 2.5–3.5 mm long, filaments filiform, 2–3 mm long, anthers ovoid or oblong, 0.5–1 mm long; staminodes 1–1.5 mm long, lanceolate or deltoid; ovary conoid or obovoid, 1 × 1.5–2 mm, truncate at apex, style stout,

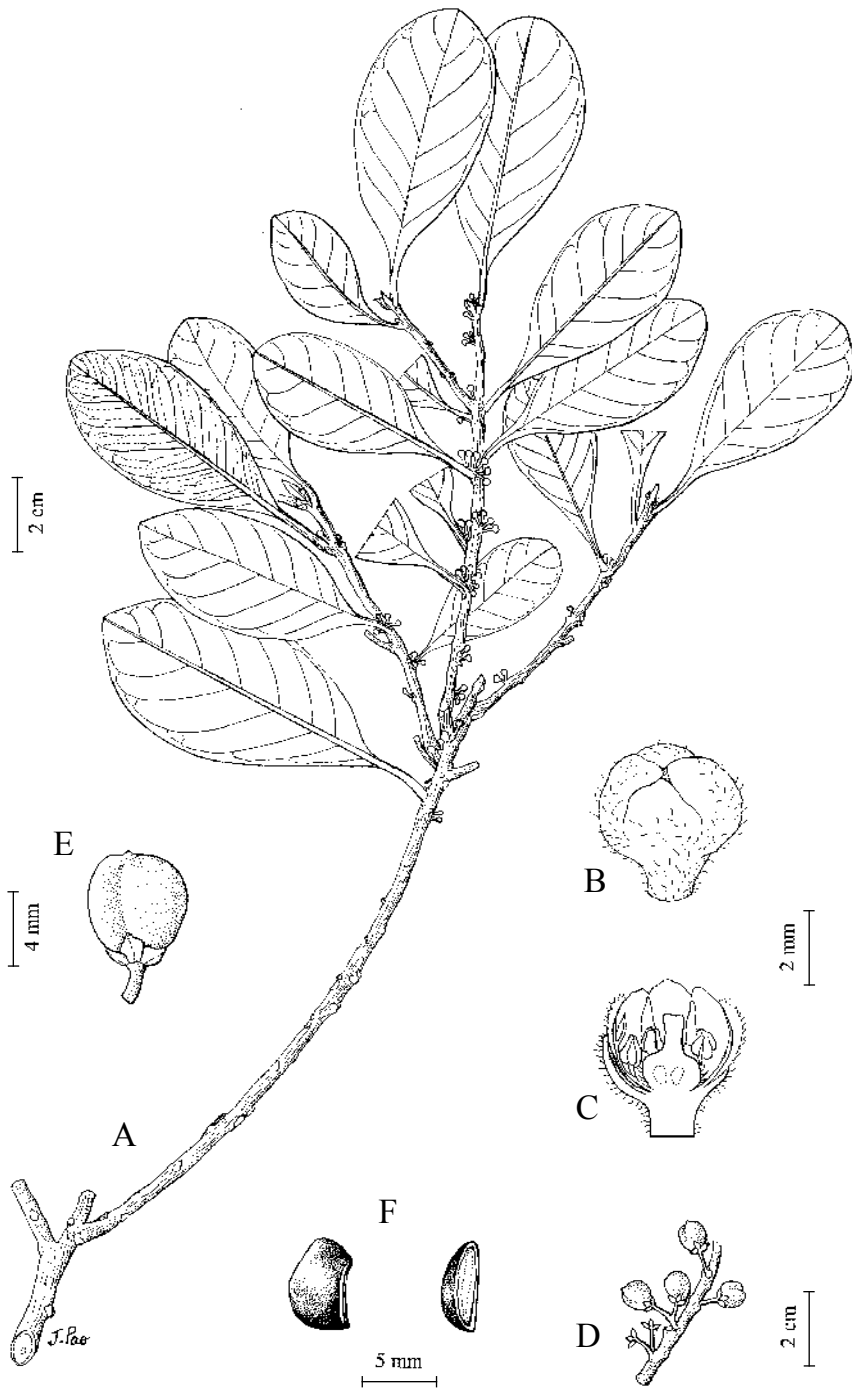


Fig. 30. *Pouteria obovata*. A, flowering leafy twig; B, flower bud; C, longitudinal section of flower bud; D, infructescences; E, fruit; F, seeds. (A–C from *S* 36619, D–F from *S* 37143.)

glabrous, 5-ribbed, *c.* 0.5 mm long, stigmas capitate, 5-lobed. **Fruits** obovoid or subglobose, broadly 2–5-ribbed, 1–1.5 cm across, glabrous; pericarp membranaceous, pale yellow, turning reddish brown upon ripening. **Seeds** 1–5, obliquely fusiform, 0.8–1.2 × 0.2–0.4 cm, obtuse to subacute at both ends; endosperm thick; cotyledons foliaceous.

Vernacular names. Sabah—*pelawan-pelawan* (Merantaman, Sipitang). Sarawak—*gumbirar merah* (around Jeidong), *nyatoh laut* (Malay).

Distribution. Seychelles Islands, India, Pakistan, S China, Taiwan, Vietnam, Cambodia, Myanmar, Thailand, Malaysia, Solomon Islands, NE Australia and S America. Common and scattered throughout Sabah (e.g., *SAN 20623*, *SAN 27141*, *SAN 78138*, *SAN 94419*, and *SAN 107871*) and Sarawak (e.g., *S 7677*, *S 10206*, *S 25576*, *S 38554*, and *S 62204*). Also occurs in Brunei (e.g., *BRUN 5066*, *Coode 6474* and *van Niel 3862*) and Kalimantan (e.g., *bb. 34572*).

Ecology. Frequent in rocky and sandy littoral fringe vegetation, occasional in lowland *kerangas*, limestone hill, and estuarine mangrove swamp forests.

Uses. The timber is suitable for carving and cabinet making, and occasionally also used for making various types of domestic utensils. A decoction of leaves is used to relieve stomach ache; poultice from crushed leaves is used to treat lumbago.

Incompletely known species

Pouteria sp. 1

Tree 25 m tall, 60 cm diameter. **Twigs** smooth, terete, 4–5 mm diameter; young parts covered with rusty-brown indumentum, soon becoming glabrous. **Leaves** coriaceous, drying brownish on both sides, glabrous above, initially rusty-brown pubescent below, soon becoming glabrous except midrib; lanceolate, 7.5–9.5 × 2–2.5 cm, base cuneate, margin wavy, apex acute; midrib and lateral veins raised on both surfaces; lateral veins 11–14 pairs, ascending at an angle of 45–50° from midrib, straight, arching and joining into intramarginal loops near leaf margin; intercostal venation scalariform-reticulate, obscure on both sides; petiole 2–2.5 cm long, minutely hairy, shallowly grooved on adaxial side. **Inflorescences** axillary, fascicles 1–7-flowered. **Flowers** greenish yellow; pedicel 1–1.5 cm long; sepals ovate, *c.* 5 × 3–4 mm, minutely hairy outside, glabrous inside; petals glabrous, membranaceous, *c.* 3 × 3.5 mm; stamens included, *c.* 2.5 mm long; staminodes *c.* 2.5 mm long; ovary conoid, *c.* 2 mm across, minutely hairy; style *c.* 2 mm long, glabrous, stigma 5-lobed. **Fruits** unknown.

Distribution. Only known by two collections (*SAN 92450* and *SAN 118204*) from Sandakan district, Sabah.

11. SARCOSPERMA Hook.f.

(Greek, *sarkos* = fleshy, *spermum* = seed)

A. Noorsiha

In Bentham & Hooker *f.*, Gen Pl. 2 (1876) 655; King & Gamble, J. As. Soc. Beng. 74, 2, Extra No. 17 (1906) 159; Ridley, FMP 2 (1923) 260; H.J. Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 248, *ibid.* 3, 8 (1927) 18, FM 1, 4 (1948) 32; H.J. Lam & Varossieau, Blumea 3, 1 (1938) 185; H.J. Lam & P. Royen, Blumea 7, 1 (1952) 148; Ng, TFM 1 (1972) 440; Anderson, CLTS (1980) 320; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 329; Pennington, Gen. Sapot. (1991) 179. **Synonyms:** *Apoia* Merr., Philip. J. Sci. 17 (1920) 605; *Bracea* King, J. As. Soc. Beng. 64 (1895) 101.

Trees or shrubs. **Stipules** *present*, small, caducous. **Leaves** *opposite* or *subopposite*, rarely spirally arranged and well-spaced along twigs, *often with glandular pits near axils of lateral veins*; lateral veins diminishing and becoming inconspicuous towards leaf margin; intercostal venation scalariform; *petiole often with a pair of stipels at distal end*. **Inflorescences** *racemose* or *paniculate*, axillary or in axils of leaf scars. **Flowers** bisexual; *sepals 4–5, in a single whorl, imbricate*; corolla funnel-shaped, tube short, lobes 5, imbricate in bud, tube shorter than lobes; stamens 5, in a single whorl, inserted at top of corolla tube, filaments short, anthers introsely or laterally dehiscent; staminodes 5, inserted at throat of corolla tube, alternating with stamens; disk (nectary) absent; ovary 1–2-loculed, glabrous, style short and stout, stigmas minutely 2–4-lobed, ovules 1 in each locule, anatropous or apotropous, placentation basal. **Fruits** 1–2-seeded; pericarp fleshy. **Seeds** ellipsoid to ovoid, not laterally compressed; scar small, circular, basal or basiventral; endosperm absent; cotyledons plano-convex, thick; endosperm absent.

Distribution. About 8 species, distributed from the eastern part of the Himalayas to Myanmar, S China, Indo-China and Malesia. Only one species occurs in Sabah and Sarawak.

Ecology. Scattered in different forest types from sea level to about 1300 m altitude.

Taxonomy. Lam (*l.c.* (1925) 248) placed the genus *Sarcosperma* in a family of its own, the Sarcospermaceae. Many authors (*e.g.* Bentham & Hooker *f.* *l.c.* 655; King & Gamble *l.c.* 159; Ridley *l.c.* 260; Keng, OFMSP (1978) 231), however, included the genus in the Sapotaceae. Following Lam, Hutchinson (Fam. Fl. Pl. 1 (1964) 351), Ng (*l.c.* 440), Anderson (*l.c.* 320), Whitmore, Tantra & Sutisna (*l.c.* 329) and van Steenis (Checkl. Gen. Names in Mal. Bot. (1987) 112) maintained the separation of the Sarcospermaceae from the Sapotaceae by the following characters: opposite and stipulate leaves, racemose or paniculate inflorescence, petiole with stipels at the distal end, and by the presence of glandular pits in the axils of lateral veins on lower leaf surface. However, the recently published generic monograph of the Sapotaceae by Pennington (*l.c.* 179) clearly indicated that on account of morphological, palynological, cytological and phytochemical evidence, the genus *Sarcosperma* should be retained in the Sapotaceae, tribe *Sideroxyloae*, together with *Argania*, *Diploon*, *Neohemsleya*, *Nesoluma*, and *Sideroxylon*. Pennington's conclusion is adopted in this account.

Sarcosperma paniculatum (King) Stapf & King

Fig. 31.

(Latin, *paniculatus* = having flowers arranged in a loosely branched inflorescence)

In Hooker *f.*, Icon Pl. 7 (1901) *t.* 2690; King & Gamble *l.c.* 160; Ridley *l.c.* 260; H.J. Lam *l.c.* (1925) 248, *l.c.* (1927) 21, *l.c.* (1948) 32; H.J. Lam & Varossieau *l.c.* 190; H.J. Lam & P. Royen *l.c.* 152; Ng *l.c.* 440; Anderson *l.c.* 320; Whitmore, Tantra & Sutisna *l.c.* 329; Pennington *l.c.* 180; Turner, Gard. Bull. Sing. 47 (1995) 468. **Basionym:** *Bracea paniculata* King, J. As. Soc. Beng. 64 (1895) 101. **Type:** King's Collector 8086, Peninsular Malaysia, Perak, Batang Padang (holotype K). **Synonyms:** *Discocalyx macrocarpa* Elmer, Leaflet. Philip. Bot. 8 (1915) 2781; *Apoia macrocarpa* (Elmer) Merr. *l.c.* 605; *Sarcosperma breviracemosum* H.J. Lam *l.c.* (1927) 21.

Tree to 40 m tall, 70 cm diameter; bole usually columnar, with steep buttresses to 2.5 m tall. Crown spreading. **Bark** reddish brown, soft, shallowly fissured; inner bark pale yellow, soft, fibrous. **Sapwood** white to pale yellow. **Stipules** subulate, triangular, *c.* 4 mm long, caducous, scars triangular or linear. **Leaves** thinly coriaceous, glabrous, dark brown when dried; elliptic oblong, (6–)9–18(–28) × 3–10 cm, base acute to attenuate, margin plane to slightly wavy, apex acuminate; midrib slender, prominent beneath, sunken above; lateral veins 6–10 pairs, slender, about 2.5 cm apart, at an angle of 50–70° with midrib, arching and diminishing toward leaf margin, often with small glandular pits near junctions with midrib; intercostal venation finely reticulate, inconspicuous on both sides; petiole 1–2.5 cm long, glabrous to slightly tomentose, grooved on adaxial side, *stipels acute, 0.5–2 mm long.* **Inflorescences** glabrous to sparsely tomentose, branched panicles of 10–15 cm long or unbranched and 1–2 cm long; bracts glabrous, acute, *c.* 1 mm long. **Flowers** fascicled or solitary along inflorescence branches, *c.* 5 mm across, yellow to pale greenish white; pedicel 1–1.5 mm long; sepals roundish or broadly ovate, *c.* 2 mm across; corolla tube *c.* 1 mm long, lobes ovate, *c.* 3 × 2 mm; stamens *c.* 1 mm long, filaments very short, anthers ovate; staminodes prominent, acute, *c.* 1 mm long; ovary conical, *c.* 2 × 1 mm, 2-loculed, glabrous, style *c.* 1 mm long, stigma 2-lobed. **Fruits** ovoid-globose, 1.7–2 × 1.5–1.7 cm, ripening red and purplish black, with persistent style and calyx, 1(–2)-seeded; stalk *c.* 0.3 cm long. **Seeds** globose, *c.* 1.5 cm across; testa thin, pale brown; scar round, *c.* 3 × 4 mm.

Distribution. Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi, Maluku, Lesser Sunda Islands, and New Guinea. In Sabah and Sarawak, uncommon and known only by 2 collections from Mt. Kinabalu in Sabah (*RSNB 103*) and Kelabit Highlands in Sarawak (*Nooteboom & Chai 2121*). Also occurs in E Kalimantan (e.g., *Kostermans 5810*).

Ecology. Scattered in secondary forest and other open habitats at altitudes ranging from 130 to 1300 m, on various soil types including andesite and limestone derived soils.

Uses. The wood is soft and not durable. No record of its use in Sabah and Sarawak but in Sumatra it is used as timber.

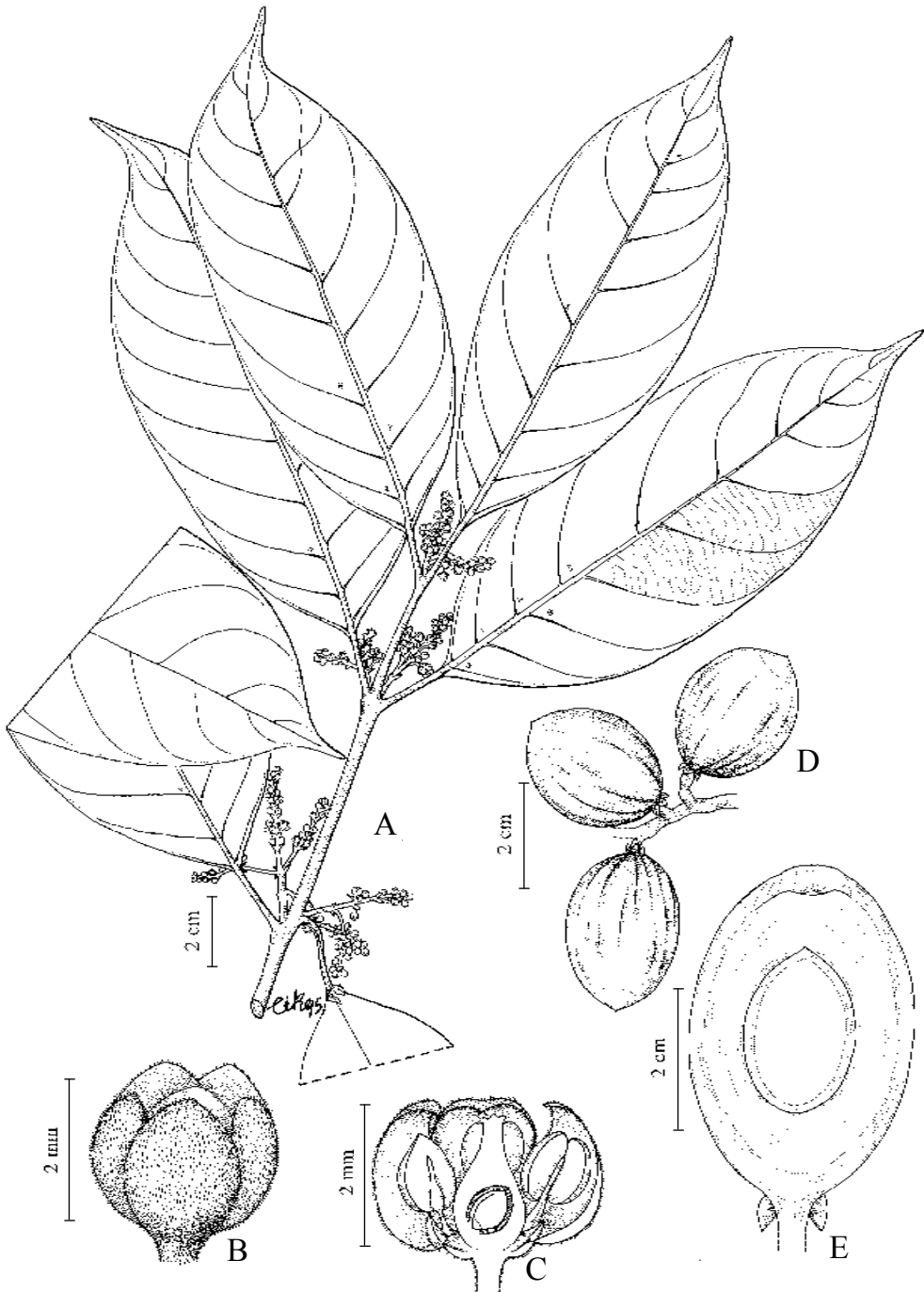


Fig. 31. *Sarcosperma paniculatum*. A, flowering leafy twig; B, flower bud; C, longitudinal section of flower bud; D, infructescence; E, longitudinal section of fruit. (A–C from *Maradjo* 142 (= *Meijer* 5005), D–E from *For. Dept.* CF 875.)

APPENDIX

New Taxa, Taxonomic Status and Combinations

OLEACEAE

Chionanthus balgooyiana* Kiew, *sp. nov.

Chionanthi rugosae simulans, sed folio brevior ad apicem acute angustatum, petiolo longiore differt. Typus: Martin S 38039, Borneo, Sarawak, G. Mulu (holotypus SAR; isotypi K, KEP, SAN).

Notes. Specimens of this species were previously listed under *C. rugosus* (Kiew, Malay. For. 43, (1980) 389). *Chionanthus rugosus* is extremely rare and is known from just three collections, all from a single lowland locality (Semengoh FR in Sarawak). Among the Bornean *Chionanthus* species, these two taxa are distinct in their very slender twigs, small narrowly lanceolate leaves with a cuspidate apex, short, few-flowered racemes, and rugose fruit surface.

The new species is named in honour of Max van Balgooy who generously shares his extensive knowledge of the Malesian flora and who first drew my attention to the fact that specimens of more than one species were cited for *C. rugosus*. *Chionanthus balgooyiana* grows at higher altitudes in lower montane forest and is distinct from *C. rugosus* in having leaves that are narrowed in the upper half (i.e., are widest in the lower half), that dry greenish grey, have a midrib raised on the upper surface and lateral veins that are plane and obscure on both the upper and lower surfaces as compared with *C. rugosus* where leaves are widest at or above the middle, that dry chestnut-brown and the midrib and lateral veins are impressed on the upper surface and are prominent on the lower surface.

Specimens examined: BORNEO, SARAWAK—Second Division, Lingga, Bt. Senyandang, Lee S 44254 (K, SAR); Fourth Division, Dulit Range, Richards 1706 (K), Richards 1773 (K), Tong S 34896 (KEP, SAN), Dayang Awa & Yui S 46777 (K); G. Mulu, Martin S 38039 (K, KEP, SAN, SAR).

Chionanthus callophyloides* Kiew, *sp. nov.

Chionantho callophylo prima facie similissima, sed foliis angustioribus, inflorescentiis brevioribus. Typus: Saikeh SAN 79917, Borneo, Sabah, Sandakan district, Sepilok FR (holotypus SAN; isotypus SING).

Notes. Among the Bornean species, *Chionanthus callophyloides* most resembles *C. callophyllus* in its subcoriaceous leaves that dry pale grey-green, its thickened petioles that do not dry black, inflorescences with first order branching and fruits that dry with a white bloom. The new species is distinct from *C. callophyllus* in its narrow leaves with an acuminate apex (the leaves of *C. callophyllus* are distinctly obovate and are broader, 23–38 × 7–13 cm) and the fruit is finely ridged

and has a narrowed base (*C. callophyllus* has a smooth fruit with a distinctly flattened base).

Specimens examined: BORNEO, SABAH—Sandakan district, Sepilok FR, *Saikeh SAN 79917* (SAN, SING), *Davies SAN 92435* (SAN, SING), Labuk Road, *Amir SAN 35605* (SAN, SING), Sg. Pamentarian, *Fidilis 120061* (SAN, SING); Lahad Datu district, *Chai SAN 25086* (SAN, SING); Ranau district, Kg. Nalumad, *Aban SAN 49386* (KEP, SAN); Pitas district, Sg. Kelang, *George & Amin SAN 121242* (SAN, SING); Sipitang district, Menggalong FR, *Saikeh SAN 72028* (SAN, SING), Lumaku FR, *Berhaman et al. SAN 132640* (KEP, SAN, SING). SARAWAK—Fourth Division, G. Mulu NP, Ulu Sg. Berar, *Chai S 39633* (SAR, SING).

Chionanthus globosus* (Kiew) Kiew, *stat. nov.

Basionym: *Chionanthus elaeocarpus* (Stapf) Kiew var. *globosus* Kiew, Malay. For. 43 (1980) 374, *ibid.* 44 (1981) 150. **Type:** *Chai S 35338*, Borneo, Sarawak, Kelabit Highlands (holotype SAR; isotype K).

Notes. *Chionanthus globosus*, previously treated as a variety of *C. elaeocarpus* (Stapf) Kiew (= a synonym of *C. macrocarpus* Blume), is here raised to species level. While the flowers of *C. macrocarpus* and *C. globosus* are similar, these two taxa are distinct not only in fruit shape but also in constant differences in leaf characters. Although leaves of both species are obovate, those of *C. globosus* are much thicker, have longer petioles, the laminas are four to five times longer than the petiole, are smaller and are only twice as long as wide and have fewer pairs of lateral veins, and those of *C. macrocarpus* are less coriaceous, have a shorter petiole, the laminas are ten times longer than the petiole, are larger and three times longer than wide and have more pairs of lateral veins.

Specimens examined: BORNEO, SABAH—Sipitang district, G. Lumaku, *Wood SAN 16715* (K, KEP, SING), Ulu Menggalong, *Wood SAN 16745* (SING). SARAWAK—Belaga district, Bakun river, *Zainuddin et al. AZ 5616* (KEP); Simunjan district, Ulu Sg. Sabal Aping, *Ilias S 38588* (K); Kelabit Highlands, *Chai S 35338* (K, SAR); Marudi district, Baram, Ulu Tinjar, *Chai S 34818* (K, KEP, SAR); Lawas district, *Anderson S 26013* (K, SING), *Ilias S 26013* (SAR); Kapit district, *Ilias S 41049* (K); Limbang district, *Wright & Othman S 32225* (K, KEP, SAR, SING); Upper Pieran, *Pickles S 3592* (SING). KALIMANTAN—W Kutei, Mt Kemoel, *Endert 3134* (K), *Endert 3634* (K), *Endert 4308* (K), and *Endert 4436* (K).

Chionanthus kinabaluensis* Kiew, *sp. nov.

A speciebuis borneensibus ceteris in nervatura tertiaria infra conspicue reticulata differt. Typus: *Clemens 29348-30229* (p.0189 *Oleaceae*), Borneo, Sabah, G. Kinabalu, Tenompok (holotypus SING; isotypus SING).

Notes. The label gives the number as between 29348 and 30229 and the date as April 20 1932 with a handwritten number “p.0189 *Oleaceae*”. There are two sheets at SING. One, chosen as the holotype, has immature unexpanded inflorescences with minute buds (field notes state that they are cream) and both have fruits. As yet, this species is known only from the type specimen. The leaves of this species are extremely distinctive in that the reticulation of the intercostal

veins on the lower surface, although almost plane with the lamina surface, is conspicuous as the reticulation is darker than the lamina surface.

Chionanthus leopoldi* Kiew, *sp. nov.

Chionantho pachyphylla in foliorum venis paucioribus, inflorescentiis ramis inferioribus brevioribus differt. **Typus:** Leopold & Taha SAN 83546, Borneo, Sabah, Labuk Sugut district, Mile 87.5 Telupid Road (holotypus SAN; isotypi K, KEP, L, SAR, SING).

Notes. *Chionanthus leopoldi* is closest to *C. pachyphyllus* in its large coriaceous leaves, inflorescence type and globose fruits. However, it is readily told apart by its lamina which has fewer lateral veins (7–8 pairs) that are plane with the upper surface (in *C. pachyphyllus* there are 8–14 pairs and they are deeply impressed above), by its more slender twigs (those of *C. pachyphyllus* are stout and have conspicuous horseshoe-shaped leaf scars), and by the shorter (1–1.25 cm long) lowest branch of the inflorescence (c. 3 cm long in *C. pachyphyllus*). Furthermore, *C. leopoldi* has been collected from lower altitudes than *C. pachyphyllus*, which is more widespread (Sabah, Sarawak and Kalimantan) and is recorded from hill and lower montane forest between 820–1350 m altitude. Much of the forest in Telupid area, such as Bt. Tingkar, is on ultramafic soil, but it is not known if this species is part of the ultramafic flora as herbarium labels do not record soil type. This distinctive species is named after Leopold Madani, who twice collected specimens of this species, in recognition of the invaluable assistance he has given many botanists in identifying plants from Sabah.

Specimens examined: BORNEO, SABAH—Labuk Sugut district, Telupid, Leopold & Taha SAN 83544 (SAN), Leopold & Taha SAN 83546 (K, KEP, L, SAN, SAR, SING), Aban & Rahim SAN 93967 (K, L, SAN, SING), Majawat et al. SAN 125946 (K, KEP, SAN, SING); Kinabatangan district, Tongod, Bt. Tingkar, Leopold SAN 133958 (KEP, SAN, SING); Crocker Range, Nordin SAN 85682 (KEP, SAN, SAR, SING).

Chionanthus plurifloroides* Kiew, *sp. nov.

A Chionantho pluriflora inflorescentiis brevibus racemosis, fructibus laevibus globosis recedit. **Typus:** Kulip & Goh SAN 137038, Borneo, Sabah, Kinabatangan district, Tongod, G. Tingkar Waterfall (holotypus SAN; isotypus KEP).

Notes. The foliage of this new species is closely similar to that of *C. pluriflorus* in shape, size and in drying chestnut-brown with the veins darker on the lower surface. It is, however, clearly distinct from this species in the inflorescences and fruits, because *C. pluriflorus* has much branched panicles and its fruits are large and ellipsoid with a verrucose surface.

Specimens examined: BORNEO, SABAH—Sipitang district, Ulu Mendulong, Wood 16828 (SING); Penampang district, Km 63 Kota Kinabalu-Tambunan Road, Amin et al. SAN 66094 (SAN); Tawau district, St. Lucia, Kadir A 2004 (SING); Sandakan district, Elmer 20332 (BRIT, SING), Taloon SAN 10788 (SING); Labuk Sugut district, Sapi FR, Leopold & Kodoh SAN 81412 (SAN), Segalind Lokan FR, Majawat SAN 124515 (SAN); Kinabatangan district, Tongod, G. Tingkar Waterfall, Kulip & Goh SAN 137078 (KEP, SAN). SARAWAK—Sri Aman district, G.

Lesong, *Lee S 43242* (SAN, SAR). KALIMANTAN—E Kutei, G. Tepian Lobang, *Kostermans 5321* (SING).

Chionanthus polygamus (Roxb.) Kiew, *comb. nov.*

Basionym: *Samara polygama* Roxb., Fl. Ind. 1 (1820) 435, *ibid.* 2nd. edition 1 (1932) 414. **Type:** *Roxburgh 2603*, Maluku (BM). **Synonyms:** *Ardisia polygama* (Roxb.) A.DC, Prod. 8 (1844) 138; *Linociera polygama* (Roxb.) S.Moore, J. Bot. (London) 51 (1913) 216; *Chionanthus laxiflorus* Blume, Mus. Bot. Lugd. Bat. 1 (1850) 319. **Type:** *Korthals s.n.* (= *RHL Sheet No. 908158835*), Borneo, Kalimantan, Martapura (holotype L; isotype K), *syn. nov.*; *Linociera oxycarpa* Lingelsh., Bot. Jahrb. 61 (1927) 10. **Lectotype:** *Ledermann 9705*, New Guinea (L).

Notes. Moore (1913) located a Roxburgh specimen from the Moluccas at BM annotated by Roxburgh as *Samara polygama* (Myrsinaceae) and concluded that it in fact belonged to *Linociera* (Oleaceae), a genus now combined with *Chionanthus*, on account of it having opposite leaves and a cymose inflorescence. Roxburgh had described the flowers as having a tetramerous calyx and corolla and stamens with “filaments short, and inserted in a notch near the edge of the base of the petals”. Moore dissected one of the two remaining flowers to find four stamens and an “apparently rudimentary” ovary. Polygamy is very unusual among Malesian *Chionanthus*, only two species, *C. laxiflorus* and *C. macrobotrys*, being known. Examination of the type of *L. polygama* (which is now bereft of inflorescences and its two flowers) shows that it is the same as *C. laxiflorus* in its dark grey-green leaves with 12 pairs of veins and attenuated apex with a rounded tip. (It would not be mistaken for *C. macrobotrys*, which has thickly coriaceous leaves with recurved margins, fewer lateral veins and the apex is shortly acuminate). There is therefore no doubt that *C. laxiflorus* is the same as Roxburgh’s *Samara polygama*. *Chionanthus polygamus* has a wide geographic distribution and shows some variation between populations as regards the stamens. In Sumatra, some specimens have male flowers with four stamens, elsewhere they have two. In New Guinea, the species is effectively unisexual as the bisexual flowers produce staminodes (the anther sacs do not develop). In Borneo, the male flowers and bisexual flowers have two stamens but those of the bisexual flower are smaller. After *C. ramiflorus*, *C. polygamus* is the most common species in Malesia and occurs in Sumatra, Peninsular Malaysia, Borneo, Sulawesi, Maluku and New Guinea.

Chionanthus sabahensis Kiew, *sp. nov.*

A Chionantho pluriflora in foliis angustioribus, fructibus laevibus globosis recedit. **Typus:** *Carr SFN 27170*, Borneo, Sabah, G. Kinabalu, Ulu Kinunut (holotypus SING).

Notes. Leaves of *C. sabahensis* rather resemble those of *C. pluriflorus* in their length, texture and in drying brown but they are different in that they are more than three times longer than wide (about twice as long as wide in *C. pluriflorus*) and the lateral veins drying concolorous with the leaf blade on the lower surface (in *C. pluriflorus* they are darker brown). In addition, the inflorescence has only first order branching compared with second order branching in *C. pluriflorus*, and the globose, smooth fruits with short stalks are very different from the ellipsoid, verrucose fruits with stalks *c.* 7 mm long of *C. pluriflorus*.

Specimens examined: BORNEO, SABAH, Crocker Range, *Beaman et al. 10447* (K); G. Kinabalu, *Clemens 27568* (BM, K, L), *Clemens 28847* (BM), *Clemens 31588* (K), *Price 218* (K), Ulu Kinunut, *Carr SFN 27170* (SING); G. Trusmadi, *Mikil SAN 41890* (K, SAN).

SAPOTACEAE

Madhuca engleri (Merr.) Vink, *comb. nov.*

Basionym: *Payena beccarii* Engl., Bot. Jahrb. Syst. 12 (1890), *nom. illeg., non Payena beccarii* Pierre, Bull. Mens. Soc. Linn., Paris (1885) 525; *Payena engleri* Merr., *nom. nov.*, J. As. Soc. Str. Br., Spec. No. (1921) 477. **Type:** *Beccari PB 1598*, Borneo, Sarawak, Kuching (holotype FI; isotypes K, P). **Synonym:** *Madhuca beccarii* (Engl.) H.J.Lam, Bull. Jard. Bot. Buitenz. 3, 7 (1925) 177, P. Royen, Blume 10 (1960) 52.

ABBREVIATIONS OF FREQUENTLY CITED REFERENCES

Anderson, J.A.R. 1980. A Checklist of the Trees of Sarawak. Forest Dept., Sarawak. CLTS

Argent, G., A. Saridan, E.J.F. Campbell, P. Wilkie, G. Fairweather, J.T. Hadiah, D.J. Middleton, C. Pendry, M. Pinard, M. Warwick & K.S. Yulita (eds.). 1997. Manual of the Larger and More Important Non-dipterocarp Trees of Central Kalimantan, Indonesia, Volumes 1 & 2. Forest Research Institute, Samarinda, Indonesia.
MNDT-CK

Ashton, P.S. 1988. Manual of the Non-Dipterocarp Trees of Sarawak. Dewan Bahasa & Pustaka, Sarawak Branch, Sarawak.
MNDTS

Backer, C.A. & R.C. Bakhuizen v.d. Brink, Jr. 1964, 1965, 1968. Flora of Java. Volumes 1–3. Noordhoff, Groningen, the Netherlands.
FJ

Beaman, J.H., Chr. Anderson & R.S. Beaman. 2001. The Plants of Mount Kinabalu 4. Dicotyledon Families: Acanthaceae to Lythraceae. Natural History Publications (Borneo) & the Royal Botanic Gardens, Kew.
PMK

Browne, F.G. 1955. Forest of Sarawak and Brunei. Govt. Press, Sarawak.
FTSB

Burgess, P.F. 1966. Timbers of Sabah. Sabah Forest Records No. 6. Forest Dept., Sabah.
TBS

Burkill, I.H. 1966. A Dictionary of the Economic Products of the Malay Peninsula. Kuala Lumpur.
EPMP

Cockburn, P.F. 1976 & 1980. Trees of Sabah, Sabah Forest Records No. 10, Vols. 1 & 2. Forest Dept., Sabah.
TS

Coode, M.J.E., J. Dransfield, L.L. Forman, D.W. Kirkup & Idris M. Said (eds.). 1996. A Checklist of the Flowering Plants and Gymnosperms of Brunei Darussalam. Forestry Department, Ministry of Industry and Primary Resources, Brunei Darussalam and Royal Botanic Gardens, Kew.
CLBD

Corner, E.J.H. 1988. Wayside Trees of Malaya, 3rd editions, Vols. 1 & 2. Malayan Nature Society, Kuala Lumpur.
WSTM

- Flora Malesiana.** Foundation Flora Malesiana. Leiden, the Netherlands.
FM
- Kessler, P. & K. Sidiyasa.** 1994. Trees of the Balikpapan-Samarinda Area, East Kalimantan, Indonesia. Tropenboss Series 7. The Tropenboss Foundation, Wageningen, the Netherlands.
TBSA-EK
- Keith, H.G.** 1937. The Timbers of North Borneo. Govt. Col. N. Borneo, Sandakan.
TNB
- Keng, H.** 1969. Orders and Families of Malayan Seed Plants. University of Malaya Press, Kuala Lumpur.
OFMSP
- Kochummen, K.M.** 1997. Tree Flora of Pasoh Forest. Malayan Forest Records No. 44, FRIM, Malaysia.
TFPF
- Mabberley, D.J.** 1987. The Plant Book. Cambridge University Press, Cambridge.
PB
- Masamune, G.** 1942. *Enumeratio Phanerogamarum Bornearum*. Taihoku.
EPB
- Merrill, E.D.** 1921. A Bibliographic Enumeration of Bornean Plants. J. Str. Br. Roy. As. Soc., Sp. No.
EB
- Merrill, E.D.** 1929. *Plantae Elmerianae Borneenses*. University of California Publications in Botany, Vol. 15. University of California Press, Berkeley.
PEB
- Ng, F.S.P.** (ed.). 1978 & 1989. Tree Flora of Malaya, Vol. 3 & 4. Longman, Malaysia.
TFM
- Ng, F.S.P.** 1991 & 1992. Manual of Forest Fruits, Seeds and Seedlings. Malaysian Forest Records, No. 34. Vols. 1 & 2. FRIM, Malaysia.
MFSS
- Perry, L.M.** 1980. Medicinal Plants of East and Southeast Asia. Cambridge.
MPESA
- Plant Resources of South East Asia.** 1989–2001. Wageningen. (Various authors and volumes).
PROSEA (to be listed without editor or author names, but to include volume and page numbers).
- Ridley, H.N.** 1923–1925. The Flora of the Malay Peninsula, Vols. 1–5. Reeves, London.
FMP

- Smythies, B.E.** 1965. Common Sarawak Trees. Borneo Literature Bureau, Sarawak.
CST
- Soepadmo, E. & K.M. Wong** (eds.). 1995. Tree Flora of Sabah and Sarawak, Vol. 1. FRIM, FD Sabah and FD Sarawak, Kuala Lumpur.
TFSS 1
- Soepadmo, E., K.M. Wong & L.G. Saw** (eds.). 1996. Tree Flora of Sabah and Sarawak, Vol. 2. FRIM, FD Sabah and FD Sarawak, Kuala Lumpur.
TFSS 2
- Soepadmo, E. & L.G. Saw** (eds.). 2000. Tree Flora of Sabah and Sarawak, Vol. 3. FRIM, FD Sabah and FD Sarawak, Kuala Lumpur.
TFSS 3
- Soepadmo, E., L.G. Saw & R.C.K. Chung** (eds.). 2002. Tree Flora of Sabah and Sarawak, Vol. 4. FRIM, FD Sabah and FD Sarawak, Kuala Lumpur.
TFSS 4
- Staff, O.** 1894. On the Flora of Mount Kinabalu, in North Borneo. Transactions of the Linnean Society, London, Ser. 2, 4, pp. 69–263.
FMK
- Whitmore, T.C.** (ed.). 1972 & 1973. Tree Flora of Malaya, Vols. 1 & 2. Longman, Malaysia.
TFM
- Whitmore, T.C. & I.G.M. Tantra.** 1986. Tree Flora of Indonesia. Check List for Sumatra. Forest Research & Development Centre, Bogor.
CLS
- Whitmore, T.C., I.G.M. Tantra & U. Sutisna.** 1990. Tree Flora of Indonesia. Check List for Kalimantan, Part 1 & Parts 2.1–2.2. Forest Research & Development Centre, Bogor.
CLK
- Willis, J.C.** 1973. A Dictionary of the Flowering Plants & Ferns, revised by H.K. Airy Shaw. Cambridge University Press, Cambridge.
DFPF
- Wong, T.M.** 1982. A Dictionary of Malaysian Timbers. Malayan Forest Records No. 30. Forest Research Institute, Kepong, Kuala Lumpur.
DMT

COMMONLY USED ABBREVIATIONS FOR LOCALITIES

English		Malay	
Word	Abbreviation	Word	Abbreviation
Central	C	Bukit	Bt.
Division	Div.	Gunung	G .
East	E	Kampung	Kg.
Forest Reserve	FR	Sungai	Sg.
Island	Is.	Tanjung	Tg.
Mount	Mt.		
National Park	NP		
North-East	NE		
North-West	NW		
River	R .		
South	S		
South-West	SE		
South-West	SW		
West	W		

INDEX TO SCIENTIFIC NAMES

Names in italics here refer to either basionyms or synonyms; family names given in upper case are those of families revised in this volume. Pages where descriptions of families, genera and species are given are printed in bolds, and pages with illustrations are listed in bolds and italics.

A

Abdulmajidia	111
<i>Achras obovata</i>	340
<i>Achras zapota</i>	206
<i>Aesandra</i>	213
<i>Agasta asiatica</i>	108
<i>Alseodaphne crassipes</i>	174
Anacardiaceae	109
<i>Apoia</i>	343
<i>Apoia macrocarpa</i>	344
AQUIFOLIACEAE	1 , 33
<i>Ardisia polygama</i>	151, 350
Argania	343
Artocarpus	191
Aulandra	203, 206 , 207
<i>Aulandra beccarii</i>	207
<i>Aulandra cauliflora</i>	208
<i>Aulandra longifolia</i>	207, 208 , 209
<i>Azaola</i>	221
<i>Azaola leerii</i>	325

B

Barringtonia	102 , 103, 111, 125
Barringtonia sect. Barringtonia	103
Barringtonia sect. Stravadium	103
<i>Barringtonia acutangula</i>	106 , 107, 115
<i>Barringtonia acutangula</i> subsp. <i>acutangula</i>	105, 106 , 107
<i>Barringtonia acutangula</i> subsp. <i>spicata</i>	107
<i>Barringtonia anacardifolia</i>	122
<i>Barringtonia ashtonii</i>	104, 105, 107
<i>Barringtonia asiatica</i>	104, 108
<i>Barringtonia baramensis</i>	111
<i>Barringtonia belagaensis</i>	125
<i>Barringtonia conoidea</i>	104, 108
<i>Barringtonia curranii</i>	104, 105, 109
<i>Barringtonia dolichobotrys</i>	122
<i>Barringtonia dolichophylla</i>	122
<i>Barringtonia elongata</i>	117
<i>Barringtonia filirachis</i>	121

<i>Barringtonia flagellata</i>	120
<i>Barringtonia gigantostachya</i>	110
<i>Barringtonia gigantostachya</i> var. <i>gigantostachya</i>	110, 111
<i>Barringtonia gigantostachya</i> var. <i>megistophylla</i>	104, 110
<i>Barringtonia gitingensis</i>	119
<i>Barringtonia hallieri</i>	102, 103, 104, 111
<i>Barringtonia havilandii</i>	106, 111
<i>Barringtonia insignis</i>	115
<i>Barringtonia lanceolata</i>	105, 112, 113
<i>Barringtonia longisepala</i>	105, 114
<i>Barringtonia macrocarpa</i>	104, 114
<i>Barringtonia macrostachya</i>	105, 115
<i>Barringtonia martensii</i>	106
<i>Barringtonia megistophylla</i>	110
<i>Barringtonia micrantha</i>	106
<i>Barringtonia musiformis</i>	116
<i>Barringtonia pedicellata</i>	106
<i>Barringtonia pendula</i>	104, 105, 116
<i>Barringtonia pseudoglomerata</i>	112
<i>Barringtonia pterita</i>	105, 106, 117
<i>Barringtonia racemosa</i>	104, 105, 106, 117, 118
<i>Barringtonia reticulata</i>	104, 119
<i>Barringtonia revoluta</i>	105, 120
<i>Barringtonia rhodochlamys</i>	109
<i>Barringtonia sarawakensis</i>	105, 121
<i>Barringtonia sarcostachys</i>	104, 122, 123
<i>Barringtonia sascostachys</i> f. <i>dolichophylla</i>	122
<i>Barringtonia scortechinii</i>	104, 105, 122
<i>Barringtonia speciosa</i>	108
<i>Barringtonia spicata</i>	106
<i>Barringtonia sumatrana</i>	115, 119
<i>Barringtonia timorensis</i>	117
<i>Bassia</i>	221
<i>Bassia</i> sect. <i>Apobassia</i>	271
<i>Bassia argentea</i>	263
<i>Bassia braceana</i>	243
<i>Bassia burckiana</i>	229
<i>Bassia cagayanensis</i>	229
<i>Bassia crassipes</i>	231
<i>Bassia curtisii</i>	233
<i>Bassia erythrophylla</i>	239
<i>Bassia hirtiflora</i>	242
<i>Bassia kingiana</i>	242
<i>Bassia korthalsii</i>	243
<i>Bassia malaccensis</i>	245
<i>Bassia mindanaensis</i>	248
<i>Bassia monticola</i>	249
<i>Bassia motleyana</i>	250

<i>Bassia oblongifolia</i>	252
<i>Bassia pallida</i>	256
<i>Bassia perakensis</i>	233
<i>Bassia sericea</i>	263, 315
<i>Bassia watsoni</i>	305
<i>Bassia wightiana</i>	220
<i>Beccariella firma</i>	332
<i>Bracea</i>	343
<i>Bracea paniculata</i>	344
Breynia	67
<i>Bureavella maclayana</i>	336
<i>Butonica</i>	102
<i>Butonica asiatica</i>	108
<i>Butonica racemosa</i>	117
Buxus	47

C

Careya	125
<i>Careya lanceolata</i>	112
<i>Careya macrostachya</i>	115
<i>Careya pendula</i>	116
<i>Careya</i> sect. <i>Barringtoniopsis</i>	102
Celastraceae	10, 33
<i>Ceratophorus</i>	312
Chionanthus	129, 130, 131 , 132, 347, 350
<i>Chionanthus balgooyiana</i>	131, 134, 135 , 136 , 347
<i>Chionanthus callophyloides</i>	132, 135 , 347
<i>Chionanthus callophyllus</i>	132, 135, 137 , 347, 348
<i>Chionanthus cordulatus</i>	132, 138
<i>Chionanthus crispus</i>	133, 138
<i>Chionanthus curvicarpus</i>	132, 139
<i>Chionanthus cuspidatus</i>	139
<i>Chionanthus elaeocarpus</i>	145, 348
<i>Chionanthus elaeocarpus</i> var. <i>globosus</i>	141, 145, 348
<i>Chionanthus enerve</i>	134
<i>Chionanthus evenius</i>	133, 140
<i>Chionanthus globosus</i>	133, 141 , 348
<i>Chionanthus havilandii</i>	133, 142
<i>Chionanthus insignis</i>	145
<i>Chionanthus kinabaluensis</i>	133, 142 , 348
<i>Chionanthus laxiflorus</i>	13, 151, 350
<i>Chionanthus leopoldi</i>	133, 143 , 144 , 349
<i>Chionanthus longipetalus</i>	132 , 158, 159
<i>Chionanthus lucens</i>	133, 134, 143
<i>Chionanthus macrobotrys</i>	130, 131, 134 , 350
<i>Chionanthus macrocarpus</i>	134, 145 , 348
<i>Chionanthus oliganthus</i>	157
<i>Chionanthus pachyphyllus</i>	133, 146 , 349

Chionanthus palustris	133, 147
<i>Chionanthus platycarpus</i>	137
Chionanthus plurifloroides	135, 147 , 349
Chionanthus pluriflorus	134, 148 , 149 , 349, 350, 351
Chionanthus polycephalus	133, 150
Chionanthus polygamus	131, 134, 151 , 152 , 156, 350
Chionanthus porcatus	134, 153 , 154
Chionanthus pubicalyx	135, 155
Chionanthus ramiflorus	13, 131, 133, 134, 155 , 350
Chionanthus rugosus	133, 156 , 347
Chionanthus sabahensis	135, 157 , 350
Chionanthus spicatus	132, 157
Chionanthus sp. 1	158
Chionanthus sp. 2	158
Chionanthus sp. 3	159
Chrysophyllum	203, 205, 208 , 210
Chrysophyllum cainito	204, 210
<i>Chrysophyllum curtisii</i>	334
<i>Chrysophyllum firmum</i>	332
<i>Chrysophyllum lanceolatum</i>	211
Chrysophyllum roxburghii	210, 211 , 212
Chydenanthus	125
Cissus	11
Cleistanthus nitidus	33
Clethra	6
Clethraceae	6
<i>Commersona speciosa</i>	108
Convolvulaceae	10
<i>Croixia</i>	271
<i>Croixia beccariana</i>	278
<i>Croixia calophylla</i>	278
<i>Croixia crassipes</i>	231
<i>Croixia gutta</i>	288
<i>Croixia hexandra</i>	289
<i>Croixia hispida</i>	290
<i>Croixia majas</i>	294
<i>Croixia ottolanderi</i>	296
<i>Croixia pseudocuneata</i>	297
<i>Croixia pseudorostrata</i>	298
<i>Croixia quercifolia</i>	299
<i>Croixia rostrata</i>	302
<i>Croixia tenuipetiolata</i>	309
<i>Croixia xanthochyma</i>	311
Cryptocarya	284
D	
Dacrydium-Casuarina	25, 283
<i>Dasyaulus malaccensis</i>	245

Derris	31
Derris elliptica	31
<i>Dichopsis</i>	271
<i>Dichopsis argentata</i>	299
<i>Dichopsis calophylla</i>	278
<i>Dichopsis gutta</i>	288
<i>Dichopsis hexandra</i>	289
<i>Dichopsis maingayi</i>	293
<i>Dichopsis obovata</i>	296
? <i>Dichopsis rubens</i>	311
Diospyros	29, 30, 31, 32, 33, 57, 87
Diospyros alatella	39, 46
Diospyros andamanica	33, 37, 40 , 59, 71
Diospyros areolata	39, 41 , 42, 47, 68 , 88
Diospyros argentea	31, 42, 44
<i>Diospyros asterocalyx</i>	87
<i>Diospyros atra</i>	63
<i>Diospyros bangueyensis</i>	67
<i>Diospyros bantamensis</i>	41, 88
<i>Diospyros beccarii</i>	42, 54, 87, 94
Diospyros beccarioides	35, 42, 43 , 95
<i>Diospyros bintuluensis</i>	98
Diospyros blancoi	31, 32, 34, 36, 42 , 44
Diospyros borneensis	32, 35, 44
<i>Diospyros</i> cf. <i>borneensis</i>	44
Diospyros brainiana	35, 45, 46 , 94
Diospyros brittano-borneensis	39, 42, 47 , 51
Diospyros buxifolia	34, 47, 48, 79, 80
<i>Diospyros</i> cf. <i>buxifolia</i>	47
<i>Diospyros carpinifolia</i>	40
Diospyros cauliflora	37, 48
<i>Diospyros celebica</i>	42, 44
Diospyros clavigera	79
<i>Diospyros clavipes</i>	92
Diospyros clementium	33, 49 , 50
Diospyros confertiflora	33, 49 , 50, 98
<i>Diospyros confusa</i>	93
<i>Diospyros consanguinea</i>	72
Diospyros cordata	36, 50
Diospyros coriacea	38, 43 , 47, 51
<i>Diospyros crassipes</i>	72, 73
Diospyros crockerensis	36, 51, 53
<i>Diospyros cubica</i>	83, 84
Diospyros curranii	38, 52
Diospyros curranii var. <i>curranii</i>	52
Diospyros curranii var. <i>kalimantanensis</i>	52
<i>Diospyros curraniopsis</i>	52
<i>Diospyros cylindrocarpa</i>	63

<i>Diospyros daemona</i>	31, 32, 36, 42, 54 , 74
<i>Diospyros dajakensis</i>	88
<i>Diospyros densa</i>	36, 54 , 55, 65
<i>Diospyros dictyoneura</i>	38, 43 , 55
<i>Diospyros diepenhorstii</i>	29, 31, 32, 35, 55
<i>Diospyros digyna</i>	31, 32
<i>Diospyros discocalyx</i>	35, 56 , 69
<i>Diospyros discolor</i>	42
<i>Diospyros durionoides</i>	42, 44
<i>Diospyros ebenaster</i>	31
<i>Diospyros elegantissima</i>	47, 48
<i>Diospyros elliptifolia</i>	32, 36, 43 , 57 , 59, 95
<i>Diospyros</i> cf. <i>elliptifolia</i>	57
<i>Diospyros elliptifolia</i> forma <i>kinabaluensis</i>	57
<i>Diospyros elmeri</i>	84
<i>Diospyros endertii</i>	76
<i>Diospyros eriantha</i>	35, 53 , 58
<i>Diospyros eucalyptifolia</i>	35, 41, 58 , 59, 71
<i>Diospyros euphlebia</i>	35, 53 , 59
<i>Diospyros evena</i>	33, 59 , 76, 80 , 87
<i>Diospyros everettii</i>	36, 51, 60 , 78
<i>Diospyros fasciculiflora</i>	48
<i>Diospyros fasciculiflora</i> var. <i>pubinervia</i>	48
<i>Diospyros ferox</i>	36, 53 , 60
<i>Diospyros ferrea</i>	32, 37, 61
<i>Diospyros ferruginescens</i>	38, 50, 62 , 71
<i>Diospyros ferruginescens</i> var. <i>ferruginescens</i>	62
<i>Diospyros ferruginescens</i> var. <i>rufotomentosa</i>	62
<i>Diospyros foveo-reticulata</i>	95
<i>Diospyros foxworthyi</i>	35, 46 , 63
<i>Diospyros frutescens</i>	38, 63 , 85
<i>Diospyros fuliginea</i>	81
<i>Diospyros fusiformis</i>	37, 53 , 64 , 79
<i>Diospyros graciliflora</i>	34, 48, 55, 65 , 79, 80 , 92
<i>Diospyros hallieri</i>	38, 46 , 65 , 66, 88
<i>Diospyros havilandii</i>	34, 66 , 80
<i>Diospyros helferi</i>	83
<i>Diospyros hermaphroditica</i>	98
<i>Diospyros hermaphroditica</i> var. <i>olivacea</i>	99
<i>Diospyros hierniana</i>	33
<i>Diospyros insidiosa</i>	31, 32, 54
<i>Diospyros ismailii</i>	32
<i>Diospyros jaherii</i>	93
<i>Diospyros kajangensis</i>	93
<i>Diospyros kaki</i>	31, 32
<i>Diospyros keningauensis</i>	35, 67 , 68
<i>Diospyros kinabaluensis</i>	57
<i>Diospyros korthalsiana</i>	39, 57, 67 , 74

<i>Diospyros korthalsiana</i> var. <i>kinabaluensis</i>	69
<i>Diospyros korthalsiana</i> var. <i>korthalsiana</i>	69
<i>Diospyros korthalsiana</i> var. <i>macrocarpa</i>	69
<i>Diospyros korthalsiana</i> var. <i>mirandae</i>	69
<i>Diospyros kurzii</i>	37, 50, 69 , 70, 98
<i>Diospyros lanceifolia</i>	32, 34, 38, 70 , 76, 92
<i>Diospyros lanceifolia</i> forma <i>consanguinea</i>	72
<i>Diospyros lanceifolia</i> forma <i>typica</i>	71
<i>Diospyros lanceifolia</i> var. <i>consanguinea</i>	71 , 72
<i>Diospyros lanceifolia</i> var. <i>iliaspaiei</i>	34, 72
<i>Diospyros lanceifolia</i> var. <i>lanceifolia</i>	71 , 72
<i>Diospyros lanceifolia</i> var. <i>renageorgei</i>	71
<i>Diospyros lanceifolia</i> var. <i>saliciformis</i>	41, 59, 70 , 71
<i>Diospyros lateralis</i>	35, 72 , 74
<i>Diospyros levigata</i>	63
<i>Diospyros longepedunculata</i>	40
<i>Diospyros lotus</i>	30, 31
<i>Diospyros lotus</i> subsp. <i>brideliifolia</i>	31
<i>Diospyros lunduensis</i>	36, 73 , 74
<i>Diospyros macrophylla</i>	31, 39, 46 , 73 , 75
<i>Diospyros maingayi</i>	30, 33, 60, 75 , 87
<i>Diospyros malam</i>	41
<i>Diospyros malayana</i>	40
<i>Diospyros maritima</i>	36, 71, 76
<i>Diospyros melanoxylon</i>	32
<i>Diospyros micromera</i>	33
<i>Diospyros mindanaensis</i>	33, 39, 76
<i>Diospyros mindanaensis</i> vel. aff.	76
<i>Diospyros</i> aff. <i>mindaenaensis</i>	76
<i>Diospyros monticola</i>	94, 95
<i>Diospyros muricata</i>	36, 59, 60, 77, 78, 80
<i>Diospyros myrmecocalyx</i>	67
<i>Diospyros neurosepala</i>	35, 43 , 45, 78
<i>Diospyros nidus-avis</i>	84
<i>Diospyros oligantha</i>	37, 78 , 79, 80 , 91, 93
<i>Diospyros olivacea</i>	99
<i>Diospyros pachycalyx</i>	73
<i>Diospyros parabuxifolia</i>	34, 48, 79 , 80
<i>Diospyros paraoesi</i>	90
<i>Diospyros pendula</i>	34, 81
<i>Diospyros penibukanensis</i>	35, 36, 81
<i>Diospyros penibukanensis</i> var. <i>penibukanensis</i>	82
<i>Diospyros penibukanensis</i> var. <i>scalarinervis</i>	82
<i>Diospyros perfida</i>	31, 32, 37, 38, 66, 82 , 83
<i>Diospyros pergamena</i>	48
<i>Diospyros pilosanthera</i>	33, 38, 39, 75, 83
<i>Diospyros pilosanthera</i> var. <i>elmeri</i>	43 , 84
<i>Diospyros pilosanthera</i> var. <i>pilosanthera</i>	82, 84

Diospyros piscicarpa	31, 38, 43 , 64, 85
Diospyros plectosepala	37, 80 , 86
<i>Diospyros plicata</i>	83
<i>Diospyros poiensis</i>	86
<i>Diospyros polyalthioides</i>	83
<i>Diospyros polyalthioides</i> var. <i>polyalthioides</i>	83
<i>Diospyros pseudomalabarica</i>	41
<i>Diospyros pulchrinervia</i>	99, 100
Diospyros puncticulosa	33, 60, 76, 80 , 86
Diospyros pyrhocarpa	31, 39, 87 , 96
Diospyros retrofracta	69
Diospyros ridleyi	39, 42, 46 , 87
Diospyros rigida	38, 43 , 77, 88
<i>Diospyros rotundiflora</i>	98
Diospyros roxburghii	31
Diospyros rufa	39, 89
<i>Diospyros sarawakana</i>	92
<i>Diospyros setosa</i>	86
Diospyros siamang	35, 46 , 89
Diospyros simaloerensis	37, 79, 80 , 89, 90
Diospyros singaporensis	34, 90, 91
<i>Diospyros sororia</i>	9, 33, 100
Diospyros squamaefolia	34, 48, 65, 80 , 91 , 92
Diospyros styraciformis	31, 32, 39, 46 , 92
<i>Diospyros styraciformis</i> var. <i>sarawakana</i>	92
Diospyros subrhomboidea	37, 79, 80 , 91, 93
<i>Diospyros subrigida</i>	88
Diospyros subtruncata	36, 93
Diospyros sulcata	39, 40, 45, 94
<i>Diospyros suluensis</i>	73
Diospyros sumatrana	33, 37, 42, 54, 94 , 97
<i>Diospyros sumatrana</i> var. <i>decipiens</i>	95
<i>Diospyros sumatrana</i> var. <i>flavicans</i>	95
<i>Diospyros swingleri</i>	89
<i>Diospyros tahanensis</i>	40, 41
<i>Diospyros tawaensis</i>	44
Diospyros toposia	37, 38, 95 , 96
Diospyros toposia var. <i>toposia</i>	96
Diospyros toposia var. <i>toposoides</i>	96
<i>Diospyros toposioides</i>	96
Diospyros tuberculata	37, 43 , 64, 95, 96 , 97
Diospyros ulo	36, 97
Diospyros venosa	37, 50, 70, 98
Diospyros venosa var. <i>olivacea</i>	99
Diospyros venosa var. <i>venosa</i>	99
Diospyros virginiana	31
Diospyros wallichii	31, 32, 38, 46 , 99
Diploknema	203, 205, 211

Diploknema sebifera	213, 214
<i>Diploon</i>	343
Diplycosia heterophylla var. latifolia	24
Dipterocarpaceae	31
Dipterocarpus	32
<i>Discocalyx macrocarpa</i>	344
<i>Doxomma macrostachyum</i>	115
<i>Doxomma pendula</i>	116
<i>Doxomma sarcostachys</i>	122
<i>Doxomma sumatrana</i>	115
Drypetes	13

E

EBENACEAE	10, 29, 102, 204
Ebenales	204
Eberhardtia	205, 215
Eberhardtia aurata	216, 217
<i>Ehretia ferrea</i>	61
Ericaceae	14, 24
Erycibe	10
Eucalyptus	58
Euclea	29
<i>Eugenia acutangula</i>	106
<i>Eugenia racemosa</i>	117
Euphorbiaceae	10, 13, 30, 33, 67

F

Fagaceae	299
<i>Finschia sumatrana</i>	173
Flacourtiaceae	10, 30
<i>Fontbrunea malaccensis</i>	338

G

<i>Galactoxylon</i>	271
<i>Ganua</i>	221, 222
<i>Ganua attenuata</i>	230
<i>Ganua beccarii</i>	244
<i>Ganua chrysocarpa</i>	233
<i>Ganua coriacea</i>	228
<i>Ganua curtisii</i>	233
<i>Ganua daemonica</i>	234
<i>Ganua fusca</i>	239
<i>Ganua glaberrima</i>	242
<i>Ganua hirtiflora</i>	242
<i>Ganua kingiana</i>	243
<i>Ganua monticola</i>	249
<i>Ganua motleyana</i>	250
<i>Ganua palembanica</i>	254

<i>Ganua pallida</i>	256
<i>Ganua pierrei</i>	227
<i>Ganua prolixa</i>	257
<i>Ganua sarawahensis</i>	230
<i>Ganua sarawakensis</i>	230
<i>Ganua sessilis</i>	264
Glochidion	67
Gluta velutina	109
Grevillea banksii	169
Grevillea robusta	170
Grias	102
Gustavia	102

H

<i>Hapaloceras</i>	312
<i>Haploceras leerii</i>	325
Helicia	169, 170 , 171, 189, 190
Helicia sect. Cyanocarpus	171
Helicia sect. Helicia	171
Helicia sect. Macadamiopsis	171
<i>Helicia artocarpoides</i>	191
<i>Helicia attenuata</i>	172, 173 , 177, 180, 183
<i>Helicia bennettiana</i>	173
<i>Helicia brachyantha</i>	186
<i>Helicia castaneaefolia</i>	183
<i>Helicia cumingiana</i> var. <i>parvifolia</i>	183
<i>Helicia curtisii</i>	186
<i>Helicia erratica</i>	180, 182
<i>Helicia excelsa</i>	171, 173, 174
<i>Helicia fuscotomentosa</i>	172, 175 , 176
<i>Helicia javanica</i>	183
<i>Helicia kingiana</i>	173, 180
<i>Helicia lanceolata</i>	173
<i>Helicia mahmudii</i>	195
<i>Helicia maxwelliana</i>	172, 177 , 178
<i>Helicia oblanceolata</i>	174
<i>Helicia oblongifolia</i>	173
<i>Helicia obovata</i>	172, 177 , 179 , 183
<i>Helicia obscurinervis</i>	180
<i>Helicia oligophlebia</i>	183
<i>Helicia petiolaris</i>	171, 172, 180 , 181
<i>Helicia petiolaris</i> var. <i>kingiana</i>	180
<i>Helicia philippinensis</i>	183
<i>Helicia pterygota</i>	172, 182
<i>Helicia robusta</i>	171, 183
<i>Helicia robusta</i> var. <i>integrifolia</i>	183, 189
<i>Helicia robusta</i> var. <i>robusta</i>	183
<i>Helicia rufescens</i>	172, 184 , 185

<i>Helicia salicifolia</i>	174
<i>Helicia scortechinii</i>	186
<i>Helicia serrata</i>	171, 173, 186
<i>Helicia serrata</i> var. <i>oreophila</i>	186
<i>Helicia serrata</i> var. <i>serrata</i>	186
<i>Helicia sessilifolia</i>	172, 187 , 188
<i>Helicia</i> sp. A	172, 189
<i>Helicia suffruticosa</i>	173
<i>Helicia sumatrana</i>	173
<i>Helicia symplocoides</i>	172, 187
<i>Helicia travancorica</i>	183
<i>Helicia velutina</i>	199
<i>Heliciopsis</i>	169, 170, 189 , 190
<i>Heliciopsis artocarpoides</i>	191 , 192
<i>Heliciopsis litseifolia</i>	190, 193 , 194
<i>Heliciopsis mahmudii</i>	191, 195 , 196
<i>Heliciopsis montana</i>	190, 191, 195
<i>Heliciopsis percoriacea</i>	191, 197 , 198
<i>Heliciopsis rufidula</i>	190, 199
<i>Heliciopsis velutina</i>	191, 199 , 200
<i>Helittophyllum</i>	170
<i>Helittophyllum javanicum</i>	183
<i>Huttum acutangulum</i>	106
<i>Huttum racemosum</i>	117
<i>Huttum speciosum</i>	108

I

<i>Ilex</i>	1, 2
<i>Ilex apiensis</i>	3
<i>Ilex beccariana</i>	5, 9
<i>Ilex borneensis</i>	6, 9, 10, 33, 100
<i>Ilex celebensis</i>	3 , 10
<i>Ilex celebensis</i> var. <i>celebensis</i>	11
<i>Ilex celebensis</i> var. <i>ranauana</i>	10
<i>Ilex cissoidea</i>	4, 11
<i>Ilex clemensiae</i>	7
<i>Ilex clethriflora</i>	6
<i>Ilex confertifolia</i>	14
<i>Ilex cumingiana</i>	12
<i>Ilex cymosa</i>	3, 12 , 13
<i>Ilex cymosa</i> var. <i>cumingiana</i>	12
<i>Ilex decussata</i>	164
<i>Ilex fruticosa</i>	5
<i>Ilex glomerata</i>	6, 13
<i>Ilex griffithii</i>	24
<i>Ilex harmsiana</i>	23
<i>Ilex havilandii</i>	5, 13 , 14
<i>Ilex havilandii</i> var. <i>camptoneura</i>	14

<i>Ilex havilandii</i> var. <i>major</i>	22
<i>Ilex havilandii</i> var. <i>subenervis</i>	14
<i>Ilex horsfieldii</i>	24
<i>Ilex hypoglauca</i>	8, 14, 15
<i>Ilex ijuensis</i>	4
<i>Ilex jacobsii</i>	4, 16
<i>Ilex kelabitana</i>	8, 16
<i>Ilex keranjiensis</i>	8
<i>Ilex kinabaluensis</i>	5
<i>Ilex laurocerasus</i>	3
<i>Ilex lobbiana</i>	24
<i>Ilex macrophylla</i>	5, 17
<i>Ilex macrophylla</i> var. <i>angustata</i>	17
<i>Ilex macrophylla</i> var. <i>ovata</i>	17
<i>Ilex malaccensis</i>	7, 18
<i>Ilex mattangicola</i>	25
<i>Ilex megaphylla</i>	4, 18
<i>Ilex mesilauensis</i>	2, 19
<i>Ilex nervulosa</i>	8, 19, 20
<i>Ilex oppositifolia</i>	2, 21, 22
<i>Ilex orestes</i>	2, 5, 22
<i>Ilex orestes</i> var. <i>dulitensis</i>	14
<i>Ilex paraguariensis</i>	1
<i>Ilex philippinensis</i>	12
<i>Ilex poiensis</i>	7
<i>Ilex polyphylla</i>	24
<i>Ilex promecophylla</i>	8, 22
<i>Ilex renae</i>	8
<i>Ilex revoluta</i>	6
<i>Ilex sarawaccensis</i>	7
<i>Ilex sclerophylloides</i>	25
<i>Ilex sclerophylloides</i> forma	19
<i>Ilex</i> sp. 1	5
<i>Ilex</i> sp. 1 ? <i>spicata</i>	24
<i>Ilex</i> sp. 2	19
<i>Ilex</i> sp. 3	6
<i>Ilex</i> sp. 4	19
<i>Ilex</i> sp. 5	22
<i>Ilex</i> sp. 6	5
<i>Ilex</i> sp. 8	16
<i>Ilex</i> sp. 9	4
<i>Ilex</i> sp. 10	3
<i>Ilex</i> sp. 11	19
<i>Ilex</i> sp. 16	8
<i>Ilex</i> sp. 17	7
<i>Ilex</i> sp. 18	9
<i>Ilex</i> sp. 19	24
<i>Ilex</i> sp. 20	17

<i>Ilex spicata</i>	7, 18, 23
<i>Ilex spicata</i> var. <i>harmsiana</i>	23
<i>Ilex spicata</i> var. <i>spicata</i>	23
<i>Ilex stapfiana</i>	4
<i>Ilex triflora</i>	6, 24
<i>Ilex</i> cf. <i>triflora</i>	13
<i>Ilex triflora</i> var. <i>horsfieldii</i>	24
<i>Ilex triflora</i> var. <i>javensis</i>	24
<i>Ilex triflora</i> var. <i>lobbiana</i>	24
<i>Ilex triflora</i> var. <i>longifolia</i>	24
<i>Ilex vacciniifolia</i>	13
<i>Ilex vacciniifolia</i> var. <i>camptoneura</i>	13
<i>Ilex vacciniifolia</i> var. <i>subenervis</i>	13
<i>Ilex venulosa</i> var. <i>nervulosa</i>	19
<i>Ilex wallichii</i>	4, 25, 26
<i>Ilex</i> sp. aff. <i>wightiana</i>	10
<i>Ilex zygophylla</i>	2, 22, 25
<i>Illipe</i>	221
<i>Illipe burckiana</i>	229
<i>Illipe crassipes</i>	231
<i>Illipe fusca</i>	239
<i>Illipe korthalsii</i>	243
<i>Illipe maclayana</i>	336
<i>Illipe motleyana</i>	250
<i>Illipe pallida</i>	256
<i>Illipe schlechteri</i>	229
<i>Imbricaria</i>	269
<i>Isonandra</i>	203, 205, 216, 218
<i>Isonandra argentata</i>	299
<i>Isonandra</i> ? <i>benjamina</i>	325
<i>Isonandra borneensis</i>	218, 219
<i>Isonandra calophylla</i>	278
<i>Isonandra curtisii</i>	233
<i>Isonandra dasyphylla</i>	284
<i>Isonandra emarginata</i>	295
<i>Isonandra gracilis</i>	220
<i>Isonandra gutta</i>	288
<i>Isonandra hexandra</i>	289
<i>Isonandra lanceolata</i>	218, 220
<i>Isonandra lanceolata</i> var. <i>gracilis</i>	220
<i>Isonandra lanceolata</i> var. <i>lanceolata</i>	220
<i>Isonandra macrophylla</i>	299
<i>Isonandra microphylla</i>	327
<i>Isonandra motleyana</i>	250
<i>Isonandra obovata</i>	296
<i>Isonandra pulchra</i>	315
<i>Isonandra quercifolia</i>	299
<i>Isonandra</i> ? <i>rostrata</i>	302
<i>Isonandra rufa</i>	260

<i>Isonandra utilis</i>	267
<i>Isonandra wightiana</i>	220
<i>Isonandra xanthochyma</i>	311

J

Jasminum	129, 130
Jasminum sambac	129

K

<i>Kakosmanthus</i>	221
<i>Kakosmanthus argenteus</i>	263
<i>Kakosmanthus costulatus</i>	231
<i>Kakosmanthus korthalsii</i>	243
<i>Kakosmanthus sarawahensis</i>	261
<i>Kaukenia</i>	269
<i>Keratophorus</i>	312
<i>Keratophorus leerii</i>	325

L

Lauraceae	193, 284
Laurus	3
LECYTHIDACEAE	101 , 102
Lecythidaceae subfam. Foetidioideae	101
Lecythidaceae subfam. Lecythidoideae	101, 102
Lecythidaceae subfam. Napoleonaeoideae	101
Lecythidaceae subfam. Planchonioideae	101, 102, 103, 125
Leptospermum	5, 6
<i>Leucoxyllum buxifolium</i>	47
Ligustrum	129, 131, 159
Ligustrum glomeratum	159 , 160
Ligustrum ovalifolium	159
Ligustrum sinense	159
<i>Linociera</i>	131, 350
<i>Linociera cuspidata</i>	139
<i>Linociera elaeocarpa</i>	145
<i>Linociera evenia</i>	140
<i>Linociera laxiflora</i>	151
<i>Linociera longipetala</i>	132
<i>Linociera macrobotrys</i>	134
<i>Linociera macrocarpa</i>	145
<i>Linociera oligantha</i>	157
<i>Linociera oxycarpa</i>	350
<i>Linociera pachyphylla</i>	146
<i>Linociera paludosa</i>	137
<i>Linociera pauciflora</i>	155
<i>Linociera pluriflora</i>	148
<i>Linociera polygama</i>	151, 350
<i>Linociera pubicalyx</i>	155

<i>Linociera ramiflora</i>	155
<i>Linociera rubrovenia</i>	164
<i>Linociera scandens</i>	134
<i>Linociera spicata</i>	157
<i>Linociera verruculosa</i>	148
Litsea	193
<i>Lucuma</i>	329
<i>Lucuma ?discolor</i>	334
<i>Lucuma lanceolata</i>	211
<i>Lucuma maclayana</i>	336
<i>Lucuma maingayi</i>	337
<i>Lucuma malaccensis</i>	338

M

<i>Maba</i>	29, 87
<i>Maba andamanica</i>	40
<i>Maba beccarii</i>	86
<i>Maba buxifolia</i>	61
<i>Maba carpinifolia</i>	40
<i>Maba confertiflora</i>	49
<i>Maba cordata</i>	50
<i>Maba hermaphroditica</i>	98
<i>Maba maingayi</i>	75
<i>Maba merguensis</i>	98
<i>Maba motleyi</i>	59, 75
<i>Maba myrmecocalyx</i>	67
<i>Maba olivacea</i>	99
<i>Maba punctata</i>	40
<i>Maba teysmanni</i>	98
<i>Maba venosa</i>	98
Macadamia	190
Macadamia ternifolia	170
Macadamia tetraphylla	170
<i>Macreightia andamanica</i>	40
Madhuca	204, 205, 218, 221 , 222, 313
<i>Madhuca acuminata</i>	315
Madhuca barbata	226, 227
<i>Madhuca beccarii</i>	238, 351
Madhuca betis	222
Madhuca borneensis	225, 228
Madhuca brochidodroma	226, 228
Madhuca burckiana	224, 229
Madhuca cheongiana	225, 230
<i>Madhuca chrysocarpa</i>	233
Madhuca costulata	222, 231
Madhuca crassipes	227, 231 , 232
Madhuca curtisii	223, 233
Madhuca daemonica	222, 234

Madhuca dubardii	225, 235
Madhuca elmeri	226, 235
Madhuca endertii	224, 236
Madhuca engkikiana	223, 236 , 237
Madhuca engleri	224, 238 , 351
<i>Madhuca eriobrachyon</i>	228
Madhuca erythrophylla	225, 239
Madhuca fusca	225, 239 , 240
<i>Madhuca fusicarpa</i>	229
<i>Madhuca glaberrima</i>	242
Madhuca glabrescens	226, 241
Madhuca hirtiflora	227, 242
Madhuca kingiana	226, 242
Madhuca korthalsii	224, 243
Madhuca kuchingensis	227, 244
Madhuca lancifolia	223, 245
Madhuca latifolia	204
<i>Madhuca leerii</i>	325
Madhuca longifolia	204
Madhuca malaccensis	224, 245
Madhuca markleena	223, 246 , 247
Madhuca mindanaensis	223, 248
Madhuca montana	225, 249
Madhuca monticola	226, 249
Madhuca motleyana	204, 222, 223, 250
Madhuca multinervia	226, 250 , 251
Madhuca oblongifolia	224, 252 , 253
Madhuca obovatifolia	222
Madhuca ochracea	225, 254 , 255
Madhuca palembanica	222, 254
Madhuca pallida	225, 256
<i>Madhuca perakensis</i>	233
Madhuca primoplagensis	225, 257 , 258
Madhuca proluxa	227, 257
Madhuca pubicalyx	224, 259
Madhuca rufa	223, 260
Madhuca sandakanensis	224, 260
Madhuca sarawahensis	223, 261 , 262
Madhuca sepilokensis	224, 263
Madhuca sericea	225, 263
<i>Madhuca sericea</i> var. <i>ridleyi</i>	263
Madhuca sessilis	226, 264
Madhuca silamensis	224, 265 , 266
Madhuca spectabilis	222, 265
<i>Madhuca stenophylla</i>	267
Madhuca utilis	226, 267
Madhuca vulpina	227, 267
<i>Madhuca watsoni</i>	305

Madhuca woodii	224, 268
Maesa	13
<i>Mammea asiatica</i>	108
Manilkara	215, 269
Manilkara zapota	204, 206 , 222
Matthaea sancta	10
<i>Megadendron macrocarpum</i>	114
Meliaceae	310
<i>Michelia</i>	102
<i>Michelia acutangula</i>	106
<i>Michelia insignis</i>	115
<i>Michelia macrocarpa</i>	115
<i>Michelia macrostachya</i>	115
<i>Michelia racemosa</i>	117
<i>Michelia spicata</i>	106
<i>Michelia timorensis</i>	117
Mimusops	203, 205, 215, 269
<i>Mimusops acuminata</i>	315
Mimusops elengi	269 , 270
<i>Mimusops elengi</i> var. <i>brevifolia</i>	269
<i>Mimusops elengi</i> var. <i>parvifolia</i>	269
<i>Mimusops elengi</i> var. <i>typica</i>	269
<i>Mimusops elengi</i> var. <i>typica</i> forma <i>longepedunculata</i>	269
<i>Mimusops javensis</i>	269
<i>Mimusops laterica</i>	269
<i>Mimusops obtusifolia</i>	269
<i>Mimusops parvifolia</i>	269
<i>Mimusops timorensis</i>	269
Monimiaceae	10
Moraceae	191
Myristicaceae	32
Myrsinaceae	13, 350
Myrtaceae	13, 101, 102
Myxopyrum	130
<i>Myxopyrum enerve</i>	134
<i>Myxopyrum nervosum</i> subsp. <i>coriaceum</i>	130
<i>Myxopyrum pierrei</i>	130

N

Nemopanthus	1
Neohemsleya	343
Nesoluma	343
<i>Nycterisition</i>	208
<i>Nycterisition lanceolatum</i>	211
Nypa	109

O

Ochnaceae	102
-----------	-----

<i>Ocotea spicata</i>	11
<i>Olea</i>	129, 131, 161 , 162
<i>Olea borneensis</i>	162 , 163
<i>Olea brachiata</i>	162, 164
<i>Olea decussata</i>	164
<i>Olea maritima</i>	164
<i>Olea pauciflora</i>	155
<i>Olea platycarpa</i>	137
<i>Olea rubrovenia</i>	161, 162, 164 , 165
OLEACEAE	13, 129 , 142, 347, 348, 350
Oncotheca	1

P

<i>Palaquium</i>	203, 206, 207, 218, 271 , 272
<i>Palaquium argentatum</i>	299
<i>Palaquium bancanum</i>	302
<i>Palaquium beauvisagei</i>	308
<i>Palaquium beccarianum</i>	275, 278 , 279
<i>Palaquium beccarii</i>	207
<i>Palaquium borneense</i>	288
<i>Palaquium calophyllum</i>	274, 278 , 280
<i>Palaquium cochlearifolium</i>	276, 281 , 282
<i>Palaquium crassifolium</i>	275, 283
<i>Palaquium cryptocariifolium</i>	275, 284
<i>Palaquium dasyphyllum</i>	274, 284
<i>Palaquium decurrens</i>	277, 285
<i>Palaquium edenii</i>	277, 286
<i>Palaquium elegans</i>	276, 286
<i>Palaquium ellipsoideum</i>	288
<i>Palaquium ferox</i>	278
<i>Palaquium ferrugineum</i>	275, 287
<i>Palaquium fulvosericum</i>	288
<i>Palaquium gutta</i>	273, 275, 287 , 288
<i>Palaquium gutta</i> f. <i>borneense</i>	288
<i>Palaquium gutta</i> f. <i>gutta</i>	288
<i>Palaquium gutta</i> f. <i>selendit</i>	288
<i>Palaquium gutta</i> f. <i>vrieseanum</i>	288
<i>Palaquium herveyi</i>	276, 289
<i>Palaquium hexandrum</i>	277, 289
<i>Palaquium hispidum</i>	277, 290
<i>Palaquium hispidum</i> var. <i>grandiflorum</i>	290
<i>Palaquium hispidum</i> var. <i>typicum</i>	290
<i>Palaquium inutile</i>	308
<i>Palaquium kinabaluense</i>	277, 291
<i>Palaquium lanceolatum</i> Blanco	272
<i>Palaquium lanceolatum</i> Burck	311
<i>Palaquium ledermannii</i>	299

<i>Palaquium leiocarpum</i>	277, 291
<i>Palaquium lisophyllum</i>	274, 292
<i>Palaquium macrocarpum</i>	291
<i>Palaquium macrophyllum</i>	299
<i>Palaquium magnoliaefolium</i>	288
<i>Palaquium maingayi</i>	277, 293
<i>Palaquium majas</i>	273, 294 , 297
<i>Palaquium membranaceum</i>	302
<i>Palaquium microphyllum</i>	273, 275, 294
<i>Palaquium molle</i>	292
<i>Palaquium multiflorum</i>	274, 295
<i>Palaquium oblongifolium</i>	288
<i>Palaquium obovatum</i>	277, 296
<i>Palaquium optimum</i>	288
<i>Palaquium ottolanderi</i>	277, 296
<i>Palaquium parvifolium</i>	302
<i>Palaquium pisang</i>	289
<i>Palaquium poilanei</i>	299
<i>Palaquium pseudocuneatum</i>	273, 276, 297
<i>Palaquium pseudorostratum</i>	273, 298
<i>Palaquium punctatum</i>	296
<i>Palaquium quercifolium</i>	274, 299
<i>Palaquium reginamontium</i>	284
<i>Palaquium richardsii</i>	306
<i>Palaquium ridleyi</i>	276, 299
<i>Palaquium rigidum</i>	276, 300
<i>Palaquium rioensis</i>	273, 301
<i>Palaquium rivulare</i>	273, 301
<i>Palaquium rostratum</i>	273, 276, 298, 302
<i>Palaquium rubens</i>	311
<i>Palaquium rufolanigerum</i>	275, 303 , 304
<i>Palaquium sambasense</i>	288
<i>Palaquium sericeum</i>	273, 305
<i>Palaquium stellatum</i>	276, 305
<i>Palaquium stenophyllum</i>	284
<i>Palaquium stipulare</i>	274, 306 , 307
<i>Palaquium sumatranum</i>	274, 308
<i>Palaquium supfianum</i>	277, 308
<i>Palaquium tammedak</i>	288
<i>Palaquium tenuipetiolatum</i>	274, 309
<i>Palaquium teysmannianum</i>	308
<i>Palaquium theoideum</i>	296
<i>Palaquium verstegei</i>	302
<i>Palaquium vexillatum</i>	275, 310
<i>Palaquium walsurifolium</i>	274, 276, 310
<i>Palaquium xanthochymum</i>	273, 275, 311
Payena	203, 205, 312 , 313
Payena sect. Payena	313

Payena sect. <i>Purpureopayena</i>	313
<i>Payena acuminata</i>	313, 315
<i>Payena acuminata</i> var. <i>acuminata</i>	315
<i>Payena acuminata</i> var. <i>pulchra</i>	315
<i>Payena bankensis</i>	250
<i>Payena beccarii</i>	238, 325, 351
<i>Payena benjamina</i>	325
<i>Payena dasyphylla</i>	313
<i>Payena endertii</i>	327
<i>Payena engleri</i>	238, 351
<i>Payena ferruginea</i>	314, 316 , 317
<i>Payena fusicarpa</i>	229
<i>Payena gigas</i>	313, 316
<i>Payena grandistipula</i>	314, 318 , 319
<i>Payena havilandii</i>	328
<i>Payena kapitensis</i>	314, 320 , 321
<i>Payena khoonmengiana</i>	314, 320 , 322
<i>Payena kinabaluensis</i>	314, 323 , 324
<i>Payena lamii</i>	314, 323
<i>Payena lancifolia</i>	245
<i>Payena latifolia</i>	250
<i>Payena leerii</i>	312, 313, 314, 325 , 326, 327
<i>Payena longipedicellata</i>	314, 316, 326
<i>Payena lowiana</i>	316
<i>Payena lucida</i>	313, 316, 327
<i>Payena malaccensis</i>	245
<i>Payena microphylla</i>	314, 327
<i>Payena obscura</i>	315, 327
<i>Payena obscura</i> var. <i>havilandii</i>	328
<i>Payena obscura</i> var. <i>obscura</i>	328
<i>Payena parvifolia</i>	325
<i>Payena ridleyi</i>	263
<i>Payena rubropedicellata</i>	250
<i>Payena sericea</i>	263
<i>Payena sericea</i> var. <i>pulchra</i>	315
<i>Payena sericea</i> var. <i>typica</i>	315
<i>Payena sessilis</i>	264
<i>Payena utilis</i>	267
Phelline	1
<i>Pirigara valida</i>	128
<i>Pisonia buxifolia</i>	61
<i>Planchonella</i>	329, 330
<i>Planchonella aurata</i>	216
<i>Planchonella beccariana</i>	278
<i>Planchonella firma</i>	332
<i>Planchonella glabra</i>	332
<i>Planchonella linggense</i>	334
<i>Planchonella littoralis</i>	334
<i>Planchonella maingayi</i>	337

<i>Planchonella mindanaensis</i>	338
<i>Planchonella nitida</i>	331
<i>Planchonella obovata</i>	340
<i>Planchonella pierreana</i>	278
Planchonia	102, 121, 124 , 125
<i>Planchonia alata</i>	128
Planchonia brevistipitata	125 , 126
<i>Planchonia elliptica</i>	128
<i>Planchonia forbesii</i>	128
Planchonia grandis	125, 127
<i>Planchonia lanceolata</i>	112
<i>Planchonia littoralis</i>	128
<i>Planchonia sumatrana</i>	128
<i>Planchonia sundaica</i>	128
<i>Planchonia undulata</i>	128
Planchonia valida	125, 128
<i>Podocarpus palembanicus</i>	254
Polygalaceae	13
Pouteria	203, 205, 329 , 330
<i>Pouteria aurata</i>	216
<i>Pouteria discolor</i>	334
Pouteria duclitan	331
Pouteria firma	330, 332 , 333
Pouteria glabra	330, 332
Pouteria linggensis	330, 334 , 335
Pouteria maclayana	330, 336
Pouteria maingayi	330, 337
Pouteria malaccensis	330, 337
Pouteria mindanaensis	331, 338 , 339
<i>Pouteria nitida</i>	331
Pouteria obovata	331, 340 , 341
Pouteria sp. 1	342
<i>Prinos cymosa</i>	12
<i>Prinos hypoglauca</i>	14
<i>Prinos spicata</i>	23
PROTEACEAE	169
Proteaceae subfam. Grevilleoideae	170
Tribe Banksiae	170
Tribe Embothriae	170
Tribe Grevilleae	170
Proteaceae subfam. Persoonioideae	170
Q	
Quercus	299
Quercus ilex	2
R	
<i>Rhipidostigma teysmanni</i>	98

<i>Roupala</i> (“ <i>Rhopala</i> ”) <i>attenuata</i>	173
<i>Roupala</i> (“ <i>Rhopala</i> ”) <i>excelsa</i>	174
<i>Roupala</i> (“ <i>Rhopala</i> ”) <i>moluccana</i>	173, 180
<i>Roupala robusta</i>	183
<i>Roupala serrata</i>	186

S

<i>Salacia castaneifolia</i>	10
<i>Salacia grandiflora</i>	33
<i>Salix</i>	70
<i>Samara polygama</i>	151, 350
SAPOTACEAE	203, 204, 313, 330, 343, 351
Sapotaceae tribe Isonandreae	313
Sapotaceae tribe Sideroxyleae	343
<i>Sarcosperma</i>	203, 205, 343
<i>Sarcosperma breviracemosum</i>	344
<i>Sarcosperma paniculatum</i>	344, 345
Sarcospermaceae	343
<i>Schrebera</i>	129, 130, 166
<i>Schrebera kusnotoi</i>	166, 167
Scytopetalaceae	102
<i>Semicipium</i>	269
<i>Sersalisia obovata</i>	340
<i>Sideroxylon</i>	343
<i>Sideroxylon balitbitan</i>	331
<i>Sideroxylon borneense</i>	337
<i>Sideroxylon duclitan</i>	331
<i>Sideroxylon firmum</i>	332
<i>Sideroxylon glabrescens</i>	250
<i>Sideroxylon glabrum</i>	332
<i>Sideroxylon lingense</i>	334
<i>Sideroxylon littorale</i>	334
<i>Sideroxylon maingayi</i>	337
<i>Sideroxylon malaccense</i>	337
<i>Sideroxylon nitidum</i>	331
<i>Sideroxylon pittosporifolium</i>	334
<i>Sphenostemon</i>	1
<i>Stenocarpus sinuatus</i>	169
<i>Stravadium</i>	102
<i>Stravadium acutangulum</i>	106
<i>Stravadium insigne</i>	115
<i>Stravadium racemosum</i>	117
<i>Stravadium reticulatum</i>	119
<i>Stravadium sarcostachys</i>	122
<i>Stravadium spicatum</i>	106
Styracaceae	92, 102, 204
<i>Styrax</i>	92
Symplocaceae	10, 187, 204

Symplocos	10, 187
Syzygium	13
T	
<i>Tetrapilus brachiatus</i>	164
<i>Tetrapilus rubrovenius</i>	164
Theaceae	102
Theales	102
V	
Vaccinium stapfianum	14
<i>Vidoricum korthalsii</i>	243
Vitaceae	11
W	
Walsura	310
X	
Xanthophyllum	13
<i>Xantolis malaccensis</i>	338
<i>Xantolis mindanaensis</i>	338

INDEX TO VERNACULAR NAMES

Scientific names in brackets are the correct names corresponding to vernacular names listed below.

A

antagiras (<i>Madhuca mindanaensis</i> (Merr.) Merr.)	248
aras (<i>Ilex cissoidea</i> Loes.)	11

B

bagoa (<i>Diospyros</i> L.)	30
balih (<i>Diospyros</i> L.)	30
balit tangan (<i>Chionanthus polygamus</i> (Roxb.) Kiew)	151
bangkulat (<i>Ilex cymosa</i> Blume)	12
bangkulatan (<i>Ilex cymosa</i> Blume)	12
bee-taul (<i>Payena acuminata</i> (Blume) Pierre)	315
bekeraiah (<i>Chionanthus pluriflorus</i> (Knobl.) Kiew)	150
belimbing hutan (<i>Ilex cymosa</i> Blume)	12
bengkulat (<i>Ilex cymosa</i> Blume)	12
bengkulatan (<i>Ilex cymosa</i> Blume)	12
bidi (<i>Diospyros melanoxylon</i>)	32
bingkolat (<i>Ilex cymosa</i> Blume)	12
bitis (Sapotaceae species with heavy, hard and durable timber; <i>Payena leeri</i> (Teijsm. & Binn.) Kurz)	204, 313
bokol (<i>Chionanthus lucens</i> Kiew; <i>Ilex nervulosa</i> (Loes.) S.Andrews)	21, 145
borah serang (<i>Chionanthus polygamus</i> (Roxb.) Kiew)	151
breyanlana (<i>Helicia serrata</i> (R.Br.) Blume)	186
buah tuba (<i>Diospyros piscicarpa</i> Ridl., <i>D. styraciformis</i> King & Gamble, <i>D. wallichii</i> King & Gamble)	31, 85
bukar (<i>Chionanthus pluriflorus</i> (Knobl.) Kiew)	150
bunga tanjong (<i>Mimusops elengi</i> L.)	271
bupok (<i>Ilex kelabitana</i> S.Andrews, <i>I. spicata</i> var. <i>harmsiana</i> (Loes.) S.Andrews)	17, 24
bupuk (<i>Ilex kelabitana</i> S.Andrews)	17

C

caimito (<i>Chrysophyllum cainito</i> L.)	210
cainito (<i>Chrysophyllum cainito</i> L.)	210
ciku (<i>Manilkara zapota</i> (L.) P.Royen)	222
cochit-zapotl (<i>Manilkara zapota</i> (L.) P.Royen)	206

D

dagu (<i>Heliciopsis artocarpoides</i> (Elmer) Sleumer)	193
--	-----

E

empala (<i>Olea rubrovenia</i> (Elmer) Kiew)	166
entam (<i>Diospyros sumatrana</i> Miq.)	95

G

gagelap (<i>Helicia serrata</i> (R.Br.) Blume)	186
geredam pangi (<i>Ilex cissoidea</i> Loes.)	11
gigi (<i>Diospyros</i> L.)	30
gumbirar merah (<i>Pouteria obovata</i> (R.Br.) Baehni)	342

J

jangkar (<i>Palaquium gutta</i> (Hook.f.) Baill.)	288
jangkar merah (<i>Palaquium gutta</i> (Hook.f.) Baill.)	288
jangkar sakat (<i>Madhuca lancifolia</i> (Burck) H.J.Lam)	245
jaring-jaringan jawa (<i>Helicia robusta</i> (Roxb.) R.Br. ex Wall.)	184
jasmin (<i>Jasminum</i> L.)	130
jempalang (<i>Barringtonia acutangula</i> (L.) Gaertn. subsp. <i>acutangula</i> , <i>B. lanceolata</i> (Ridl.) Payens)	106, 112
jempalang apoi (<i>Barringtonia lanceolata</i> (Ridl.) Payens)	112

K

kajo tata (<i>Helicia</i> Lour.)	170
karuk (<i>Barringtonia macrostachya</i> (Jack) Kurz)	116
karut (<i>Barringtonia</i> J.R. & G.Forst., <i>B. revoluta</i> Merr.)	103, 121
karut putat (<i>Barringtonia sarawakensis</i> P.Chantaranothai)	121
katjang (<i>Helicia attenuata</i> (Jack) Blume)	173
kayo talat (<i>Helicia</i> Lour.)	170
kayu arang (<i>Diospyros</i> L.)	29, 32
kayu balik (<i>Diospyros borneensis</i> Hiern, <i>D. elliptifolia</i> Merr., <i>D. lanceifolia</i> Roxb., <i>D. styraciformis</i> King & Gamble, <i>D. wallichii</i> King & Gamble)	32
kayu birang (<i>Diospyros</i> L.)	30
kayu bura (<i>Chionanthus macrocarpus</i> Blume)	146
kayu djung (<i>Ilex nervulosa</i> (Loes.) S.Andrews)	21
kayu lusang (<i>Diospyros</i> L.)	30
kayu malam (<i>Diospyros</i> L., <i>D. diepenhorstii</i> Miq.)	29, 56
kayu malam balih (<i>Diospyros siamang</i> Bakh.)	90
kayu malam pinang (<i>Diospyros confertiflora</i> (Hiern) Bakh.)	50
kayu padang (<i>Diospyros</i> L.)	30
kayu pak-peting (<i>Madhuca korthalsii</i> (Pierre ex Burck) H.J.Lam)	244
kayu rambis (<i>Chionanthus polygamus</i> (Roxb.) Kiew)	151
kayu tam (<i>Diospyros</i> L.)	30
kayu tatah (<i>Helicia</i> Lour.)	170
kayu tatat (<i>Helicia</i> Lour.)	170
kemuding (<i>Ilex cissoidea</i> Loes.)	11
kerdam (<i>Chionanthus macrocarpus</i> Blume; <i>Ilex</i> L., <i>I. malaccensis</i> Loes., <i>I. orestes</i> Ridl., <i>I. wallichii</i> Hook.f.)	2, 18, 22, 25, 146

kerdam ayer (<i>Ilex cymosa</i> Blume)	12
kerdam daun kechil (<i>Ilex wallichii</i> Hook.f.)	25
kerdam mungkulat (<i>Ilex hypoglauca</i> (Miq.) Loes.)	16
kerungguon (<i>Heliciopsis artocarpoides</i> (Elmer) Sleumer)	193
ketiau (<i>Madhuca motleyana</i> (de Vriese) J.F.Macbr.)	250
ketiau badas (<i>Madhuca curtisii</i> (King & Gamble) Ridl.)	234
ketiau hantu (<i>Madhuca daemonica</i> (Van den Assem) Yii & P.Chai)	234
ketiau merah (<i>Madhuca brochidodroma</i> T.D.Penn.)	229
ketiau paya (<i>Madhuca motleyana</i> (de Vriese) J.F.Macbr.)	250
ketiau putih (<i>Madhuca barbata</i> T.D.Penn.)	227
kuku mendo (<i>Chionanthus pluriflorus</i> (Knobl.) Kiew)	150
kuku nglipan (<i>Ilex</i> L.)	2
kurunggu (<i>Heliciopsis artocarpoides</i> (Elmer) Sleumer)	193
kurungu (<i>Helicia petiolaris</i> Benn.)	182

L

langidan (<i>Ilex cissoidea</i> Loes.)	11
langkong (<i>Barringtonia</i> J.R. & G.Forst., <i>B. acutangula</i> (L.) Gaertn. subsp. <i>acutangula</i> , <i>B. lanceolata</i> (Ridl.) Payens, <i>B. pendula</i> (Griff.) Kurz, <i>B. sarcostachys</i> (Blume) Miq.)	103, 106, 112, 116, 112
lengabah (<i>Ilex hypoglauca</i> (Miq.) Loes.)	16
lengidan (<i>Ilex cissoidea</i> Loes.)	11
loboh (<i>Ilex cissoidea</i> Loes.)	11
luang (<i>Helicia excelsa</i> (Roxb.) Blume)	174
lundudon payon (<i>Ilex cissoidea</i> Loes.)	11

M

madhuka (<i>Madhuca</i> Buch.-Ham. ex J.F.Gmelin)	221
magis agis (<i>Ilex cissoidea</i> Loes.)	11
magisugis (<i>Ilex cissoidea</i> Loes.)	11
majang ketapang (<i>Madhuca pallida</i> (Burck) Baehni)	257
mak ulat (<i>Chionanthus curvicarpus</i> Kiew)	140
malau pedara (<i>Payena acuminata</i> (Blume) Pierre)	315
maligalas (<i>Madhuca glabrescens</i> H.J.Lam)	241
manatu (<i>Madhuca dubardii</i> H.J.Lam)	235
mangkulat (<i>Ilex cymosa</i> Blume)	12
marogis (<i>Ilex cissoidea</i> Loes.)	11
mengkulat (<i>Ilex wallichii</i> Hook.f.)	25
mer pinggau (<i>Ilex cymosa</i> Blume)	12
merkulat (<i>Ilex nervulosa</i> (Loes.) S.Andrews)	21
merpinang (<i>Diospyros</i> L.)	30
merpinang daun besar (<i>Diospyros maingayi</i> (Hiern) Bakh.)	75
merpinang daun kecil (<i>Diospyros evena</i> Bakh.)	60
mogkulat (<i>Ilex cymosa</i> Blume)	12
mok (<i>Chionanthus</i> L., <i>C. pluriflorus</i> (Knobl.) Kiew; <i>Olea rubrovenia</i> (Elmer) Kiew)	131, 150, 166
morogis (<i>Ilex cissoidea</i> Loes.)	11
morogis sawa (<i>Ilex cissoidea</i> Loes.)	11

muak (<i>Chionanthus pluriflorus</i> (Knobl.) Kiew)	150
mungkulat (<i>Ilex hypoglauca</i> (Miq.) Loes.)	16

N

nato hitam (<i>Payena ferruginea</i> J.T.Pierre)	316
nato mergatakan (<i>Payena microphylla</i> (de Vriese) Pierre)	327
natu (<i>Payena acuminata</i> (Blume) Pierre)	315
natu hitam (<i>Payena ferruginea</i> J.T.Pierre)	316
nginjojo (<i>Chionanthus spicatus</i> Blume)	158
njotu (<i>Palaquium Blanco</i>)	272
nyato (<i>Payena obscura</i> Burck var. <i>obscura</i>)	329
nyato berlali (<i>Payena lamii</i> A.Bruggen)	325
nyatoh (Sapotaceae with moderately hard, lighter and less durable timber; <i>Madhuca motleyana</i> (de Vriese) J.F. Macbr., <i>M. pubicalyx</i> Ridl., <i>M. utilis</i> (Ridl.) H.J. Lam; <i>Palaquium Blanco</i> ; <i>Payena</i> A.DC.; <i>Pouteria linggensis</i> (Burck) Baehni, <i>P. maingayi</i> (C.B.Clarke) Baehni)	204, 211, 221, 250, 260, 267, 272, 313, 336, 337
nyatoh babi (<i>Palaquium pseudorostratum</i> H.J.Lam)	298
nyatoh babi kecil (<i>Palaquium pseudocuneatum</i> H.J.Lam)	298
nyatoh batu (<i>Madhuca utilis</i> (Ridl.) H.J.Lam; <i>Payena</i> A.DC., <i>P. leerii</i> (Teijsm. & Binn.) Kurz; <i>Pouteria malaccensis</i> (C.B.Clarke) Baehni)	267, 313, 326, 338
nyatoh beludu (<i>Madhuca lancifolia</i> (Burck) H.J.Lam)	245
nyatoh bulu (<i>Palaquium beccarianum</i> (Pierre) P.Royen)	278
nyatoh bulu merah (<i>Madhuca borneensis</i> P.Royen)	228
nyatoh burung (<i>Payena leerii</i> (Teijsm. & Binn.) Kurz)	326
nyatoh cabi (<i>Madhuca brochidodroma</i> T.D.Penn.; <i>Payena leerii</i> (Teijsm. & Binn.) Kurz)	229, 326
nyatoh daun besar (<i>Madhuca primoplagensis</i> Vink)	257
nyatoh daun licin (<i>Madhuca glabrescens</i> H.J.Lam)	241
nyatoh daun mata lembing (<i>Madhuca cheongiana</i> Yii & P.Chai)	230
nyatoh empelit (<i>Chrysophyllum roxburghii</i> G.Don)	211
nyatoh entalit (<i>Chrysophyllum roxburghii</i> G.Don)	211
nyatoh gasing (<i>Madhuca markleeana</i> Yii & P.Chai)	248
nyatoh jangkar (<i>Palaquium walsurifolium</i> Pierre ex Dubard; <i>Payena</i> <i>obscura</i> Burck var. <i>obscura</i>)	311, 329
nyatoh jelutong (<i>Madhuca crassipes</i> (Pierre ex Becc.) H.J.Lam, <i>M. utilis</i> (Ridl.) H.J.Lam; <i>Palaquium cochlearifolium</i> P.Royen)	233, 267, 283
nyatoh kabang (<i>Payena leerii</i> (Teijsm. & Binn.) Kurz)	326
nyatoh kelabu (<i>Madhuca ochracea</i> Yii & P.Chai)	254
nyatoh kemayan (<i>Madhuca malaccensis</i> (C.B.Clarke) H.J.Lam)	246
nyatoh king (<i>Madhuca kingiana</i> (Brace ex King & Gamble) H.J.Lam)	243
nyatoh kusta (<i>Madhuca hirtiflora</i> (Ridl.) H.J.Lam)	242
nyatoh laut (<i>Pouteria obovata</i> (R.Br.) Baehni)	342
nyatoh merah (<i>Payena acuminata</i> (Blume) Pierre)	315
nyatoh padang (<i>Payena lamii</i> A.Bruggen)	325
nyatoh padi (<i>Madhuca engleri</i> (Merr.) Vink)	238
nyatoh pipit (<i>Palaquium microphyllum</i> King & Gamble); <i>Payena</i> <i>leerii</i> (Teijsm. & Binn.) Kurz)	295, 326

nyatoh putih (<i>Madhuca engleri</i> (Merr.) Vink; <i>Pouteria malaccensis</i> (C.B.Clarke) Baehni)	238, 338
nyatoh rian (<i>Palaquium gutta</i> (Hook.f.) Baill.; <i>Payena acuminata</i> (Blume) Pierre)	288, 315
nyatoh semukau (<i>Madhuca costulata</i> (Pierre ex Dubard) H.J.Lam)	231
nyatoh sidang (<i>Palaquium dasyphyllum</i> Pierre ex Dubard)	285
nyatoh sulit (<i>Pouteria malaccensis</i> (C.B.Clarke) Baehni)	338
nyatoh taban merah (<i>Palaquium gutta</i> (Hook.f.) Baill.)	288
nyatoh taban putih (<i>Payena obscura</i> Burck var. <i>obscura</i>)	329
nyatoh tangkai panjang (<i>Madhuca palembanica</i> (Miq.) Forman)	256
nyatoh tembaga (<i>Palaquium leiocarpum</i> Boerlage)	292
nyatoh temiang (Sapotaceae species with heavy, hard and durable timber; <i>Palaquium cochlearifolium</i> P.Royen, <i>P. crassifolium</i> Pierre ex Dubard)	204, 283
nyatoh terong (<i>Palaquium ridleyi</i> King & Gamble)	300
nyatu (<i>Palaquium</i> Blanco)	272
nyatu dien (<i>Palaquium calophyllum</i> (Teijsm. & Binn.) Pierre)	281

O

obah putih (<i>Chionanthus plurifloroides</i> Kiew)	148
--	-----

P

paga (<i>Palaquium cochlearifolium</i> P.Royen)	283
palak-palak (<i>Palaquium</i> Blanco)	271
palawak (<i>Aulandra longifolia</i> H.J.Lam)	208
palih (<i>Helicia</i> Lour.)	170
palis (<i>Helicia</i> Lour.; <i>Heliciopsis</i> Sleumer, <i>H. velutina</i> (Prain) Sleumer)	170, 189, 201
pangkabar (<i>Diospyros</i> L.)	30
parong (<i>Diospyros</i> L.)	30
pasir-pasir (<i>Helicia excelsa</i> (Roxb.) Blume)	174
pasis (<i>Helicia</i> Lour.; <i>Heliciopsis</i> Sleumer)	170, 189
peka (<i>Ilex</i> L.)	2
pelawan-pelawan (<i>Pouteria obovata</i> (R.Br.) Baehni)	342
pelenuim (<i>Barringtonia sarawakensis</i> P.Chantaranothai)	121
penarahan arang (species of Myristicaceae)	32
perdoh (<i>Ilex cymosa</i> Blume)	12
perdulan (<i>Pouteria malaccensis</i> (C.B.Clarke) Baehni)	338
perluak (<i>Pouteria firma</i> (Miq.) Baehni)	332
pulut (<i>Palaquium</i> Blanco)	272
pulut badan (<i>Payena microphylla</i> (de Vriese) Pierre)	327
putat (<i>Barringtonia</i> J.R. & G.Forst., <i>B. acutangula</i> (L.) Gaertn. subsp. <i>acutangula</i> , <i>B. lanceolata</i> (Ridl.) Payens, <i>B. sarcostachys</i> (Blume) Miq.; <i>Heliciopsis artocarpoides</i> (Elmer) Sleumer; <i>Planchonia grandis</i> Ridl.)	103, 106, 112, 122, 127, 193
putat ayer (<i>Barringtonia racemosa</i> (L.) Spreng.)	119
putat laut (<i>Barringtonia asiatica</i> (L.) Kurz)	108
putat paya (<i>Barringtonia reticulata</i> (Blume) Miq.; <i>Planchonia</i> Blume, <i>P. brevistipitata</i> Kuswata, <i>P. valida</i> (Blume) Blume)	120, 125, 127, 128
putat rambai (<i>Barringtonia racemosa</i> (L.) Spreng.)	119
putat samba (<i>Barringtonia revoluta</i> Merr.)	121

putat sungai (*Barringtonia conoidea* Griff., *B. racemosa* (L.) Spreng.) 109, 119

S

sapah hutan (*Chionanthus evenius* (Stapf) Kiew) 141
sapo (*Ilex* L.) 2
selangan kangkong (*Planchonia valida* (Blume) Blume) 128
siamang (*Diospyros siamang* Bakh.) 89
sidapong (*Ilex cymosa* Blume) 12
sitam (*Diospyros* L.) 30
sulau kelap (*Ilex* L.) 2
sundip (*Pouteria malaccensis* (C.B.Clarke) Baehni) 338

T

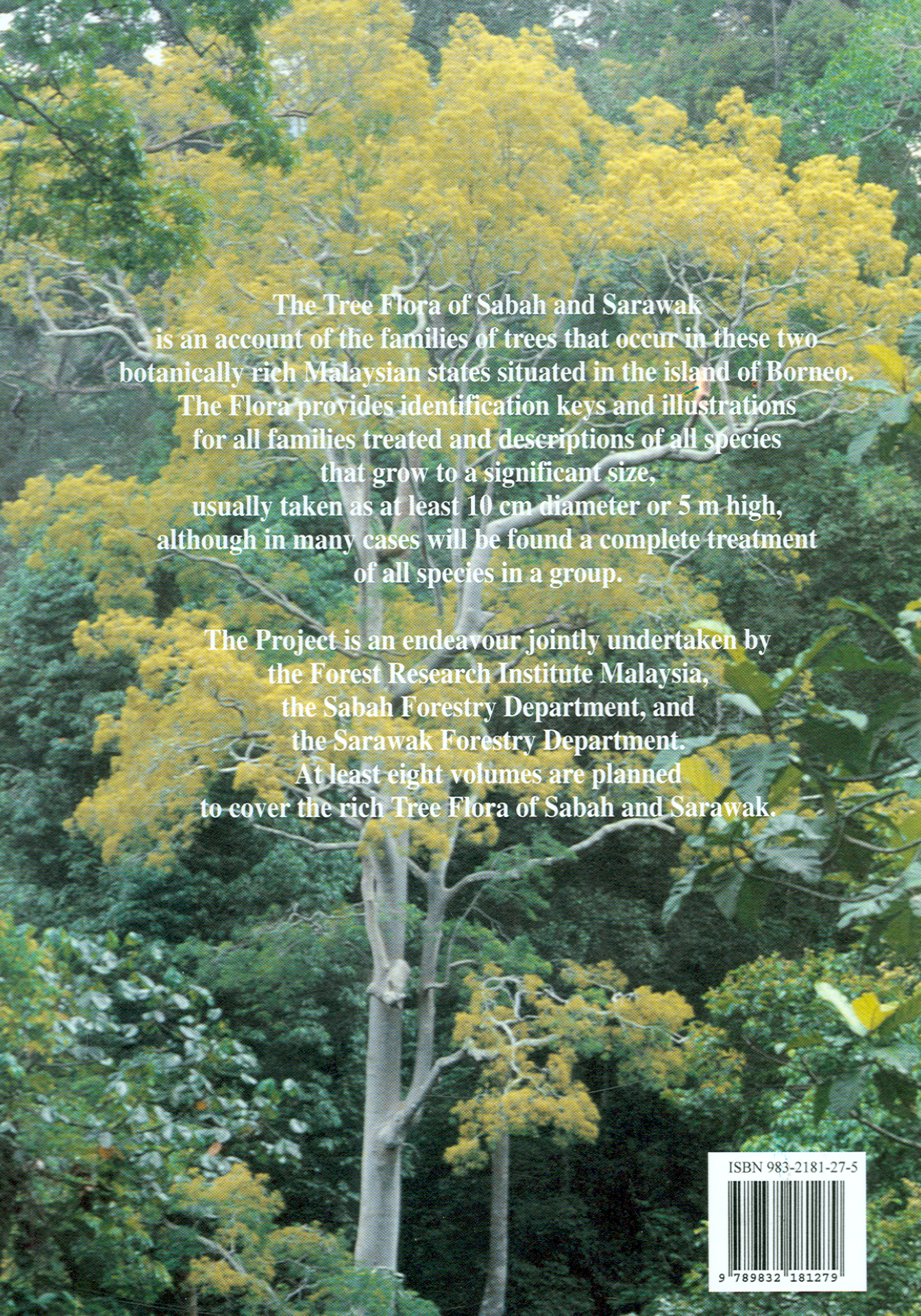
tampalang (*Barringtonia* J.R. & G.Forst., *B. acutangula* (L.) Gaertn.
subsp. *acutangula*, *B. ashtonii* Payens, *B. longisepala* Payens,
B. macrostachya (Jack) Kurz, *B. sarcostachys* (Blume)
Miq.) 103, 106, 107, 114, 116, 122
tampulan (*Ilex cymosa* Blume) 12
temi (*Ilex havilandii* Loes.) 14
temiang (*Ilex havilandii* Loes.) 14
tempalang (*Barringtonia scortechinii* King) 124
tengkawang (*Diploknema sebifera* Pierre) 215
terkam balau (*Madhuca lancifolia* (Burck) H.J.Lam) 245
termiang (*Ilex orestes* Ridl.) 22
toeba api (*Diospyros perfida* Bakh.) 83
toposi (*Diospyros toposia* Ham.) 95
topu (*Ilex* L.) 2
tuba (*Derris* Lour., *D. elliptica* (Roxb.) Benth.; *Diospyros piscicarpa* Ridl.,
D. styraciformis King & Gamble, *D. wallichii* King & Gamble) 31, 85
tuba api (*Diospyros piscicarpa* Ridl., *D. styraciformis* King & Gamble,
D. wallichii King & Gamble) 31, 85
tuba kalingan (*Diospyros piscicarpa* Ridl.) 85
tuba monyet (*Diospyros piscicarpa* Ridl., *D. styraciformis* King & Gamble,
D. wallichii King & Gamble) 31
tubai langkong (*Barringtonia sarcostachys* (Blume) Miq.) 122

U

ubah mata (*Chionanthus palustris* Kiew) 147
ulo (*Diospyros ulu* Merr.) 97
utak-utak (*Barringtonia racemosa* (L.) Spreng.) 119

W

wa bupok (*Ilex spicata* Blume var. *harmsiana* (Loes.) S.Andrews) 24



The Tree Flora of Sabah and Sarawak
is an account of the families of trees that occur in these two
botanically rich Malaysian states situated in the island of Borneo.
The Flora provides identification keys and illustrations
for all families treated and descriptions of all species
that grow to a significant size,
usually taken as at least 10 cm diameter or 5 m high,
although in many cases will be found a complete treatment
of all species in a group.

The Project is an endeavour jointly undertaken by
the Forest Research Institute Malaysia,
the Sabah Forestry Department, and
the Sarawak Forestry Department.
At least eight volumes are planned
to cover the rich Tree Flora of Sabah and Sarawak.

ISBN 983-2181-27-5



9 789832 181279

TREE FLORA of SABAH AND SARAWAK

Volume Five

edited by

E. Soepadmo, L.G. Saw and R.C.K. Chung



Government of Malaysia

TREE FLORA
of
SABAH AND SARAWAK

Produced with the financial support of



**MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION
GOVERNMENT OF MALAYSIA**

Tree Flora of Sabah and Sarawak Editorial Committee — Chairman: *E. Soepadmo* (Forest Research Institute Malaysia). Members: *A. Latiff* (Universiti Kebangsaan Malaysia), *Ruth Kiew* (Singapore Botanic Gardens), *L.G. Saw* (Forest Research Institute Malaysia), *R.C.K. Chung* (Forest Research Institute Malaysia). Editorial assistants: *W.K. Soh* (Forest Research Institute Malaysia), *S. Julia* (Forest Research Centre, Kuching). **Advisors:** *P.S. Ashton* (Harvard University, U.S.A.), *J. Dransfield* (Royal Botanic Gardens, Kew, U.K.), *W.J.J.O. de Wilde* (National Herbarium of the Netherlands, Leiden Branch, the Netherlands).

TREE FLORA of SABAH AND SARAWAK

Volume Five

edited by

E. Soepadmo, L.G. Saw and R.C.K. Chung

A joint publication of



Sabah Forestry
Department, Malaysia



Forest Research
Institute Malaysia



Sarawak Forestry
Department, Malaysia

2004

electronic version prepared by
L.G. Saw & B. Aslina (2008)

Copyright © Forest Research Institute Malaysia (FRIM)
Sabah Forestry Department, Malaysia
Sarawak Forestry Department, Malaysia

Correspondence:

Forest Research Institute Malaysia (FRIM), Kepong, 52109 Kuala Lumpur, Malaysia

First published 30 September 2004

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Tree Flora of Sabah and Sarawak / edited by E. Soepadmo, L.G. Saw and
R.C.K. Chung.

Includes bibliographical references and index

ISBN 983-2181-59-3

1. Botany—Sabah. 2. Botany—Sarawak. 3. Botany—Classification.

I. E. Soepadmo. II. Saw, L.G. III. Chung, R.C.K.

581.959521

Front cover: Lowland and hill forests on ultramafic soil, Bt. Tawai FR, Sabah. (Photograph by E. Soepadmo.)

Back cover: *Koompassia excelsa* (Becc.) Taub. with new growth. (Photograph by E. Soepadmo.)

CONTENTS

	<i>Page</i>
Foreword	vii
Acknowledgements	ix
FAMILIES:	
1. Apocynaceae (<i>David J. Middleton</i>)	1
<i>Alstonia</i> R.Br. (<i>Kade Sidiyasa</i>)	13
2. Dipterocarpaceae (<i>P.S. Ashton</i>)	61
3. Symplocaceae (<i>K.G. Pearce</i>)	383
4. Thymelaeaceae (<i>C.S. Tawan</i>)	427
Appendix: New Dipterocarp Species from Sabah and Sarawak	479
Abbreviations of Frequently Cited References	481
Commonly Used Abbreviations for Localities	485
Plates	487
Index to Trade Groups of <i>Shorea</i> (Dipterocarpaceae)	501
Index to Scientific Names	503
Index to Vernacular Names	517

FOREWORD

We are particularly pleased to provide this foreword towards Volume 5 of the Tree Flora of Sabah and Sarawak. Considering the tremendous richness of Borneo's flora, each volume of the Tree Flora of Sabah and Sarawak marks a milestone in botanical science. Volume 5 comes just two years after the publication of Volume 4, a remarkable achievement that reflects the commitment and dedication of all those involved in the Tree Flora project. Like any other project of this nature, adequate funding is necessary. Therefore, we are particularly grateful to the Ministry of Science, Technology and Environment (now the Ministry of Science, Technology and Innovation), for approving a generous research grant to provide the much-needed financial support for the period 2002–2006.

Volume 5 contains four important tree families, *viz.* the Apocynaceae (David J. Middleton, Harvard University, U.S.A.), Dipterocarpaceae (P.S. Ashton, Harvard University, U.S.A. and Royal Botanic Gardens, Kew, U.K.), Symplocaceae (K.G. Pearce, Sarawak) and Thymelaeaceae (C.S. Tawan, Universiti Malaysia Sarawak), covering 373 species in 28 genera. Of the total number of species treated, 211 or about 56.6% are endemic in Borneo, 18 or about 4.8% in Sabah, 32 or about 8.6% in Sarawak, and 7 species are new to science. The account of the Dipterocarpaceae makes Volume 5 particularly significant, being the most structurally dominant tree family, as well as the principal source of commercial timbers from Borneo's natural forest. It will be of special interest to ecologists and foresters alike, and we hope that this account, which also includes information pertaining conservation status of all known dipterocarp species occurring in Sabah and Sarawak, will in some way contribute towards the conservation and better management of this economically important tree family. The project continues to improve the quality of this publication series, and in this volume, together with the usual botanical line drawings, some colour plates of the trees revised are included.

As with previous volumes, we wish to thank the Curators, Keepers and Directors of the Arnold Arboretum of the Harvard University, Herbarium Bogoriense, Botany Department, Natural History Museum, London, Royal Botanic Garden, Edinburgh, Royal Botanic Gardens, Kew, National Herbarium of the Netherlands, Leiden Branch, Herbarium, New York Botanic Garden, New York, Herbarium, Botanische Staatssammlung, München, Department of Plant Sciences, University of Oxford, Singapore Botanic Gardens, Botany Department, Smithsonian Institution, Washington and the

Sabah Parks. Their continual support has been essential to the success of the project. We are also extremely pleased with the close partnership and cooperation amongst the three key forestry institutions involved in the Tree Flora project (i.e. Forest Research Institute Malaysia, Forestry Department of Sabah, and Forestry Department of Sarawak).

Finally, we would like to record our sincere appreciation to the botanists, members of the editorial committee, botanical artists and supporting staff of the project secretariat for their dedication and hard work in producing Volume 5 of the Tree Flora of Sabah and Sarawak.

Dato' Dr. Abdul Razak Mohd. Ali

*Director-General
Forest Research Institute Malaysia*

Mr. Sam Mannan

*Director
Sabah Forestry Department
Malaysia*

Datu Cheong Ek Choon

*Director
Sarawak Forestry Department
Malaysia*

May 2004

ACKNOWLEDGEMENTS

A long-term project such as the Tree Flora of Sabah and Sarawak will require strong institutional commitment and we are extremely grateful that the heads of the partner institutions continue to give the project their tremendous support, encouragement and guidance. Our special thanks to Dato' Seri Lim Chong Keat, Chairman of the MFRDB, Dato' Dr. Abdul Razak Mohd. Ali, Director-General of FRIM, Datuk Daniel Khiong Kok Sin and Mr. Sam Mannan, the previous and current Director of Forestry Department, Sabah and Datu Cheong Ek Choon, Director of Forestry, Sarawak. We are also very much obliged to the Directors/Keepers/Curators of the following herbaria, A, BM, BO, E, K, KEP, L, M, NY, SAN, SAR, SING, UKMB, US and the Sabah Parks for making available herbarium loans and/or providing access to their library and database facilities to botanists involved in the TFSS project. We would also like to make particular reference and acknowledgements to many fellow botanists who have contributed in one way or another in helping the project either as contributors, advisors or have provided facility support: Prof. Dr. P.S. Ashton, Prof. Dr. Pieter Baas, Dr. John Dransfield, Dr. Hans-Joachim Esser, Dr. Je F. Veldkamp, Dr. W.J.J.O. de Wilde, Dr. Ding Hou, Dr. Chin See Chung, Dr. Ruth Kiew, Dr. Irawati, Dr. Eko B. Walujo and Mr. Peter Wilkie. Within our own home institutions we would like to acknowledge the advice, encouragement and support given by Dato' Dr. Wan Razali Wan Mohd, Dr. Che Abdul Rahim Nik, Dr. Chan Hung Tuck, Dr. Zakaria Ibrahim, Dr. Lillian S.L. Chua and Mr. Nor Azman Hussein (FRIM); Dr. Lee Ying Fah and Mr. Robert Ong (FD, Sabah); Dr. Lee Hua Seng, Mr. Abang Abdul Hamid Abang Karim, Mr. See Kuan Chin and Ms. Lucy Chong (FD, Sarawak); Prof. Dato' Dr. Abdul Latiff Mohamad (Universiti Kebangsaan Malaysia); Dr. Paul P.K. Chai (ITTO Project, FD Sarawak); and Dr. Jamili Nais and Ms. Rimi Repin (Sabah Parks). Last but not least our thanks go to the botanists and supporting staff of FRIM, FD Sabah and FD Sarawak for their assistance. We finally would like to thank Mr. Joseph Pao (FD, Sarawak) who illustrated all the drawings, and to Mrs. Zainun Othman and Ms. Fazilah Ahmad for meticulously typing the manuscripts.

May 2004

E. Soepadmo
L.G. Saw
R.C.K. Chung

APOCYNACEAE

David J. Middleton¹

With contribution by Kade Sidiyasa² (*Alstonia*)

Adans., Fam. Pl. 2 (1763) 167; King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 387; Merrill, EB (1921) 494; Ridley, FMP 2 (1923) 320; Masamune, EPB (1942) 617; Browne, FTSB (1955) 60; Backer & Bakhuizen *f.*, FJ 2 (1965) 218; Whitmore, TFM 2 (1973) 3; Cockburn, TS 1 (1976) 13; Anderson, CLTS (1980) 147; Ashton, MNDTS 2 (1988) 16; Corner, WSTM 3rd. edition 1 (1988) 146; Whitmore, Tantra & Sutisna, CLK 1 (1990) 24; Kessler & Sidiyasa, TBSA-EK (1994) 50; Coode *et al.* (eds.), CLBD (1996) 24; Argent *et al.* (eds.), MNDT-CK 1 (1997) 78; Middleton, Fl. Thailand 7 (1999) 1; Beaman *et al.*, PMK 4 (2001) 102.

Trees, shrubs or climbers, rarely herbs; buttresses and/or pneumatophores sometimes present; *latex present, this usually white, less commonly cream-coloured, yellowish or bluish white.* **Indumentum** of simple hairs. **Leaves** simple, opposite or, more rarely, verticillate or spirally arranged, pinnately veined, margin entire, rarely crenulate (in Bornean species). **Inflorescences** cymose, corymbose, rarely fasciculate or paniculate, or flowers solitary, terminal or axillary. **Flowers** bisexual, 5-merous, rarely 4-merous (in *Leuconotis*), radially symmetrical or, very rarely, slightly bilaterally symmetrical (in *Allamanda*); calyx mostly of 5 more or less free lobes, sometimes fused into a tube with shortened lobes (in *Voacanga*, *Chonemorpha*), sometimes with glands at the base inside; corolla consisting of a short or long tube and erect or spreading lobes, funnel-shaped, salver-shaped, platter-shaped, trumpet-shaped, urn-shaped or rotate, lobes overlapping to the left or right, more rarely valvate; stamens inserted on the inside of the corolla tube, completely included or exerted from corolla tube throat, anthers dorsifixed, sagittate or ovate, free or adnate to the pistil head, dehiscing by longitudinal slits, sometimes with the base and apex sterile; disk present or absent, if present then of 2 or 5 lobes or an annular ring, crenate or not; ovary superior or, rarely, semi-inferior, of 2 separate carpels united into a common style, a single bilocular ovary or a unilocular ovary; pistil head with a stigmatic base and a 2-cleft apex. **Fruit** a drupe, berry, capsule or follicle, solitary if from a syncarpous ovary or paired if from an apocarpous ovary, sometimes secondarily fused appearing syncarpous (in *Parsonsia*). **Seeds** simple, arillate, winged, with a ciliate margin or with an apical and/or basal coma (hair-tuft).

Distribution. Approximately 400 genera with about 4500 species (including the Asclepiadaceae; see Taxonomy and classification below) found throughout the world but particularly diverse in the tropics. In Sabah and Sarawak, the family is represented by 24 native genera with *c.* 81 native species. In addition, 8 exotic genera with 10 species are cultivated as ornamentals.

¹Arnold Arboretum, Harvard University Herbaria, Cambridge, Massachusetts, U.S.A.

²Herbarium Wanariset, Balikpapan, Indonesia

Ecology. The Apocynaceae include small scramblers and climbers as well as large forest lianas, shrubs, small trees and large emergent trees. Amongst the tree species, most occur at lower altitudes on well drained soil with two species, *Alstonia pneumatophora* and *Dyera polyphylla*, are confined to swamp forest and *Alstonia spatulata* often in swamp forest. *Cerbera manghas* is a littoral species and *Cerbera odollam* is a riverine species.

Uses. Much has been written on the uses of various species of Apocynaceae. An attempt was made in the early 20th century to see if the latex of various species, especially *Dyera* spp. (*jelutong*), could be commercially produced. For a time, the latex of *jelutong* was an important ingredient of chewing gum. A number of species have limited local uses as timber. Several species of climbers and non-native herbs are used in the pharmaceutical industry. In Sabah and Sarawak, the most commercially important use of species of Apocynaceae is in horticulture, particularly species of *Adenium*, *Allamanda*, *Catharanthus*, *Cerbera*, *Nerium*, *Plumeria*, *Tabernaemontana*, and *Thevetia*.

Taxonomy and classification. The traditional delimitation of the Apocynaceae has been followed here, but purely for the sake of expediency. It is now becoming increasingly accepted that a more broadly delimited Apocynaceae, including the Asclepiadaceae, would more accurately reflect the evolutionary relationships within this group. Endress & Bruyns (Bot. Rev. 66 (2000) 1) have proposed 5 subfamilies within Apocynaceae *s.l.*, *viz.* the Apocynoideae, Asclepiadoideae, Periplocoideae, Rauvolfoideae, and Secamonoideae. The traditionally delimited Apocynaceae *s.s.* includes the Apocynoideae and Rauvolfoideae. The description given above and the key given below includes all the tree, shrub, climber and herb genera which are native or commonly cultivated in Sabah and Sarawak but only from these two subfamilies. There are no trees in the other three subfamilies, the traditionally delimited Asclepiadaceae, in this region. *Alstonia*, *Cerbera*, *Dyera*, *Kopsia*, *Ochrosia*, *Rauvolfia*, *Tabernaemontana*, and *Voacanga* are in the subfamily Rauvolfoideae, which in most of the previous literature is referred to as the later synonym Plumerioideae. *Kibatalia* is in the subfamily Apocynoideae.

Hunteria zeylanica (Retz.) Gardn. ex Thwaites and *Spirolobium cambodianum* Baill. have both been mentioned as occurring in Borneo but I have been unable to find a single specimen of either species from there and, consequently, have not included either in this account. *Trachelospermum borneanum* (Miq.) Boerl. is known from Borneo only by two old specimens from Kalimantan and the genus is, therefore, also not included in this key. It would key out at couplet 32 with *Parsonsia* but can be distinguished from *Parsonsia* by having the anthers only slightly exserted, subsessile stamens and two separate carpels in the ovary.

Key to genera

1. Herbs, sometimes with a woody base.....

Catharanthus G.Don

(Greek, *katharos* = pure pink; *anthos* = flower; with pure pink flowers)

Gen. Syst. 4 (1837) 95; Plaizier, Med. Landb. Wag. 81-9 (1981) 13.

Erect herb, sometimes with a woody base. Leaves opposite, with glands in the leaf axils and on the interpetiolar ridge. Inflorescences 1–2-flowered, terminal but often appearing axillary. Flowers: sepals without colleters inside; corolla lobes overlapping to the left in bud, mature corolla salver-shaped, constricted at throat;

- stamens free from the pistil head, completely included in the corolla tube; disk of 2 narrow lobes; ovary of 2 separate carpels united into a common style, with many ovules per carpel, style filiform with a collared style head. Fruits of paired follicles, many-seeded. Seeds cylindrical, blunt-ended, rugose, without a coma.
About 8 species in the tropics, 7 of which are endemic in Madagascar. One species, *Catharanthus roseus* (L.) G.Don, is cultivated in Sabah and Sarawak.
- Woody plants which are trees, shrubs or climbers.....2
2. Trees or shrubs.....3
Climbers.....19
3. Leaves spirally arranged.....4
Leaves opposite or whorled.....7
4. Leaves narrowly oblong, less than 1 cm wide; cultivated.....
Thevetia L., *nom. cons.*
(Andre Thevet, 1503/04–1592, a French missionary)
Opera Varia (1758) 212.
Small trees or shrubs. Leaves spirally arranged, with glands in the leaf axils. Inflorescences cymose, terminal. Flowers: sepals with glands inside; corolla lobes overlapping to the left in bud, mature corolla funnel-shaped; small corona lobes present above and below stamens inside; stamens completely included in corolla tube, inserted at point at which corolla tube widens, subsessile, anthers attached to each other apically across top of pistil head but not adnate to it, fertile except for acumens; disk smaller than ovary, fleshy; ovary of 2 carpels connate in lower half, then free and uniting again into common style, with several ovules per carpel, style filiform, head with wide bluntly-lobed frill. Fruit a drupe with mericarps united into an obdeltoid shape, laterally compressed; exocarp fleshy; mesocarp stony; endocarps free from each other. Seeds flattened with a small wing, one per mericarp.
About 8 species in tropical America. One species, *Thevetia peruviana* (Pers.) K.Schum., is cultivated in Sabah and Sarawak as an ornamental.
Leaves obovate or elliptic, more than 2 cm wide; cultivated or wild.....5
5. Succulent shrub, noticeably thickened at base of trunk; corolla tube wide; anthers with long bristly appendages; cultivated.....
Adenium Roem. & Schult.
(Greek, *adenos* = gland; referring to the presence of glands in the axils of leaves)
Syst. Veg. 4 (1819) 35; Plazier, Med. Landb. Wag. 80-12 (1980) 3.
Succulent shrubs. Leaves spirally arranged, clustered at branch ends, with glands in the axils. Inflorescences thyrsoid. Flowers slightly bilaterally symmetrical; corolla lobes overlapping to the right in bud, mature corolla funnel-shaped; small corona lobes present between corolla lobes; stamens completely included or exerted, inserted at point where tube widens, anthers with a long appendage at the apex, adnate to the pistil head; disk absent; ovary of 2 separate carpels united into a common style, ovules numerous per carpel. Fruits of paired follicles. Seeds many, with a coma at both ends.
About 5 species in tropical and subtropical Africa to Arabia. One species, *Adenium*

- obesum* (Forssk.) Roem. & Schutt., is commonly cultivated in Sabah and Sarawak as an ornamental.
 Small trees; corolla tube narrow; anthers without long bristly appendages; cultivated or wild.....6
6. Young twigs more than 1 cm diameter; anthers free from each other, inserted at base of corolla tube; cultivated.....
- Plumeria L.**
 (Charles Plumier, 1646–1704, a French missionary, explorer and botanist)
 Sp. Pl. 1 (1753) 209; Woodson, Ann. Miss. Bot. Gard. 25 (1938) 202.
 Trees. Branches thick and fleshy. Leaves spirally arranged; petioles long. Inflorescences cymose, terminal. Flowers: sepals without colleters inside; corolla lobes overlapping to the left in bud, mature corolla funnel-shaped; stamens free from the pistil head, inserted near base of corolla tube, completely included in tube; disk absent; ovary of two separate carpels, ovules numerous per carpel, style short. Fruits of paired follicles. Seeds flat, with a membranous wing.
 About 7 species in tropical America. *Plumeria obtusa* L. and *P. rubra* L. are cultivated in Sabah and Sarawak as ornamentals.
 Young twigs less than 1 cm diameter; anthers adnate to each other by their appendages at the top, inserted at the middle of corolla tube or higher; cultivated or wild.....
-**2. Cerbera**
7. Leaves whorled.....8
 Leaves opposite.....13
8. Shrubs or small trees with little clear latex in cut leaves; anthers with a long appendage.
Nerium L.
 (Latinised old Greek plant name—*nerion* = oleander; plants growing in damp habitat along river-bank)
 Sp. Pl. 1 (1753) 209; Pagen, Agric. Uni. Wag. Pap. 87-2 (1987) 5.
 Shrubs or small trees. Leaves in whorls of 3 or, occasionally opposite, with glands in the axils. Inflorescences thyrsoid, terminal or axillary. Flowers: sepals with glands inside; corolla with lobes overlapping to the right in bud, mature corolla funnel-shaped, sometimes doubled, with a corona at the mouth; stamens mostly completely included, inserted at point where tube widens, adnate to the pistil head at base of anther, anthers with twisted terminal appendages; disk absent; ovary syncarpous, bilocular, ovules numerous per carpel, style short. Fruit a follicle, very narrowly oblong; glabrous. Seeds pubescent, oblong, with an apical coma.
 One species in S Europe, N Africa and SW Asia. *Nerium oleander* L. is cultivated in Sabah and Sarawak as an ornamental.
 Shrubs to large emergent trees with milky latex in the cut leaves; anthers without a long appendage.....9
9. Shrubs with arching stems; flowers trumpet-shaped, more than 5 cm long.....
- Allamanda L.**
 (Frederik Allamand, ± 1736, a Swiss physician who collected the plant from Surinam in 1770)
 Mant. Pl. 2 (1771) 146; Sakane & Shepherd, Revta. Brasil. Bot. 9 (1986) 125.
 Climbers or shrubs. Leaves in whorls of 3–5, with glands in the axils. Inflorescences cymose, terminal or axillary. Flowers large and showy; sepals with

or without glands inside; corolla lobes overlapping to the left in bud, mature corolla funnel-shaped; stamens weakly coherent to the pistil head, completely included in the corolla tube; disk annular or crenate; ovary glabrous, syncarpous, unilocular with 2 parietal placentas, style filiform, pistil head collared. Fruit a spiny capsule. Seeds smooth, ovoid.

About 14 species in tropical America. *Allamanda cathartica* L. is cultivated in Sabah and Sarawak as an ornamental.

- Trees or shrubs, when young then with erect stems; flowers salver- or platter-shaped, less than 2 cm long.....10
10. Intrapetiolar stipules more than 3 mm long; large tree, trunk columnar, unbuttressed; leaf margin weakly crenulate or entire; corolla tube much shorter than lobes; fruit a follicle with winged seeds.....**3. Dyera**
 Intrapetiolar stipules less than 3 mm long or absent; shrub to large tree, with or without buttresses; leaf margin entire; corolla tube longer than lobes; fruit drupes or of paired follicles with ciliate seeds.....11
11. Corolla lobes overlapping to the right in bud; fruits of paired follicles containing seeds with one end acuminate or caudate, or drupes with thick fibrous walls or V-shaped drupes with hard walls.....**7. Rauvolfia** (in part)
 Corolla lobes overlapping to the left in bud; fruits of paired follicles containing ciliate seeds with rounded ends, or drupes which are either paired or fused and more or less globose.....12
12. Corolla throat densely pubescent; fruit of long paired follicles.....**1. Alstonia**
 Corolla throat glabrous; fruit of fibrous or hard drupes.....**6. Ochrosia** (in part)
13. Calyx lobes connate into a tube for at least half their length; seeds with a fleshy aril.....**9. Voacanga**
 Calyx lobes free except at very base; seeds with or without a fleshy aril.....14
14. Leaves with a small flap inside the base of the petiole; flowers without a disc; seeds with a fleshy aril.....**8. Tabernaemontana**
 Leaves without a small flap inside the base of the petiole; flowers with a disc; seeds simple or with long hairs at the end.....15
15. Cultivated shrubs with delicate branches; flowers in pendulous cymes; seeds with a tuft of hairs pointing back towards the base of the fruit.....
Wrightia R.Br.
 (William Wright, 1735–1819, a British physician and botanist)
 Mem. Wern. Soc. 1 (1811) 73; Ngan, Ann. Miss. Bot. Gard. 52 (1965) 114.
 Shrubs or small trees. Leaves opposite. Inflorescences cymose, terminal. Flowers: corolla lobes overlapping to the left in bud, mature corolla rotate, salver-shaped or funnel-shaped; corona of varying degrees of elaboration usually present, rarely absent or completely adnate to the corolla; stamens inserted at corolla mouth or in tube, strongly exserted from or completely included in corolla tube, anthers adnate to the pistil head; disk absent; ovary of 2 separate carpels united into a common style or of two connate carpels. Fruits of paired or connate follicles, spindle-shaped. Seeds linear, with a coma directed towards the base of the follicle.

About 24 species, distributed in the Old World tropics. One species, *Wrightia religiosa* (Teijsm. & Binn.) Benth., is cultivated as an ornamental shrub in Sabah and Sarawak.

- Wild or cultivated trees or shrubs with robust or moderate branches; flowers in erect cymes or inflorescence fasciculate; if seed has a tuft of hairs this is pointing towards apex of the follicle.....16
16. Small trees, most often near the sea; corolla lobes overlapping to the right in bud; fruits very fibrous or stone-hard.....
.....**6. Ochrosia** (in part; rare form of *Ochrosia* without verticillate leaves)
Shrubs to large trees, generally inland; corolla lobes overlapping to the right or left in bud; fruits either follicles or drupes.....17
17. Leaf blade papery; corolla lobes overlapping to the left in bud.....
.....**7. Rauvolfia** (in part; rare form of *Rauvolfia verticillata* without verticillate leaves)
Leaf blade coriaceous; corolla lobes overlapping to the right in bud.....18
18. Leaves with or without domatia on the undersurface, uppermost pair not concealing apical bud; flowers in fascicles, stamens attached to the pistil head; fruit of paired follicles; seeds with a long stalk and backward pointing hairs.....**4. Kibatalia**
Leaves without domatia on the undersurface, uppermost pair more or less concealing apical bud; flowers not in fascicles; stamens not attached to the pistil head; fruits of paired or solitary drupes, when paired with a hook on one side; seeds simple..**5. Kopsia**
19. Climbers with tendrils formed from modified inflorescences; ovary syncarpous, unilocular.....
Willughbeia Roxb., *nom. cons.*
(Fr. Willughby, 1635–1672, English zoologist)
Pl. Corom. 3 (1819) 77, t. 280; Middleton, Blumea 38 (1993) 2.
Woody climbers, producing white latex. Branches bearing tendrils formed from modified inflorescences. Leaves opposite, those of a pair equal, entire, petiolate; colleters absent from leaf axils; blade papery to coriaceous. Inflorescences cymose, axillary and, rarely, terminal, often very short, appearing fasciculate; axes puberulent or glabrous; bracts small, ovate or oblong. Flowers 5-merous, radially symmetrical; sepals connate at the base, lobes free and erect or slightly reflexed; colleters absent; corolla: lobes in bud overlapping to the left forming a cone or cylinder of erect lobes, in mature flowers spreading, ovate, elliptic or oblong, tube cylindric, somewhat inflated around the stamens, or short and inflated; stamen insertion variable, completely included within the tube, free from the pistil head, filament varying in length, anthers ovate to lanceolate, apex acute or obtuse, base rounded; disk absent; ovary single, unilocular, with 2 parietal placentas, glabrous, superior to semi-inferior, style columnar, stigma ellipsoid or cylindric, stigmatic apex as long as or longer than the stigma. Fruit a fleshy berry, spherical, ellipsoid or pear-shaped, few- to many-seeded, indehiscent. Seeds compressed ovoid, without a coma, smooth, with a very thin endosperm and thick horny cotyledons.
Sixteen species in Indo-China and W Malesia. Six species in Sabah; 7 species in Sarawak.
Climbers without tendrils; ovary syncarpous and bilocular or apocarpous.....20

20. Leaves in whorls of three or more.....
Alyxia R.Br., *nom. cons.* (in part)
 (Greek, *halusis* = chain; the fruit shape)
 Prod. (1810) 469; Middleton, *Blumea* 45 (2000) 1.
 Climbers. Leaves whorled or, more rarely, opposite, often with an intramarginal vein, usually with few glands in the axils. Inflorescences cymose, sometimes paniculate, axillary and/or terminal. Flowers: sepals without glands inside; corolla lobes overlapping to the left in bud, mature corolla salver-shaped; stamens free from the pistil head, inserted in top half of corolla tube, completely included in tube, anthers ovate, base cordate, fertile for the entire length; disk absent; ovary of 2 separate carpels united into a common filiform style. Fruit a drupe, usually moniliform (= cylindrical but constricted at regular intervals like a string of beads) with one or more subglobose segments, frequently reduced to one in mature fruit, outside somewhat succulent when mature, one-seed per segment. Seeds ovoid, with a horny and deeply ruminant endosperm.
 About 106 species, distributed from NE India through S China to Taiwan and southwards through SE Asia to Australia and eastwards through the Solomon Is. out into the Pacific west as far as Henderson Is. and north to Hawaii. In Sabah and Sarawak, six species are known.
 Leaves opposite.....21
21. Leaves punctate below (careful observation needed in thickly coriaceous leaves).....22
 Leaves not punctate below.....24
22. Leaves without a strong intramarginal vein.....
Anodendron A.DC. (in part)
 (Greek, *ano* = climbing, *dendron* = tree)
 Prod. 8 (1844) 443; Middleton, *Blumea* 41 (1996) 38; PROSEA 17 (2003) 75.
 Climbers or scramblers, with white latex. Leaves opposite, those of a pair equal, petiolate, entire. Inflorescences cymose, often paniculate, axillary and/or terminal. Flowers 5-merous, radially symmetrical; sepals free, colleters axillary; corolla consisting of a narrow cylindrical tube which widens slightly at the point of stamen insertion into the upper tube and then with spreading lobes which are usually narrow oblong or narrow elliptic, rarely ovate, falcate and overlapping to the right in bud; stamens included in the corolla tube, attached in a ring to the pistil head, anthers narrow triangular, apex acuminate, base sagittate, sterile at apex and base; disk annular, 5-dentate or 5-crenate; ovary of 2 separate carpels united into a common style, superior, ovoid, glabrous, ovules numerous, style glabrous, short; pistil head ovoid with a short sharp projection on top. Fruits of paired follicles, divergent or sub-divergent, wide at base, narrowing toward the ends, longitudinally dehiscent. Seeds beaked, grain narrow ovate or elliptic, flattened, glabrous; coma pointing towards end of fruit.
 Seventeen species, distributed from India and China northeastwards to Japan and southwards and eastwards through Indo-China to the Solomon Is. and Vanuatu. Eight species occur in Sabah and Sarawak.
 Leaves with a strong intramarginal vein.....23
23. Leaves without a small flap on the inside of petiole base; flowers 4-merous; fruit not dehiscent; seeds without a corky aril.....
Leuconotis Jack
 (Greek, *leukos* = white, *notis* = sap; with white sap)

Trans. Linn. Soc. 14 (1823) 121; Leeuwenberg, Syst. Geogr. 72 (2002) 111.

Climbers. Leaves opposite, usually with distantly spaced lateral veins, punctate below; axillary glands absent. Inflorescences cymose, axillary and/or terminal. Flowers 4-merous; sepals with or without colleters inside, outer pair and inner pair sometimes slightly of different sizes; corolla lobes overlapping to the left in bud, open corolla salver-shaped; stamens completely included in the corolla tube, anthers lanceolate, rounded at the base, fertile for the entire length, filaments short, filiform; disk absent; ovary syncarpous, bilocular, with 2–3 ovules in each locule, style short. Fruit a berry, pulpy inside. Seeds with a membranous testa.

Five species in S Thailand and Malesia. Four species are recorded from Sabah and Sarawak.

Leaves with a small flap on the inside of petiole base; flowers 5-merous; fruit dehiscent; seeds with a corky aril.....

Chilocarpus Blume

(Greek, *cheilos* = lip; *karpos* = fruit; with a fruit dehiscent like a pair of lips)

Cat. (1823) 22; Leeuwenberg, Syst. Geogr. 72 (2002) 127.

Climbers. Leaves opposite, distinctly or obscurely punctate below; intrapetiolar stipules present. Inflorescences cymose, axillary and/or terminal. Flowers: bud drumstick-shaped; sepals usually slightly connate at base, without colleters inside; corolla lobes overlapping to the left in bud, mature corolla salver-shaped with the lobes asymmetrical and slanting to the left as viewed from the inside, acuminate; stamens free from the pistil head, completely included in the corolla tube, inserted about middle or in lower half of corolla tube, filaments short and narrow, anthers ovate, base cordate, apex acute, fertile for the entire length; disk absent; ovary syncarpous, unilocular with 2 parietal placentas, ovules numerous, style filiform. Fruit a berry/capsule, fleshy when young, dehiscent into two when mature. Seeds ovoid, with a corky aril.

Thirteen species, distributed in continental SE Asia and Malesia. Ten species occur in Sabah and Sarawak.

- 24. Domatia present in the axils of lateral veins with the midrib.....25
- Domatia absent.....27

- 25. Corolla lobes overlapping to the left in bud; fruit weakly to strongly torulose (= constricted at regular intervals).....

Parameria Benth.

(Greek, *para* = close, near, *meros/meris* = parts, portions; with the fruits bunched together resembling a garland of roses)

In Bentham & Hooker *f.*, Gen. Pl. 2 (1876) 715; Middleton, Blumea 41 (1996) 74.

Climbers with white latex. Leaves opposite, those of a pair equal, petiolate, with axillary glands; blade papery to subcoriaceous, entire. Inflorescences cymose, often paniculate, terminal and/or axillary. Flowers 5-merous, radially symmetrical; sepal lobes free, with colleters inside; corolla lobes overlapping to the left in bud, consisting of a narrow tube and a globose head or whole bud ovoid, open corolla salver-shaped to campanulate with the lobes falcate, broad and rounded or oblong and acute to obtuse; stamens completely included within the corolla tube, attached in a ring to the pistil head, filament short, anthers narrow triangular, base sagittate, sterile at apex and base; disc 5-crenate to completely 5 separate lobes; ovary of 2 separate carpels united into a common style, superior, ovoid, densely puberulent on top, ovules numerous, style glabrous, very short; pistil head ovoid with a projection on top. Fruits of paired follicles, long, narrow and strongly to weakly torulose,

longitudinally dehiscent. Seeds hirsute, ellipsoid, flattened, with a coma pointing towards the end of the fruit.

Three species, distributed from India and S China to W Indonesia. Two species in Sabah and Sarawak, viz. *Parameria laevigata* (Juss.) Mold. and *P. polyneura* Hook.f.

Corolla lobes overlapping to the right or valvate in bud; fruit torulose to spindle-shaped26

26. Petiole 2–7 mm long; lateral veins 3–8 pairs; sepals with colleters on the inner surface; seed grain glabrous, long and narrow.....

Baharuia D.J.Middleton

(from a Malay word—*baharu* = new)

Blumea 40 (1995) 445.

Climbers or scramblers, with white latex. Leaves opposite, those of a pair equal, petiolate; blade papery, entire; lateral veins few, strongly ascending; hair-filled domatia present in the axils of lateral veins with the midrib. Inflorescences cymose, terminal and/or axillary, lax. Flowers 5-merous, radially symmetrical, small; sepals free, colleters present in a row on the inside of the base; corolla lobes overlapping to the right in bud, mature corolla urn-shaped to salver-shaped, consisting of a tube and somewhat spreading, narrow, strap-shaped lobes which are strongly bent to the right as viewed from inside; stamens completely included within the corolla tube, attached in a ring to the pistil head at the attachment of the filaments to the anthers, anthers with a short filament, narrowly triangular, apex acuminate, base sagittate, sterile at apex and base; disc 5-dentate or 5-crenate, usually slightly shorter than ovary; ovary of 2 separate carpels united into a common style, superior, ovoid, pubescent. Fruits of 2 parallel or slightly divergent follicles, narrow and torulose, longitudinally dehiscent. Seeds linear, glabrous, unbeaked apex bearing a cream-coloured coma.

One species, *Baharuia gracilis* D.J.Middleton, in Sumatra and Borneo. In Borneo occurring in both Sabah and Sarawak.

- Petiole (6–)8–34 mm long; lateral veins 3–16 pairs; sepals without colleters on the inner surface; seed grain pubescent, ellipsoid.....

Urceola Roxb. (in part)

(Latin, *urceolus* = urn-shaped; the corolla)

As. Res. 5 (1798) 169; Middleton, Kew Bull. 49 (1994) 760, Blumea 41 (1996) 82.

Climbers with latex. Leaves opposite, those of a pair equal, petiolate, with or without glands in the axils; blade papery to coriaceous, entire. Inflorescence cymose or sometimes paniculate, terminal and/or axillary. Flowers 5-merous, radially symmetrical; sepal lobes free, with a few colleters inside or absent; corolla lobes in bud overlapping to the right or valvate, open corolla urn-shaped to campanulate, lobes triangular or falcate to the right often with a marked projection pointing to the right as viewed from the inside; stamens completely included within the corolla tube, attached in a ring to the pistil head, filament short, anthers narrow triangular, base sagittate, sterile at apex and base; disc annular to 5-dentate; ovary of 2 separate carpels united into a common style, superior, ovoid, densely puberulent on top, ovules numerous, style glabrous, very short; pistil head ovoid with a projection on top. Fruits of paired follicles, very variable in shape, longitudinally dehiscent. Seeds hirsute, ellipsoid, flattened, with a coma pointing towards the end of the fruit.

Sixteen species, distributed from India and China through Indo-China and the Indonesian Archipelago to New Guinea. Five species occur in Sabah and Sarawak.

27. Branchlets densely covered in pale lenticels.....28
 Branchlets without lenticels, or with a very few lenticels.....29

28. Lateral veins clearly ascending, anastomosing or not into an intramarginal vein; anthers with an elongated acumen; seeds with long stalk bearing hairs.....

Strophanthus DC.

(Greek, *strophe* = twist, turning, *anthos* = flower; with twisting corolla lobes)
 Bull. Soc. Philom. 3 (1802) 122; Beentje, Meded. Landb. Wag. 82-4 (1982) 17.

Large woody climbers, sometimes forming large shrubs with pendant branches before beginning to climb. Leaves opposite, with axillary glands, the outer two of which appear like small stipules, glabrous. Inflorescences cymose, terminal; bracts mostly persistent. Flowers: sepals with colleters inside; corolla lobes overlapping to the right in bud, sometimes forming a long twisted acumen, tube widening around the middle, corona 10-lobed, inserted at the base of the lobes, the lobes ovate or elongated into narrow tails, glabrous, mature corolla funnel-shaped; stamens completely included in the corolla tube except for long acumen on anthers, filaments short, swollen abaxially, pubescent, anthers narrowly triangular, base sagittate, with sterile area and apex drawn out into a long acumen, adnate to the pistil head; disk absent; ovary of two free carpels, often partly connate at the base, ovules numerous, style glabrous; pistil head with basal frill, 10-lobed. Fruits of 2 divergent follicles, connate at the base. Seeds apically beaked, with a deciduous basal coma and an apical coma, flattened.

Thirty eight species, distributed in Africa, India, China, SE Asia and Malesia. Two species, *Strophanthus caudatus* (L.) Kurz and *S. singaporianus* (Wall. ex G. Don) Gilg, occur in Sabah and Sarawak.

- Lateral veins more or less straight and anastomosing into a strong intramarginal vein; anthers with no elongated acumen; seeds without stalk, hairs in a tuft from seed end.....

Aganosma (Blume) G. Don

(Greek, *aganos* = friendly/agreeable, *osme* = odour/fragrance; the flowers)
 Gen. Syst. 4 (1837) 77; Middleton, Kew Bull. 51 (1996) 456. Basionym: *Echites* sect. *Aganosma* Blume, Bijdr. Fl. Ned. Ind. (1826) 1040.

Climbers, sometimes forming a shrub with arching branches when young. Leaves opposite, usually with an interpetiolar ridge bearing glands. Inflorescences cymose often forming a panicle, terminal, sometimes also axillary. Flowers: sepals narrowly ovate to linear, colleters many to absent inside; corolla lobes overlapping to the right in bud, mature corolla with spreading or erect lobes; stamens inserted near base of corolla tube, filaments short or anthers subsessile, anthers sagittate, with a sterile area, adnate to the pistil head; disk annular or 5-dentate; ovary of two separate carpels united into a common style, ovules numerous, ovary pubescent or glabrous. Fruits of paired follicles, linear. Seeds flattened, with an apical coma.

Eight species, distributed from India and S China to W Indonesia. One species, *Aganosma marginata* (Roxb.) G. Don., occurs in Sabah.

29. Lateral and intercostal veins fine and forming an anastomosing network; anthers exerted from corolla tube.....

Vallariopsis Woodson

(resembling the genus *Vallis*, Apocynaceae)
 Philip. J. Sci. 60 (1936) 228; Rudjiman, Agric. Univ. Wag. Pap. 86-5 (1986) 89.

Climbers. Leaves opposite, those of a pair equal, petiolate; blade papery. Inflorescences cymose, terminal or axillary. Flowers 5-merous, radially symmetrical; sepals with axillary colleters; corolla with lobes in bud overlapping to the right, consisting of a narrow cylindrical part and an upper campanulate part starting at the point of stamen insertion, lobes spreading, falcate; stamens slightly exserted from the corolla tube, attached in a ring to the pistil head, anthers subsessile, narrow triangular, apex acuminate, base sagittate, sterile at apex and base; disk cup-shaped, shorter than the ovary, 5-lobed; ovary of 2 separate carpels united into a common style, superior, ovoid, glabrous, ovules numerous; pistil head ellipsoid. Fruits of paired follicles, long and thin, glabrous. Seeds long narrow linear, glabrous, with a terminal coma pointing towards fruit apex.

One species, *Vallariopsis lancifolia* (Hook.f.) Woodson, occurs in Peninsular Malaysia, Sumatra and Borneo. Not yet collected in Sabah or Sarawak but is known from Brunei and W Kalimantan.

Lateral veins usually distinct from intercostal venation and not forming an anastomosing network; anthers included or exserted from corolla tube.....30

30. Lateral veins very straight, often anastomosing into an intramarginal vein.....31
 Lateral veins curved-ascending, even if only at the ends, joining into an intramarginal vein or not.....32

31. Lateral veins at an angle of *c.* 80° from midrib; corolla tube more than 20 mm long; fruits of paired follicles.....

Eucorymbia Stapf

(Greek, *eu* = good, well-developed, *korumbos* = bunch; with flowers borne in well-developed bunches)

In Hooker, Icon. Pl. ser. 4, 28 (1905) *t.* 2764.

Climbers with white latex. Twigs terete or weakly angled, lenticellate; branchlets glabrous. Leaves opposite. Inflorescences cymose, glabrous. Flowers 5-merous, radially symmetrical; sepals deciduous, with colleters inside; corolla lobes overlapping to the right in bud, open corolla salver-shaped, tube narrow at base and widening at stamen insertion, lobes obovate, narrow at base, rounded at apex; stamens sessile, anthers narrowly triangular, apex acute or acuminate, base sagittate, with sterile area, weakly adnate to the pistil head; disk annular, 5-lobed; ovary of two carpels united into a common style, ovules numerous, style filiform. Fruits of paired follicles, spindle-shaped, slightly flattened, densely lenticellate. Seeds elliptic, flattened, without a terminal coma.

One species, *Eucorymbia alba* Stapf., in W Malesia. Uncommon in both Sabah and Sarawak.

Lateral veins at an angle of less than 80° from midrib; corolla tube less than 10 mm long; fruit a berry with a woody wall.....

Melodinus Forst.

(Greek, *melon* = apple, *dinein* = creeper, climber; a creeper/climber with apple-like fruits)

Char. Gen. (1776) 37; Pichon, Mém. Mus. Nat. Hist. Nat. sér 2, 24 (1948) 125.

Climbers. Leaves opposite, without or with a few glands in the axils; venation often raised, lateral veins anastomosing before margin forming an intramarginal vein; petiole base usually meeting across the stem. Inflorescences cymose or often paniculate, axillary and/or terminal. Flowers: corolla lobes overlapping to the left

in bud, open corolla funnel-shaped or salver-shaped, with a corona at the mouth; stamens completely included in corolla tube, anthers narrowly elliptic or lanceolate, base very short bluntly sagittate, fertile for the entire length, filaments short, filiform; disk absent; ovary syncarpous, bilocular, with numerous ovules, glabrous, style slender. Fruit a hard-walled solitary berry. Seeds ellipsoid, flattened; surface patterned.

Nineteen species, distributed in SE Asia, Malesia, Australia, and the W Pacific. One species, *Melodinus orientalis* Blume, in Sabah and Sarawak.

32. Stamens exerted from the throat of the corolla; fruit of a single follicle formed from fused carpels.....

Parsonsia R.Br., *nom. cons.*

(J. Parson, 1705–1770, English naturalist)

Asclep. (1810) 53; Middleton, *Blumea* 42 (1997) 193.

Climbers. Leaves opposite, axillary glands present or absent. Inflorescences cymose, axillary. Flowers: sepals with wide deltoid colleters inside; corolla lobes overlapping to the right in bud, elliptic, lanceolate or oblong, mature corolla salver-shaped; stamens inserted near top of corolla tube, exerted, filaments spiral or strongly bent, anthers lanceolate, sagittate, with sterile area, adnate to the pistil head; disk of 5 separate lobes or annular; ovary of two almost separate, closely adnate carpels or syncarpous and bilocular, glabrous, ovules numerous. Fruits of two adnate follicles or a single follicle which splits into two on dehiscence, spindle-shaped, not lenticellate, glabrous. Seeds glabrous, long and narrow, with an apical coma.

About 82 species, occurring in India, China, SE Asia, Malesia, W Pacific, Australia, and New Zealand. Three species occur in Sabah and Sarawak.

Stamens completely included within corolla; fruits of paired follicles or drupes.....33

33. Corolla lobes overlapping to the left in bud; stamens not adnate to the pistil head; fruit a single drupe or string of moniliform drupes.....

Alyxia

R.Br. (in part; uncommon opposite leaved form of *Alyxia reinwardtii* Blume)
Corolla lobes overlapping to the right in bud; stamens adnate to the pistil head; fruits of paired follicles.....34

34. Corolla tube more than 2 times as long as corolla lobes; inflorescences in umbelliform cymes.....

Epigynum Wight

(Greek, *epi* = upon, *gyne* = female; with superior ovary)

Icon. Pl. Ind. Orient. (1848) t. 1308.

Climbers. Leaves opposite with axillary glands; lateral veins anastomosing before margin. Inflorescence a congested flat-topped panicle formed from terminal and axillary cymes; bracts small. Flowers: sepals with or, rarely, without colleters inside; corolla in bud a narrow tube, bulging around the anthers, and an ovate head, lobes overlapping to the right in bud, tomentose outside, pubescent inside, salver-shaped when open with obovate lobes; stamens with a short filament, inserted in lower half of tube, anthers narrowly triangular, apex acuminate or acute, base sagittate, with sterile area, adnate to the pistil head; disk of 5 separate lobes or appearing annular, glabrous; ovary of 2 separate semi-inferior carpels united into a common style, ovules numerous, style filiform; pistil head long cylindrical, with an acuminate apex. Fruits of paired follicles, spindle-shaped. Seeds consisting of a

flattened grain and a coma directed towards the fruit apex, glabrous.

About 6 species, distributed from the Himalayas to Borneo. One species, *Epigynum borneense* Merr., occurs in Sabah and Sarawak.

Corolla tube less than 2 times as long as corolla lobes; inflorescences variable but not in umbelliform cymes.....35

35. Corolla lobes in bud not strongly twisted; ovary pubescent; seeds not elongated at one end.....36
 Corolla lobes in bud strongly twisted; ovary glabrous; seeds elongated at one end.....37

36. Leaves densely pubescent only on the midrib below, or pubescent all over or glabrous; stamens not inserted at the very base of corolla tube; seeds glabrous apart from coma.....

Ichnocarpus R.Br., *nom. cons.*

(Greek, *ischnos* = slender, *karpos* = fruit; with narrow and slender fruits)

Asclep. (1810) 50; Middleton, Blumea 39 (1994) 74.

Climbers or trailers. Leaves opposite. Inflorescences terminal and/or axillary. Flowers: sepals with or without axillary glands; corolla lobes overlapping to the right in bud, asymmetrical with a slant to the right, tube cylindrical or somewhat inflated, widening at the point of stamen insertion and somewhat constricted at throat, mature corolla salver-shaped; stamens inserted at around the middle or in the lower half of the corolla tube, completely included within the tube, filaments short, anthers elliptic or narrowly triangular, apex mucronate or acuminate, base shortly sagittate, with a sterile area, adnate to the pistil; disk of 5 narrow lobes longer than the ovary or entire and 5-dentate; ovary of two separate carpels united into a common style, pubescent, ovules numerous; pistil head globular or cup-shaped, apex a long narrow point or conical. Fruits of paired follicles, linear and narrow, pubescent or glabrous. Seeds unbeaked, narrowly lanceolate or linear, glabrous, with an apical coma.

Twelve species, distributed from Pakistan to Australia. Two species, *Ichnocarpus frutescens* (L.) W.T.Aiton and *I. serpyllifolius* (Blume) P.I.Forst., occur in Sabah and Sarawak.

Leaves pubescent or glabrous below but not densely pubescent only on midrib; stamens inserted at very base of corolla tube; seeds pubescent on grain...**Urceola** Roxb. (in part)

37. Intercostal venation mostly obscure or only weakly visible; calyx not united into a tube at the base; seeds with long stalk and hairs on this stalk...**Anodendron** A.DC. (in part)
 Intercostal venation clearly visible; calyx united into a tube at the base; seeds with a stalk but hairy only on the end of the stalk.....

Chonemorpha G.Don, *nom. cons.*

(Greek, *chone* = funnel, *morphe* = form, shape; with funnel-shaped flowers)

Gen. Syst. 4 (1837) 76; Middleton, Novon 3 (1993) 455.

Leaves opposite, axillary glands present. Inflorescence a terminal panicle. Flowers: sepals often connate for large part of length, colleters present inside; corolla lobes overlapping to the right and twisted to the left in bud, lobes obovate, slightly asymmetrical, salver-shaped in mature flower; stamens inserted near base of corolla tube, anthers sessile, sagittate, with sterile area, adnate to the pistil head; disk entire, 5-dentate, shorter than the ovary, glabrous; ovary of two separate carpels united into a common style, glabrous, ovules numerous. Fruits of paired

follicles. Seeds with a long beak topped with a coma directed towards the fruit apex.

About 10 species, distributed in India, China, SE Asia. One species, *Chonemorpha verrucosa* (Blume) D.J.Middleton, occurs in Sabah and Sarawak.

1. ALSTONIA R.Br.

(Charles Alston, 1685–1760, a Scottish botanist)

Kade Sidiyasa

pulai (preferred name)

Mem. Wern. Soc. 1 (1811) 75; King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 435; Ridley, FMP 2 (1923) 345; Monachino, Pacific Science 3 (1949) 137; Smythies, CST (1965) 17; Whitmore, TFM 2 (1973) 7; Markgraf, Blumea 22 (1974) 20; Cockburn, TS 1 (1976) 15; Anderson, CLTS (1980) 147; Ashton, MNDTS 2 (1988) 18; Corner, WSTM 3rd. edition 1 (1988) 149; Whitmore, Tantra & Sutisna, CLK 1 (1990) 24; PROSEA 5, 1 (1994) 82, PROSEA 12, 2 (2001) 61; Kessler & Sidiyasa, TBSA-EK (1994) 51; Coode *et al.* (eds.), CLBD (1996) 24; Argent *et al.* (eds.), MNDT-CK 1 (1997) 78; Sidiyasa, Blumea Suppl. 11 (1998) 77; Middleton, Fl. Thailand 7 (1999) 41; Beaman *et al.*, PMK 4 (2001) 103.

Small to large trees to 60 m tall; crown in young trees (except in *A. angustifolia* and *A. macrophylla*) pagoda-shaped and with a monopodial appearance; mature trees typically sympodial; *buttresses usually present, small to large, massive, symmetrical or steep, or at least fluted at base of the trunk* (pneumatophore roots found in *A. pneumatophora*). **Bark** smooth to very rough, sometimes corky (in *A. angustiloba* and *A. iwahigensis*), grey, or yellowish brown to dull brown; inner bark granular, mostly yellowish outward and whitish inward, with copious white latex (except in *A. angustifolia* and *A. macrophylla*). **Leaves** in whorls of 3–8(–9), sessile or petiolate, penninerved, *margin entire*; lateral veins vary from very numerous and close to few and distant. **Inflorescences** cymose or corymbose, compound, terminal, usually in whorls of 1–7 (sometimes up to 9), few- to many-flowered. **Flowers** fragrant, *salver-shaped*; corolla white, yellow or pinkish, *lobes overlapping to the left or right in bud*, spreading in open flower, glabrous to densely pubescent outside, *tube longer than the lobes*, almost cylindrical, mostly slightly widened around stamens, *throat densely pubescent*; stamens included, inserted at about $\frac{1}{2}$ to $\frac{3}{4}$ up from the base of corolla tube, filaments filiform, *anthers without long appendage*, ovate or, rarely, triangular, apex obtuse, acute or, rarely, mucronate; *ovary of 2 free carpels*, superior, glabrous or pubescent, without or with a distinct thickening-like disk at the base. **Fruits** of paired follicles. **Seeds** oblong, sometimes elliptic, *ends rounded, caudate, acute or acuminate*, glabrous or pubescent, *with long brown cilia longer at the ends*.

Distribution. A pantropical genus with about 45 species, predominantly in the Pacific Is. and Malesia. In Sabah and Sarawak, the genus is represented by 7 species.

Ecology. Secondary or primary forests, in various habitats from swamp forest to drier forest types at altitudes to 1700 m.

Uses. Many alkaloids have been isolated from the bark and latex. Henry (1939), cited by

Monachino (Pac. Sci. 3, 2 (1949) 134), listed 11 species of *Alstonia* with positive findings of alkaloids. The wood (except in *A. angustifolia* and *A. macrophylla*) is classified as a lightweight hardwood, suitable for making boxes, crates, coffins, drawing boards, picture frames, maches, furnitures, and handicrafts such as wooden shoes, toys, puppets and masks (cf. PROSEA 5, 1 (1994) 82). The bark and latex are used in traditional medicines (cf. PROSEA 12, 2 (2001) 61).

Key to *Alstonia* species

1. Inner bark without white latex; leaves with well-spaced lateral veins and forming an acute angle of a maximum of 80° with the midrib; corolla lobes overlapping to the right in bud; seeds acute, acuminate to caudate at one end..... 2
 Inner bark with copious white latex; leaves with closely spaced lateral veins almost perpendicular to the midrib; corolla lobes overlapping to the left in bud; seeds rounded at both ends..... 3
2. Leaves mostly in whorls of 3 (sometimes of 4); calyx mostly rusty pubescent, rarely puberulous or glabrescent at the apex outside; corolla lobes suborbicular or ovate, to 2.3 mm long..... **1. A. angustifolia**
 Leaves mostly in whorls of 4 (sometimes of 3); calyx glabrous or puberulous outside; corolla lobes narrowly ovate to oblong, 3.6–7 mm long..... **4. A. macrophylla**
3. Leaves with a distinct intrapetiolar stipule at base of the petiole; corolla pubescent or puberulous outside..... **6. A. scholaris**
 Leaves without a distinct intrapetiolar stipule at base of the petiole; corolla glabrous outside..... 4
4. Trees with pneumatophore roots; leaves sessile or almost so..... **5. A. pneumatophora**
 Trees without pneumatophore roots; leaves distinctly petiolate, petiole usually slightly winged..... 5
5. Leaves spatulate or sometimes obovate with a rounded apex; inflorescence with a few loose flowers; calyx glabrous outside..... **7. A. spatulata**
 Leaves obovate, elliptic or narrowly so; inflorescence with many and very crowded flowers; calyx pubescent outside..... 6
6. Corolla tube 1–1.7 times as long as corolla lobes; corolla lobes 4–6.5 mm long; fruits (follicles) pubescent..... **2. A. angustiloba**
 Corolla tube 1.8–2.8 times as long as corolla lobes; corolla lobes 2.6–4 mm long; fruits (follicles) glabrous..... **3. A. iwahigensis**

1. *Alstonia angustifolia* Wall. ex A.DC.

Fig. 1.

(Latin, *angustus* = narrow, *folium* = leaf; with narrow leaves)

Prodr. 8 (1844) 409; King & Gamble *op. cit.* 440; Merrill, EB (1921) 497; Ridley *op. cit.* (1923) 348; Masamune, EPB (1942) 617; Monachino *op. cit.* 159; Browne, FTSB (1955) 65; Smythies *op. cit.* 18; Whitmore *op. cit.* 8; Markgraf *op. cit.* 26; Anderson *op. cit.* 147; Ashton *op. cit.* 20; Corner *op. cit.* 151;

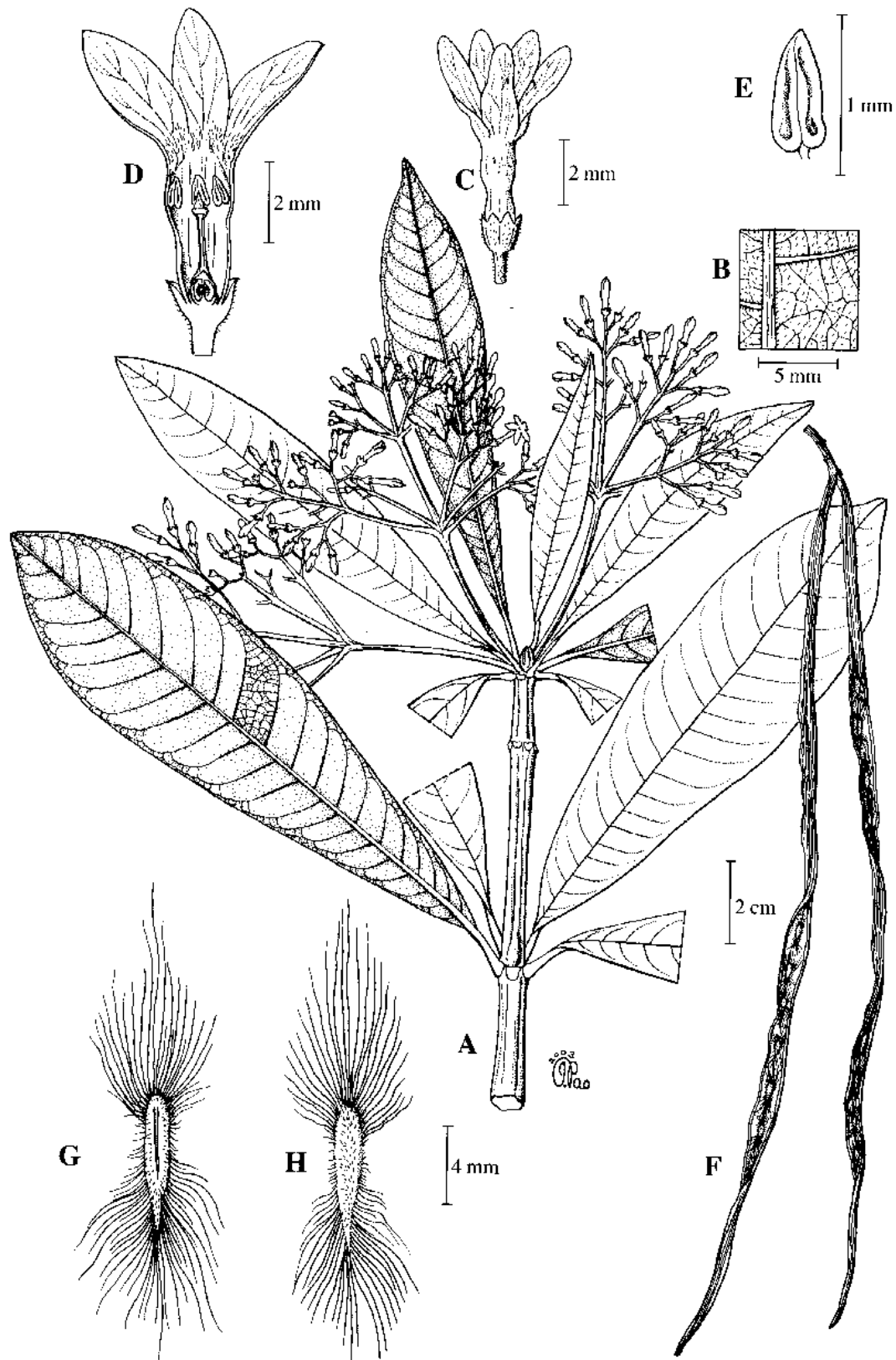


Fig. 1. *Alstonia angustifolia*. A, flowering leafy twig; B, detail of venation on lower leaf surface; C, open flower; D, longitudinal section of open flower; E, stamen; F, dehiscent fruit (follicle); G–H, seeds at different view. (A–E from SAN 33809, F–H from S 18867.)

Whitmore, Tantra & Sutisna *op. cit.* 24; Kessler & Sidiyasa *op. cit.* 51; PROSEA *op. cit.* (1994) 87, *op. cit.* (2001) 65; Turner, Gard. Bull. Sing. 47 (1995) 123; Coode *et al.* (eds.) *op. cit.* 24; Argent *et al.* (eds.) *op. cit.* 79; Sidiyasa *op. cit.* 101; Beaman *et al.* *op. cit.* 103. **Type:** *Wallich 1650*, Singapore (holotype G-DC; isotypes G, K-W). **Synonyms:** *Amblyocalyx beccarii* Benth. in Hooker, Icon. Pl. 3, 2 (1876) t.1179; *Alstonia angustifolia* Wall. ex A.DC. var. *elliptica* King & Gamble *op. cit.* 441; *A. angustifolia* Wall. ex A.DC. var. *latifolia* King & Gamble *op. cit.* 441, Kessler & Sidiyasa *op. cit.* 51; *A. latifolia* (King & Gamble) Ridl., *op. cit.* 347, Corner *op. cit.* 151.

Small to medium-sized (rarely big) tree, 5–35(–46) m tall, 8–50 cm diameter, fluted at base or with tall and steep buttresses. **Bark** smooth, shallowly fissured or flaky, grey or brownish, sometimes mottled with grey or greenish lichens; *inner bark* yellowish or straw-coloured, *without white latex*. **Leaves** in whorls of 3 (sometimes 4), chartaceous or thinly coriaceous, mostly dark red-brown when dry, glabrous above, glabrous or puberulous below; blade obovate to narrowly obovate (rarely elliptic), 4–16 × 1.5–5 cm, base acute to narrowly cuneate or decurrent onto the petiole, apex acuminate, acumen *c.* 7(–13) mm long with a blunt point; midrib sunken above; *lateral veins 10–15(–20) pairs, well-spaced, forming an acute angle of less than 80° with the midrib*, joining and forming a fine submarginal vein; intercostal venation reticulate, sometimes conspicuous on both sides; petiole 8–28 mm long, flattened or canaliculate above, slightly winged. **Inflorescences** 3–9 cm long, compound, corymbose, many-flowered. **Flowers** fragrant; pedicels 0.5–2(–3) mm long, pubescent; *calyx rusty pubescent outside, and at the apex inside*, apex mostly reflexed; corolla white or pale yellow, 3–5(–6) × 0.8–1.3 mm in mature bud, rusty pubescent outside, or sometimes puberulous or glabrescent around the apex, *lobes overlapping to the right in bud, suborbicular or ovate, 1–2.3 × 1–1.5 mm*, spreading in open flower; ovary ovoid or broadly ovoid, 0.5–0.8 × 0.6–0.7 mm, glabrous; disk 0.1–0.3 mm high. **Fruits** glabrous, 20–53 cm long, 1.7–2.5(–3) mm diameter. **Seeds** elliptic or oblong, (4.6–)6–8.6 × 1.2–1.6 mm, pubescent on both sides, *one end acute with long acumen to 4 mm long, the other end rounded*; coma 8–13 mm long, reduced towards the side margins.

Vernacular names. Sarawak—*mergalang* (Iban), *pelai* (Iban), *pelai pipit* (Iban).

Distribution. Sumatra (including Bangka), Peninsular Malaysia, Singapore, and Borneo. In Borneo, widespread in Sabah (e.g., *SAN 32355*, *SAN 64013*, *SAN 85578*, *SAN 85698*, and *SAN 132150*) and Sarawak (e.g., *S 26024*, *S 46018*, *S 48630*, *S 64330*, and *S 76721*). Also occurring in Brunei (e.g., *BRUN 5406*) and in Kalimantan (e.g., *Kostermans 6786* and *Sidiyasa 1425*).

Ecology. Primary and secondary forests, peat swamps, hilly lands, on sandy or granitic soils, at altitudes to 1700 m.

2. *Alstonia angustiloba* Miq.

(Latin, *angustus* = narrow, *lobus* = lobe; the narrow calyx lobes)

Fl. Ned. Ind. 2 (1856) 438; King & Gamble *op. cit.* 438; Merrill *op. cit.* 497; Ridley *op. cit.* 347; Masamune *op. cit.* 617; Monachino *op. cit.* 152; Browne *op. cit.* 63; Smythies *op. cit.* 18; Whitmore *op. cit.* 9; Markgraf *op. cit.* 24; Cockburn *op. cit.* 16; Anderson *op. cit.* 148; Ashton *op. cit.* 22; Corner *op. cit.* 151; Whitmore, Tantra & Sutisna *op. cit.* 25; Kessler & Sidiyasa *op. cit.* 52; PROSEA *op. cit.* (1994) 87, *op. cit.* (2001) 65; Turner *op. cit.* 123; Argent *et al.* (eds.) *op. cit.* 79; Sidiyasa *op. cit.* 104; Middleton *op. cit.* 42. **Type:** *Blume 910*, Java (holotype L). **Synonyms:** *Alstonia calophylla* Miq., *op. cit.* 439; *Paladelpa angustiloba* (Miq.) Pichon, Bull. Mus. Hist. Nat. Paris 2, 9 (1947) 299 (*excl. syn. A. iwahigensis*).

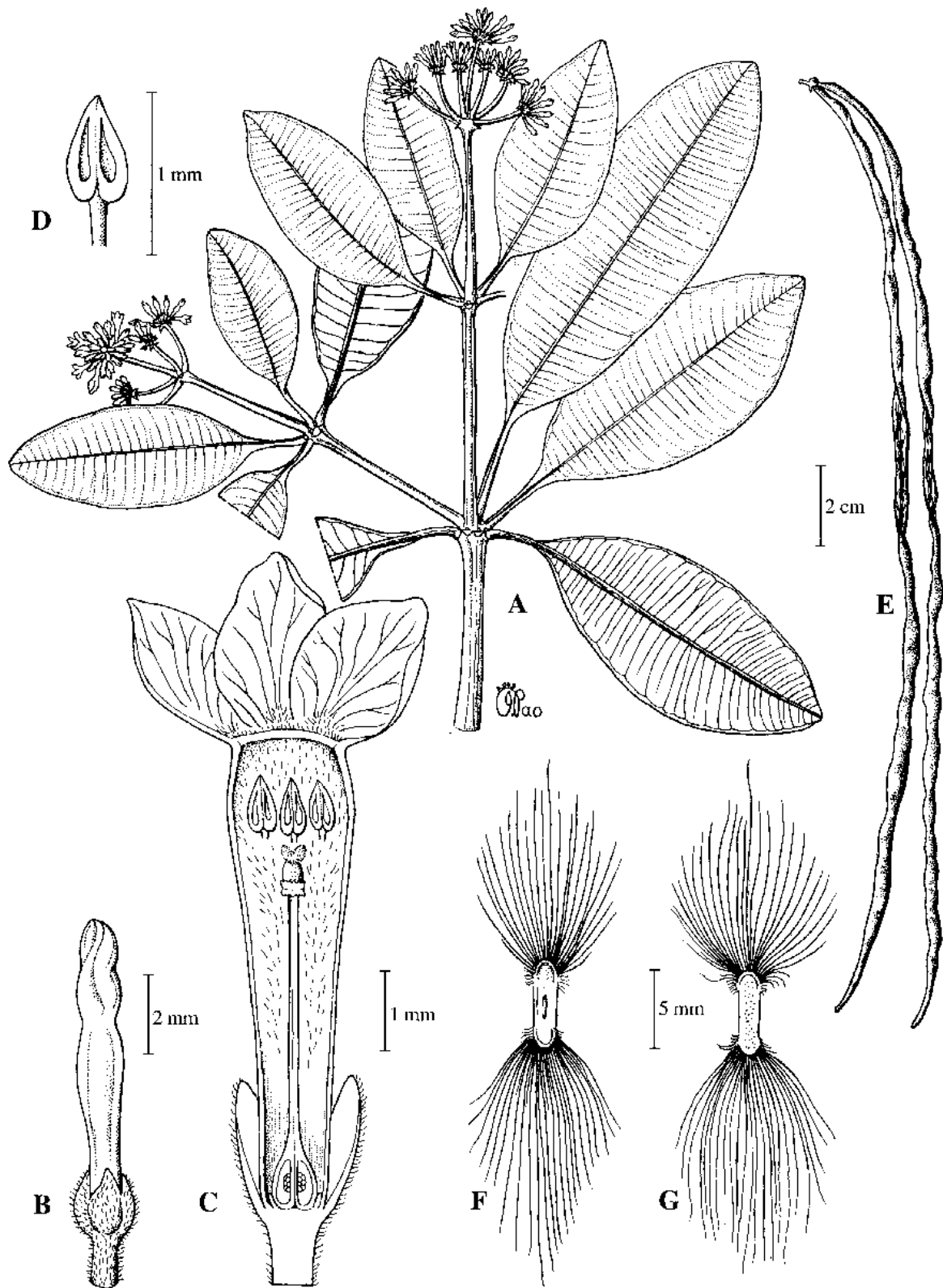


Fig. 2. *Alstonia iwahigensis*. A, flowering leafy twig; B, mature flower bud; C, longitudinal section of open flower; D, stamen; E, dehiscent fruit; F-G, seeds. (A-D from SAN 72319, E-G from SAN 142617.)

Big tree to 40 m tall, to 60(–100) cm diameter; *bole fluted at the base and forming tall steep buttresses to 8 m high*. **Bark** rough, fissured, or scaly and peeling off in rectangular flakes, greyish or brownish; *inner bark granular outwards, cream or yellow, with copious white latex*. **Leaves** in whorls of 4–7(–9), *without distinct intrapetiolar stipule at the base of petiole*, coriaceous, glabrous on both sides, pale to dark brown or blackish above, glaucous to reddish brown below; *blade elliptic, obovate or narrowly so (rarely ovate)*, 4.5–22 × 2.1–7 cm, base obtuse or acute, apex obtuse, sometimes shortly acuminate with a blunt acumen to 0.6 cm long; midrib sunken above; *lateral veins closely spaced, almost perpendicular to the midrib*, 30–60(–70) pairs; intercostal venation inconspicuous; *petiole 7–20(–30) mm long, slightly winged, flattened and shallowly canaliculate above*. **Inflorescences** 3–14 cm long, compound, usually in the form of two nodes of umbellate branches, *many-flowered*. **Flowers** fragrant; pedicels (0–)1–3 × 0.3–0.5 mm, pubescent; *calyx pubescent outside; corolla glabrous outside*, white, yellow, or cream, 8–11 mm long in mature bud, *tube 1–1.7 times as long as lobes, lobes in bud overlapping to the left*, oblique, ovate, narrowly ovate or oblong, 4–6.5 × 1.6–3 mm, spreading in open flower; ovary ovoid or broadly ovoid, 0.8–1.1 × 0.8–1 mm, glabrous, sometimes very sparsely hairy around the apex; disk obscure or absent. **Fruits** *brownish pubescent*, 15–35 cm long, 1.6–2.3 mm diameter. **Seeds** oblong, 5–7 × 1.3–1.5 mm, pubescent on the hilar side (except surrounding the hilum which is glabrous), glabrous at the other side, *ends rounded or obtuse*; coma 10–15 mm long.

Vernacular name. Sabah and Sarawak—*pulai bukit* (preferred name).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Singapore, Java, and Borneo. In Borneo, found only in the western parts of Sarawak (e.g., *S 19497, S 21587, S 28937, S 65659, and S 73307*) and in Kalimantan (e.g., *bb. 31968 and Kostermans 11140*).

Ecology. Primary and secondary forests, on hillsides, along streams, swampy areas (usually at the edges), on loamy or sandy soils and on limestone, at altitudes to 200 m.

Uses. The latex is used as a medicine to treat boils and abscesses (*Mamit S 35874*).

3. *Alstonia iwahigensis* Elmer (of Iwahig on Palawan Is., the Philippines)

Fig. 2, Plate 1A.

Leaflet. Philip. Bot. 4 (1912) 1447; Sidiyasa *op. cit.* 135; Beaman *et al. op. cit.* 103; PROSEA *op. cit.* (2001) 66. **Lectotype** (Sidiyasa, 1998): *Elmer 13167*, the Philippines, Palawan Is., Puerto Princesa, Mt. Pulgar (lectotype L; isolectotypes A, BO, G, HBG, MO, US, Z).

Medium-sized to large tree, 15–45 m tall, 20–100 cm diameter; *bole fluted at base and forming tall buttresses to 6 m high, to 2 m out*. **Bark** smooth to slightly rough, scaly or both longitudinally and horizontally fissured, greyish, yellowish or dark brown; *inner bark yellow or pale yellow, or yellowish brown inside and brown outside, with copious white latex*. **Leaves** in whorls of 4–7, *without a distinct intrapetiolar stipule at the base of petiole*, thinly coriaceous, greyish (glaucous) to pale brown below, glabrous on both sides; *blade elliptic to narrowly elliptic or obovate*, 3.5–15.2 × 1.5–4.8 cm, base acute, obtuse or rounded, apex obtuse or

rounded, sometimes shortly acuminate; midrib sunken above; *lateral veins closely spaced and almost perpendicular to the midrib*, 25–40 pairs; intercostal venation somewhat conspicuous above; *petiole* (5–)10–28 mm long, *slightly winged*, flattened and shallowly canaliculate above. **Inflorescences** 2.5–10 mm long, compound, *forming two bunches of many and densely clustered flowers*. **Flowers** fragrant; pedicels 0–1 mm long (very short or flowers sessile), pubescent; *calyx puberulous or pubescent outside*; *corolla* yellow or pinkish, 8–10 mm long in mature bud, *glabrous outside* or only sparsely ciliate around the apex, *tube 1.8–2.7 times as long as lobes, lobes overlapping to the left in bud*, ovate, mostly slightly oblique, 2.6–4 × 1.3–2.8 mm, spreading in open flower; ovary ovoid or broadly ovoid, 0.8–1.1 × 0.7–1 mm, glabrous; disk obscure or absent. **Fruits** *glabrous*, 25–35 cm long, *c.* 1.5(–2) mm diameter. **Seeds** oblong, 5–6 × 1 mm, *ends rounded*, glabrous on both sides; coma 13–17 mm long.

Vernacular names. Sabah—*tombailik* (Bundu Tuhan), *tomboilik* (Dusun, Papar).

Distribution. Borneo and the Philippines (Palawan Is.). In Borneo, common in Sabah (e.g., *SAN 30938*, *SAN 100024*, *SAN 127050*, *SAN 133976*, and *SAN 142617*) and Brunei (e.g., *Niga NN 184* and *BRUN 5005*). There are no known collections from Sarawak but the species is likely to occur in Limbang and Lawas districts. Also occurring in Kalimantan (e.g., *Sidiyasa 474*, *Sidiyasa 1432*, *Kostermans 6456*, and *Kostermans 9559*).

Ecology. Primary and secondary forests, on hillsides, on loamy or sandy soils, at altitudes to 500 m.

Notes. This species has previously mostly been treated as a synonym of *A. angustiloba*. Although difficult to tell apart when sterile, they differ in the pubescence of the fruits and in the length ratio of the corolla tube to the corolla lobes.

4. *Alstonia macrophylla* Wall. ex G. Don

Plate 1B.

(Greek, *makro* = long or large, *phullon* = leaf; with large leaves)

Gen. Syst. 4 (1837) 87; King & Gamble *op. cit.* 439; Merrill *op. cit.* 497; Ridley *op. cit.* 347; Masamune *op. cit.* 617; Monachino *op. cit.* 164; Whitmore *op. cit.* 9; Markgraf *op. cit.* 28; Cockburn *op. cit.* 18; Corner *op. cit.* 151; Whitmore, Tantra & Sutisna *op. cit.* 25; PROSEA *op. cit.* (1994) 88, *op. cit.* (2001) 66; Turner *op. cit.* 123; Argent *et al.* (eds.) *op. cit.* 79; Sidiyasa *op. cit.* 149; Middleton *op. cit.* 44; Beaman *et al.* *op. cit.* 103. **Type:** *Wallich 1648*, India, Hort. Bot. Calcutta (holotype K-W). **Synonyms:** *Alstonia macrophylla* β *glabra* A.DC., *op. cit.* 410; *A. pangkorensis* King & Gamble *op. cit.* 442.

Small to big tree, 3–40 m tall, 5–50 cm diameter, with small buttresses. **Bark** smooth, grey or brownish; *inner bark* cream or straw-coloured and with broken orange laminations, *without white latex*. **Leaves** *usually in whorls of 4 (sometimes of 3, especially on flowering branchlets)*, chartaceous or thinly coriaceous, glabrous above, glabrous to pubescent below; blade narrowly obovate, sometimes obovate or narrowly elliptic, 10–28 × 2.5–6(–9.3) cm (on sterile materials the size can be much larger to 40 × 12 cm), base narrowly cuneate to cuneate or decurrent into the petiole, apex shortly acuminate, acumen to 10(–20) mm long; midrib sunken above; *lateral veins well-spaced, forming an acute angle of less than 80° with the midrib*, 13–25(–31) pairs; submarginal vein present; intercostal venation reticulate, mostly inconspicuous above; *petiole* (3–)10–35 mm long, canaliculate above. **Inflorescences** 2.5–11 cm long, compound, many-flowered. **Flowers** fragrant; *calyx glabrous or puberulous outside, glabrous inside (around the*

apex sometimes laxly puberulous), ciliate; corolla white, 7–10 × 0.9–1 mm in mature bud, glabrous or very sparsely hairy on the apical part outside, *lobes overlapping to the right in bud, narrowly ovate or oblong*, sometimes slightly falcate, 3.6–7 × 1–2.6 mm, spreading in open flower; ovary ovoid, 1–1.4 × 0.7–1 mm; thickening-like disk 0.3–0.4 mm high. **Fruits** glabrous, 20–40 cm long, (1.5–)2–2.5 mm diameter. **Seeds** elliptic or oblong, 6–8 × 1.6–2 mm, pubescent on both sides, *one end long-acuminate with an acumen to 2 mm long* (which is sometimes bifid at the apex), the other end rounded; coma 6–10 mm long, reduced towards the side margins.

Vernacular names. Sabah—*mangalang* (Kota Belud), *pulai daun besar* (preferred name), *sayongan* (Bajau, Bum-Bum Is.).

Distribution. Sri Lanka, India (Nicobar Is.), Thailand, Cambodia, Vietnam, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Maluku, and New Guinea. In Borneo, common in Sabah (e.g., *SAN 25756*, *SAN 64145*, *SAN 89387*, *SAN 132068*, and *SAN 261300*) but not yet reported from Sarawak.

Ecology. Primary and secondary forests, on sandy, loamy or on ultrabasic soils, edge of mangrove and *kerangas* forests, at altitudes to 500 m.

5. *Alstonia pneumatophora* Backer ex Den Berger

(Greek, *pneumatophorus* = bearing knee-shaped breathing roots)

Meded. Proefst. Thee 97 (1926) 153; Monachino *op. cit.* 153; Smythies *op. cit.* 18; Anderson *op. cit.* 148; Whitmore *op. cit.* 11; Markgraf *op. cit.* 25; Ashton *op. cit.* 22; Whitmore, Tantra & Sutisna *op. cit.* 25; Kessler & Sidiyasa *op. cit.* 52; PROSEA *op. cit.* (1994) 88; Turner *op. cit.* 123; Argent *et al.* (eds.) *op. cit.* 81; Sidiyasa *op. cit.* 165. **Lectotype** (Sidiyasa, 1998): *Boschproefst. (Endert) 28E IP. 505*, Sumatra, Palembang, Banyuasin (hololectotype L; isolectotypes BO, P, U).

Large tree, 25–55 m tall, 30–100(–200) cm diameter; bole fluted at base and forming tall steep buttresses to 8 m high, to 3 m out; *pneumatophore roots well-developed*. **Bark** smooth or sparsely scaly, grey or yellowish grey; *inner bark* pale yellow or orange-brown, soft, granular, *with copious white latex*. **Leaves** in whorls of (3–)4–6, *sessile or shortly petiolate, without a distinct intrapetiolar stipule at the base of petiole*, subcoriaceous, grey-green above, brownish or dark red-brown below, glabrous on both sides; blade spatulate, sometimes obovate, 4.3–13 × 1.5–4.2 cm, base acute or tapering narrowly and evenly right down the petiole, rarely obtuse, *apex rounded, sometimes retuse*; midrib sunken above; *lateral veins closely spaced and almost perpendicular to the midrib*, 18–30 pairs; intercostal venation inconspicuous. **Inflorescences** 3–10 cm long, compound, forming two bunches of densely clustered flowers. **Flowers** fragrant; calyx pubescent outside, ciliate; *corolla glabrous outside*, white, 9–13 × 1–1.6 mm in mature bud, *lobes overlapping to the left in bud*, ovate, 3–4.3 × 2–3.2 mm, not ciliate, spreading in open flower; ovary ovoid, 0.8–1.2 × 0.7–0.9 mm, glabrous; disk obscure or absent. **Fruits** *pubescent*, 10–20 cm long, 1.5–2 mm diameter. **Seeds** oblong, 4–4.8 × 1–1.2 mm, *ends rounded*, glabrous on both sides; coma 8–12 mm long.

Vernacular names. Sabah—*pulai lilin* (Beaufort). Sarawak—*pulai paya* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Singapore, Borneo, and Sulawesi. In Borneo, common in its suitable habitat in Sabah (e.g., *SAN 42556*, *SAN 73764*, *SAN 89352*, *SAN 139744*, and *SAN 140181*), Sarawak (e.g., *Haviland 1689*, *S 551*, *S 552*, and *S 16414*), Brunei (e.g., *BRUN 48167*), and Kalimantan (e.g., *bb. 4961*, *bb. 1299*, *bb. 502*, *bb. 19853*, and *Kostermans 4537*).

Ecology. Swampy areas, on periodically inundated habitats along stream, on sandy loam or heavy loam soils, at altitudes to 50 m.

6. *Alstonia scholaris* (L.) R.Br.

(Latin, *schola* = school; pertaining to a school)

Mem. Wern. Soc. 1 (1811) 76; King & Gamble *op. cit.* 436; Merrill *op. cit.* 498; Ridley *op. cit.* 346; Masamune *op. cit.* 617; Monachino *op. cit.* 146; Smythies *op. cit.* 20; Whitmore *op. cit.* 11; Markgraf *op. cit.* 23; Anderson *op. cit.* 148; Ashton *op. cit.* 23; Corner *op. cit.* 152; Whitmore, Tantra & Sutisna *op. cit.* 25; Kessler & Sidiyasa *op. cit.* 52; PROSEA *op. cit.* (1994) 88, *op. cit.* (2001) 67; Turner *op. cit.* 123; Coode *et al.* (eds.) *op. cit.* 25; Argent *et al.* (eds.) *op. cit.* 81; Sidiyasa *op. cit.* 176; Middleton *op. cit.* 45; Beaman *et al.* *op. cit.* 103. **Basionym:** *Echites scholaris* L., Mant. (1767) 53. **Type:** LINN. 302.2 (holotype LINN). (For further synonymy, *cf.* Sidiyasa *op. cit.* (1998) 176).

Medium-sized to large tree, 10–50(–60) m tall, 20–80(–130) cm diameter; *bole fluted at base and forming tall steep buttresses to 10 m high, to 4 m out.* **Bark** smooth, scaly and peeling off in rectangular flakes, mostly with large horizontal lenticels, pale brown; *inner bark* granular, creamy, yellow or straw-coloured, *with copious white latex.* **Leaves** in whorls of 4–8(–9), *with a distinct intrapetiolar stipule at the base of petiole, to 2.5 mm long,* subcoriaceous, glabrous, glossy and dark green above, glabrous or velutinous and glaucous below; blade obovate, elliptic or narrowly obovate, (5–)6–17(–31) × (1.5–)2.5–8.5 cm, base acute or decurrent into the petiole, sometimes obtuse, apex obtuse or rounded, sometimes retuse; midrib sunken above; *lateral veins 25–45(–55) pairs, closely spaced and almost perpendicular to the midrib;* intercostal venation reticulate; petiole 5–25 mm long, flattened and shallowly canaliculate above, slightly winged. **Inflorescences** 4–13(–17) long, compound, many-flowered, mostly forming two bunches of many and densely clustered flowers. **Flowers** fragrant; pedicels 0–2 mm long, pubescent; calyx pubescent outside; *corolla pubescent or partly pubescent outside,* white, yellow or cream, 7–12 mm long in mature bud, *lobes overlapping to the left in bud,* ovate to broadly ovate, or suborbicular, 3–5 × 2.5–4.5(–7) mm, spreading in open flower; ovary ovoid or broadly ovoid, 0.9–1.5 × 0.7–1 mm, tomentose; disk obscure or absent. **Fruits** glabrous, 20–40(–63) cm long, *c. 2(–2.5) mm diameter.* **Seeds** oblong, 4.5–5.5(–7) × 1.2–1.6(–2) mm, glabrous on both sides, *ends rounded;* coma 8–14 mm long.

Vernacular names. Sabah—*pulai* (Malay). Sarawak—*kacau gitik* (Malay), *pulai lilin* (preferred name).

Distribution. India, Myanmar, Thailand, Laos, Vietnam, Malesia, Australia, Solomon, and Vanuatu. In Borneo, scattered in Sabah (*SAN 27410*, *SAN 51713*, *SAN 94109*, *SAN 95355*, and *SAN 122167*), Sarawak (e.g., *S 19640*, *S 54284* and *S 57432*), Brunei (e.g., *BRUN 5407*), and Kalimantan (e.g., *Ambriansyah & Arifin AA959*, *Sidiyasa 1103* and *Kostermans 6772*).

Ecology. Primary and secondary forests, along streams (rarely in swamps), coastal plains, ridges, on clay or ultrabasic soils, granite bedrock and limestone, at altitudes to 1230 m.

Uses. As a treatment for diarrhoea, stomach ache and snakebite. For snakebites the latex is applied at the edge of the wound.

7. *Alstonia spatulata* Blume

(Latin, *spatulatus* = spatula-shaped; the leaf)

Bijdr. Fl. Ned. Ind. (1826) 1037; King & Gamble *op. cit.* 437; Merrill *op. cit.* 498; Ridley *op. cit.* 346; Masamune *op. cit.* 617; Monachino *op. cit.* 153; Browne *op. cit.* 63; Smythies *op. cit.* 20; Whitmore *op. cit.* 12; Markgraf *op. cit.* 25; Anderson *op. cit.* 148; Ashton *op. cit.* 26; Corner *op. cit.* 152; Whitmore, Tantra & Sutisna *op. cit.* 25; PROSEA *op. cit.* (1994) 89, *op. cit.* (2001) 68; Turner *op. cit.* 123; Coode *et al.* (eds.) *op. cit.* 25; Argent *et al.* (eds.) *op. cit.* 81; Sidiyasa *op. cit.* 181; Middleton *op. cit.* 46. **Type:** *Blume s.n.* (= RHL Sheet No. 898129143), Java (holotype L). **Synonym:** *Alstonia cuneata* Wall. ex G. Don *op. cit.* 87.

Medium-sized tree, 10–25 m tall, 15–40 cm diameter; *bole sometimes forming plank symmetrical buttresses to 1.2 m high*. **Bark** smooth, scaly or minutely fissured and peeling off in square or rectangular flakes, pale to dark grey or almost black; *inner bark white, creamy or pale yellow, with copious white latex*. **Leaves** in whorls of 3–5, *without a distinct intrapetiolar stipule at the base of petiole*, coriaceous, glabrous on both sides, glossy and dark green above, pale green below, yellowish grey when dry; *blade spatulate, sometimes obovate*, 3–12 × 1.8–4.8 cm, base obtuse, acute, or decurrent into the petiole, *apex rounded*, sometimes retuse; midrib sunken above; *lateral veins closely spaced and almost perpendicular to the midrib*, 20–40 pairs; intercostal venation inconspicuous; *petiole 4–15 mm long*, flattened and shallowly canaliculate above, *slightly winged*. **Inflorescences** 3–11 cm long, *with a few (3–6), loose flowers*. **Flowers** fragrant; pedicels (2.5–)4–9 mm long, glabrous; *calyx glabrous on both sides, ciliate; corolla glabrous outside*, white, yellow or cream, 14–15 mm long in mature bud, *lobes overlapping to the left in bud*, elliptic, 6.7–11 × 3.5–6 mm, margins most often undulate, not ciliate, spreading or almost reflexed in open flower; ovary ovoid to broadly ovoid, 0.8–1.5 × 0.9–1.5 mm; disk absent. **Fruits** glabrous, 12–25 cm long, 2.5–3 mm diameter, smooth or almost so. **Seeds** oblong, 5–6 × 1.6–2.2 mm, *ends rounded or sometimes obtuse*, glabrous on both sides; coma (12–)15–22 mm long.

Vernacular names. Sabah—*pulai basong* (preferred name). Sarawak—*pulai apong* (Malay), *pulai pipit* (Malay).

Distribution. Cambodia, Thailand, Vietnam, Sumatra, Peninsular Malaysia, Singapore, Java, Borneo, and New Guinea. In Borneo, scattered in Sabah (e.g., *SAN 84745*, *SAN 102989*, *SAN 115213*, *SAN 126124*, and *SAN 126179*), Sarawak (e.g., *S 12441*, *S 16701*, *S 26696*, *S 29377*, and *S 30156*), Brunei (e.g., *BRUN 5711*), and Kalimantan (e.g., *bb. 18115* and *bb. 12625*).

Ecology. Swampy areas, mostly in secondary vegetations, on sandy soils, at altitudes to 600 m.

2. CERBERA L.

(Greek, *cerberos* = the dog guarding the gates of hell in Greek mythology; inference unknown but may be due to the presence of scales over the stamens at the red corolla throat in *C. manghas*)

Sp. Pl. (1753) 208; King & Gamble, J. As. Soc. Beng 74, 2 (1907) 426; Ridley, FMP 2 (1923) 338; Backer & Bakhuizen *f.*, FJ 2 (1965) 232; Whitmore, TFM 2 (1973) 12; Anderson, CLTS (1980) 148; Ashton, MNDTS 2 (1988) 26; Corner, WSTM 3rd. edition 1 (1988) 153; Kessler & Sidiyasa, TBSEK (1994) 53; Coode *et al.* (eds.), CLBD (1996) 26; Argent *et al.* (eds.), MNDT-CK 1 (1997) 81; PROSEA 5, 3 (1998) 154, PROSEA 12, 2 (2001) 151; Middleton, Fl. Thailand 7 (1999) 65; Leeuwenberg, Agric. Univ. Wag. Pap. 98-3 (1999) 5.

Shrubs or small trees, most frequently growing near sea or along rivers (also often cultivated). Sapwood grey and soft. *Twigs* (young) less than 1 cm diameter. *Leaves* spirally arranged, with axillary glands; *blade* obovate or elliptic, more than 2 cm wide. **Inflorescences** panicate, terminal; bracts foliolyse, very similar to the sepals. **Flowers:** sepals generally quite large, without colleters inside; *corolla tube* narrow, lobes overlapping to the left in bud, mature corolla salver-shaped, sometimes weakly funnel-shaped at top of tube, lobes elliptic to obovate, corona of short lobes perpendicular to the corolla tube above and below stamens; *stamens* completely included in corolla tube, more or less sessile, *anthers* connate to each other by their non-bristly appendages at the top, ovate, fertile except for the appendage; disk absent; ovary of 2 separate carpels united into a common style, glabrous, with several ovules per carpel, style filiform. **Fruit** a drupe, with one seed per locule, often only one carpel developing; exocarp fleshy; *mesocarp* fibrous; *endocarp* lignified. **Seeds** flattened, ellipsoid.

Notes. Care has to be exercised when referring to the literature on *Cerbera* species as the names *C. manghas* and *C. odollam* have frequently been used incorrectly.

Key to *Cerbera* species

Stamens inserted at apex of corolla tube leading to a bulge right at corolla throat; corolla mostly white with a red “eye”; principally sea-shore trees.....**1. *Cerbera manghas***

Stamens inserted around the middle of corolla tube leading to a bulge in the middle of the tube; corolla mostly white with a yellow “eye”; principally riverine trees.....**2. *Cerbera odollam***

1. *Cerbera manghas* L.

(from the word mango; referring to the mango-like fruit)

Sp. Pl. (1753) 208; Merrill, EB (1921) 500; Masamune, EPB (1942) 619; Browne, FTSB (1955) 66; Backer & Bakhuizen *f. op. cit.* 233; Whitmore *op. cit.* 12; Anderson *op. cit.* 148; Ashton *op. cit.* 27; Corner *op. cit.* 153; Coode *et al.* (eds.) *op. cit.* 26; PROSEA *op. cit.* (1998) 156, *op. cit.* (2001) 154; Middleton *op. cit.* 67; Leeuwenberg *op. cit.* 21. **Type:** *Osbeck s.n.*, “East India” (LINN 298.2). **Synonyms:** *Tanghinia manghas* (L.) G.Don *op. cit.* (1837) 98; *Cerbera lactaria* auct. non Buch.-Ham. ex Spreng; Ridley *op. cit.* 339. (For further synonymy, *cf.* Leeuwenberg *op. cit.* 21).

Tree to 25 m tall, generally much smaller, to 70 cm diameter, generally much less. **Bark** grey or reddish brown, smooth or flaky; inner bark white or khaki. **Sapwood** white. **Twigs** glabrous. **Leaves** papery to coriaceous, brittle when dry; blade elliptic to obovate, 5–31 × 1–7 cm, 1.7–7 times as long as wide, base decurrent onto the petiole, apex acute, acuminate or apiculate, rarely rounded; lateral veins 13–40 pairs; intercostal venation reticulate to obscure; petiole 0.9–4.5 cm long. **Inflorescence** few- to many-flowered, robust, lax although more congested at top, 5–31 cm long, glabrous. **Flowers:** pedicels 0.3–2.8 cm

long; sepals narrowly elliptic to oblanceolate, 8–21 × 2–9 mm, erect or somewhat spreading, apex acute or acuminate, glabrous; *corolla mostly white with a red “eye”*, reported also as pure white, tube 1.7–4.3 cm long, *widening near top and not bulging around the middle*, lobes obliquely elliptic, 1.5–2.9 × 9–18 mm, 1.1–2.1 times as long as wide, glabrous outside, pubescent for most of the length of tube inside; *stamens inserted just beneath the mouth of corolla tube*, anthers 1.3–3 × 1.1–2 mm; ovary 1.2–2 mm long, style and pistil head 2.1–4 mm long. **Fruits** ripening red, oblong to ellipsoid, 5–12 × 3–7 cm.

Vernacular names. Sabah—*pong-pong* (preferred name). Sarawak—*entiba* (preferred name).

Distribution. From Seychelles through eastern Asia and Malesia to the Pacific Is. and northern Australia. In Borneo, common in Sabah (e.g., *SAN 41590*, *SAN 86166*, *SAN 86781*, and *SAN 103222*), Sarawak (e.g., *S 24318* and *S 41959*) and Kalimantan (e.g., *Ambriansyah & Arifin 177*).

Ecology. On beaches above the high tide mark or in forest near sea.

Uses. In traditional medicine, the fruits are said to alleviate rheumatism and the latex to counteract sting-ray poison. The wood is soft and of little use except for making charcoal.

2. *Cerbera odollam* Gaertn.

Fig. 3, Plate 1C.

(from the name *odallam* in Rheede’s Hortus Malabaricus)

Fruct. Sem. Pl. 2 (1791) 193; King & Gamble *op. cit.* 427, *p.p.*; Ridley *op. cit.* 339; Backer & Bakhuizen *f. op. cit.* 233; Whitmore *op. cit.* 12; Anderson *op. cit.* 148; Ashton *op. cit.* 28; Corner *op. cit.* 153; PROSEA *op. cit.* (1998) 156, *op. cit.* (2001) 154; Middleton *op. cit.* 67. **Type:** *Odallam* Rheede, *Hort. Malab. 1* (1678) t. 39. **Synonyms:** *Cerbera lactaria* Buch.-Ham. *ex Spreng.*, Syst. 1 (1825) 642; *C. dilatata* Markgr. *in Engler, Bot. Jahrb.* 61 (1927) 196.

Tree to 24 m tall, although generally much smaller, to 40 cm diameter, generally much less. **Bark** white or grey; inner bark white or pale brownish. **Sapwood** white. **Leaves** papery to coriaceous, brittle when dry; blade obovate, 8.9–26 × 2–5.7 cm, 2.5–5 times as long as wide, base decurrent onto the petiole, apex acute, acuminate or apiculate; lateral veins 12–25 pairs; intercostal venation reticulate to obscure; petiole 1.6–4 cm long. **Inflorescences** few- to many-flowered, robust, lax although more congested at top, 8.8–35 cm long, glabrous. **Flowers:** pedicels 0.5–4 cm long; sepals narrowly elliptic to oblanceolate, 6–26 × 2.5–5 mm, erect or somewhat spreading, apex acute or acuminate, glabrous; *corolla mostly white with a yellow “eye”*, reported also as pure white, tube 13–25 mm long, *bulging around the middle*, lobes obliquely elliptic, 12–38 × 8–15 mm, 1.4–3 times as long as wide, glabrous outside, pubescent in upper half of tube inside; *stamens inserted at 6.5–15 mm from the base of corolla tube*, anthers 2–4 × 1.2–2 mm; ovary 1.2–2 mm long, style and pistil head 8–12 mm long. **Fruits** ripening red, subglobose to ellipsoid, 4.7–11 × 3.7–11 cm.

Distribution. From Sri Lanka to New Caledonia. In Borneo, scattered in Sabah (e.g., *SAN 77677*, *SAN 79630*, *SAN 80643*, *SAN 126139*, and *SAN 127068*), Sarawak (e.g., *Clemens 21214*, *S 18153*, *S 18575*, *S 33601*, and *S 40189*), Brunei (e.g., *BRUN 5174*, *BRUN 16175*, *BRUN 15946*, *BRUN 5069*, and *BRUN 3104*), and Kalimantan (e.g., *Winkler 3433*).

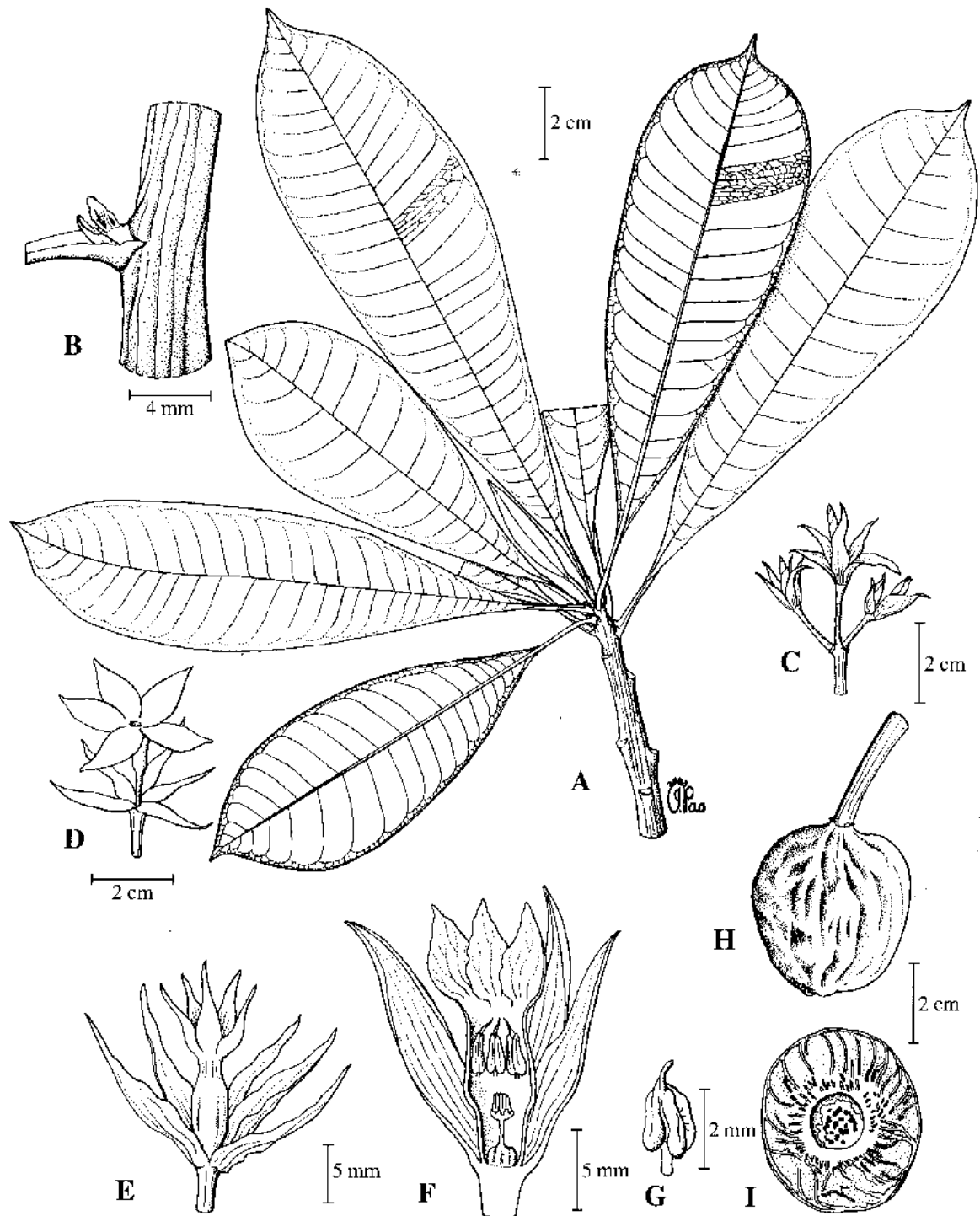


Fig. 3. *Cerbera odollam*. A, leafy twig; B, intrapetiolar stipule-like flap; C, part of inflorescence; D, fully open flower; E, partially open flower; F, longitudinal section of partially open flower; G, stamen; H, fruit; I, cross-section of fruit. (A–B and H from SAN 80643, C from Clemens 21214, D–G from S 18575, I from FA 8.)

Ecology. In, or on the edge of, mangrove and riverine forests.

Uses. Very commonly planted as a roadside tree and in gardens. Also used medicinally in a bath after childbirth.

3. **DYERA** Hook.f.

(W. Thiselton Dyer, 1843–1928, an English botanist)

jelutong (preferred name)

J. Linn. Soc. 19 (1882) 293; King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 442; Ridley, FMP 2 (1923) 344; Monachino, Lloydia 9 (1946) 174; Backer & Bakhuizen *f.*, FJ 2 (1965) 227; Smythies, CST (1965) 20; Whitmore, TFM 2 (1973) 13; Cockburn, TS 1 (1976) 18; Anderson, CLTS (1980) 148; Ashton, MNDTS 2 (1988) 28; Corner, WSTM 3rd. edition 1 (1988) 154; Whitmore, Tantra & Sutisna, CLK 1 (1990) 25; Kessler & Sidiyasa, TBSA-EK (1994) 53; PROSEA 5, 2 (1995) 225, PROSEA 18 (2000) 65; Coode *et al.* (eds.), CLBD (1996) 26; Argent *et al.* (eds.), MNMT-CK 1 (1997) 81; Middleton, Fl. Thailand 7 (1999) 36.

Trees, often growing to enormous size; trunk columnar; buttresses absent; white latex present in all plant parts. Twigs usually strongly longitudinally ribbed when young, occasionally weakly so. Intrapetiolar stipules more than 3 mm long. Leaves whorled; blade often weakly crenulate at margin, glabrous; petioles relatively long. Inflorescences of umbelliform or paniculate cymes, lax or somewhat congested in upper parts. Flowers: sepals with colleters inside, connate at base, lobes often of different sizes; *corolla lobes overlapping to the left in bud, mature corolla platter-shaped, tube much shorter than the lobes, lobes oblong to lanceolate, more or less symmetrical, auriculate at the base on both sides, glabrous on both sides; stamens free from the pistil head, completely included in the corolla tube, filaments short and narrow, anthers lanceolate, base cordate, apex apiculate without long appendage, dehiscing laterally; disc annular, inconspicuous, adnate to the ovary; ovary apocarpous but carpels closely associated and appearing syncarpous, pubescent, with many ovules per carpel, style and pistil head short. Fruits of paired, divergent heavy and woody follicles, dehiscing at maturity. Seeds elliptic, flattened, with a broadly membranous wing.*

Distribution. Two species, distributed in S Thailand, Sumatra, Peninsular Malaysia, and Borneo.

Ecology. In evergreen and swamp forests at relatively low altitudes.

Uses. Formerly the latex of both species was an important ingredient for chewing gum. This led to overtapping, especially of *Dyera polyphylla*. This use has greatly diminished. The light and soft timber of *jelutong* is excellent for hand-carving and for making or manufacturing a variety of products requiring light, soft and light-colour (whitish) wood, e.g., pattern in foundry work, pencils, picture frames, wooden toys, clogs, ceilings, partitioning, matchsticks, match boxes, packing cases, etc. (For more details see PROSEA *op. cit.* (1995) 225, *op. cit.* (2000) 65).

Note. The two species are very closely related and not always easy to distinguish.

Key to *Dyera* species

- Tree without pneumatophore roots; leaf apex mostly obtuse to shortly acuminate, rarely rounded; leaf base subcordate to rounded, rarely cuneate, not decurrent onto petiole.....
 **1. *D. costulata***
- Tree with pneumatophore roots; leaf apex emarginate, rarely rounded or apiculate; leaf base cuneate and decurrent onto petiole..... **2. *D. polyphylla***

1. *Dyera costulata* (Miq.) Hook.f. Fig. 4, Plate 1D.
 (Latin, *costulatus* = ribbed; possibly in reference to the ribbed twigs)

J. Linn. Soc. 19 (1882) 293; King & Gamble *op. cit.* 443; Merrill, EB (1921) 498; Ridley *op. cit.* (1923) 345; Masamune, EPB (1942) 619; Monachino *op. cit.* 190; Browne, FTSB (1955) 60; Backer & Bakhuizen *f. op. cit.* 227; Smythies *op. cit.* 21; Whitmore *op. cit.* 13; Cockburn *op. cit.* 19; Anderson *op. cit.* 148; Ashton *op. cit.* 32; Corner *op. cit.* 154; Whitmore, Tantra & Sutisna *op. cit.* 25; Kessler & Sidiyasa *op. cit.* 53; Turner, Gard. Bull. Sing. 47 (1995) 126; PROSEA *op. cit.* (1995) 229, *op. cit.* (2000) 65; Coode *et al.* (eds.) *op. cit.* 26; Argent *et al.* (eds.) *op. cit.* 83; Middleton *op. cit.* 36. **Basionym:** *Alstonia costulata* Miq., Fl. Ind. Bat. Suppl. (1861) 556. **Lectotype** (designated here): *Diepenhorst HB 1114*, Sumatra, Priaman (hololectotype U; isolectotypes K, L). **Synonyms:** *Alstonia grandifolia* Miq., *op. cit.* 555; *A. eximia* Miq., *op. cit.* 555; *Dyera laxiflora* Hook.f., Fl. Brit. Ind. 3 (1882) 644, King & Gamble *op. cit.* 444, Ridley *op. cit.* 345.

Tree to 80 m tall, to 300 cm diameter, sometimes with somewhat exposed roots *but without knee-shaped pneumatophores*. **Bark** dark grey, brown or black, peeling off evenly in small, squarish flakes bearing a dappled, somewhat rough appearance on the lower part; inner bark cream, pale grey or pale reddish. **Sapwood** cream or white. **Twigs** 3.5–9 mm diameter, glabrous. **Stipules** 3–6 mm long. **Leaves** in whorls of 4–8, coriaceous to papery, glabrous on both surfaces; blade obovate, oblong or elliptic, 5.5–42 × 1.8–14 cm, 1.6–4.3 times as long as wide, *base subcordate to rounded, rarely cuneate, not decurrent onto petiole*, margin crenulate or weakly crenulate, *apex obtuse, short-acuminate or rarely rounded*; midrib sunken to slightly raised above; lateral veins 12–24 pairs, forming 45–80° angle with the midrib, clearly distinguishable from the intercostal venation, prominent or flat above, prominent below; intercostal venation reticulate or subscalariform, prominent on both sides; petiole 2–6.2 cm long, glabrous. **Inflorescences** arranged in whorls, 4–18 cm long, glabrous, many-flowered; peduncles 2.5–9.2 cm long. **Flowers:** pedicels 1.5–6.5 mm long; sepals ovate or orbicular, 1–3 × 0.8–2 mm, 1–1.5 times as long as wide, apex rounded to acute, ciliate or not, glabrous; corolla white, yellowish green or pinkish yellow, tube 1.1–3 mm long, glabrous on both sides, lobes 3–9 × 1.2–2.3 mm, 1.7–4.4 times as long as wide, glabrous on both sides; stamens inserted at 0.5–0.6 mm from the base of corolla tube, anthers 1.1–1.4 × 0.4–0.5 mm, 2.7–3 times as long as wide, exerted 0–0.8 mm from corolla throat; ovary 0.3–0.6 mm long, style 0–0.2 mm long; pistil head 0.5–0.7 mm long. **Fruits** 18–40 × 2.5–4 cm. **Seed** grains *c.* 2.5 × 1.5 cm, including wings *c.* 5 × 2 cm.

Vernacular name. Sabah and Sarawak—*jelutong bukit* (preferred name).

Distribution. S Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, common in Sabah (e.g., *SAN 28098*, *SAN 36768*, *SAN 49557*, *SAN 55688*, and *SAN 84691*), Sarawak (e.g., *S 3565*, *S 28738*, *S 37551*, *S 65627*, and *S 68565*), Brunei (e.g., *BRUN 3152*, *Wong*

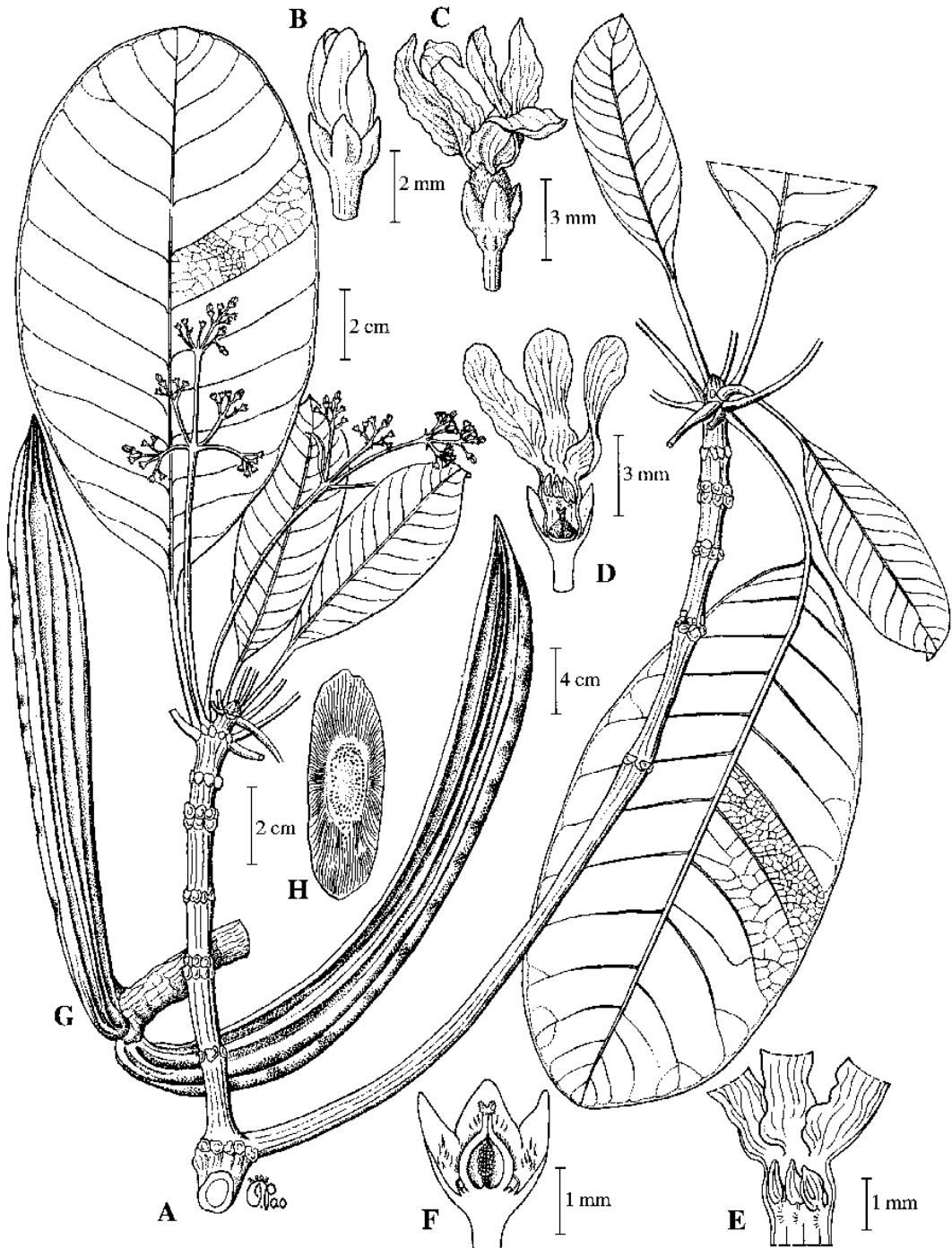


Fig. 4. *Dyera costulata*. A, flowering leafy twig; B, flower bud; C, open flower; D, longitudinal section of open flower; E, stamens showing attachment to corolla tube; F, longitudinal section of gynoecium; G, fruit; H, seed. (A from S 37571, B–F from FMS 7999, G–H from KLU 1355.)

WKM 252, Ashton 1107, and Tan 87), and Kalimantan (e.g., *bb. 16255, bb. 16962 and bb. 18246*).

Ecology. In both open areas and forest where it can be a large emergent tree, at altitudes to 1220 m.

2. *Dyera polyphylla* (Miq.) Steenis

(Greek, *poly-* = many, *phullon* = leaf; with many leaves)

Blumea 14 (1967) 316; Cockburn *op. cit.* 20; Anderson *op. cit.* 148; Ashton *op. cit.* 32; Whitmore, Tantra & Sutisna *op. cit.* 25; PROSEA *op. cit.* (1995) 230, *op. cit.* (2000) 65; Argent *et al.* (eds.) *op. cit.* 83. **Basionym:** *Alstonia polyphylla* Miq. *op. cit.* 556. **Lectotype** (designated here): *Teijsmann HB 3212*, Sumatra, Bangka, Jebus (hololectotype U; isolectotype L). **Synonyms:** *Dyera lowii* Hook.f., *op. cit.* 293, Merrill *op. cit.* 498, Masamune *op. cit.* 619, Monachino *op. cit.* 194, Browne *op. cit.* 63, Smythies *op. cit.* 21, Coode *et al.* (eds.) *op. cit.* 26; *D. borneensis* Baill., Bull. Soc. Linn. Paris, 1 (1888) 751, Merrill *op. cit.* 498, Masamune *op. cit.* 619.

Tree to 60 m tall, to 200 cm diameter; *knee-shaped pneumatophore roots chocolate brown, lenticellate*. **Bark** chocolate-brown or greyish brown with corky paler lenticels and horizontal ridges; inner bark cream. **Sapwood** cream. **Twigs** 11–14 mm diameter, glabrous. **Stipules** 4.5–5 mm long. **Leaves** in whorls of 6–8, coriaceous or subcoriaceous; blade obovate, 4–24 × 2.3–10.7 cm, 1.7–2.9 times as long as wide, *base cuneate, decurrent onto petiole*, margin not crenulate or only weakly so, *apex emarginate, retuse, or, more rarely, rounded, obtuse or apiculate*; midrib flat or slightly raised above; lateral veins 17–32 pairs, with 3–12 mm spacing, forming 65–75° angle with the midrib, more or less straight to curved-ascending, slightly prominent or flat above, not prominent below; intercostal venation reticulate to somewhat scalariform, not prominent on both sides; petiole 2.1–4.5 cm long. **Inflorescences** arranged in whorls, 8.5–14 cm long, glabrous; peduncles 4–11 cm long. **Flowers:** pedicels 1.5–3 mm long; sepals ovate to orbicular, 1–1.4 × 1–1.4 mm, 0.9–1.2 times as long as wide, apex rounded or obtuse, not ciliate, glabrous; corolla tube 1–3 mm long, glabrous or slightly pubescent below stamens inside, glabrous outside, lobes 1.8–4 × 1–1.7 mm, 1.4–3 times as long as wide, glabrous on both sides, not ciliate; stamens inserted at 0.5–0.6 mm from the base of corolla tube, filaments *c.* 0.3 mm long, anthers 0.8–1.5 × 0.3–0.4 mm, 2.7–3.8 times as long as wide, exserted 0.1–0.8 mm from corolla throat; ovary 0.5–0.9 mm long, style 0–0.1 mm long; pistil head *c.* 0.5 mm long. **Fruits** 22–30 × 1.8–4 cm. **Seed** grains 1.8–2 × 0.8–1.2 mm, including wings 3.7–4.5 × 1.2–1.5 mm.

Vernacular name. Sabah and Sarawak—*jelutong paya* (preferred name).

Distribution. Sumatra and Borneo. In Borneo, locally common in Sabah (e.g., *SAN 22297, SAN 36671 and SAN 130247*), Sarawak (e.g., *Haviland 2170, KEP 10816, KEP 79326, S 9750, and S 58063*), Brunei (e.g., *BRUN 16911, FMS 30549, Van Niel 3966, Watson 39633, and Kamaruddin KMS 2406*), and Kalimantan (e.g., *bb. 18112, bb. 28079, bb. 29444, bb. 35355, and bb. 19973*).

Ecology. Peat swamp forest at low altitude, frequently in association with *Alstonia pneumatophora*.

4. KIBATALIA G. Don

(from a Sundanese name—*ki batali*)

Gen. Syst. 4 (1837) 86; Backer & Bakhuizen *f.*, FJ 2 (1965) 238; Whitmore, TFM 2 (1973) 16; Anderson, CLTS (1980) 149; Rudjiman, Agric. Univ. Wag. Pap. 86-5 (1986) 36; Ashton, MNDTS 2 (1988) 33; Whitmore, Tantra & Sutisna, CLK 1 (1990) 25; PROSEA 5, 3 (1998) 313, PROSEA 12, 2 (2001) 322; Middleton, Fl. Thailand 7 (1999) 90; Beaman *et al.*, PMK 4 (2001) 107. **Synonyms:** *Hasseltia* Blume, Bijdr. Fl. Ned. Ind. 15 (1826) 1045; *Kickxia auct. non* Dumortier: Blume, Rumphia 4 (1848) 25.

Trees or large shrubs with white latex in all parts. **Twigs** sparsely lenticellate, often transversely fissured. **Leaves** *opposite, without a flap inside the base of petiole, uppermost pair not concealing apical bud; blade coriaceous; midrib prominent below; domatia present in the axils of lateral veins with the midrib or absent.* **Inflorescences** *with a very short peduncle; flowers laxly fascicled.* **Flowers** often distinctly 5-angled; *sepals free except at the very base, ovate, with colleters inside; corolla lobes overlapping to the right in bud, mature corolla salver-shaped; stamens sessile or subsessile, anthers narrowly triangular, apex acute or acuminate, base sagittate, with sterile area, adnate to the pistil head, exerted from or included in the corolla tube; disk not as high as ovary, 5-lobed, glabrous; ovary of two separate carpels united into a common style, ovules numerous, style filiform; pistil head conical or ovoid.* **Fruits** *of paired follicles, narrowly ellipsoid or cylindrical, lenticellate or not.* **Seeds** *consisting of seed grain and a long basal beak with coma; hairs of coma directed towards apex of follicle.*

Distribution. About 15 species, distributed in SE Asia and Malesia. Two species in Sabah; 4 species in Sarawak.

Key to *Kibatalia* species

1. Lateral veins to 7 pairs; corolla tube mostly less than 10 mm long.....**3. K. maingayi**
Lateral veins 8 pairs or more; corolla tube mostly more than 10 mm long.....**2**
2. Intercostal venation obscure; blade 3–6.1 times as long as wide; corolla lobes more than 3.5 times as long as wide.....**2. K. borneensis**
Intercostal venation clearly visible; blade 1.7–3.8 times as long as wide; corolla lobes less than 3.5 times as long as wide.....**3**
3. Domatia absent on leaves below; stamens included.....**1. K. arborea**
Domatia present on leaves below; stamens exerted.....**4. K. villosa**

1. *Kibatalia arborea* (Blume) G. Don

(Latin, *arboreus* = tree-like; the growth habit)

Gen. Syst. 4 (1837) 86; Blume *op. cit.* (1848) 26; Woodson, Philip. J. Sci. 60 (1936) 226; Backer & Bakhuizen *f. op. cit.* 238; Anderson *op. cit.* 149; Rudjiman *op. cit.* 43; PROSEA *op. cit.* (1998) 313, *op. cit.* (2001) 323; Middleton *op. cit.* (1999) 91; Beaman *et al. op. cit.* 107. **Basionym:** *Hasseltia arborea* Blume *op. cit.* (1826) 1046. **Lectotype** (Rudjiman, 1986): *Blume s.n.* (= RHL Sheet No.

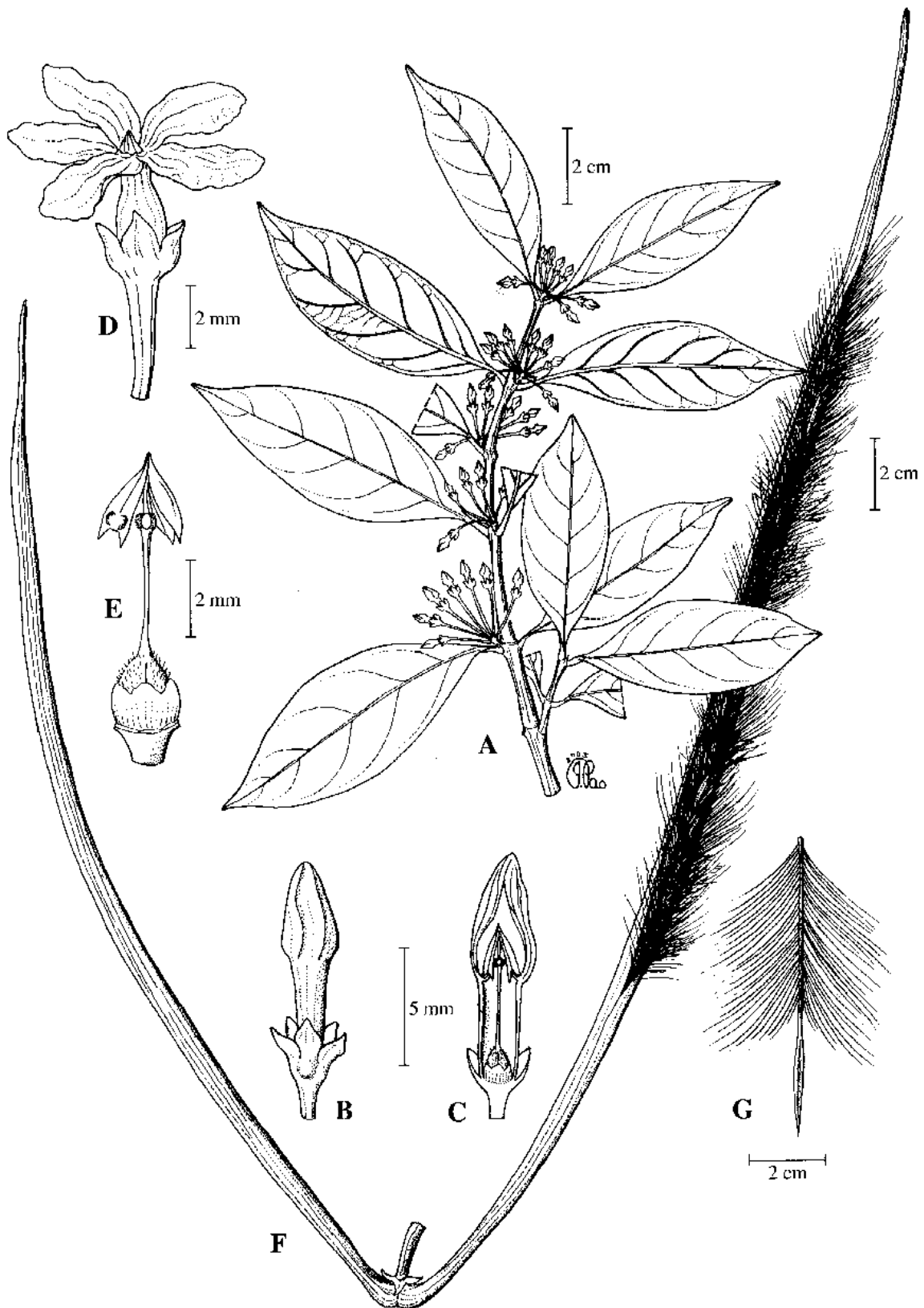


Fig. 5. *Kibatalia maingayi*. A, flowering leafy twig; B, flower bud; C, longitudinal section of flower bud; D, open flower; E, pistil showing anther attachment; F, fruit with one of the two follicles dehiscent; G, seed. (A–E from *S 15637*, F–G from *FA 1306*.)

25250255), Java, Bogor, Cihampea (hololectotype L; isolectotypes M, W). **Synonym:** *Kickxia arborea* (Blume) Blume, Fl. Jav. Ins. (1828) 7.

Tree to 45(–65) m tall, to 100 cm diameter; bole straight with short buttresses. **Bark** grey, grey-brown, dark brown or black; inner bark white, light orange or greenish. **Sapwood** white or pale yellow. **Leaves** coriaceous or papery; blade elliptic, less often obovate, 9.7–26(–35) × 3.5–13 cm, 1.7–2.5 times as long as wide, base rounded to cuneate, apex acute, acuminate or obtuse; *domatia absent*; *lateral veins 11–18 pairs*; *intercostal venation clearly visible*; petiole 5–14(–30) mm long. **Inflorescences** lax, 8–10 cm long, 1–2-flowered; peduncles 2–5 mm long. **Flowers:** pedicels 3–5 mm long; sepals 4–7 × 2–3 mm, obtuse, acute to acuminate at apex, glabrous outside; corolla white or creamy, *tube 24–45 mm long*, lower part 10–15 mm long, upper part 12–25(–40) mm long, glabrous, *lobes 2.3–3.2 times as long as wide*, elliptic or narrowly obovate, 30–40 × 10–18 mm, glabrous or pubescent on both sides; *stamens included*, inserted at 7–19 mm from the base of corolla tube, anthers 6–7 × 1–2 mm; disk cup-shaped, 2–3 mm high, obscurely 5-lobed; ovary 2.5–4 mm high, glabrous, style 1–1.9 cm long; pistil head 1–3 mm long. **Fruits** pendulous, 25–85 × 1–2.5 cm. **Seed** grains 28–35 × 2–3.5 mm, beak glabrous for *c.* 5 cm with an apical coma for 3–8 cm; coma hairs 2–10 cm long.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, Sulawesi, and the Philippines (Palawan Is.). In Borneo, scattered in Sabah (e.g., *SAN 17287*, *SAN 25131*, *SAN 30296*, *SAN 107853*, and *SAN 133833*), rare in Sarawak (e.g., *Richards 1307*).

Ecology. Lowland forest at altitudes to 500 m.

Uses. Used with great care as a tonic against internal parasites in Java.

2. *Kibatalia borneensis* (Stapf) Merr. (of Borneo)

Philip. J. Sci. 17 (1920) 309; Anderson *op. cit.* 149; Rudjiman *op. cit.* 50; Ashton *op. cit.* 33; Whitmore, Tantra & Sutisna *op. cit.* 26. **Basionym:** *Kickxia borneensis* Stapf. in Hooker, Icon. Pl. ser. 4, 27 (1901) t. 2693, Merrill, EB (1921) 501. **Type:** *Lobb s.n.*, Sarawak (holotype K). **Synonym:** *Kibatalia villosa* Rudjiman *op. cit.* 82, *p.p.* (excluding the type).

Shrub or small tree to 5 m tall. **Bark** dark brown. **Leaves** coriaceous; *blade* elliptic, oblong or slightly obovate, 9–20 × 2.4–6 cm, 3–6.1 times as long as wide, base cuneate, apex acuminate to caudate; *domatia present*, rarely absent; *lateral veins 8–11(–15) pairs*; *intercostal venation mostly obscure*; petiole 5–20 mm long. **Inflorescences** lax, 5–8 cm long, 1–2-flowered, glabrous; peduncles *c.* 2 mm long. **Flowers:** pedicels *c.* 5 mm long; sepals narrowly ovate, 4–7.5 × 2–2.5 mm, 2–3.8 times as long as wide, apex acuminate; corolla white, *tube (20–)30–37 mm long*, lower part (11–)15–18 mm long, upper part (8–)15–20 mm long, glabrous outside, pubescent inside, *lobes 3.7–4.2 times as long as wide*, narrowly elliptic, (15–)30–36 × (5–)8–9 mm, glabrous on both sides or with few hairs at base inside; stamens included, inserted at 19–22 mm from the base of corolla tube, anthers 5–5.5 × 1–1.5 mm; disk ring-shaped, *c.* 0.5 mm high, obscurely 5-lobed; ovary 2–4 mm high, glabrous, style *c.* 18 mm long; pistil head 1–2 mm long. **Fruits** very narrowly cylindrical, 10–30 × 0.4–0.6 cm. **Seeds** with a coma all over; grains 18–20 × 2–3 mm, beak 3–11 mm long; coma hairs 15–30 mm long.

Vernacular name. Sarawak—*pulai ucong* (preferred name).

Distribution. Endemic in Borneo. Known only from Sarawak (e.g., *S 12251*, *S 12954*, *S 13052*, *S 24323*, and *S 27076*).

Ecology. Swamp or *kerangas* forest at low altitude.

3. *Kibatalia maingayi* (Hook.f.) Woodson

Fig. 5.

(A.C. Maingay, 1836–1869, British physician and botanist, sometime jail-warden in Malacca, Peninsular Malaysia)

Philip. J. Sci. 60 (1936) 213; Whitmore *op. cit.* 18; Anderson *op. cit.* 149; Ashton *op. cit.* 36; Rudjiman *op. cit.* 69; Whitmore, Tantra & Sutisna *op. cit.* 26; PROSEA *op. cit.* (1998) 315; Middleton *op. cit.* 92. **Basionym:** *Vallaris maingayi* Hook.f., Fl. Brit. Ind. 3 (1882) 651, King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 461, Ridley, FMP 2 (1923) 351. **Lectotype** (Rudjiman, 1986): *Maingay 2948* (= *Kew Distr. 1084*), Peninsular Malaysia, Malacca (holotype K; isotypes K, L). **Synonyms:** *Paravallaris maingayi* (Hook.f.) Kerr, Fl. Siam. En. 2 (1939) 456; *Holarrhena daronensis* Elmer, Leafl. Philip. Bot. 4 (1912) 1455; *Vallaris daronensis* (Elmer) Merr., Philip. J. Sci., Bot. 10 (1915) 70; *Kibatalia daronensis* (Elmer) Woodson *op. cit.* 218.

Tree to 40 m tall, to 120 cm diameter, sometimes with buttresses. **Bark** smooth or rough, pale brown, dark grey or whitish; inner bark pale yellow, less often brown. **Leaves** coriaceous, glabrous; blade narrowly to broadly elliptic, 3.5–14 × (1–)2–6 cm, 2.1–4.75 times as long as wide, base cuneate or decurrent onto petiole, apex acuminate or subcaudate; domatia absent or present, if present, with or without hairs; *lateral veins 4–7 pairs*; intercostal venation obscure; petiole 2–10 mm long. **Inflorescences** congested, 1.5–2.5 cm long, 4–25-flowered; peduncles 1–3 mm long. **Flowers:** pedicels 7–12(–15) mm long; sepals acute or acuminate at apex, 1.5–3 × 1–2 mm, glabrous or, rarely, pubescent; *corolla* white or pale yellow, *tube 5–8(–10) mm long*, lobes obovate or ovate, rarely elliptic, 6–12 × 3–7 mm, 1.4–2.3 times as long as wide, sparsely to densely pubescent on both sides; stamens exserted, inserted at 5–8(–10) mm from the base of corolla tube, anthers 2–2.5(–3) × 0.75–1 mm; disk ring- to cup-shaped, 0.5–1.5 mm high, 5-lobed; ovary 1–2 mm high, style 4.5–6.5(–9) mm long; pistil head to 1 mm long. **Fruits** very narrowly cylindrical, 8–50 × 0.4–0.6 cm. **Seed** grains 20–35 × 1.5–3 mm, beak glabrous for 5–10 mm, bearing an apical coma for 0–65 mm; coma hairs 10–80 mm long.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines (Mindanao). In Borneo, very local in Semengoh FR, Sarawak (e.g., *Carroll 1185*, *S 12725*, *S 13953*, *S 15637*, and *S 37185*) and in Kalimantan (e.g., *Kostermans 6698*, *Kostermans 10051*, *Kostermans 10689*, and *Rudjiman 242*).

Ecology. In lowland and lower montane forests.

4. *Kibatalia villosa* Rudjiman

(Latin, *villosus* = villous; referring to the densely hairy corolla mouth)

Agric. Univ. Wag. Pap. 86-5 (1986) 82, *p.p.* (excluding some of the paratypes); PROSEA *op. cit.* (1998) 315. **Type:** *Rudjiman 266*, Borneo, S Kalimantan, Kuala Barito, Bambang (holotype BO; isotypes BO, L, WAG).

Tree to 30 m tall, to 70 cm diameter. **Bark** smooth; inner bark brown. **Sapwood** pale yellow. **Leaves** coriaceous, glabrous; *blade* elliptic to slightly obovate, 8–18 × 3.6–7.5 cm, 1.2–3.1 times as long as wide, base cuneate, apex acute to acuminate, less often obtuse or caudate; *domatia* consisting of pits; *lateral veins* 8–12 pairs; *intercostal venation* clearly visible below, perpendicular to midrib and oblique to lateral veins; petiole 5–15 mm long. **Inflorescences** congested, 8–25-flowered, 2.5–2.75 cm long; peduncles 1–5 mm long. **Flowers:** pedicels 10–12 mm long, glabrous or sparsely puberulent near base; sepals acute at apex, 1.75–4.5 × 1.5–2 mm, glabrous or sparsely puberulent; corolla white or yellowish green, *tube* (9–)11–14 mm long, *lobes* 0.9–2 times as long as wide, narrowly elliptic or elliptic, 7–9 × 4.5–7.5(–10) mm, outside glabrous, inside glabrous at base, pubescent at top of tube and inside of lobes; *stamens exerted*, inserted at 10–12 mm from the base of corolla tube, anthers 3 × 1–1.5 mm; disk ring- to cup-shaped, 1–2 mm high; ovary 2–3 mm high, style 8–11 mm long; pistil head 1.5–2 mm long. **Fruits** narrowly spindle-shaped, 18.5–22.5 × 0.8–0.9 cm.

Distribution. Peninsular Malaysia and Borneo. In Borneo, uncommon in Sabah (e.g., *SAN 61372* and *SAN 118479*), Sarawak (e.g., *Haviland 3050*, *S 12954* and *S 23014*), Brunei (e.g., *Davies & Othman A 1369*), and Kalimantan (e.g., *bb. 18491* and *Kostermans 5585*).

Ecology. Swamp to lower or montane forests, often on limestone, at altitudes to 1200 m.

5. KOPSIA Blume, *nom. cons.*

(J. Kops, 1765–1849, a Dutch botanist)

Cat. (1823) 12; King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 429; Ridley, FMP 2 (1923) 336; Sleseen, Fl. Mal. Misc. Rec. 1 (1959) 1; Backer & Bakhuizen *f.*, FJ 2 (1965) 232; Markgraf, Blumea 20 (1972) 416; Whitmore, TFM 2 (1973) 18; Anderson, CLTS (1980) 149; Ashton, MNDTS 2 (1988) 36; Corner, WSTM 3rd. edition 1 (1988) 155; Sévenet *et al.*, J. Ethnopharm. 41 (1994) 147; Coode *et al.* (eds.), CLBD (1996) 27; Middleton, Fl. Thailand 7 (1999) 60; Beaman *et al.*, PMK 4 (2001) 108.

Shrubs or small trees. Leaves opposite, uppermost pair more or less concealing terminal bud, without domatia below, with a large interpetiolar ridge and glands in the axils; *blade* coriaceous. **Inflorescences** cymose, sometimes raceme-like or cinninate-like in appearance due to aborting flowers; bracts persistent. **Flowers:** *sepals* free except at base, without colleters inside; *corolla lobes* overlapping to the right in bud, mature corolla salver-shaped, white or pink, sometimes with a coloured “eye”, lobes oblong or obovate, acute to rounded; *stamens* free from the pistil head, completely included in the corolla tube, filaments short and narrow, anthers narrowly ovate, base cordate, apex acute, fertile for the entire length; *disk* of 2 narrow lobes; ovary of 2 separate carpels united into a common style, glabrous or pubescent, 2 ovules per carpel, style filiform with a collared style head. **Fruits** drupes, solitary or paired, often with an appendage on one side, this sometimes hooked. **Seeds** simple, ovoid, flattened.

Distribution. About 22 species in E Asia, through Malesia to the W Pacific and N Queensland. Six species in Sabah and Sarawak.

Key to *Kopsia* species

1. Inflorescence delicate with clear internodes; corolla tube less than 20 mm long.....**5. *K. tenuis***
 Inflorescence not delicate, with or without clear internodes; corolla tube more than 20 mm long, if less than 20 mm then inflorescence congested.....2
2. Leaves elliptic or oblong with lateral veins forming 40–60° angle with the midrib; inflorescence with a robust peduncle and long branches with closely spaced flowers, only one open at a time.....**4. *K. rajangensis***
 Leaves variable with lateral veins forming (55–)60–80° angle with the midrib; inflorescence variable but if lateral veins angle is less than 60° then inflorescence short and congested.....3
3. Sepals mostly acute, more rarely obtuse; fruit without an appendage.....**1. *K. arborea***
 Sepals rounded to obtuse at apex; fruit with an appendage on one side.....4
4. Inflorescence axes mostly robust, pedicels 2.8–5.2 mm long; lateral veins 23–43 pairs...
K. sleeseni Markgr.
 (E.H.L. Timmerman-van der Sleen, a Dutch botanist)
 Blumea 20 (1972) 421; Sévenet *et al. op. cit.* 161. Type: *Haviland 3046*, Borneo, Sarawak, Bintulu district (holotype SING; isotypes K, L, SAR). Synonym: *Kopsia* sp., Sleen *op. cit.* (1959) 15, Ashton *op. cit.* 39.
 Shrub to 2 m tall. Twigs glabrous, not lenticellate, terete or weakly angled. Leaves papery to subcoriaceous, glabrous; blade elliptic or oblong, 8.5–21.5 × 3.6–7.8 cm, 2.2–5 times as long as wide, base rounded to cuneate, apex caudate or long acuminate with a blunt tip; midrib shallowly sunken or raised and with a central groove above; *lateral veins 23–43 pairs, forming c. 70° angle with the midrib*, with 2–9 mm spacing, prominent on both sides, intramarginal vein straight or only weakly looped, distant from or right at margin; petiole 7–12 mm long, glabrous. Inflorescences dichasial, higher order branching is not opposite but alternate, *6–10.2 cm long with axes 2.2–7.5 cm long*, glabrous; peduncles 0.6–4.5 cm long, 1.4–2.2 mm diameter, glabrous. Flowers: pedicels 2.8–5.2 mm long, glabrous; bracteoles absent; *sepals ovate, 1.3–1.6 × 1–1.6 mm, 1–1.3 times as long as wide, apex rounded or obtuse*, ciliate, glabrous on both sides; corolla completely white, *tube 26.5–32 mm long, 1.9–2.6 mm wide, 1.6–2.1 times as long as lobes, 18.7–20.4 times as long as calyx, lobes narrowly elliptic or oblong, 13.2–20 × 3.3–6 mm, 3.3–4 times as long as wide, apex obtuse, not ciliate*, glabrous on both sides; stamens inserted at *c. 22 mm from the base of corolla tube, anthers c. 2.4 × 0.8 mm, c. 3 times as long as wide, c. 1.1 mm from corolla throat*; disk awl-shaped, *c. 0.8 mm long, apex acuminate, glabrous, c. 0.7 times as long as ovary*; ovary *c. 1.2 mm high, densely pubescent on top, style c. 19.4 mm long; pistil head c. 0.9 mm long. Fruits flattened oblique ellipsoid with a blunt hooked spur, 16–17 × 7 × 4 mm, densely puberulent.*
 Only known from Sarawak, around Bintulu and in Similajau NP (e.g., *Haviland 3046, S 40133, S 65629, and S 65651*). Lowland mixed dipterocarp and beach forests at altitudes to 80 m.
 Inflorescence axes mostly not robust; pedicels 1.2–2.5 mm long; lateral veins 9–24 pairs.....5

5. Inflorescences more than 10 cm long, densely puberulent.....**2. K. dasyrachis**
 Inflorescences less than 10 cm long, glabrous to densely puberulent.....**3. K. pauciflora**

1. *Kopsia arborea* Blume

(Latin, *arboreus* = tree-like; the growth habit)

Cat. (1823) 13; Slesesen *op. cit.* (1959) 9; Backer & Bakhuizen *f. op. cit.* 232; Markgraf *op. cit.* 419; Ashton *op. cit.* 37; Sévenet *et al. op. cit.* 149; Middleton *op. cit.* (1999) 61; Beaman *et al. op. cit.* 108. **Type:** *Blume s.n.* (= RHL Sheet No. 898110313), Java, Mt. Salak (holotype L). **Synonyms:** *Kopsia longiflora* Merr., Philip. Gov. Lab. Bur. Bull. 29 (1905) 47; *K. scortechinii* King & Gamble *op. cit.* 431, Ridley *op. cit.* (1923) 337, Whitmore *op. cit.* 20, Turner, Gard. Bull. Sing. 47 (1995) 127; *K. laxinervia* Merr., Philip. J. Sci. Bot. 13 (1918) 55; *K. lancibracteolata* Merr., Philip. J. Sci. 23 (1923) 262. (For further synonymy, *cf.* Middleton *op. cit.* (1999) 61).

Tree to 14 m tall, to 10 cm diameter. **Bark** grey; inner bark pale brown. **Twigs** glabrous or sparsely puberulent when young, sparsely lenticellate or not. **Leaves** subcoriaceous to coriaceous, glabrous; blade elliptic, 4.5–30.5 × 1.4–12 cm, 1.9–5.7 times as long as wide, base acute or cuneate, apex caudate to acuminate with a blunt tip; midrib sunken or raised and with a central groove above; *lateral veins forming 60–65° angle with the midrib*, 9–18 pairs, with 4–13 mm spacing, prominent on both sides; intramarginal vein strongly looped; petiole 3–10 mm long, glabrous. **Inflorescences** *dichasial*, 4.8–15.3 cm long, glabrous to sparsely puberulent; peduncles 0.7–8.1 cm long, glabrous or puberulent in upper parts. **Flowers:** pedicels 0–5 mm long, glabrous to densely puberulent; *sepals* ovate, lanceolate or oblong, 1.8–6.3 × 0.6–1.9 mm, 1–3.7 times as long as wide, *apex acute, more rarely obtuse*, ciliate, glabrous to sparsely puberulent outside; corolla completely white, *tube 20.5–35 mm long*, 1.6–2.2 mm wide, lobes elliptic or oblong, apex rounded to obtuse, 7–21.5 × 3.4–6.5 mm, 1.6–4.4 times as long as wide, inside glabrous or sparsely pubescent in upper quarter, outside glabrous; stamens inserted at 18–32.3 mm from the base of corolla tube, anthers 1.2–1.7 × 0.5–0.8 mm, 2–3.4 times as long as wide, 0.1–1.4 mm from corolla throat; disk oblong, hourglass-shaped, or awl-shaped, apex shape variable and often quite complex ranging from simply acuminate to rounded to horizontally V-shaped and flat on top or horizontally V-shaped and retuse on top, 0.7–2.1 mm long, glabrous, 1.1–1.9 times as long as ovary; ovary 0.9–1.2 mm high, glabrous to sparsely pubescent all over, style 18–25 mm long; pistil head 0.8–1.1 mm long. **Fruits** *without a hooked appendage*, oblique ellipsoid or subglobose, 14–42.4 × 5.5–15.5 × 8–22 mm, glabrous, blue-black.

Distribution. India (Andaman Is.), Myanmar and S China through Indo-China and Malesia to N Queensland. In Borneo, scattered in Sabah (e.g., *Andau 848*, *Bakia 235*, *Lugas 1409*, *SAN 126903*, and *SAN 131248*), Sarawak (e.g., *S 16033* and *S 40186*) and Kalimantan (e.g., *Kostermans 7673* and *Laman et al. TL 594*).

Ecology. In a wide variety of forest types and soil types at altitudes to 1500 m.

2. *Kopsia dasyrachis* Ridl.

(Greek, *dasy-* = thickly hairy, *rachis* = rachis; the hairy peduncle)

Bull. Misc. Inform. Kew (1934) 123; Masamune, EPB (1942) 620; Slesesen *op. cit.* (1959) 8; Markgraf *op. cit.* 424; Sévenet *et al. op. cit.* 151. **Type:** *Arsat 1211*, Borneo, Sabah, Lukan (holotype K).

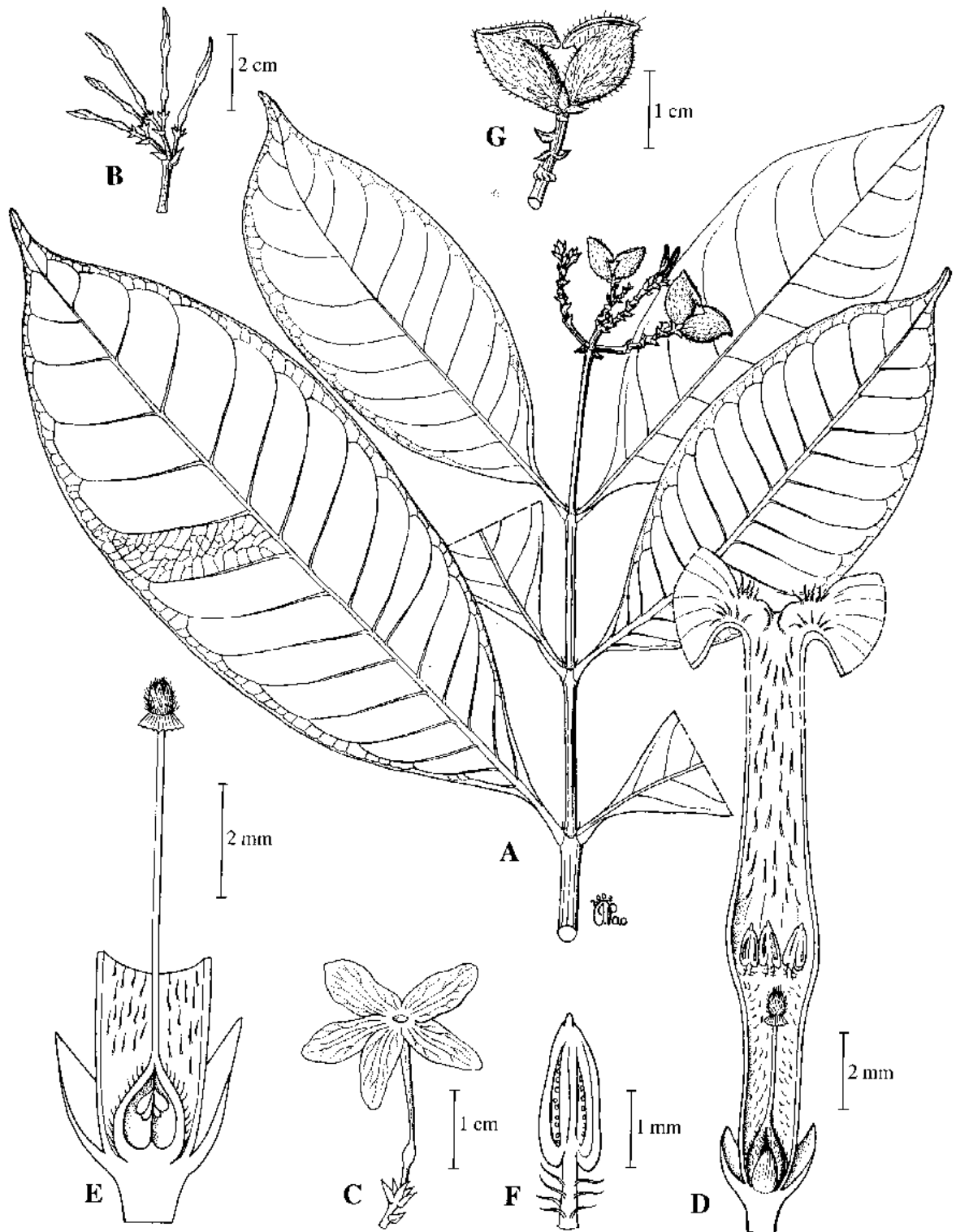


Fig. 6. *Kopsia pauciflora* var. *mitrephora*. A, fruiting leafy twig; B, part of inflorescence; C, open flower; D, longitudinal section of open flower; E, longitudinal section of flower showing gynoecium; F, stamen; G, dehiscent fruit. (A and G from SAN 4065, B–F from SAN 89338.)

Tree to 10 m tall, to 15 cm diameter. **Bark** grey or yellow, smooth; inner bark white. **Twigs** glabrous, sparsely lenticellate, weakly winged. **Leaves** subcoriaceous to coriaceous, glabrous; blade elliptic, 6.5–24.5 × 2–10.2 cm, 2.1–3.3 times as long as wide, base acute to cuneate, apex long-acuminate with a blunt tip; midrib shallowly sunken or raised and with a central groove above; *lateral veins 9–16 pairs, with 6–18 mm spacing, forming 65–70° angle with the midrib*, prominent to sunken above, prominent below; intramarginal vein straight, weakly or strongly looped, inset from margin; petiole 5–7 mm long, glabrous. **Inflorescences** terminal with dichasial branching followed by cincinnate branches and then compact dichasial inflorescence ends, *10.7–15.2 cm long with axes 3.7–16 cm long, densely puberulent*; peduncles 2.7–9.3 cm long, 1.9–2.3 mm diameter, puberulent. **Flowers:** *pedicels c. 1.2 mm long, densely puberulent*; *sepals* oblong, 2.3–3.7 × 1.4–2.2 mm, 1.6–1.75 times as long as wide, *apex rounded to obtuse*, ciliate, densely puberulent outside; corolla completely white, *tube 22–35 mm long, c. 1.4 mm wide*, lobes elliptic, apex rounded, 16–28 × 6.2–7 mm, 2.6–4 times as long as wide, ciliate only at lobe base, glabrous on both sides; stamens inserted at 19–21 mm from the base of corolla tube, anthers 1.9–2.6 × 0.5–0.6 mm wide, 3.8–4.6 times as long as wide, 5.2–5.8 mm from corolla throat; disk awl-shaped, narrowly deltoid or lanceolate, apex acuminate, 1.1–1.5 mm long, glabrous, 0.9–1.7 times as long as ovary; ovary 0.9–1.5 mm high, densely pubescent on top or densely pubescent all over, style 17–20 mm long; pistil head 1.1–1.4 mm long. **Fruits** 12–17 × 5.4–6 × 7–10 mm, sparsely puberulent; *spur blunt, hooked, 3.5–6 mm long*.

Distribution. Endemic in Borneo and currently only known from Sabah (e.g., *SAN 22491*, *SAN 22492*, *SAN 23377*, *SAN 60023*, and *SAN 67340*), where it is locally fairly common.

Ecology. Mostly in lowland mixed dipterocarp forest, generally on well drained soils, at altitudes to 900 m.

3. *Kopsia pauciflora* Hook.f.

Fig. 6, Plate 1E.

(Latin, *pauci-* = few, *florus* = flower; with few-flowered inflorescence)

Fl. Brit. Ind. 3 (1882) 639; Ridley *op. cit.* (1923) 337; Sleesen *op. cit.* (1959) 14; Whitmore *op. cit.* 19; Markgraf *op. cit.* 422; Ashton *op. cit.* 38; Sévenet *et al.*, *op. cit.* 160; Turner *op. cit.* 127. **Type:** *Maingay Kew Distr. 1056*, Peninsular Malaysia, Johore, Mt. Ophir (holotype K; isotype L). **Synonyms:** *Kopsia parvifolia* Merr., Philip. J. Sci. 29 (1926) 412, Sleesen *op. cit.* (1959) 8, Sévenet *et al. op. cit.* 160, Beaman *et al. op. cit.* 108; *K. caudata* Merr., PEB (1929) 254, Sévenet *et al. op. cit.* 150, Coode *et al.* (eds.) *op. cit.* 27; *K. caudata* Merr. var. *glabra* Merr. *op. cit.* (1929) 255, Sévenet *et al.*, *op. cit.* 151; *K. alba* Ridl. ex Henderson, Gard. Bull. S. S. 5 (1930) 78, Sévenet *et al.*, *op. cit.* 149, Turner *op. cit.* 127; *K. lancifolia* Markgr., *op. cit.* 425, Sévenet *et al.*, *op. cit.* 156.

Tree to 10 m tall, to 15 cm diameter. **Bark** grey, olive-brown or white, smooth; inner bark pale brown, straw-coloured or white. **Twigs** glabrous or sparsely puberulent, not lenticellate to densely lenticellate, weakly angled to markedly winged. **Leaves** subcoriaceous to coriaceous, glabrous or, rarely, puberulent on midrib on both sides, rarely also puberulent on major veins below; blade elliptic or oblong, 5–24 × 1.1–7.5 cm, 1.8–6.1 times as long as wide, base rounded to cuneate, apex caudate to shortly acuminate with a blunt tip; midrib shallowly to deeply sunken to raised and with a central groove above; *lateral veins 9–24 pairs, with 2–14 mm spacing, forming (55–)65–80° angle with the midrib*, prominent or flat above, prominent below; intramarginal vein straight to weakly or strongly looped, sometimes obscure; petiole 0–9 mm long, glabrous. **Inflorescences** *dichasial or cincinnate, 3.5–7 cm long with axes 0.5–5 cm long, glabrous to densely puberulent*; peduncles 0–1.8

cm long, 0.8–2 mm diameter, glabrous or puberulent. **Flowers:** *pedicels* 0.5–2.5 mm long, glabrous to densely puberulent; *sepals* ovate or oblong, 1.5–2.9 × 1–2.5 mm, 0.8–2 times as long as wide, *apex rounded*, ciliate or not, glabrous to densely puberulent on upper half inside; corolla completely white, white with a yellow eye, or white and green, *tube* 15–44 × 1.1–2.8 mm, lobes elliptic, 9–33 × 3.5–19 mm, 1.7–4.1 times as long as wide, apex rounded or obtuse, ciliate or not, glabrous on both sides; stamens inserted at 3.5–33 mm from the base of corolla tube, anthers 1.7–2.8 × 0.4–0.8 mm, 2.6–5.6 times as long as wide, 2.4–19 mm from corolla throat; disk awl-shaped or deltoid, apex acute, acuminate, or irregularly toothed, 0.7–1.9 mm long, glabrous, 0.7–1.9 times as long as ovary; ovary 0.5–1.2 mm high, sparsely to densely pubescent, style 2.5–29.5 mm long; pistil head 0.5–1.3 mm long. **Fruits** *falcate with a small blunt hooked spur on one side*, sparsely puberulent, black when ripe, 12–18 × 2.5–6 × 6–9 mm; spur 3–5 mm long.

Distribution. S Thailand, Sumatra, Peninsular Malaysia, Borneo, and Java.

Ecology. In primary or secondary evergreen forest, on a variety of soils, often on limestone, at altitudes to 700 m.

Notes. In Sabah and Sarawak, two varieties (*viz.* var. *mitrephora* and var. *pauciflora*) are recognised.

Key to varieties

Corolla tube 25–44 mm long; stamens inserted at 22–33 mm from the base of corolla tube, anthers at 2.4–5 mm from corolla throat; style 20–29.5 mm long.....

var. **pauciflora**

Tree to 10 m tall, to 15 cm diameter. Leaf blade elliptic; intramarginal vein usually straight or only weakly looped. Inflorescences dichasial or cincinnate. Flowers: *corolla tube* 25–44 mm long; *stamens inserted at 22–33 mm from the base of corolla tube*, *anthers at 2.4–5 mm from corolla throat*; *style* 20–29.5 mm long.

Distribution as the species. In Sabah common (e.g., *SAN 41227*, *SAN 49838*, *SAN 80114*, *SAN 120372*, and *SAN 129966*) but rare in Sarawak (e.g., *Native Collector 21*).

Also occurring in Brunei (e.g., *BRUN 310*).

Corolla tube 25–28.5 mm long; stamens inserted at 3.5–15.5 mm from the base of corolla tube, anthers at 6.5–19 mm from corolla throat; style 2.5–12.5 mm long.....

var. **mitrephora** (Sleesen) D.J.Middleton

(Greek, *mitra* = helmet, *phora* = bearing; referring to the fruit which is said to look like the helmets of ancient Greek soldiers)

Gard. Bull. Sing. 55 (2003) 66. Type: *Wood SAN 16118*, Borneo, Sabah, Lahad Datu district, path between Sg. Sabahan and Sg. Dok (holotype L; isotype BRI). Basionym: *Kopsia mitrephora* Sleesen, *Blumea* 10 (1960) 136, Markgr., *op. cit.* 424, Whitmore *op. cit.* 19, Sévenet *et al.*, *op. cit.* 159.

Tree to 3 m tall. Leaf blade elliptic or oblong; intramarginal vein straight to strongly looped. Inflorescences dichasial. Flowers: *corolla tube* 15–28.5 mm long; *stamens inserted at 3.5–15.5 mm from the base of corolla tube*, *anthers at 6.5–19 mm from corolla throat*; *style* 2.5–12.5 mm long.

Only known from Sabah (e.g., *SAN 39373*, *SAN 51546*, *SAN 107254*, *SAN 124514*, and *SAN 141634*). In primary and secondary forests at altitude to 600 m.

4. *Kopsia rajangensis* D.J.Middleton

(of Rajang River, Sarawak)

Gard. Bull. Sing. 55 (2003) 65. **Type:** *Clemens & Clemens 21221*, Borneo, Sarawak, Kapit district, Upper Rajang R. (holotype MO; isotypes A, BM, BO, K, NY, SAR). **Synonyms:** *Kopsia larutensis* auct. non King & Gamble: Anderson *op. cit.* 149, Ashton *op. cit.* 38; *K. arborea* auct. non Blume: Markgraf *op. cit.* 419, *p.p.*

Shrub or small tree to 5 m tall. **Twigs** glabrous, not or sparsely lenticellate, terete. **Leaves** papery to subcoriaceous, glabrous; *blade elliptic or oblong*, 13.4–32 × 3.8–9.6 cm, 2.6–4.3 times as long as wide, base obtuse to cuneate, apex caudate; midrib shallowly sunken or raised and with a central groove above; *lateral veins forming 40–60° angle with the midrib*, 9–25 pairs, with 6–25 mm spacing, prominent or flat above, prominent below; intramarginal vein looped and inset from margin; petiole 4–9 mm long, glabrous. **Inflorescences** *dichasial and then with cincinnate branches*, 4–15 cm long with axes 1.4–20 cm long, glabrous to densely puberulent; *peduncles robust*, 0.2–7.6 cm long, 1.7–3.7 mm diameter. **Flowers:** pedicels *c.* 4 mm long; sepals ovate, 1.5–1.7 × 1.1–1.4 mm, 1.2–1.4 times as long as wide, apex rounded, ciliate, otherwise glabrous on both sides; corolla white, *tube 21.5–26.5 mm long*, *c.* 2.3 mm wide, lobes elliptic or oblong, 11–15 × 2.7–4.7 mm, 3–4.5 times as long as wide, apex obtuse or acute, not ciliate, glabrous on both sides; stamens inserted at 17–21 mm from the base of corolla tube, anthers 1.7–2 × 0.6–0.8 mm, 2.5–2.8 times as long as wide, at 1.1–2 mm from corolla throat; disk awl-shaped, *c.* 0.9 mm high; ovary *c.* 0.9 mm high, glabrous to densely pubescent, style *c.* 20 mm long; pistil head *c.* 0.8 mm long. **Fruits** falcate with small blunt projection near the base, 15–16 × 4 × 6.5–7 mm; projection 3–4 mm long.

Distribution. Endemic in Borneo and apparently confined to the Rajang R. basin in Sarawak (e.g., *Clemens & Clemens 21211*, *Clemens & Clemens 21221*, *Haviland 3042*, *S 17797*, and *S 27738*).

Ecology. In hill primary and disturbed forests on rich clay soils.

5. *Kopsia tenuis* Leenh. & Steenis

(Latin, *tenuis* = slender; the delicate inflorescence)

Blumea 10 (1960) 138; Markgraf *op. cit.* 424; Sévenet *et al. op. cit.* 162. **Type:** *Ridley s.n.*, Borneo, Sarawak, Matang (holotype K).

Tree to 6 m tall, to 15 cm diameter. **Bark** brown, slightly flaky. **Twigs** glabrous, sparsely lenticellate or not, terete. **Leaves** papery, glabrous; *blade elliptic, oblong or ovate*, 3.2–13 × 1.2–3.3 cm, base acute to cuneate, apex caudate; lateral veins 16–28 pairs, with 1–3 mm spacing, forming 70–80° angle with the midrib; intramarginal vein right at margin; petiole 1–2 mm long, glabrous. **Inflorescences** *dichasial or flowers solitary, delicate*, 3.7–12.5 cm long with axes 1.1–15 cm long and 0.5–5 mm diameter, sparsely puberulent; peduncles 0.2–2.2 cm long, 0.4–5 mm diameter, puberulent. **Flowers:** pedicels 4.5–5 mm long, glabrous or sparsely puberulent; sepals ovate, rounded, *c.* 1 × 0.9–1 mm, ciliate, glabrous; corolla completely white or yellowish, *tube 16–17 mm long*, *c.* 1.8 mm wide, pubescent around stamens and slightly below inside, throat glabrous outside, lobes narrowly elliptic or oblong, 11.5–15 × 2.4–3 mm, apex obtuse, not ciliate, glabrous on both sides; stamens inserted at *c.* 14 mm from the base of corolla tube, anthers *c.* 2 × 0.4 mm, *c.* 5 times as long as wide, at *c.*

2 mm from corolla throat; disk awl-shaped, *c.* 0.6 mm long, apex obtuse, glabrous, *c.* 0.7 times as long as ovary; *ovary c.* 0.9 mm high, glabrous, style *c.* 13 mm long; pistil head *c.* 0.9 mm long. **Fruits** flattened oblique ellipsoid with a blunt hooked spur, 12.5–15 × 5.6–7.3 × 3–3.4 mm; spur 3–4 mm long, arising in lower part of fruit, sparsely puberulent.

Distribution. Endemic in Borneo and so far only known from the western parts of Sarawak (e.g., *Clemens & Clemens 20129*, *Clemens & Clemens 20178*, *Clemens & Clemens 20898*, *S 34459*, and *S 43441*).

Ecology. In mixed dipterocarp forest at altitude *c.* 735 m on Mt. Pueh.

6. OCHROSIA Juss.

(Greek, *ochros* = ochre-yellow colour)

Gen. Pl. (1789) 144; Ridley, FMP 2 (1923) 339; Backer & Bakhuizen *f.*, FJ 2 (1965) 231; Markgraf, Blumea 25 (1979) 233; Anderson, CLTS (1980) 149; Ashton, MNDTS 2 (1988) 39; Corner, WSTM 3rd. edition 1 (1988) 156; Middleton, Fl. Thailand 7 (1999) 64; PROSEA 12, 2 (2001) 386; Hendrian, Blumea 49 (2004) 101. **Synonyms:** *Calpicarpum* G. Don, Gen. Syst. 4 (1837) 100; *Lactaria* Raf., Sylva Tell. (1838) 162; *Neisosperma* Raf., *op. cit.* 162; *Pseudochrosia* Blume, Ann. Mus. Bot. Lugd. Bat. 1 (1850) 158; *Bleekeria* Hassk., Retzia 1 (1855) 38; *Excavatia* Markgr., Bot. Jahrb. 61 (1927) 194.

Shrubs or trees with white latex. Twigs glabrous, not lenticellate. **Leaves** in whorls of 3–6, more rarely opposite, without a small flap inside the base of petiole; blade coriaceous to papery, glabrous, *margin entire*; midrib sunken above, prominent below; lateral veins usually rather straight, rarely strongly arcuate-ascending, usually joining and forming a submarginal vein, rarely not joining. **Inflorescences** terminal and axillary cymes, in whorls or solitary, loose or congested, few- to many-flowered, glabrous. **Flowers** sometimes fragrant, small, pedicellate; *sepals connate only at base*, without colleters inside; corolla salver-shaped, white, greenish white, creamy white, or yellowish white, pubescent inside, glabrous outside, *tube longer than lobes, lobes overlapping to the right in bud*; stamens included, free from each other, filaments filiform, short, *anthers without a long appendage; disk absent*; ovary of 2 carpels, glabrous, style filiform. **Fruits** drupes, usually apocarpous, rarely joined in lower half; *mericarps ellipsoid, obovoid, ovoid, or subglobose, sometimes somewhat dorso-ventrally compressed, sometimes with lateral and or apical ridges; endocarps splitting into diverging fibres, or consisting of thick and hard tissue surrounding 2 lateral cavities*. **Seeds** simple, 1–3 on each placenta, flat, suborbicular or elliptic, with a wing-like structure along the margin, glabrous.

Distribution. About 40 species, distributed from the Mascarene Is. and Seychelles in the west through continental S and SE Asia to Malesia and N Australia and into the Pacific Is. as far east as the Marquesas and Hawaiian Is. Three species in Sabah; one species in Sarawak.

Key to *Ochrosia* species

1. Twigs (4–)6–9 mm diameter; leaves mostly strongly obovate with a rounded or an apiculate apex; blades 1–3 times as long as wide; at least some lateral veins with spacing of more than 7 mm.....**3. O. oppositifolia**
Twigs 2–6 mm diameter; leaves elliptic to obovate, mostly with an acuminate apex; blades 2.1–5.8 times as long as wide; lateral veins with spacing 7 mm or less.....2
2. Twigs 2–4 mm diameter; calyx ciliolate at margin; fruits fused at base with two parts diverging.....**1. O. ackeringae**
Twigs 3.5–6 mm diameter; calyx not ciliolate at margin; fruits in pairs, sometimes with one absent.....**2. O. glomerata**

1. *Ochrosia ackeringae* (Teijsm. & Binn.) Miq.

(J.E. Akkeringa, 1829–1864, a Dutch engineer who collected plants in Bangka)

Ann. Mus. Bot. Lugd. Bat. 4 (1869) 138; Backer & Bakhuizen *f. op. cit.* 232; Fosberg & Sachet, *Adansonia* 17 (1977) 29; Markgraf *op. cit.* (1979) 238; Hendrian *op. cit.* 117. **Basionym:** *Lactaria ackeringae* Teijsm. & Binn., Tijds. Ned. Ind. 29 (1867) 249. **Type:** *Ackeringa s.n.* (= RHL Sheet No. 89811113), Sumatra, Bangka (holotype L). **Synonyms:** *Ochrosia ackeringae* (Teijsm. & Binn.) Miq. var. *angustifolia* Baker *f. in* C.W. Andrews, Monogr. Christmas Isl. (1900) 182; *Ochrosia littoralis* Merr., Philip. J. Sci. 4 (1909) 315; *Bleekeria ackeringae* (Teijsm. & Binn.) Koidz., Bot. Mag. Tokyo 37 (1923) 52; *Bleekeria littoralis* (Merr.) Koidz. *op. cit.* 52; *Excavatia littoralis* (Merr.) Markgr., *op. cit.* (1927) 194.

Tree to 10 m tall. **Bark** brown, smooth; inner bark yellowish. **Sapwood** white. **Twigs** 2–4 mm diameter, not lenticellate, glabrous. **Leaves** mostly in whorls of 3, rarely opposite, papery to coriaceous; *blade obovate to elliptic, 2.1–4.6 times as long as wide, 5.5–20 × 2.5–4.4 cm, base cuneate or decurrent onto petiole, apex usually acuminate*, sometimes acute or cuspidate, very rarely to shallowly retuse; *lateral veins with 1–2 mm spacing*, more than 35 pairs, inconspicuous, not prominent; intercostal venation indistinct; petiole 0.4–1.6 cm long, glabrous. **Inflorescences** 2.5–10.7 cm long, in whorls of 2–3, repeatedly dichotomous, glabrous; flowers loose or congested; peduncles 1–6.9 cm long, glabrous. **Flowers** fragrant, 8–20 on each inflorescence; pedicels 2–2.5 mm long, glabrous, bracteolate; *sepals ciliolate*, ovate to broadly so, 1.9–2.3 × 1.5–2 mm, 0.9–1.5 times as long as wide, apex rounded, glabrous; corolla white, glabrous outside, pubescent inside, tube cylindrical, *c.* 12.5 mm long, lobes narrowly ovate, *c.* 12 × 3 mm, apex rounded or acute, glabrous; stamens inserted at *c.* 3 mm below the mouth of corolla tube, anthers *c.* 1.3 × 0.5 mm; pistil glabrous; ovary *c.* 1.9 mm high, style filiform, *c.* 6.5 mm long; pistil head *c.* 0.5 mm long. **Fruits** *V-shaped, carpels fused at base and then free ends diverging*, unequal in size, sometimes only one carpel developing, each mericarp ellipsoid or narrowly so, sometimes narrowly obovoid, 2–4.4 × 0.6–1.9 × 0.5–2 cm, apex acute or acuminate, smooth, glabrous, indehiscent, green and turning red when ripe; endocarps massive, hard, surrounding 2 lateral spongy cavities. **Seeds** 2–3 at either placenta, flat, suborbicular to ellipsoid, 0.4–0.9 × 0.3–0.6 cm, apex acuminate, glabrous, whitish-brown.

Distribution. Sumatra, Java, Borneo, the Philippines, Sulawesi, Maluku, New Guinea, and New Ireland. In Borneo, known only from Sabah (e.g., *SAN 18406*, *SAN 49136* and *SAN 68109*).

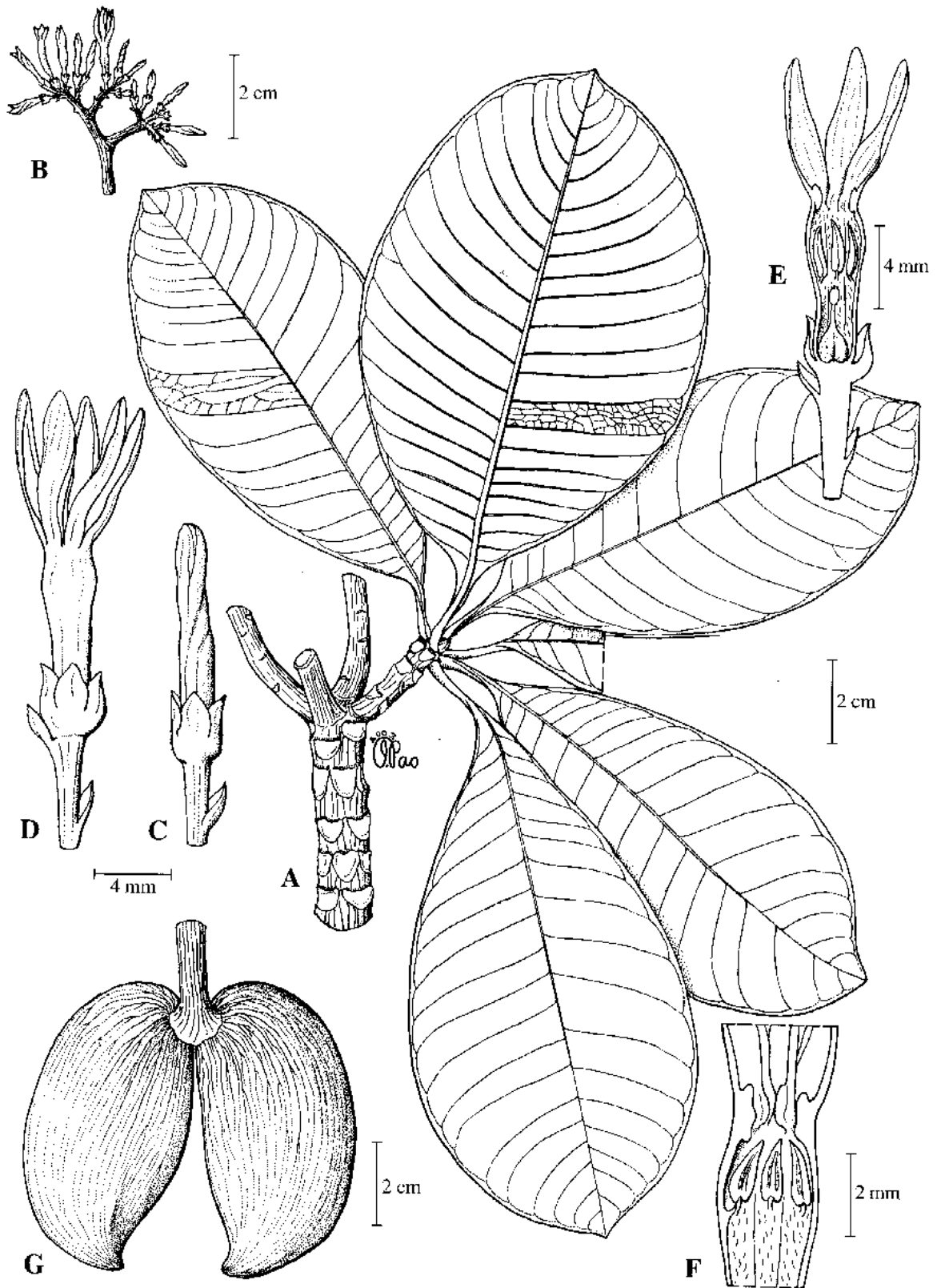


Fig. 7. *Ochrosia oppositifolia*. A, leafy twig; B, part of inflorescence; C, flower bud; D, partially open flower; E, longitudinal section of partially open flower; F, longitudinal section of corolla tube showing the attachment of stamens; G, fruits. (A–F from KN 651, G from SAN 126254.)

Ecology. In coastal forest and strand vegetation.

2. *Ochrosia glomerata* (Blume) Valetton

(Latin, *glomeratus* = collected into a head; referring to the congested flowers)

Ann. Jard. Bot. Buitenz. 12 (1895) 233; Hendrian *op. cit.* 112. **Basionym:** *Pseudochrosia glomerata* Blume *op. cit.* (1850) 158. **Type:** *Zippelius s.n.* (= *RHL Sheet No. 898111243*), West Papua (holotype L). **Synonyms:** *Neisosperma glomerata* (Blume) Fosberg & Sachet *op. cit.* 29, Markgraf *op. cit.* (1979) 246; *Lactaria glomerata* (Blume) Koidz., *op. cit.* 51.

Tree to 30 m tall, to 30 cm diameter. **Bark** pale greyish brown to blackish brown, smooth to lightly fissured; inner bark pale brown to yellowish. **Sapwood** yellowish. **Twigs** 3.5–6 mm diameter, not lenticellate, glabrous. **Leaves** in whorls of 3–4, rarely opposite, coriaceous; *blade obovate to elliptic, 2.1–5.8 times as long as wide, 5.4–26 × 2.1–8 cm*, base decurrent onto petiole, *apex usually acuminate*, sometimes acute, or very rarely shallowly retuse; *lateral veins with 1–7 mm spacing, 28–45 pairs*, conspicuous, slightly prominent below, forming a submarginal vein; intercostal venation often indistinct; petiole 0.6–5.3 cm long, glabrous. **Inflorescences** 1.5–18 cm long, in whorls of 2–4, sometimes solitary, congested, glabrous; peduncles 1–8 cm long, glabrous. **Flowers** fragrant, more than 30 on each inflorescence; pedicels *c.* 2 mm long, glabrous; *sepals not ciliate*, ovate, unequal in size, 1.5–2 × 1.3–2 mm, 1–1.1 times as long as wide, apex acute, glabrous on both sides; corolla white, glabrous outside, pubescent inside, tube cylindrical, *c.* 3 mm long, lobes narrowly elliptic, *c.* 8 × 2 mm, apex rounded, glabrous; stamens inserted at *c.* 1 mm below the mouth of corolla tube, anthers ovate to narrowly so, 1.5–1.8 × 0.5 mm; pistil glabrous; ovary *c.* 1 × 1 mm, style filiform, *c.* 1 mm long; pistil head *c.* 0.5 mm long. **Fruits** of 2 separate *mericarps*; *mericarps* blackish brown or brown when dried, ovoid, ellipsoid, or subglobose, 4.1–7.6 × 1.8–3.5 × 1.7–3.5 cm, base rounded to blunt, apex apiculate, acumen often strongly curled, glabrous, rather glossy, indehiscent, green and turning yellow or orange when ripe; endocarps splitting into fibres which penetrate the mesocarps; fibres rather thin and slender, not forming hard thick pointed ends. **Seeds** 2 at either placenta, flat, suborbicular to ellipsoid, 1.3–3 × 1–2.1 cm, apex acuminate, glabrous, whitish.

Distribution. Borneo, the Philippines, Maluku, and New Guinea. In Borneo, only known from Sabah (e.g., *SAN 21666*, *SAN 36023*, *SAN 47675*, *SAN 57436*, and *SAN 117472*).

Ecology. In primary and secondary forests, and more open areas, on a variety of soil types at altitudes to 900 m.

3. *Ochrosia oppositifolia* (Lam.) K.Schum.

Fig. 7.

(Latin, *oppositus* = opposite, *folius* = leaves; with opposite leaves)

In Engler & Prantl, Nat. Pflanzenfam. 4, 2 (1895) 156; Merrill, Enum. Philip. Fl. Pl. 3 (1923) 330; Backer & Bakhuizen *f. op. cit.* 232; Ashton *op. cit.* 40; Corner *op. cit.* 157; Middleton *op. cit.* 65; PROSEA *op. cit.* 389; Hendrian *op. cit.* 113. **Basionym:** *Cerbera oppositifolia* Lam., Encycl. 1 (1783) 62. **Type:** *Rumphius Herb. Amboin. 2 (1742) 255, t. 84*. **Synonyms:** *Lactaria oppositifolia* (Lam.) Kuntze, Rev. Gen. (1891) 415; *Neisosperma oppositifolia* (Lam.) Fosberg & Sachet, Micronesica 8 (1972) 48, Markgraf *op. cit.* (1979) 243. (For other synonyms, *cf.* Middleton *op. cit.* 65).

Tree 6–18 m tall, to 30 cm diameter, sometimes with small buttresses. **Bark** grey or brown, smooth, slightly fissured; inner bark green, yellowish or reddish. **Sapwood** white, khaki or

pale orange. **Twigs** (4–)6–9 mm diameter, not lenticellate, glabrous. **Leaves** in whorls of 3–4(–5), papery or coriaceous; *blades usually obovate, very rarely elliptic*, 6.5–36 × 3.4–18 cm, 1–3 times as long as wide, base decurrent onto petiole, *apex mostly rounded, more rarely acuminate, sometimes retuse*; *lateral veins with 2–15 mm spacing*, 21–42 pairs, conspicuous on both sides, not prominent, with a distinct intramarginal vein; intercostal venation rather inconspicuous; petiole 1.5–6.6 cm long, glabrous. **Inflorescences** 2–17 cm long, in whorls of 2–4, glabrous, flowers congested; peduncles 1–10.5 cm long, glabrous. **Flowers** fragrant, more than 30 per inflorescence; pedicels 2.1–4 mm long, glabrous; sepals ovate, 2–2.3 × 1.8–2 mm, apex rounded, glabrous on both sides; corolla white, creamy white, or yellowish white, glabrous outside, pubescent inside, tube cylindrical, 5.3–7 mm long, lobes narrowly elliptic, 9–12 × 3.5–4 mm, apex rounded, glabrous; stamens inserted at 2–2.5 mm below the mouth of corolla tube, anthers ovate to narrowly so, 1.2–1.5 × 0.5–0.8 mm; pistil glabrous; ovary *c.* 1 × 1 mm, style filiform, 1–1.9 mm long; pistil head 0.5–0.6 mm long. **Fruits** of 2 separate mericarps; mericarps blackish brown or light brown when dried, ovoid to ellipsoid, sometimes subglobose, 5–8.5 × 3–5.1 × 2.8–4 cm, apex apiculate, acumen strongly curled, sometimes acuminate, glabrous, indehiscent, green and turning yellow or orange when ripe; endocarps splitting into fibres which penetrate the mesocarps; fibres hard and thick or rather thin and slender, forming hard thick pointed ends or not. **Seeds** often one at either placenta, flat, suborbicular to ellipsoid, 2.6–3.8 × 1.9–2.9 cm, rarely with a small second one, flat, ellipsoid, 1–2.5 × 0.7–1.7 cm, apex acuminate, glabrous, brown.

Distribution. Sri Lanka, India (Andaman Is.), S Thailand through Malesia to Solomon Is., Marianne Is., New Hebrides, Fiji, Samoa, and Tonga Is. In Borneo, recorded from Sabah (e.g., *SAN 84736*, *SAN 126047*, *SAN 126254*, *SAN 126798*, and *SAN 126966*) and Sarawak (e.g., *S 20899* and *S 41811*).

Ecology. Coastal vegetation on sandy and rocky shores.

Notes. Ironically *Ochrosia oppositifolia* is the only one of the three species occurring in Sabah and Sarawak which never has opposite leaves!

7. RAUVOLFIA L.

(L. Rauvolf, 1540–1596, an Austrian botanist)

Sp. Pl. (1753) 208; King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 423; Ridley, FMP 2 (1923) 335; Backer & Bakhuizen *f.*, FJ 2 (1965) 230; Whitmore, TFM 2 (1973) 20; Anderson, CLTS (1980) 149; Markgraf, Blumea 30 (1984) 157; Ashton, MNDTS 2 (1988) 40; Corner, WSTM 3rd. edition 1 (1988) 158; Whitmore, Tantra & Sutisna, CLK 1 (1990) 26; Middleton, Fl. Thailand 7 (1999) 50; Hendrian & Middleton, Blumea 44 (1999) 450; PROSEA 12, 1 (1999) 424; Beaman *et al.*, PMK 4 (2001) 110. **Synonyms:** *Ophioxylon* L., *op. cit.* 1043; *Dissolena* Lour., Fl. Cochinch. (1790) 137; *Cyrtosiphonia* Miq., Fl. Ned. Ind. 2 (1856) 401; *Heurckia* Müll.Arg., Flora 53 (1870) 168.

Shrubs, trees or, sometimes, rhizomatous undershrubs, with white latex. **Bark** smooth, rough, fissured or scaly. **Twigs** lenticellate. **Leaves** in whorls of 3–7, often confined to the apices of the twigs, sometimes opposite on the lower nodes, very rarely all opposite, glabrous, without a small flap inside the base of petiole; *blade papery to coriaceous, margin entire; lateral veins arcuate-ascending or straight.* **Inflorescences** terminal, sometimes seemingly lateral, few- to many-flowered cymes, flowers lax or congested, glabrous or

pubescent. **Flowers:** *sepals connate only at base*, glabrous or pubescent outside, glabrous inside, ciliate or not; *corolla salver-shaped, tube longer than the lobes*, glabrous outside, variably hairy inside, *lobes overlapping to the left in bud*; stamens free from each other or from the pistil, included or exerted, *anthers without a long appendage*; *disc cup-shaped, entire*; *ovary superior, composed of two free to completely fused carpels*, style filiform, glabrous to pubescent; pistil-head cylindrical with a membranous collar at the base. **Fruits** of two separate or two almost completely fused drupes, often only one carpel developing, each carpel contains a single seed. **Seeds** simple, laterally compressed, obliquely ovoid or ellipsoid.

Distribution. A pantropical genus of c. 60 species. The genus is represented by two species in Sabah and Sarawak.

Ecology. Primary and secondary lowland to montane forests on a variety of soil types, at altitudes to 2000 m.

Uses. *Rauvolfia* has been used in Ayurvedic medicine since ancient times to treat snake bites, mental diseases and epilepsy. In Vietnam extracts of the plants are mainly used as an anti-hypertensive agent and as a tranquilizer. In other parts of its geographical range an extract from the roots is considered to be an effective remedy against high blood-pressure. Other medicinal uses include treatments for dysentery, diarrhoea, liver diseases, insanity and cholera. In modern medicine, *Rauvolfia* species (e.g., *R. serpentina*, *R. sumatrana* and *R. verticillata*) are used as a source of the alkaloids reserpine, ajmalicine and ajmaline. Reserpine is marketed for the treatment of arterial hypertension; ajmalicine as an ingredient of proprietary products used to treat psychological and behavioural problems associated with senility, and sensory problems; and ajmaline is used as a remedy for heart arrhythmias. The wood is used for making small objects such as knife-handles (For more details see PROSEA 12, 1 (1999) 424).

Key to *Rauvolfia* species

Leaf blade coriaceous; lateral veins more or less straight, 9–32 pairs; corolla tube less than 6 mm long; ovary syncarpous.....**1. *R. sumatrana***

Leaf blade papery or, rarely, subcoriaceous; lateral veins arcuate-ascending, 6–13 pairs; corolla tube more than 8 mm long; ovary of 2 separate carpels.....**2. *R. verticillata***

1. *Rauvolfia sumatrana* Jack (of Sumatra)

Fig. 8.

Mal. Misc. 1, 5 (1820) 22; King & Gamble *op. cit.* 424; Ridley *op. cit.* 336; Masamune, EPB (1942) 624; Anderson *op. cit.* 149; Markgraf *op. cit.* 167; Whitmore, Tantra & Sutisna *op. cit.* 26; Turner, Gard. Bull. Sing. 47 (1995) 128; Middleton *op. cit.* 53; Hendrian & Middleton *op. cit.* 462; Beaman *et al. op. cit.* 110. **Neotype** (Markgraf, 1984): *Diepenhorst s.n.*, W Sumatra, Pariaman (K). **Synonyms:** *Rauvolfia sumatrana* Jack var. *longifolia* Blume, Bijdr. Fl. Ned. Ind. (1826) 1034; *R. reflexa* Teijsm. & Binn., Nat. Tijds. Ned. Ind. 3 (1852) 329, Whitmore *op. cit.* 21, Markgraf *op. cit.* 164, Ashton *op. cit.* 41; *Cyrtosiphonia sumatrana* (Jack) Miq., *op. cit.* 401; *C. reflexa* (Teijsm. & Binn.) Miq., *op. cit.* 402; *C. spectabilis* Miq., *op. cit.* 402; *R. spectabilis* (Miq.) Boerl., Handl. Fl. Ned. Ind. 2 (1899) 393, Merrill, EB (1921) 500, Masamune *op. cit.* 624; *R. samarensis* Merr., Philip. J. Sci., Bot. 4 (1900) 316, PEB (1929) 254, Masamune *op. cit.* 623, Markgraf *op. cit.* 165.

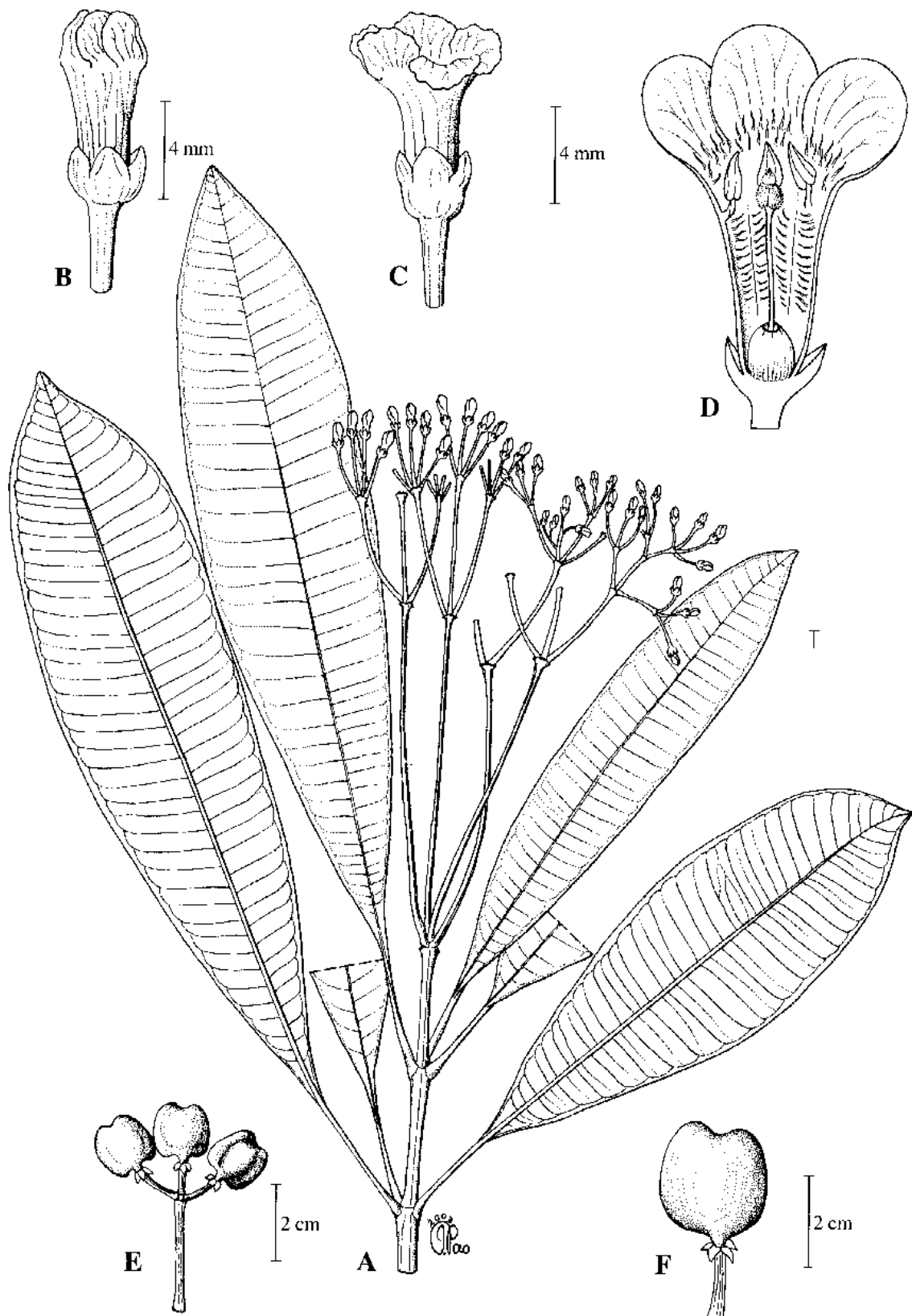


Fig. 8. *Rauwolfia sumatrana*. A, flowering leafy twig; B, flower bud; C, open flower; D, longitudinal section of open flower; E, infructescence; F, fruit. (A from SAN 89977, B–D from S 65435, E–F from S 34584.)

Tree to 27 m tall, to 43 cm diameter. **Bark** grey, yellowish grey, greenish yellow or brown, smooth, slightly fissured or flaky; inner bark white or yellowish. **Sapwood** white, cream, red or brown. **Twigs** rather densely lenticellate, glabrous. **Leaves** in whorls of 3 or 4, *coriaceous*; blade elliptic to obovate, 7–31 × 2–9.3 cm, base cuneate to decurrent, apex acute, acuminate, rarely rounded, retuse, or emarginate; *lateral veins* 9–32 pairs, with 0.15–1(–1.5) cm spacing, more or less prominent, conspicuous, *straight, or slightly arcuate-ascending*, forming an angle of 45–90° with the midrib, anastomosing and forming a submarginal vein; intercostal venation not prominent but conspicuous; petiole 0.6–5.2 cm long, glabrous. **Inflorescences** (2.5–)5–21.5(–27) cm long, in whorls of 3–5(–6), 26–35 (or more)-flowered; peduncles 1.8–14 × 0.2–0.25 cm. **Flowers:** pedicels 0.1–1.2 cm long, glabrous; sepals mostly broadly ovate or suborbicular, 1–2 × 1.4–2 mm, 0.5–1.3 times as long as wide, apex obtuse to rounded, rarely acute, entire to undulate, connate at base for 1 mm; corolla white, glabrous outside, pubescent in a belt of 1.5–2 mm wide just at the mouth, and gradually turning sparsely so downwards, *tube cylindrical, 3.4–4.9 mm long*, broader towards the apex, lobes obliquely and broadly ovate, or suborbicular, 1.3–2.1 × 1.3–2.1 mm, 0.7–1 times as long as wide, apex rounded, rarely retuse; stamens inserted at 2.5–4.5 mm from base of corolla tube, anthers 0.9–1.5 × 0.25–0.7 mm, 1.6–4 times as long as wide; disc cup-shaped, 1–1.8 × 0.7–1.4 mm, 0.6–0.9 times as long as ovary, crenate; *ovary syncarpous*, ovoid, 1–1.75 mm long, style plus pistil head 1.9–3.4 mm long. **Fruits** bluish black or purplish black when mature, syncarpous, globose, rounded, sometimes truncate, retuse or slightly cleft at apex, rarely ovoid or ellipsoid, 6.5–21 × 7–18 mm, 0.9–1.8 times as long as wide, connate for 6–11.7 mm, 0.9–1 of its length; endocarps two layers, sometimes only one developing.

Distribution. Myanmar, Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, Nusa Tenggara, Sulawesi, Maluku, and the Philippines. In Borneo, widespread in Sabah (e.g., *SAN 30007*, *SAN 44652*, *SAN 81149*, *SAN 88631*, *SAN 106815*, and *SAN 114285*), but localised in Sarawak (e.g., *Chew WL 689*, *S 41876* and *S 65435*) and Kalimantan (e.g., *Kostermans 4862* and *Kuswata 985*).

Ecology. In open areas, scrub, and a variety of primary and secondary forests on many different soil types. Mostly lowland.

2. *Rauvolfia verticillata* (Lour.) Baill.

(Latin, *verticillatus* = whorled; with whorled leaves)

Bull. Mens. Soc. Linn. Paris 1 (1888) 768; Whitmore *op. cit.* 21; Markgraf *op. cit.* 160; Whitmore Tantra & Sutisna *op. cit.* 26; Turner *op. cit.* 129; Middleton *op. cit.* 54; Hendrian & Middleton *op. cit.* 464; Beaman *et al. op. cit.* 110. **Basionym:** *Dissolena verticillata* Lour., *op. cit.* 137. **Lectotype** (Markgraf, 1984): *Loureiro s.n.*, China, Canton (holotype BM; isotype P). **Synonyms:** *Rauvolfia serpentina* (L.) Benth. *ex Kurz* var. *gracilis* Stapf, FMK (1894) 207, Merrill *op. cit.* (1921) 499, Masamune *op. cit.* 623; *R. perakensis* King & Gamble *op. cit.* 424, Ridley *op. cit.* 335, Corner *op. cit.* 158. (For other synonyms, *cf.* Middleton *op. cit.* 54 and Hendrian & Middleton *op. cit.* 465).

Shrub to 5 m tall. **Bark** yellowish black or brown; inner bark greenish. **Sapwood** whitish or yellowish. **Twigs** slightly rough, slightly lenticellate, glabrous. **Leaves** confined to the apex of twigs, usually in whorls of 3 or 4, sometimes also opposite, glabrous; *blade papery*, obovate or elliptic, sometimes narrowly so, 5–25 × 2.2–10 cm, 2–4.5(–6.5) times as long as wide, base cuneate to slightly decurrent, apex acuminate to cuspidate; midrib prominent on both sides; *lateral veins* 6–13 pairs, with 0.5–2.5 cm spacing, prominent on both sides, *arcuate-ascending*, rarely straight, forming an angle of (45–)55–85° with the midrib, not

reaching the margin or sometimes joining near the margin to form a submarginal vein; petiole 0.2–2 cm long, glabrous. **Inflorescences** 3–12 cm long, usually in whorls of 3 or 4, rarely solitary, 8–24(–35 or more)-flowered, flowers lax; peduncles 3–7.7 × 0.1–0.2 cm, rather delicate, glabrous. **Flowers:** pedicels 0.2–1.2 cm long, glabrous; sepals ovate to narrowly ovate, 2–5.5 × 0.8–1 mm, 2–7 times as long as wide, apex acute to acuminate; corolla white or slightly pinkish, glabrous outside, *tube cylindrical, 9–17 mm long*, straight to slightly twisted, swollen around the stamens, lobes suborbicular to obliquely ovate, 2–4.5(–6.5) × 2–3.5(–6) mm, 1–1.5 times as long as wide, apex obtuse to rounded; stamens inserted at 6–10 mm from base of corolla tube, anthers 1–1.5 × 0.3–0.6 mm, 2.2–4.3 times as long as wide; disc cup-shaped, 0.8–1.4 high, 0.4–0.6 times as long as ovary, slightly crenate, sometimes thicker at the edge; *ovary consisting of two carpels which are free from each other*, ovoid, 1.2–2.1 mm long, style plus pistil head 4.6–7.6 mm long. **Fruits** whitish purple when mature, usually of paired mericarps free from each other, with a very short stalk, sometimes only one carpel developing, ovoid, 9–14 × 4.5–7 mm, 1.7–2.5 times as long as wide, apex acute to obtuse.

Distribution. India, Sri Lanka, Myanmar, Thailand, China, Laos, Cambodia, Vietnam, Sumatra, Peninsular Malaysia, Borneo, Java, Nusa Tenggara, Sulawesi, and the Philippines. In Borneo, widespread in Sabah (e.g., *KEP 71620, SAN 32332, SAN 131437, SAN A 1659*, and *Stevens et al. 663*) but localised in Sarawak (e.g., *S 50523*).

Ecology. In open areas, lowland and montane rain forests on a variety of soils, at altitudes to 2000 m.

8. TABERNAEMONTANA L.

(Jakob Dietrich of Bergzabern, died 1590, a German botanist—
Tabernaemontana is the latinisation of Bergzabern)

Sp. Pl. (1753) 210; Whitmore, TFM 2 (1973) 21; Anderson, CLTS (1980) 149; Ashton, MNDTS 2 (1988) 41; Corner, WSTM 3rd. edition 1 (1988) 159; Leeuwenberg, J. Ethnopharm. 10 (1984) 1, Agric. Univ. Wag. Pap. 87-5 (1988) 1, Rev. *Tabernaemontana* 1 (1991) 1; Kessler & Sidiyasa, TBSE-EK (1994) 54; Coode *et al.* (eds.), CLBD (1996) 28; Argent *et al.* (eds.), MNDT-CK 1 (1997) 83; Middleton, Fl. Thailand 7 (1999) 27; PROSEA 12, 2 (2001) 530; Beaman *et al.*, PMK 4 (2001) 111. **Synonyms:** *Tabernaemontana* sect. *Ervatamia* A.DC. in DC., Prod. 8 (1844) 373; *Ervatamia* (A.DC.) Stapf, Fl. Trop. Afr. 4, 1 (1902) 126, King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 447, Ridley, FMP 2 (1923) 340, Backer & Bakhuizen *f.*, FJ 2 (1965) 228, Cockburn, TS 1 (1976) 13; *Pagiantha* Markgr., Notizbl. Bot. Gart. Mus. Berl. 12 (1935) 549.

Shrubs or small trees. **Bark** with copious white latex. **Twigs** glabrous or sparsely pubescent. **Leaves** *opposite, often a pair unequal in size, with distinct but small stipule-like flaps inside the base of petiole*; blade papery to coriaceous, elliptic to obovate; lateral veins arching upwards towards margins, weakly anastomosing near margin. **Inflorescence** a cyme or solitary flower, lax; 2 inflorescences at each ramification, occasionally with one missing. **Flowers** usually fragrant; *sepals free except at the very base*, often with glands inside; corolla in mature bud with a narrow tube and globose to ovoid head, in bud lobes overlapping to the left and folded inwards, mature corolla salver-shaped; stamens subsessile or with short filaments, completely included in the corolla tube, anthers narrowly triangular to oblong, base cordate, apex acute, fertile for the entire length, free from the pistil; *disc absent*; ovary of two separate carpels united into a common style, style filiform, pistil head

short. **Fruits** of paired follicles, sometimes connate by their bases, obliquely ellipsoid to somewhat elongated, ridged or smooth, sometimes torulose. **Seeds** covered in a fleshy aril.

Distribution. About 99 species, found throughout the aseasonal and seasonal tropics in evergreen and deciduous forests. In Borneo, one introduced and six native species are known; all six native species occur in Sabah but only four occur in Sarawak.

Ecology. Mostly understory shrubs or small trees.

Uses. The most common use is in horticulture, particularly *T. divaricata* and *T. pandacaqui*. A number of species are used to treat nose ulcerations and boils and for hypertension, inflammations and fevers.

Taxonomy. The generic limits of *Tabernaemontana* are still somewhat controversial, with some authors preferring to recognise a number of segregate genera. Large numbers of species have been described in *Tabernaemontana* and its various segregate genera, many of which have now been synonymised with the result that many of the still recognised species are very widespread, variable and have long lists of synonyms. Synonyms have only been given if based on specimens from the western parts of Malesia. (Full synonymy can be found in Leeuwenberg, Rev. *Tabernaemontana* 1 (1991) 1–201).

Key to *Tabernaemontana* species

1. Leaf blade mostly thickly coriaceous, apex usually apiculate to rounded; lateral veins more or less straight; sepals not much longer than wide; fruits more than 5 cm wide.....
3. **T. macrocarpa**
 Leaf blade papery or subcoriaceous, apex usually acuminate or caudate; lateral veins curved-ascending; sepal ratio variable; fruits less than 3.5 cm wide.....2
2. Cultivated plants; corolla sometimes doubled; stamens frequently inserted in the lower third of corolla tube.....

T. divaricata (L.) R.Br. ex Roem. & Schult.

(Latin, *divaricatus* = spreading at a wide angle; referring to the corolla lobes)
 Syst. 4 (1819) 427; Merrill, EB (1921) 498; Masamune, EPB (1942) 624; Backer & Bakhuizen *f.*, *op. cit.* 228; Corner *op. cit.* 161; Turner, Gard. Bull. Sing. 47 (1995) 129; Leeuwenberg *op. cit.* (1991) 153; PROSEA *op. cit.* 535. Basionym: *Nerium divaricatum* L., *op. cit.* 209. Lectotype (Leeuwenburg, 1984): *Herb. Hermann I: 7* (hololectotype BM).

Shrub or small tree to 5 m tall, 3–10 cm diameter. Leaves opposite, of equal or unequal size, petiolate. Inflorescences pedunculate, 1–30-flowered, rather lax, 3–14 cm long. Flowers sweet-scented, open during the day; sepals pale green, connate at base to about two thirds of the length, inside with 1–4 colleter in one row *c.* 1 mm above the base; *corolla sometimes doubled*, white, often with a yellow throat, tube 15–27 mm long, lobes mostly falcate, spreading, 15–27 × 8–20 mm; *stamens inserted in the lower third of corolla tube*. Fruits of 2 separate follicles; follicles orange, red or less often green, obliquely narrowly ellipsoid or pod-like, 20–70 × 6–15 × 6–15 mm. Seeds obliquely ellipsoid, 7–8 × 4–6 × 3–4 mm, longitudinally grooved.

Native of NE India, Nepal, Bhutan, Bangladesh, Myanmar, Thailand, Laos, and China (Yunnan). Widely cultivated as garden plants in the tropics throughout the world.

Wild plants; corolla never doubled; stamens inserted in the upper two thirds of corolla tube.....3

3. Leaves generally drying yellowish; lateral veins 6–9 pairs; corolla tube 4.5–5.2 mm long; fruit 1–2(–rarely 3)-seeded.....**1. T. antheonicta**

Leaves mostly drying dark brown, brownish or greenish, sometimes yellowish; lateral veins 5–16 pairs; corolla tube more than 8 mm long; fruit 1–many-seeded.....4

4. Sepals not ciliate, 4–10 mm long, leafy and often cordate, or linear but always narrower at the base than in the middle.....

T. rostrata Roxb. ex Wall.

(Latin, *rostratus* = beaked; possibly in reference to the fruit)

Bot. Reg 15 (1829) *sub t.* 1273; Middleton *op. cit.* 36; PROSEA *op. cit.* 537; Beaman *et al. op. cit.* 112. Type: *Wallich 1578*, Myanmar, Segaing, Irawaddy R. (holotype K-W; isotypes BM, G-DC, K). Synonyms: *Ervatamia corymbosa* Roxb. ex Wall. var. *kelsallii* King & Gamble *op. cit.* 449; *E. cylindrocarpa* King & Gamble *op. cit.* 452, Ridley *op. cit.* (1923) 344; *E. curtisii* King & Gamble *op. cit.* 453, Ridley *op. cit.* (1923) 344; *Tabernaemontana cylindrocarpa* (King & Gamble) Merr., Pap. Mich. Acad. Sci. 20 (1935) 107, Corner *op. cit.* 161; *E. rostrata* (Wall.) Markgr., *op. cit.* 547; *T. crispa auct. non* Roxb.: Hooker *f.*, Fl. Brit. Ind. 3 (1882) 648, Leeuwenberg *op. cit.* (1991) 145. (For further synonymy, cf. Leeuwenberg *op. cit.* (1991) 145, under *T. crispa*).

Shrub to 2 m tall. Twigs sparsely lenticellate, glabrous. Leaves glabrous, papery; blade elliptic, 6–20.5 × 2.5–6.5 cm, base cuneate, apex acuminate; lateral veins 4–11 pairs, weakly anastomosing near margin; intercostal venation mostly obscure; petiole 2–20 mm long. Inflorescences 4.6–18 cm long. Flowers: *sepals 4–10 mm long, 3–6 times as long as broad*, ovate to linear, apex obtuse or rounded, *base cordate or not, often leafy, not ciliate*; corolla white, in mature bud 1.4–2.6 cm long with an ovoid head 0.2–0.4× the length of bud, apex rounded or obtuse, glabrous on both sides or pubescent around stamen insertion, tube 1.3–2.2 cm long, twisted or not, lobes 10–20 × 2.5–10 mm, apex rounded; stamens inserted around the middle or upper half of corolla tube, anthers 2–3 × 0.5–0.8 mm; ovary 1–1.2 mm long, style and pistil head 5–14 mm long. Fruits shortly stipitate, apex acuminate, torulose, 2–7 × 0.7–2.3 cm, several-seeded. Seeds ovoid, 7–10 × 4.5–6 mm.

India (Andaman and Nicobar Is.), Myanmar, Thailand, Vietnam, Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Borneo, widespread in Sabah (e.g., *SAN 114295*, *SAN 117225*, *SAN 118953*, *SAN 123566*, and *SAN 141178*). Not yet known from Sarawak. In scrub or forest at altitudes to 1400 m.

Sepals minutely ciliate or not, 1–5 mm long, not narrower at the base than in the middle.....5

5. Corolla lobes minutely ciliate, at least in the lower half; flower robust; sepals ciliate.....

.....**2. T. corymbosa**
Corolla lobes not ciliate; flower robust or slender; sepals ciliate or not.....6

6. Lateral veins frequently much paler than the blade above; head of mature corolla bud rounded or obtuse; sepals minutely ciliate or not.....**4. T. pandacaqui**

Lateral veins generally of the same colour as or only slightly paler than the blade; head of mature corolla bud acute or acuminate; sepals usually not ciliate.....5. **T. pauciflora**

1. **Tabernaemontana antheonycta** Leeuwenberg

(Greek, *anthos* = flower, *nyctios* = of the night; referring to night-time flowering)

Rev. *Tabernaemontana* 1 (1991) 117; Coode *et al.* (eds.) *op. cit.* 28. **Type:** *Sibat S 23639*, Borneo, Sarawak, Balingian, Mt. Iju (holotype L; isotypes A, BO, K, KEP, SAN, SAR, SING).

Shrub or small tree to 5 m tall. **Bark** grey, smooth; inner bark pale brown. **Sapwood** pale brown. **Twigs** lenticellate, glabrous. **Leaves** *subcoriaceous*, *mostly drying yellowish*, glabrous; blade narrowly elliptic, 4–19 × 1–6 cm, 2.5–6.3 times as long as wide, base cuneate, *apex acuminate*; *lateral veins 6–9 pairs, curved-ascending*, often somewhat obscure above; intercostal venation obscure; petiole 2–15 mm long. **Inflorescences** few-flowered, 3–11.4 cm long, delicate with a long thin peduncle to 6 cm long, glabrous, not densely lenticellate. **Flowers:** pedicels 4–6 mm long; sepals ovate, 1–1.2 × 0.8–1 mm, apex rounded, glabrous, ciliate, without glands inside; *corolla never doubled*, pale yellow to white, in mature bud 6–7 mm long with small, globose head *c.* 0.25× the length of bud, apex rounded, *tube 4.5–5.2 mm long*, lobes obliquely elliptic, 3.5–5 × 0.9–1.4 mm, glabrous on both sides; *stamens inserted in the upper two thirds of corolla tube*, anthers *c.* 1.2 × 0.4 mm; ovary glabrous, *c.* 1.2 mm long, style *c.* 0.1 mm long; pistil head *c.* 0.7 mm long. **Fruits** of paired follicles, orange, obliquely obovoid, 15–32 × 8–18 mm, with or without ridges, 1–(3)-seeded.

Vernacular name. Sarawak—*kerimpa patong* (Iban).

Distribution. Endemic in Borneo and known from Sabah (e.g., *SAN 58740*), Sarawak (e.g., *S 16766*, *S 23639*, *S 24626*, *S 41796*, and *S 44006*) and Brunei (e.g., *BRUN 498* and *Wong WKM 1073*).

Ecology. In lowland mixed dipterocarp forest at altitudes to 250 m.

Note. The name implies, and the protologue states, that the flowers in this species only open at night, a conclusion reached because no open flowers were seen on the specimens studied. However, open flowers have now been seen on specimens with no indication on the label that the specimen was collected at night. Further study is needed to elucidate this.

2. **Tabernaemontana corymbosa** Roxb. *ex* Wall.

(Latin, *corymbosus* = corymbose; with the flowers in corymbs)

Bot. Reg. 15 (1829) t.1273; Whitmore *op. cit.* 23; Corner *op. cit.* 161; Leeuwenberg *op. cit.* (1988) 5, *op. cit.* (1991) 138; Turner *op. cit.* 129; Middleton *op. cit.* 31; PROSEA *op. cit.* 534; Beaman *et al. op. cit.* 111. **Type:** *Wallich 1572* (holotype K-W; isotypes BM, CGE, E, K, SING). **Synonyms:** *Tabernaemontana hirta* Hook.f., *op. cit.* 646; *Ervatamia corymbosa* (Roxb. *ex* Wall.) King & Gamble *op. cit.* 448, Ridley *op. cit.* (1923) 341; *E. hirta* (Hook.f.) King & Gamble *op. cit.* 449, Ridley *op. cit.* (1923) 342, Whitmore *op. cit.* 23; *E. corymbosa* Roxb. *ex* Wall. var. *pubescens* King & Gamble *op. cit.* 449; *T. sumatrana* (Miq.) Hallier f., Bot. Jahrb. 49 (1913) 375; *E. pauciflora* Blume var. *minor* Ridl., J. As. Soc. Str. Br. 86 (1922) 300, Ridley *op. cit.* (1923) 343; *E. pauciflora auct. non* Blume:

Ridley *op. cit.* (1923) 342; *Pagiantha corymbosa* (Roxb. ex Wall.) Markgr., *op. cit.* 546. (For further synonymy, cf. Leeuwenberg *op. cit.* (1991) 138).

Tree to 12 m tall, to 20 cm diameter. **Bark** dark brown, shallowly fissured. **Twigs** lenticellate, glabrous, rarely pubescent. **Leaves** *subcoriaceous to papery, drying dark brown*, glabrous or, rarely, sparsely pubescent below; blade elliptic to obovate, 7–30 × 2–14 cm, 2–6 times as long as wide, base cuneate, *apex acuminate to caudate; lateral veins 6–16 pairs, curved-ascending*, weakly anastomosing before reaching the margin; intercostal venation irregularly scalariform or more or less obscure; petiole 3–20 mm long. **Inflorescences** 2–25-flowered, 5–13 cm long, glabrous to pubescent; axes lenticellate or not. **Flowers:** pedicels 5–30 mm long; *sepals ovate, 2–5 × 1–2.5 mm*, apex acute to rounded, *ciliate*, otherwise glabrous outside; *corolla never doubled*, white, in mature bud 1.7–3.2 cm long with ovoid to subglobose head 0.25–0.33× the length of bud, apex obtuse, *tube 15–31 mm long, lobes 9–16 × 4–10 mm*, apex rounded, pubescent at least at base inside, *usually ciliate; stamens inserted at 13–23 mm from the base of corolla tube*, anthers 2–5 × 0.5–1.5 mm; ovary glabrous or with a few hairs, 1.5–2 mm long, style 10–16 mm long; pistil head 1.5–2.2 mm long. **Fruits** of 2 separate follicles, red or yellow, 2–4.5 × 0.6–3 cm, with or without ridges, 5–20-seeded. **Seeds** with a red or orange aril.

Distribution. S China, Myanmar, Vietnam, Laos, Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo, and Nusa Tenggara. In Borneo, common in Sabah (e.g., *SAN 28710*, *SAN 34638*, *SAN 68577*, *SAN 78113*, *SAN 82546*, and *SAN 109388*) and Sarawak (e.g., *S 22662*, *S 23439*, *S 43732*, *S 48195*, and *S 52397*). Also occurring in Kalimantan (e.g., *Teijsmann 7910*).

Ecology. In lowland and lower montane forests at altitudes to 1500 m.

Uses. The latex from the leaves can be applied to sores. Infusions from all plant parts are used to treat syphilis. Also an ingredient of arrow poison.

3. *Tabernaemontana macrocarpa* Jack

Fig. 9.

(Greek, *makro* = large, *karpos* = fruit; with large fruit)

Mal. Misc. 2, 7 (1882) 80; Merrill *op. cit.* (1921) 498; Masamune *op. cit.* 624; Anderson *op. cit.* 149; Ashton *op. cit.* 45; Leeuwenberg *op. cit.* (1991) 165; Turner *op. cit.* 129; Coode *et al.* (eds.) *op. cit.* 28; Argent *et al.* (eds.) *op. cit.* 83; Middleton *op. cit.* 32; PROSEA *op. cit.* 535; Beaman *et al.* *op. cit.* 112. **Neotype** (Leeuwenberg, 1991); *W.J. de Wilde 14396*, Sumatra, Ketambe, Lau Alas Valley (holoneotype L; isoneotypes BO, K, KEP, US, Z). **Synonyms:** *Pagiantha macrocarpa* (Jack) Markgr., *op. cit.* 546; *Ervatamia macrocarpa* (Jack) Merr., J. Arn. Arb. 33 (1952) 246.

Shrub or tree to 30 m tall, to 50 cm diameter, with low buttresses. **Bark** yellowish brown, brown, grey-brown or grey, finely fissured or with corky lenticels; inner bark pale cream. **Sapwood** pinkish cream to white. **Twigs** glabrous, lenticellate. **Leaves** *mostly thickly coriaceous*, glabrous; blade elliptic, 10–41 × 1.9–22 cm, 2–6.2 times as long as wide, base cuneate, *apex apiculate or rounded, rarely acuminate; lateral veins 9–22 pairs, more or less straight*; intercostal venation mostly obscure; petiole 10–40 mm long. **Inflorescences** few- to many-flowered, 7–20 cm long, glabrous. **Flowers** fragrant; pedicels 10–45 mm long; *sepals 3–6 × 3–5 mm*, ovate or suborbicular, apex rounded, *ciliate*, otherwise glabrous or with a few hairs outside; corolla with various combinations of cream, white and orange, in mature bud 1.5–3.1 cm long with ovoid to subglobose head 0.25–0.4× the length of bud,

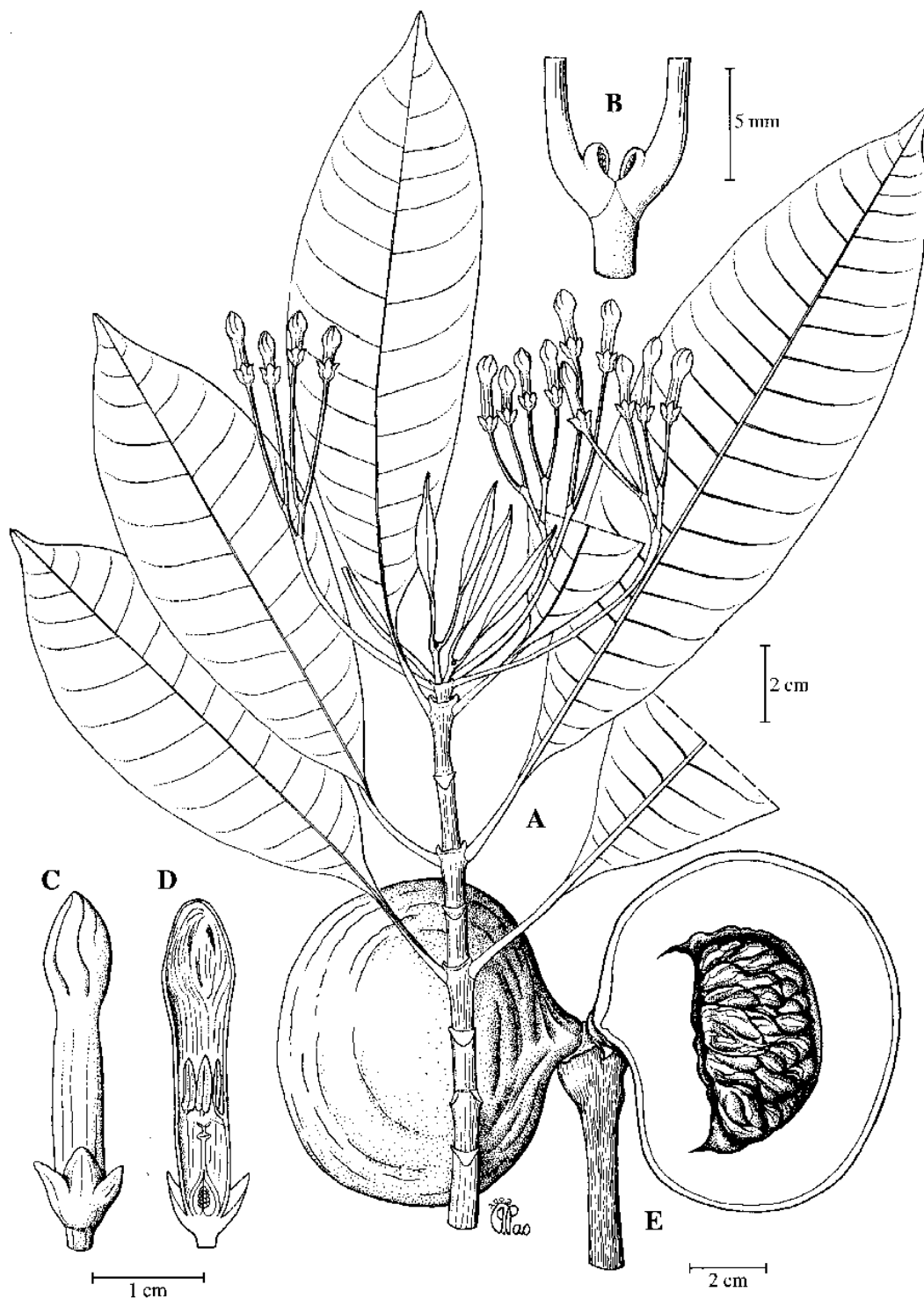


Fig. 9. *Tabernaemontana macrocarpa*. A, flowering leafy twig; B, intrapetiolar ocrea; C, flower bud; D, longitudinal section of flower bud; E, fruits. (A–D from *S* 23620, E from *Hansen* 1110.)

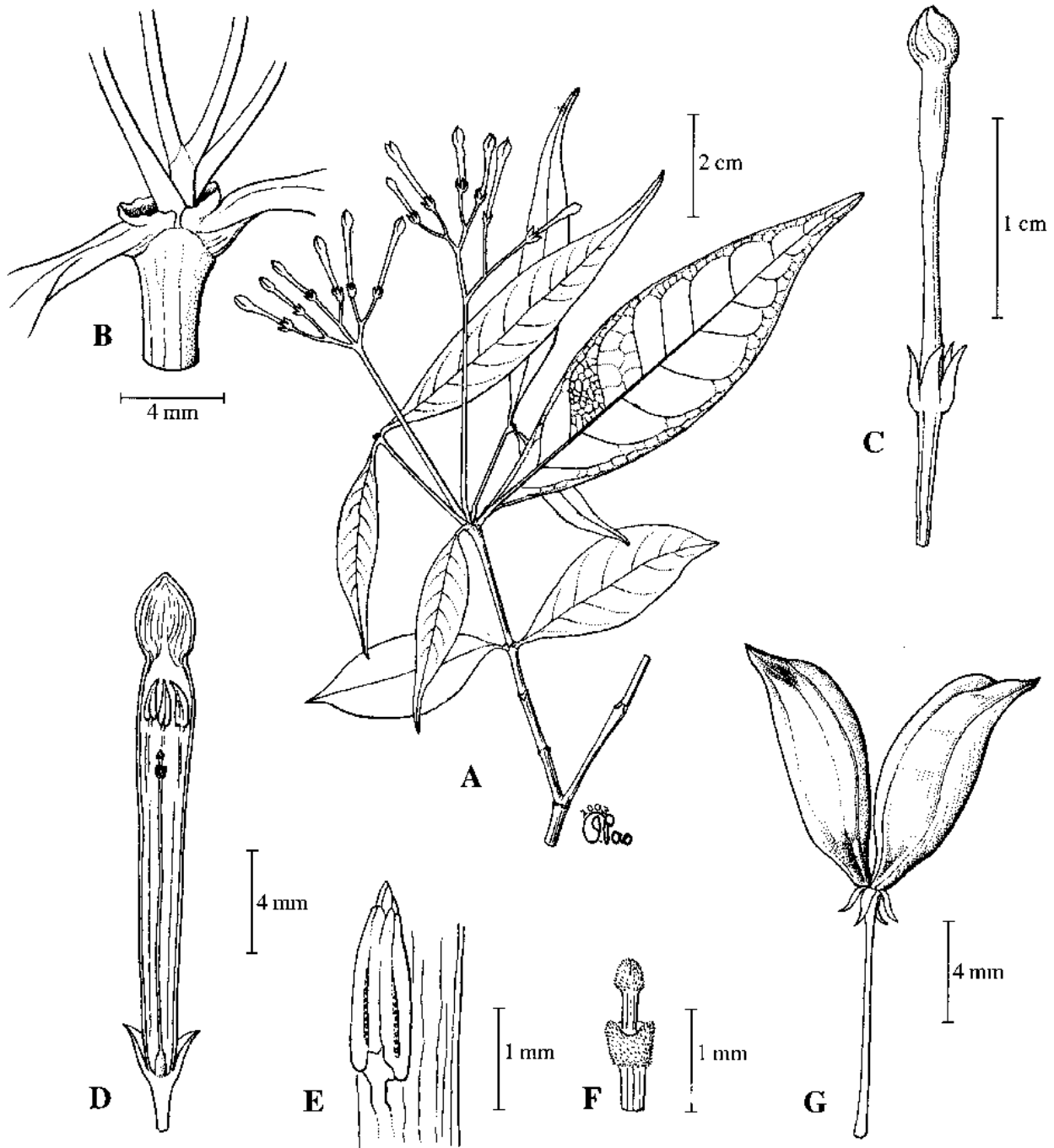


Fig. 10. *Tabernaemontana pauciflora*. A, flowering leafy twig; B, intrapetiolar ocrea; C, flower bud; D, longitudinal section of flower bud; E, stamen; F, upper part of style head; G, fruits. (A–F from SAN 80500, G from S 31146.)

apex acute to rounded, tube 10–21 mm long, lobes 14–31 × 7–15 mm, apex rounded; stamens inserted at 4–9 mm from the base of corolla tube, anthers 2.3–3.5 × 1–1.4 mm; ovary glabrous, 2.5–4 mm long, style 1.7–4.5 mm long; pistil head 0.7–2.5 mm long. **Fruits** of 2 follicles, separate or joined at base, orange, 8–16 × 5–16 cm, sometimes with faint ridges, many-seeded. **Seeds** with a red aril.

Vernacular names. Sabah—*burut-burut* (preferred name), *lampada* (Dusun, Ranau). Sarawak—*pelel kambing* (Brunei Iban), *tara manang* (Iban).

Distribution. S Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo, widespread in Sabah (e.g., *SAN 32011*, *SAN 82449*, *SAN 83889*, *SAN 127116*, and *SAN 127377*) and Sarawak (*S 43693*, *S 44875*, *S 49148*, *S 49679*, and *S 49680*). Also occurring in Brunei (e.g., *BRUN 1057* and *BRUN 3122*) and Kalimantan (e.g., *Kostermans 4952*, *Kostermans 21187*, *Leeuwenberg 13027*, and *Ridsdale PBU 551*).

Ecology. Common in primary and secondary lowland and lower montane forests on sandy loam soils, at altitudes to 1500 m.

Uses. Fruit used to alleviate toothache; the chopped root is an ingredient of arrow poison.

4. *Tabernaemontana pandacaqui* Poir.

(of Pandacaqui in the Philippines)

In Lam., *Encycl.* 7 (1806) 529; Merrill, *Enum. Philip. Fl. Pl.* 3 (1923) 325; Leeuwenberg *op. cit.* (1991) 169; Middleton *op. cit.* 33; PROSEA *op. cit.* 535. **Type:** *Sonnerat s.n.*, the Philippines, Luzon, near Manila (holotype P-LA; isotype P). **Synonyms:** *Tabernaemontana orientalis* R.Br., *Prodr.* (1810) 468, Merrill *op. cit.* (1921) 499, Masamune *op. cit.* 624; *T. floribunda* Blume, *Bijdr. Fl. Ned. Ind.* (1826) 1028, Backer & Bakhuizen *f. op. cit.* 229, Anderson *op. cit.* 149, Ashton *op. cit.* 43. (For further synonymy, cf. Leeuwenberg *op. cit.* (1991) 169).

Shrub or small tree to 14 m tall. **Twigs** lenticellate, occasionally sparsely pubescent. **Leaves** *papery or subcoriaceous*, glabrous or pubescent; blade elliptic or obovate, 3–14.1(–25) × 1–6.5(–10) cm, base cuneate, *apex acuminate or caudate*; *lateral veins 4–14 pairs, curved-ascending*, weakly anastomosing near margin, *frequently much paler than the blade above*; intercostal venation mostly reticulate, sometimes obscure, often paler than the blade; petiole 3–20 mm long. **Inflorescences** pubescent or glabrous, 4–11 cm long, 2–many-flowered. **Flowers** weakly or not scented; *sepals ovate, 1–4 × 0.5–2 mm*, apex rounded to acuminate, pubescent or glabrous, *ciliate or not ciliate*; *corolla never doubled*, white or pale yellow, in mature bud (1–)2.2–3 cm long with globose head 0.2–0.4× the length of bud, *apex rounded or obtuse*, glabrous on both sides, rarely pubescent at base of lobes or in throat, *tube (8–)18–23 mm long*, twisted or not, *lobes not ciliate, (6–)15–17 × 2–10 mm*; *stamens inserted at 5–14 mm from the base of corolla tube*, anthers 1.1–5 × 0.4–1 mm; ovary 1–2.8 mm long, style and pistil head 1.1–1.6 mm long. **Fruits** of 2 separate follicles, orange, red or yellow, obliquely ellipsoid, 0.9–7.1 × 0.5–3 cm, apex acuminate, slightly reflexed, distinctly longitudinally ridged, glabrous or pubescent, *1–40-seeded*. **Seeds** with a red or orange aril.

Distribution. S China, Taiwan, Thailand, Borneo, eastern parts of Indonesia, northern parts of Australia, and western Pacific. In Borneo, only known from Sabah, scattered in islands in Kota Belud, Kudat, Lahad Datu and Lamag districts (e.g., *SAN 22154*, *SAN 110071*, *SAN 125369*, *SAN 129417*, and *SAN 135370*).

Ecology. Found in a wide variety of habitats, particularly in drier areas.

Uses. Used in a bath after childbirth and is applied to bruises, wounds and swellings.

5. *Tabernaemontana pauciflora* Blume

Fig. 10, Plate 1F.

(Latin *pauci-* = few; *florus* = flower; few-flowered)

Bijdr. Fl. Ned. Ind. (1826) 1028; Merrill *op. cit.* (1921) 499; Masamune *op. cit.* 624; Leeuwenberg *op. cit.* (1991) 182; Turner *op. cit.* 130; Coode *et al.* (eds.) *op. cit.* 28; Middleton *op. cit.* 33; PROSEA *op. cit.* 536; Beaman *et al.* *op. cit.* 112. **Type:** Blume 73, Java, near Rompien (holotype L). **Synonyms:** *Tabernaemontana malaccensis* Hook.f., *op. cit.* 649, Corner *op. cit.* 161; *Ervatamia malaccensis* (Hook.f.) King & Gamble *op. cit.* 452, Ridley *op. cit.* (1923) 343; *T. polysperma* Merr., Philip. J. Sci. 21 (1922) 531, Merrill, PEB (1929) 254, Masamune *op. cit.* 624. (For further synonymy, cf. Leeuwenberg *op. cit.* (1991) 182).

Shrub or small tree to 6 m high, to 10 cm diameter. **Bark** pale grey to grey-brown, smooth; inner bark pale yellow. **Sapwood** pale yellow. **Twigs** glabrous, with few lenticels. **Leaves** papery, glabrous; blade narrowly elliptic or elliptic, 3–26 × 0.6–10 cm, base cuneate, apex acuminate or caudate; lateral veins 5–20 pairs, curved-ascending, concolourous or slightly paler than the blade; intercostal venation obscure; petiole 2–7 mm long. **Inflorescences** 3–15-flowered, 2–10 cm long, glabrous to minutely puberulent. **Flowers** fragrant; pedicels 3–10 mm long; sepals ovate to oblong, 2–4 × 0.7–1.2 mm, not ciliate, apex acuminate to acute, glabrous to sparsely puberulent; corolla never doubled, white, sometimes yellow in the throat, in mature bud 1.4–3.8 cm long with ovoid head 0.2–0.33 × the length of bud, apex acuminate to obtuse, tube 12.5–23 mm long, lobes not ciliate, 7–14 × 3–9 mm, apex rounded, glabrous inside; stamens inserted at 9–16 mm from the base of corolla; anthers 1.5–4 × 0.5–1 mm; ovary glabrous, 0.6–2 mm long, style 8.5–15 mm long; pistil head 0.7–1.2 mm long. **Fruits** of 2 separate follicles, yellow or orange, 2–6 × 0.7–2 cm, with 1 or 2 clear lateral ridges on each side, many-seeded. **Seeds** with a red aril.

Vernacular names. Sabah—*lampada* (Dusun, Ranau), *berancang asu* (Dusun).

Distribution. Myanmar, Thailand, Cambodia, Vietnam, Sumatra, Peninsular Malaysia, Singapore, Java, and Borneo. In Borneo, common in Sabah (e.g., *SAN 81998*, *SAN 86598*, *SAN 86860*, *SAN 118758*, and *SAN 126270*) but scattered in the eastern parts of Sarawak (e.g., *S 30683*, *S 31146*, *S 31922*, *S 52315*, and *S 65633*). Also occurring in Brunei (e.g., *Bernstein 236*, *Cowley 108* and *Wong WKM 1161*) and in Kalimantan (e.g., *Kostermans 10577A*, *Kostermans 21671* and *Leeuwenberg & Rudgejiman 13026*).

Uses. As in *T. pandacaqui*.

Note. The specific limit between *T. pauciflora* and *T. rostrata* are not entirely clear. Further research may reveal that specimens with long narrow calyx lobes, which have been assigned to *T. pauciflora* by Leeuwenberg (*op. cit.* 1991) and also in this work, might have to be transferred to a more broadly defined *T. rostrata*.

9. VOACANGA Thouars

(Latinisation of a Malagasi plant name)

Gen. Nov. Madag. (1810) 10; Backer & Bakhuizen *f.*, FJ 2 (1965) 229; Anderson, CLTS (1980) 150; Leeuwenberg, Agric. Univ. Wag. Pap. 85-3 (1985) 9; Ashton, MNDTS 2 (1988) 45; PROSEA 12, 2 (2001) 582.

Shrubs or trees with dichotomous branching; with white latex. **Leaves** *opposite*, with small stipule-like flaps in the axils, sometimes obscure. **Inflorescences** cymose or flowers solitary, lax; 2 inflorescences at each ramification. **Flowers** usually fragrant; *sepals in most species with a distinct connate tube and free lobes*, usually with glands inside, shed with the corolla; corolla lobes overlapping to the left in bud, mature corolla with narrow or trumpet-shaped tube and spreading lobes; stamens subsessile, completely included in the corolla tube or slightly exserted, anthers narrowly triangular, base sagittate, apex acuminate, sterile at apex, weakly attached to the pistil head; disc adnate to sides of carpels; ovary of two separate carpels united into a common style, style filiform; pistil head short. **Fruits** of paired follicles, usually somewhat united at least at the base. **Seeds** *covered in a fleshy aril*.

Distribution. About 12 species, distributed in Africa and Malesia. Two species occur in Sabah and Sarawak.

Ecology. Mostly in wet aseasonal or seasonal lowland evergreen forests.

Key to *Voacanga* species

Leaves glabrous below; corolla tube more than 20 mm long.....1. **V. foetida**

Leaves pubescent below; corolla tube less than 15 mm long.....2. **V. havilandii**

1. *Voacanga foetida* (Blume) Rolfe

(Latin, *foetidus* = evil-smelling; the flowers)

J. Bot. London 21 (1883) 202; Backer & Bakhuizen *f. op. cit.* 229; Leeuwenberg *op. cit.* 47; PROSEA *op. cit.* 584. **Basionym:** *Orchipeda foetida* Blume, Bijdr. Fl. Ned. Ind. (1826) 1027. **Type:** *Blume s.n.* (= RHL Sheet No. 898112361), Java, without locality (holotype L; isotypes MEL, P, U).

Tree to 20 m tall, to 40 cm diameter. **Bark** grey, whitish brown, or grey-brown, smooth; inner bark medium yellow-brown, fibrous. **Sapwood** pale yellow. **Twigs** glabrous, lenticellate. **Leaves** papery, *glabrous*; blade elliptic, obovate or ovate, 7–37 × 3–11 cm, base cuneate, apex acuminate or apiculate; lateral veins 7–15(–17) pairs, curved-ascending; intercostal venation scalariform or inconspicuous; petiole 5–9(–15) mm long. **Inflorescences** few-flowered, 12–22 cm long, glabrous; peduncles 5–15 cm long. **Flowers** with an unpleasant smell; pedicels (1–)2.5–4 cm long; calyx forming a campanulate tube, slightly fleshy, glabrous outside, tube 12–28 mm long, lobes 4–12 × 5–11 mm, apex rounded; corolla white, *tube 28–45 mm long*, widening towards apex, glabrous on both sides, lobes 37–95 × 22–44 mm, apex rounded, glabrous; stamens inserted near the base of the corolla tube; disc annular, *c.* 0.5 mm high; ovary glabrous, *c.* 2 mm high, style short.

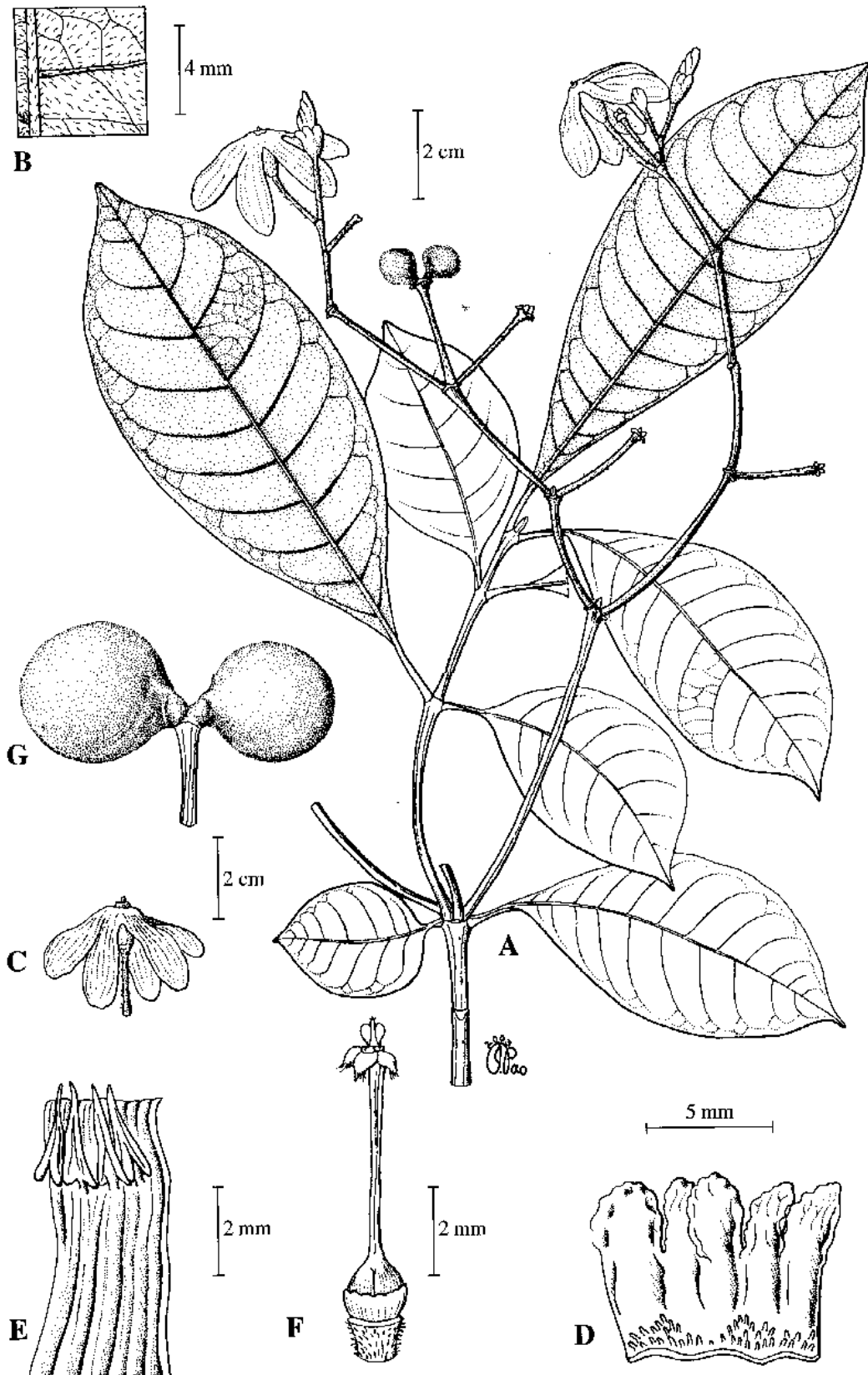


Fig. 11. *Voacanga havilandii*. A, flowering and fruiting leafy twig; B, detail of venation and indumentum on lower leaf surface; C, open flower; D, adaxial view of calyx showing colleters; E, stamens; F, gynoecium; G, fruits. (A–B from *S* 29303, C–F from *S* 18456, G from *S* 65623.)

Fruits fleshy, free from each other, subglobose, 6–11 cm diameter. **Seeds** with an orange aril.

Distribution. Sumatra, Borneo, and Java. In Borneo, known from Sandakan district in Sabah (e.g., *Wong WKM 2653*) and in Kalimantan (e.g., *Dachlan 2149*).

Ecology. In forest at altitudes to 600 m.

Uses. Latex can be applied externally against skin diseases.

2. *Voacanga havilandii* Ridl.

Fig. 11.

(G.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Bull. Misc. Inform. Kew (1926) 473; Masamune, EPB (1942) 625; Anderson *op. cit.* 150; Leeuwenberg *op. cit.* 63; Ashton *op. cit.* 46. **Type:** *Haviland 593*, Borneo, Sarawak, Kuching (holotype K; isotype SAR). **Synonym:** *Voacanga borneensis* Markg., Mitt. Bot. Staatssamml. München 1 (1950) 28.

Small tree to 15 m tall, to 15 cm diameter. **Bark** pale green to whitish, lenticellate. **Twigs** pale grey-brown with a few large lenticels, glabrous. **Leaves** *pubescent below*, thinly coriaceous; blade elliptic to obovate, 3.7–25 × 1.7–9.5 cm, 1.3–4.1 times as long as wide, base cuneate, apex acuminate to apiculate; lateral veins 7–14 pairs, almost perpendicular to the midrib, anastomosing into a looped intramarginal vein; petiole 4–25 mm long. **Inflorescences** lax, many-flowered, to 35 cm long, glabrous to pubescent; peduncles 4.5–16 cm long. **Flowers:** pedicels 1–2.4 cm long; calyx 6–12 mm long, tube campanulate, 3–9.5 mm long, glabrous to sparsely pubescent; corolla white or cream, *tube 7–11 mm long*, cylindrical, somewhat wider around the anthers, lobes 15–24 × 7–11 mm, apex rounded, spreading or recurved; stamens inserted in the upper part of corolla tube, anther apex near corolla mouth; disc annular, crenate, 0.4–0.8 mm high; ovary 1–2 mm high, glabrous. **Fruits** subglobose, 3.5–5 cm diameter. **Seeds** with an orange-red aril.

Vernacular name. Sarawak—*bardal* (Iban).

Distribution. Endemic in Borneo. In Sarawak, scattered (e.g., *S 18456*, *S 19475*, *S 29303*, *S 39934*, and *S 64345*) but not yet known from Sabah. Also occurring in Kalimantan (e.g., *Burley et al. 2826*).

Ecology. In lowland mixed dipterocarp forest at altitudes to 200 m.

DIPTEROCARPACEAE

P.S. Ashton

Arnold Arboretum, Harvard University Herbaria, Cambridge, Massachusetts, U.S.A. and
Royal Botanic Gardens, Kew, England, U.K.

Blume, *Bijdr. Fl. Ned. Ind.* (1825) 223; F. Heim, *Rech. Dipt.* (1892) 1; King, *J. As. Soc. Beng.* 62, 2 (1893) 87; Brandis, *J. Linn. Soc. Bot.* 31 (1895) 1; Merrill, *EB* (1921) 397; Ridley, *FMP* 1 (1922) 209; Gilg *in Engler & Prantl, Nat. Pflanzenfam.* edition 2, 21 (1925) 237; Foxworthy, *Philip. J. Sci.* 6 (1911) *Bot.* 231, *Philip. J. Sci.* 13 (1918) *Bot.* 163, *Malay. For. Rec.* 10 (1932) 4, *Philip. J. Sci.* 67 (1938) 241; Masamune, *EPB* (1942) 482; Symington, *Malay. For. Rec.* 16 (1943) 1; Brown, *FTSB* (1955) 88; Backer & Bakhuizen *f.*, *FJ* 1 (1964) 328; Ashton, *MDB* (1964) 1, *MDBS* (1968) 1, *FM* 1, 9 (1982) 237, *in Kubitzki et al. (eds.)*, *Fam. Gen. Fl. Pl.* 5 (2000) 182; Meijer & Wood, *Sabah For. Rec.* 5 (1964) 9; Burgess, *TBS* (1966) 93; Anderson, *CLTS* (1980) 110; Kessler & Sidiyasa, *TBSA-EK* (1994) 86; Coode *et al. (eds.)*, *CLBD* (1996) 66; Newman *et al.*, *MDFB-LHW* (1996) 55, *MDFB-MHHW* (1998) 57.

Mostly large canopy or emergent, *resinous trees*; usually buttressed. **Bark** smooth, fissured or flaky. *Indumentum comprising fascicled hairs*, sometimes also simple hairs, unicellular or multicellular glandular hairs or short- or long-lobed peltate scales. Shoot growth rhythmic. **Twigs** with small or large, sometimes species-specific (*Dipterocarpus*), shoot-buds. **Stipules** species-specific in some taxa (especially in *Dipterocarpus*), *generally caducous leaving distinct scars*. **Leaves** alternate; blade simple, generally penninerved, *base generally terminating abruptly at the frequently geniculate petiole*, margin entire though sometimes sinuate, often narrowly revolute, apex generally acuminate; lateral veins very slender (densely parallel in *Cotylelobium*, *Dryobalanops* and some *Hopea*), *often with axillary domatia*; intercostal venation scalariform or reticulate. **Inflorescences** *generally paniculate*, sometimes racemose or rarely subcymose, terminal, axillary or sometimes ramiflorous, furnished with paired modified stipules at nodes, generally regularly 1–2(–3)-branched, the branchlets bearing distichous or secund flowers. **Flowers** bisexual, radially symmetrical, scented, nodding; calyx persistent, 5-merous, *sepals free and quincuncial-imbricate* or united at base with valvate lobes, *with 2–3(–5) (outer if imbricate) lobes enclosing those remaining and generally greatly expanding and spatulate and lightly twisted in fruit*; corolla 5-merous, *petals contorted*, weakly connate at base or free, *almost always partially unicellular-hairy outside*; stamens 5 to more than 100, 1–3-verticillate or irregular, hypogynous or subperigynous, centrifugal, *filaments generally compressed at base, tapering and filiform distally*, or filiform throughout, frequently connate to petals, anthers erect, 2-loculed with (2–)4 pollen sacs, introrse or latrorse, *connective with more or less prominent appendage*, variously short or long, aristate or stout, erect or reflexed; *ovary generally superior*, sometimes semi-inferior, (2–)3(–5)-loculed, style generally columnar, often thickened at base into a stylopodium, stigma generally obscure, more or less distinctly trifold; ovules 2(–many) per locule, axile, pendulous or laterally anatropous, bitegmic with ventral raphe and superior micropyle. **Fruits** indehiscent *1(–many)-seeded nuts with woody pericarp and persistent calyx appressed to the base; calyx lobes more or less expanding into spatulate wings; cotyledons generally fleshy*, sometimes laminar, entire or variously lobed, *frequently unequal, one more or less enclosing the other, both enclosing the radicle*. **Germination** epigeal or hypogeal, the pericarp splitting loculicidally or irregularly.

Distribution. Pantropical, with about 500 species in 3 subfamilies and 17 genera. In Sabah and Sarawak the family is represented by 9 genera with 267 species.

Ecology. In Sabah and Sarawak, occurring especially in mixed and upper dipterocarp forests but also in other non-saline habitats, at altitudes to 1800 m. Rare in secondary forest following clearing.

Notes. The resinous smell of fresh wood and bark, the twig with stipular scars, and the stipulate leaf with simple entire-margined blade terminating abruptly at the frequently geniculate petiole, serves to distinguish a dipterocarp at any stage in the field.

The Dipterocarpaceae have been regarded as allied to Guttiferae, Theaceae and Order Malvales, especially the Tiliaceae. Ashton (1982) considered the family to be allied to Sarcolaenaceae and Tiliaceae, and to be within Order Malvales. Molecular evidence (Alverson *et al.*, *Am. J. Bot.* 85 (1998) 876) indicates Dipterocarpaceae to share a clade allied to but not within core Malvales, with Sarcolaenaceae (trees of Madagascar and formerly Africa) and Cistaceae which are temperate shrubs. Molecular evidence (Alverson *et al.*, *op. cit.*; Dayanandan *et al.*, *Am. J. Bot.* 86 (1999) 1182) supports the close affinity of the three putative subfamilies of the Dipterocarpaceae.

Maguire & Ashton (*Taxon* 26 (1977) 341) subdivided the Dipterocarpaceae into three subfamilies, which can be distinguished as follows:

1. Anthers basifixed; sepals, if amplicate, then generally conspicuously unequal with 2–3 becoming wing-like in fruit; ovary (2–)3-loculed, each locule with 2 ovules. Wood, leaves and ovary with resin or secretory ducts; wood-rays multiseriate. Tropical Asia and Malesia.....subfam. **Dipterocarpoideae**
Anthers basi-versatile; sepals equally accrescent, papyraceous; ovary (2–)3–4(–5)-loculed, each locule with 2–4 ovules. Wood, ovary and, commonly, leaves without resin or secretory ducts.....2
2. Petals longer than sepals; anthers little or deeply basi-versatile, connective little or moderately projected as an apical appendage; ovary 3(–5)-loculed, each locule with 2 ovules. Wood-rays predominantly uniseriate. Tropical Africa and Madagascar..... subfam. **Monotoideae**
Petals shorter than sepals; anthers deeply basi-versatile, connective conspicuously projected as an apical appendage; ovary 4(–5)-loculed, each locule with 4 ovules. Wood-rays predominantly biseriate. Tropical America.....subfam. **Pakaraimoideae**

Phytogeography. The subfam. Dipterocarpoideae comprise 13 genera, with *c.* 475 species, confined to the Asian tropics between the Seychelles Is. and S Asia to New Guinea but absent in the Lesser Sunda Is. east of Sumbawa. Most genera and species occur in the W Malesia: Sumatra, Peninsular Malaysia, Singapore, Java, Borneo, the Philippines and islands in between. Sabah and Sarawak, which have 267 species in 9 genera, is the richest area in the world for dipterocarp species.

Within NW Borneo, dipterocarps manifest rather distinct geographical provinces, partially irrespective of the geographical range of their specific habitats. One distinct province is north of a line from Pontianak following the Sg. Kapuas to the Kapuas Lakes in Kalimantan, then across the Sarawak lowlands to Sipitang District in SW Sabah, with a few entities occurring north to Papar. Species confined to this province, yet not endemic in Borneo, indicate this province to be the Borneo extension of Corner's Riau Pocket. Within it, there is a distinct barrier at the Lupar valley, including several Peninsular Malaysian/Sumatran elements west of it, as well as some endemics. It is noteworthy that the boundary of this province coincides with the extent of major areas of peat swamp, *kerangas*, and mixed dipterocarp forest on deep yellow humult sandy soils; several of these soils specialists extend to E Sabah, mainly on ultrabasic substrates. A second mainly lowland province occurs from Sandakan district in E Sabah southwards, with no distinct southern boundary but gradual attrition of species southwards to Balikpapan and beyond though many only reach Tidung and Berau in NE Kalimantan. This province includes some Philippine species, some of which extend westwards to NE Sarawak and Brunei. Most species confined to Borneo to this province occur in mixed dipterocarp forest on clay soils. A third province, overlapping with the other two, contains species of the central Borneo uplands. Those species of low altitudes are centred, in Malesia, around the Rajang hinterland, extending across to Ulu Barito, Kayan, and sometimes the poorly explored Kapuas hinterland. Those of the upper dipterocarp forest are mostly as yet unrecorded from Kalimantan and there is increasing endemism towards the northeast, peaking around Mt. Kinabalu.

We have relied, for our distribution and ecological records, in this account on the extensive data cited in the unpublished report of Brunig (1966)* the identifications for which I was responsible; Anderson's (1963) Checklist for the peat swamps, and my own data from 105 sample plots, and the 52 ha plot in Lambir Hills NP. In mixed dipterocarp from Miri to Kuching districts.

Ecology. Members of the subfamily Dipterocarpoideae are overwhelmingly concentrated in aseasonally wet lowland evergreen forests on well-drained soils, at altitudes below 800 m and with declining numbers above 400 m. There, the subfamily is characterised by supra-annual mass flowering especially among canopy species, mast fruiting synchronised at subfamily level, and high survival of germinants: forests most dense in dipterocarp species have abundant saplings at all times. Dipterocarp species are either late successional, their juveniles with relatively high growth rates and low shade tolerance; or climax, their juveniles having relatively low maximum growth rates but high shade tolerance. Dipterocarps are most rich in species in forests with high canopy heterogeneity imparted by frequent small to moderate-not large-gap formation. Dipterocarps are ectotrophic mycorrhizal: they are most species-rich on yellow soils with shallow acid raw humus, and their juveniles are easily eliminated by soil surface disturbance; dipterocarps return to abandoned *ladang* slowly, in part owing to their limited dispersal; but they may not return for centuries on humic soils whose surface has been removed or destroyed by machinery, burning or cultivation. Nevertheless, the fast growth rates and superior timber quality of many species, combined with their abundant regeneration, makes them the easiest major rain forest timber family, world-wide, to be sustainably managed for timber. Most dipterocarps are highly habitat specific: local conservation planning for dipterocarp species must first conserve adequate area of each of the main habitats in which they occur.

*Brunig, E.F. 1966. Der Heidewald von Sarawak und Brunei—eine Studie seiner Vegetation und Ökologie. 2 Beschreibung der Arten. Pp. 41–73.

Particularly, species are generally highly soil-specific, and appropriate choice of species is essential for plantation. Many species appear to be able to occur, occasionally, to the altitudinal limits of lowland tropical soils, which is generally at 700–1200 m altitude; those that are confined to low altitudes appear to be on soils similarly constrained. The subfamily as a whole reaches its highest biomass, and stand density on yellow and red lowland soils, where the major division in forest species composition correlates with the presence or absence of surface acid raw humus. On these yellow/red soils, dipterocarps comprise more than half the above-ground tree biomass, and more than 70% of the emergent individuals; they are less well represented by species which reach maturity in the main canopy or subcanopy though these ‘mixed dipterocarp forests’ support many juvenile dipterocarps of all sizes, especially saplings. In this treatment, commonness is estimated in relation to ecology, for forest prior to logging.

Dipterocarps are insect pollinated; species within each major taxon share the same insect pollinators. Flowering within a major taxon, especially in the sections of *Shorea*, is sequential within one habitat and species association, with overlap in flowering between successive species. Dipterocarps are self-compatible, though available evidence suggests that outcrossing is high in nature, and that progeny from outcrossing have higher survivorship than those originating from selfing. Apomixis through adventive embryony appears to be important in some species. Dipterocarp seeds lack dormancy, the species populations therefore being dependant on an abundant population of juveniles. Fruits are primarily dispersed by gyration occasioned by the twisted wing-like fruit sepals, though many appear to have no means of dispersal. Terrestrial mammals, especially rodents, may inadvertently disperse seed for short distances, and scatter-hoarding occurs. A few species are water-dispersed. Fruit dispersal is, therefore, mostly very limited in the aseasonal wet tropics except during exceptional wind storms. Dipterocarps may take centuries, or longer, to disperse back into extensive cleared areas.

Dipterocarps are, generally, a poor source of food for larger animals; their resinous parts are astringent with tannin and difficult to digest, while the lipid-rich fruits are only produced at long intervals when their superabundance far exceeds the capacity of animals to consume them; this thereby permits their copious regeneration. Supra-annual mast fruiting appears to explain both the success of dipterocarps in western Malesia, and the relatively low animal carrying capacity of vertebrates there compared with evergreen lowland tropical forests in Africa and America. Recently, it has been discovered that wild pigs (*Sus scrofa*) in Pasoh FR, Peninsular Malaysia, preferentially harvest dipterocarp saplings to build their nests; the increase in food availability for pigs, provided by fallen fruit in oil palm plantations adjacent to mixed dipterocarp forest, is thereby leading to dramatic declines in dipterocarp saplings, and may lead to a declining role of the subfamily at least near the edge of the forest.

Uses. Dipterocarps have had a wealth of traditional uses (PROSEA 5, 1 (1993) 94, 139, 166, 186, 238, 299, 325, 384, 458 & 461), few of which have survived rural economic change.

The earliest recorded use was for camphor, from *Dryobalanops aromatica*, which was exported in mediaeval times to the Middle East, where it has been said it was worth its weight in gold as a base for incense. Iban girls formerly used camphor resin in a similar way, melting the camphor then infusing it with other scents; it was then used as a solid perfume and hidden in their pillows. There would appear to be opportunities for commercial development of this attractive fashion for a wider market.

The viscid resin of *Dipterocarpus* was used, eventually commercially, as a basis for paints and for caulking wooden boats, particularly in seasonal continental Asia where several species produce copious resin and are tapped with the aid of fire. This practise continues in the poorer rural economies. The crystalline resin of some species of *Hopea*, known as *mata kucing*, was used as a base for medicines, and for varnishes. A charcoal, prepared from resin of *Shorea* sect. *Richetioides*, was formerly used for blackening teeth, a custom then among Lun Dayuh and Brunei women.

The abundance of astringent compounds in dipterocarp tissues, specifically the inner bark, was availed of as *laru*: macerated bark introduced to rice and coconut beer to arrest further fermentation; it was also used to prevent frothing during boiling of palm syrup during sugar manufacture.

The fat-rich cotyledons have formerly been an important source of famine food throughout Asia, and nuts of certain *Shorea* are still collected in Sri Lanka for preparation of sweetmeats, and in Borneo as a source of cooking fat with a high melting point. The large nuts of some species of *Shorea* sect. *Pachycarpae* and also sect. *Brachypterae*, sect. *Mutica* and sect. *Shorea* are particularly favoured, and are exported during most years for use in chocolates, lipstick and other industrial products.

But since the early seventies, dipterocarps have provided the bulk of hardwoods traded on international markets; the light hardwood *Shorea* timbers being particularly in demand though the heavy hardwood *selangan batu* is marketed for decking, garden furniture and other purposes where a high quality weather resistant wood is required. Although timber harvesting can be managed sustainably (but almost certainly not also sustaining biodiversity), this has not been done because it involves additional costs and reduces profits. In particular, careless and inappropriate use of machinery, and especially re-entry for further logging while the residual stand is developing, has led to soils disturbance and damage to the original stand on such a scale that it is unlikely that economically merchantable stands of dipterocarps will return for at least one, and possibly several centuries. Although this practise is logical financially to the concession holder, it has economically impoverished the nation by degrading its most valuable sustainable resource.

By virtue of their commanding role in the structure of the lowland and hill forests of Sabah and Sarawak, dipterocarps possess unique economic service values, esthetically including for tourism, and in the conservation of the overall biodiversity of these ecosystems which are the most species-rich forests in the Old World, being matched only by some in the headwaters of the Amazon River. Their value in sequestration of atmospheric carbon is almost certainly greater than any other tropical plant family. The harvesting of the dipterocarp trees for timber dramatically affects the demography, hence interdependences, of the other plants and animals of the forest, and extinctions can be predicted. This are major reasons why the forests of the national parks must remain sacrosanct.

Conservation status. I have endeavoured, on available evidence and personal experience, to predict the degree of endangerment of the dipterocarp species in our region. My criteria require explanation. The International Union for the Conservation of Nature (IUCN) has drawn up criteria for making standard comparable assessments of conservation status for organisms in general, plants as well as animals. Their criteria are based, however, mainly on animal population characteristics. Most animals are less physical-habitat-specific than plants, and their populations therefore generally extend more continuously over large areas. Animals also have shorter life-spans than trees. IUCN has placed high emphasis, therefore,

on the amount by which habitat has been reduced in area over the last three generations of a species. Were this criterion literally applied to dipterocarps, all our species would be judged to be at some level of endangerment!. Dipterocarp populations, by being highly habitat-specific, are already often fragmented in nature into an archipelago of habitat-islands. It is, therefore, the number of these islands that survive forest harvesting or conversion that matters to them, rather than the absolute decline in primary (or logged) forest area. A further important rule of thumb, which can reasonably be applied to both plants and animals, is the minimum acceptable size of populations of mature reproductive individuals that is needed to sustain the genetic diversity found in nature through outbreeding. It is generally assumed that a minimum of 200 mature individuals, in a given area/habitat, is needed, that is a minimum of 200 within the foraging range of the pollinating insect in the dipterocarp case. It is thus obvious that logging has a major impact on the distribution and frequency of adequate dipterocarp breeding populations. It can reasonably be argued that the regeneration which survived from the primary forest through the logging process will in due course grow to become new populations of acceptable density. We hope that this may be the case, but fear that soil disturbance, uniformly low light conditions beneath the later regrowth, and the slow growth rates of climax species in relation to the length of the felling cycle, may all have adverse effects, particularly on the soil specialists and other less common species. I have therefore placed high emphasis on the accessibility and suitability of species' habitats for conversion to agriculture, and their occurrence in the national parks system, when assigning a level of threat to a species' survival within Sabah and Sarawak. The generally lower level of endangerment of species in Sabah and Sarawak when compared to their global distribution (*cf.* Oldfield *et al.* 1998. *The World List of Threatened Trees*, WCMC & IUCN) testifies largely to their generally good conservation in the legislated Sabah and Sarawak park systems, which have been largely protected from logging. In logged forests, surviving juveniles of the more light-demanding species may be expected to survive to maturity, as may those of understorey species; but the shade-tolerant, generally heavy hardwood species have an uncertain future there.

Key to genera

(based on flowering/fruitlet specimens)

1. Fruit calyx lobes valvate, not incrassate, at base. Chromosome number $x = 11$ (tribe **Dipterocarpeae**).....2
 Fruit calyx lobes at least slightly imbricate at base (often becoming fully valvate in *Dryobalanops* and *Parashorea*), with a distinct incrassate expanded spoon-shaped base (united into a cup in *Dryobalanops*). Chromosome number $x = 7$ (tribe **Shoreae**).....6
2. Base of fruit calyx united into a tube enclosing at least the basal half of the nut.....3
 Fruit sepals free to the base, or united into a shallow cup enclosing less than one third of the nut.....4
3. Connective appendage of stamen stout, tapering, at most $1\frac{1}{2}x$ the length of anthers. Nut free within calyx tube. Epidermis lacking peltate scales. Leaf bud prominent; stipules large, amplexicaul; leaf aestivation plicate; lateral veins not uniting into an intramarginal vein.....**3. Dipterocarpus**
 Connective appendage of stamen slender, at least twice the length of anther. Nut adnate to calyx tube. Epidermis in part furnished with peltate scales. Leaf bud small;

- stipules linear, with short scars; leaf aestivation not plicate; lateral veins joining distally into a prominent looped intramarginal vein.....**1. Anisoptera**
4. Stamens at least 25; connectival appendage at least twice the length of anther. Nut triangular in cross-section.....**8. Upuna**
 Stamens at most 15; connectival appendage at most 1½x the length of anther. Nut round in cross-section.....5
5. Anthers linear-oblong, setose along lateral margins; style at least twice the length of ovary; stigma small, trifid. Leaf lateral veins densely parallel, unequal, slender and hardly raised, main veins joining distally uniting into a looped intramarginal vein..... **2. Cotylelobium**
 Anthers broadly oblong to subglobose, glabrous; style less than twice the length of ovary; stigma conical, prominent. Leaf lateral veins well-spaced, usually distinctly raised below, with short or no intermediate veins, not or obscurely distally joined into an intramarginal vein.....**9. Vatica**
6. Fruit calyx lobes all equal, all spatulate, wing-like, or all short. Leaf lateral veins very slender, dense, parallel, connected by a vein just within the margin.....**4. Dryobalanops**
 Fruit calyx lobes unequal, spatulate (except in *Shorea isopectera*), or all short. Leaf lateral veins, if slender and dense, not joining into an intramarginal vein.....7
7. Fruit calyx lobe base narrow, hardly imbricate; nut verrucose-lenticellate, ripening globose to ellipsoid.....**6. Parashorea**
 Fruit calyx lobe base broad, distinctly imbricate; nut not verrucose-lenticellate, ripening not so.....8
8. Flower calyx lobes with 2 outer ones thicker, more acuminate than the 3 inner ones, 2 becoming wing-like, spatulate in fruit, or all 5 short.....**5. Hopea**
 Flower calyx lobes with 3 outer ones thicker, more prominently acuminate than the 2 inner ones, 3 becoming wing-like, spatulate in fruit or all 5 short.....**7. Shorea**

**Field key to the genera and main field groups
 of *Hopea* and *Shorea***

1. Leaf lateral veins curving round towards the margin and anastomosing to form a distinctly looped intramarginal vein.....2
 Leaf lateral veins either without or with indistinct intramarginal vein, or intramarginal vein straight.....3
2. Bark surface remaining smooth at first, eventually irregularly flaky and becoming scroll-marked; inner bark homogeneous pale brown. Leaf intercostal venation obscure; main lateral veins very slender, hardly raised below, with many variably shorter intermediates; petiole not geniculate; leaf blade not lepidote below.....**2. Cotylelobium**
 Bark surface vertically cracked, oblong-flaky; inner bark distinctly tangentially laminated. Leaf intercostal venation distinct, well-spaced, scalariform or reticulate; main lateral veins distinctly raised below; petiole geniculate; leaf blade petalate lepidote below.....**1. Anisoptera**

3. Leaf lateral veins densely parallel, ending abruptly in a more or less straight intramarginal vein close within margin.....**4. Dryobalanops**
 Leaf lateral veins pinnate or, if densely parallel, then not ending in intramarginal vein.....4
4. Bark with large pale lenticels. Leaf lateral veins straight, hardly arched except towards the margin; leaf blade usually distinctly corrugated with distinct ridges between the lateral veins.....5
 Bark with small lenticels hardly paler than bark surface. Leaf lateral veins arched; leaf blade flat or bullate but not corrugated with distinct ridges.....6
5. Bark surface yellowish to orange- or rust-brown, rarely pinkish brown, becoming more or less irregularly flaky; lenticels scattered or in clusters, pale yellowish brown. Terminal (leaf) buds prominent; stipules large, scars amplexicaul; leaf blade coriaceous, never silvery below; petiole geniculate.....**3. Dipterocarpus**
 Bark surface mauve- to dark purple- or tawny-brown, closely shallowly fissured and narrowly oblong-flaky; lenticels initially in vertical lines, eventually following the bottom of fissures and ridges of buttresses, whitish. Terminal buds and stipules generally small (except in *Parashorea macrophylla*), stipular scars short (except in *P. macrophylla* and *P. malaanonan*); leaf blade usually silvery below, particularly in juveniles.....**6. Parashorea**
6. Lower leaf surface, twig, lateral veins and petiole densely whitish felty with brown tomentum; bark dark chocolate-brown, closely vertically cracked and flaky; buttresses stout, in groups.....**8. Upuna**
 Leaf lower surface not whitish felty or, if so, bark tawny-brown, and buttresses not grouped.....7
7. Buttresses low, stout; bark surface smooth except in very large trees; inner bark homogeneous, pale cream-brown; wood dense, fine textured, ray ends not glistening on tangential surface. Leaf intercostal venation generally reticulate but not drying darker than the leaf blade.....**9. Vatica**
 Bark surface, if smooth, then tree with prominent buttresses; inner bark fibrous; wood dense, ray ends glistening on tangential surface. Leaf intercostal venation scalariform or if reticulate, drying much darker than the leaf blade.....8
8. Leaf lateral veins densely parallel, variously unequal to subequal.....**5. Hopea** (in part; many species)
 Leaf lateral veins strictly pinnate, sometimes with short intermediates only.....9
9. Wood dense, hard, ray ends not glistening on tangential surface.....10
 Wood not dense, not hard, ray ends glistening on tangential surface.....11
10. Inner bark yellowish brown or, if reddish, closely even-textured, not fibrous.....
**7. Shorea** (in part; *selangan batu*) and **5. Hopea** (in part; some species)
 Inner bark fibrous, reddish orange, pale at cambium.....
**7. Shorea** (in part; *S. inaequilateralis* and *S. kunstleri*)
11. Inner bark distinctly tangentially laminated; leaf midrib obscure, sunken above.....
**7. Shorea** (in part; white meranti)

- Inner bark not distinctly laminated; leaf midrib usually evident, if furrowed, occasionally obscure above.....12
12. Inner bark greenish yellow; dammar blackish; bark tawny flaky (except in *S. acuminatissima*). Leaf intercostal venation subscalariform, or reticulate and drying darker than the blade.....7. **Shorea** (in part; yellow meranti)
Inner bark yellowish- to reddish-brown; dammar whitish or yellow or, if blackish, then inner bark pinkish; bark otherwise. Leaf intercostal venation scalariform.....13
13. Bark becoming blackish brown, flaky, with prominent white dammar incrustations; inner bark and sapwood homogeneous, cream.....5. **Hopea** (in part; e.g., *H. sangal*)
Bark, if blackish, with yellow dammar incrustations, inner bark and sapwood not cream or homogeneous.....14
14. Buttresses narrow, frequently with flying buttresses and stilt roots; bark surface chocolate-brown and grey-mottled, remaining smooth or patchily cracked and thinly flaky.....5. **Hopea** (in part)
Buttresses stout, rarely stilted; bark, if remaining smooth, pale not chocolate-brown.....7. **Shorea** (in part; most red meranti)

1. ANISOPTERA Korth.

(Greek, *anisos* = unequal; *pteron* = wing; the unequal fruit calyx lobes)

kelapok (Iban), *mersawa* (Malay), *pengiran* (preferred name in Sabah)

Kruiddk. (1841) 65; King, J. As. Soc. Beng. 62, 2 (1893) 100; Ridley, FMP 1 (1922) 218; Merrill, EB (1921) 400; Slooten, Bull. Jard. Bot. Buitenz. 3, 8 (1926) 3; Symington, Gard. Bull. S. S. 8 (1934) 1, Malay. For. Rec. 16 (1943) 199; Masamune, EPB (1942) 482; Browne, FTSB (1955) 92; Ashton, Gard. Bull. Sing. 20 (1963) 230, MDB (1964) 9, MDBS (1968) 3, FM 1, 9 (1982) 327; Backer & Bakhuizen *f.*, FJ 1 (1964) 329; Meijer & Wood, Sabah For. Rec. 5 (1964) 292; Burgess, TBS (1966) 93; Anderson, CLTS (1980) 110; PROSEA 5, 1 (1993) 94; Kessler & Sidiyasa, TBSA-EK (1994) 89; Coode *et al.* (eds.), CLBD (1996) 66; Newman *et al.*, MDFB-LHW (1996) 57. **Synonyms:** *Antherotriche* Turcz., Bull. Soc. Nat. Mosc. 2 (1846) 505; *Scaphula* Parker in Fedde, Rep. 30 (1932) 326.

Emergent trees with stout, short or tall and straight buttresses; crown irregularly hemispherical, rather narrow, often diffuse, with a few large twisted ascending branches. **Bark** becoming shallowly irregular-section fissured and thinly flaky; inner bark prominently tangentially laminated, thick, fibrous. **Sapwood** pale yellowish white, siliceous; dammar opaque, yellow or white, occurring as smear-like exudates on bole. *Indumentum on young parts and leaf undersurface in part consists of dense unicellular peltate scales.* **Twigs** more or less prominently ribbed on drying. *Leaf buds* ovoid, acute, small, c. 5 × 3 mm, somewhat compressed. **Stipules** relatively large, linear-tapering, falling early and leaving short scars. **Leaves** aestivation not plicate; thinly to thickly coriaceous, peltate-lepidote below; blade oblong-obovate, base usually obtuse, equal, apex shortly acuminate; midrib sunken above; main lateral veins distinctly raised below, curving toward margins and anastomosing to form a distinctly looped intramarginal vein; intercostal venation distinct, laxly scalariform, or subreticulate, or reticulate, prominent and raised below; petiole relatively long, prominently geniculate. **Inflorescences** racemose, terminal or

axillary, pendent; rachis lax, long, many-flowered; bracteoles small, caducous. **Flowers** distichous, pedicellate; buds lanceolate or globose (in *A. laevis*); sepals imbricate to valvate (in *A. laevis*), the 2 outer lobes obtuse, thicker than the 3 acute inner ones; petals linear; stamens *c.* 15 (in *A. laevis*) or more than 30, glabrous, filaments short, tapering, connate at base, anthers latrorse, *connectival appendage slender, at least twice the length of anther*; ovary semi-inferior, with distinct stylopodium, style long or short, stigma distinctly trifid, rarely obscure (in *A. laevis*). **Fruits:** *calyx lobes valvate, with a subglobose base enclosing and adnate to the nut*, with 2 long narrowly spatulate untwisted 3-veined lobes and 3 short lobes. **Nuts** *imbedded in the calyx tube but for the apex*, with broad discoid (in *A. laevis*) or cylindrical stylopodium and persistent columnar (in *A. laevis*) or short style; cotyledons unequal; first leaves paired with interpetiolar stipules, or in a whorl of 4 without stipules; germination epigeal, the pericarp breaking open irregularly.

Distribution. Ten species, ranging from Chittagong (Bangladesh) to S Indo-China, east and southeastwards to New Guinea. Five species in Borneo, all of which occur in Sabah and Sarawak; 2 endemic in Borneo of which one endemic to Sabah, Sarawak and Brunei.

Ecology. In mixed dipterocarp, mixed peat swamp and *kerangas* forests, rarely at altitudes above 1000 m. In our area generally as scattered individuals, but occasionally semi-gregarious in the seasonal tropics.

Uses. The timber is a light hardwood; it is siliceous, but makes excellent peeler for veneer.

Key to *Anisoptera* species
(base on flowering/fruited specimens)

1. Flower buds subglobose; stamens *c.* 15; stylopodium in flower broad, discoid, glabrous; style columnar, slender, glabrous, stigma obscure (sect. **Glabrae**).....**3. A. laevis**
Flower buds spindle-shaped or ovoid-lanceolate; stamens 20–36; stylopodium in flower as broad as ovary, ovoid, oblong to cylindrical, densely pubescent; style and stigma short, trifid (sect. **Anisoptera**).....2
2. Leaf greyish brown or bright yellow lepidote below.....3
Leaf golden scaly or glabrous below.....4
3. Leaf drying greyish brown above, greyish brown lepidote below; venation below and petiole greyish brown tomentose; stylopodium cylindrical, not tapering at base.....**1. A. costata**
Leaf drying mauve-brown above, bright yellow lepidote below; venation below densely rufous scabrid-pubescent; stylopodium ovoid, tapering at both ends....**2. A. grossivenia**
4. Leaf golden scaly below, matt above; lateral veins slender, hardly raised below; stamens *c.* 25; stylopodium truncate.....**4. A. marginata**
Leaf not golden scaly below, shiny above; lateral veins stout, prominent below; stamens *c.* 35; stylopodium tapering at apex.....**5. A. reticulata**

Key to *Anisoptera* species
(based on field characters)

1. Leaf blade, at least on the veins below and petiole, variously hairy/lepidote.....2
Leaf blade below and petiole glabrous or scaly.....4
2. Leaf blade drying mauve-brown above, rufous scabrid-pubescent on the veins below....
.....**2. *A. grossivenia***
Leaf blade drying greyish brown above, shortly greyish brown lepidote/hairy below.....3
3. Leaf blade sparsely scabrid-hairy and greyish brown lepidote below; buttresses tall,
straight.....**1. *A. costata***
Leaf blade below sparsely tomentose on the veins only; buttresses short.....
.....**4. *A. marginata*** (in part)
4. Leaf blade drying yellowish brown below, shiny above; lateral veins prominent below;
intercostal venation reticulate.....**5. *A. reticulata***
Leaf blade more or less golden scaly below, not shiny above; lateral veins slender;
intercostal venation subscalariform.....5
5. Leaf midrib sharp below, drying conspicuously darker than the leaf blade; twigs pale,
striated; bark surface patchily fissured and flaked.....**3. *A. laevis***
Leaf midrib rounded below, drying greyish brown; twigs uniform brown; bark closely
parallel fissured and flaked.....**4. *A. marginata*** (in part)

1. *Anisoptera costata* Korth.

(Latin, *costatus* = ribbed; the prominent venation of the leaf blade)

Kruidk. (1841) 67; Merrill *op. cit.* 400; Slooten *op. cit.* 7, Reinwardtia 2 (1952) 8; Symington *op. cit.* (1934) 9, *op. cit.* (1943) 204; Masamune *op. cit.* 482; Ashton *op. cit.* (1964) 11, *op. cit.* (1968) 5, Gard. Bull. Sing. 31 (1978) 13, *op. cit.* (1982) 330; Meijer & Wood *op. cit.* 293; Burgess *op. cit.* 93; Anderson *op. cit.* (1980) 110; PROSEA *op. cit.* 99; Newman *et al. op. cit.* 60; Coode *et al.* (eds.) *op. cit.* 66. **Type:** *Korthals s.n.* (= RHL Sheet No. 90214642), Borneo, S Kalimantan, G. Sakumbang, Tanah Laut (holotype L). **Synonyms:** *Anisoptera oblonga* Dyer, Fl. Brit. Ind. 1 (1874) 301; *A. cochinchinensis* Pierre in Lanessan, Pl. Util. Colon. Fr. (1886) 268; *A. robusta* Pierre, Fl. For. Coch. 3 (1889) t. 236; *A. marginatoides* F.Heim, Bot. Tidsskr. 25 (1902) 44; *A. mindanensis* Foxw., Philip. J. Sci. 13 (1918) Bot. 181.

Huge tree, to 65 m tall, to 1.5 m diameter; *buttresses massive, straight, to 4 m tall and continuing as ribs up bole to 10 m.* **Bark** greyish brown, vertically fissured and thinly flaking; inner bark laminated cream and pale yellow; dammar secretions as greyish green smears. *Young parts more or less sparsely greyish brown hairy.* **Leaves** thinly coriaceous, frequently slightly bullate, *sparsely scabrid-hairy and greyish brown lepidote below, drying greyish brown above;* blade oblong to obovate, 6–18 × 7–11 cm, base obtuse or broadly cuneate, apex with an acumen to 0.5 cm long; *lateral veins 8–22 pairs, prominent and tomentose below; petiole 2–4 cm long, greyish brown short-hairy.* **Inflorescences** to 20 cm long, pubescent. **Flowers:** *buds ovoid-lanceolate, to 12 × 6 mm; corolla cream, petals narrow; stamens c. 25, subequal, anthers oblong, tapering, connectival appendage c. twice the length of anther, tapering; stylopodium cylindrical, somewhat tapering apically, not tapering at base, densely pubescent; style and stigma short, trifid.* **Fruits:** calyx tube to 1.2

cm diameter, puberulent; calyx lobes glabrous, 2 longer lobes spatulate, to 16×2 cm, constricted to *c.* 5 mm at base, 3 shorter ones hastate, to 2×0.4 cm, hardly constricted at base. **Nut** apex broadly conical, shortly pubescent; stylopodium cylindrical, *c.* 2.5×1.5 mm.

Vernacular names. Sabah—*pengiran kesat* (preferred name). Sarawak—*mersawa kesat* (preferred name).

Distribution. Coastal hills of Myanmar, S and C Thailand, Cambodia and Cochin-China, Sumatra, Peninsular Malaysia, W Java, Borneo, the Philippines (Mindanao), and Maluku. In Borneo, scattered throughout Sabah and recorded from Keningau, Kota Marudu, Lahad Datu, Sandakan, Semporna, and Tawau districts (e.g., *FMS 41471*, *FMS 48764*, *SAN 7839*, *SAN 15283*, *SAN 21511*, and *SAN 122039*) and in Sarawak from Limbang district (e.g., *S 32209*). Also occurring in Brunei (e.g., *BRUN 3387*, *BRUN 3389* and *BRUN 5651*) and Kalimantan (e.g., *bb. 31198*, *Kostermans 4384* and *Kostermans 10577*).

Ecology. Evergreen and semi-evergreen lowland forests of Indo-Burma; in mixed dipterocarp forests on clay ultisols in Sabah and Sarawak, at altitudes to 700 m. Uncommon, vulnerable.

2. *Anisoptera grossivenia* Slooten

(Latin, *grossus* = an unripe fig, *venius* = veined; the purple lateral veins of the leaf blade)

Bull. Jard. Bot. Buitenz. 3, 16 (1940) 431; Symington *op. cit.* (1943) 13; Masamune *op. cit.* 483; Browne *op. cit.* 93; Ashton *op. cit.* (1964) 12, *op. cit.* (1968) 55, *op. cit.* (1982) 331; Meijer & Wood *op. cit.* 296; Burgess *op. cit.* 94; Anderson *op. cit.* (1980) 110; PROSEA *op. cit.* 100; Coode *et al.* (eds.) *op. cit.* 66; Newman *et al. op. cit.* 61. **Type:** *bb. 29708*, Borneo, Kalimantan, Dusun Lands, Pepas, Muara Teweh (holotype BO; isotypes KEP, L).

Tree to 60 m tall, to 1.5 m diameter; buttresses low, stout. **Bark** purplish brown, closely fissured and flaking; inner bark pale yellow and rich orange laminated; dammar smears rich yellow, long. **Leaf venation below, petiole, stipule outside, buds, inflorescence, and twig persistently rufous scabrid-pubescent.** **Leaves** often slightly bullate, *drying mauve-brown above, brilliant yellow lepidote below* (juveniles excepted); blade narrowly obovate to oblong, $9\text{--}12 \times 3\text{--}5$ cm, base cuneate, margin slightly recurved, apex with narrow acumen to 1 cm long; lateral veins 18–28 pairs, dense, arched; intercostal venation hardly raised (juveniles excepted), subreticulate; petiole 2–2.5 cm long. **Inflorescences** to 20 cm long. **Flowers:** *buds lanceolate*, to 5×2.5 mm long; corolla magenta in bud, yellow on opening, petals narrow; *stamens c. 36*, anthers subglobose, connectival appendage *c.* thrice as long as anther, slender; *stylopodium ovoid, tapering at both ends, densely golden pubescent; style and stigma short, trifid.* **Fruits:** calyx sparsely puberulent; tube to 1.3 cm diameter; 2 longer calyx lobes narrowly spatulate, to 20×2.5 cm, constricted to *c.* 5 mm at base, 3 shorter ones linear, to 0.6 cm long. **Nut** apex obtuse, densely rufous puberulent; stylopodium oblong-ovoid, *c.* 8×2 mm.

Vernacular names. Sabah—*pengiran kunyit* (preferred name). Sarawak—*mersawa kunyit* (preferred name).

Distribution. Endemic in Borneo. Widespread throughout the lowlands of Sabah and recorded from Beaufort, Sandakan and Sipitang districts (e.g., *KEP 80257*, *SAN 15058* and *SAN 15159*) and in Sarawak from Belaga, Kuching, Lawas, Lundu, and Miri districts (e.g., *S 8915*, *S 9617*, *S 10285*, *S 22312*, and *S 46495*). Also occurring in Brunei (e.g., *BRUN 3028*, *BRUN 3055*, *BRUN 3286*, *S 1644*, and *S 5780*) and C and NE Kalimantan (e.g., *bb. 22874*, *bb. 29605*, *Jarvie & Ruskandi 5896*, and *Kostermans 9113*) where its habitat occurs.

Ecology. In mixed dipterocarp forest and its ecotone to *kerangas* forest, on shallow and deep yellow sandy soils, at altitudes below 400 m. Well represented in Bako and Lambir NPs and not currently endangered.

3. *Anisoptera laevis* Ridl.

(Latin, *laevis* = smooth; the leaf blade)

Fig. 1.

FMP 1 (1922) 219; Symington *op. cit.* (1943) 205; Ashton *op. cit.* (1964) 13, *op. cit.* (1968) 5, *op. cit.* (1982) 335; Meijer & Wood *op. cit.* 298; Burgess *op. cit.* 94; Anderson *op. cit.* (1980) 100; PROSEA *op. cit.* 101; Coode *et al.* (eds.) *op. cit.* 66; Newman *et al.* *op. cit.* 62. **Type:** Ridley *SFN 6886*, Singapore Botanic Gardens (holotype SING; isotype KEP).

Vast emergent tree, to 65 m tall, to 2 m diameter; buttresses to 15 m tall, 4 m wide, stout. **Bark** pale greyish buff, *patchily fissured and flaked*; inner bark pale brownish laminated, rather thin; dammar in greyish brown smears, often not present. *Young parts pale brown to rust caducous lepidote, epilose* (without hairs). **Twigs** pale, *striated*. **Leaves** flat, *golden scaly below* (mature trees), *not shiny above*, drying pale greenish brown below; blade oblong-obovate, 7–11 × 3–4 cm, base obtuse or broadly cuneate, apex with an acumen to 1 cm long; *midrib sharp below, drying conspicuously darker than the blade; lateral veins 10–14 pairs, slender; intercostal venation subscalariform; petiole 1.5–2 cm long, minutely scaly*. **Inflorescences** to 12 cm long, pale brown caducous puberulent. **Flowers:** *buds subglobose*; petals small, elliptic-oblong, pale yellow; *stamens c. 15*, anther narrowly oblong, connectival appendage short, erect; *stylopodium discoid, glabrous; style columnar, glabrous, stigma obscurely 3-lobed*. **Fruits:** calyx glabrous; tube to 1.5 cm diameter; 2 longer lobes spatulate, to 15 × 1.5 cm, 3 shorter ones hastate, linear, to 1.5 × 0.3 cm, slightly recurved. **Nut** apex discoid, puberulent; style remnant to 8 mm long, prominent, filiform.

Vernacular names. Sabah—*pengiran durian* (preferred name). Sarawak—*mersawa durian* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Borneo, known in Sabah from Beaufort, Sipitang and Ranau districts (e.g., *SAN 15083* and *SAN 16944*) and in Sarawak from Bau, Kapit, Lawas, Limbang and Tatau districts (e.g., *S 1109*, *S 17756*, *S 22279*, *S 22305*, *S 24810*, and *S 32297*). Also occurring in Brunei (e.g., *BRUN 3053*, *BRUN 3192*, *BRUN 5251*, *FMS 35455*, and *S 5780*).

Ecology. Widespread but uncommon in mixed dipterocarp forest on clay loam soils derived from shale and basic to intermediate volcanic rocks. Recorded from Mulu NP but vulnerable.

4. *Anisoptera marginata* Korth.

Fig. 2G–H.

(Latin, *marginatus* = bordered; the distinct intramarginal vein of the leaf blade)

Kruidk. (1841) 66; Merrill *op. cit.* 401; Slooten *op. cit.* 5; Masamune *op. cit.* 483; Symington *op. cit.* (1943) 206; Anderson, Gard. Bull. Sing. 20 (1963) 157, *op. cit.* (1980) 110; Ashton *op. cit.* (1964) 14, *op. cit.* (1968) 5, *op. cit.* (1982) 328; Meijer & Wood *op. cit.* 298; Burgess *op. cit.* 93; PROSEA *op. cit.* 101; Coode *et al.* (eds.) *op. cit.* 66; Newman *et al.* *op. cit.* 63. **Type:** *Korthals s.n.* (= RHL Sheet No. 90214648), Borneo, Kalimantan, G. Pamaton (holotype L). **Synonym:** *Anisoptera grandiflora* Brandis, J. Linn. Soc. Bot. 31 (1895) 43.

Tree to 45 m tall, to 1.5 m diameter; *buttresses low, rounded*. **Bark** greyish brown, *shallowly fissured and flaking*; inner bark brown and cream laminated, thick; dammar as greyish cream smears. **Twigs** *uniformly brown*. *Young parts greyish brown pubescent*. **Leaves** *matt above, golden to greyish brown lepidote below or sparsely tomentose on the lateral veins only, drying greyish to yellowish brown, shallowly bullate in juveniles*; blade oblong-obovate, 7–10 × 3.5–4.5 cm, base obtuse or broadly cuneate, apex with an acumen to 0.6 cm long; *midrib round below, drying the same colour as the blade; lateral veins* 10–14 pairs, *slender, hardly raised below; intercostal venation subscalariform*; petiole 1.5–2 cm long. **Inflorescences** to 14 cm long. **Flowers:** *buds lanceolate*, to 8 × 3.5 mm; petals broadly elliptic, pale yellow; *stamens c. 25*, anther oblong, connectival appendage *c. twice the length of anther, slender*; *ovary and stylopodium puberulent, stylopodium cylindrical, truncate, style and stigma short, trifid*. **Fruits:** calyx tube to 1.3 cm diameter; 2 longer calyx lobes spatulate, to 12 × 2 cm, 3 shorter ones linear, to 2 × 0.3 cm. **Nut** apex almost flat; stylopodium oblong, *c. 3 × 1.5 mm*.

Vernacular names. Sabah—*pengiran kerangas* (preferred name). Sarawak—*mersawa paya* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo (widespread). In Sabah known from Beaufort, Sandakan and Tawau districts (e.g., *D.D. Wood 2386, SAN 18461* and *SAN 31588*) and in Sarawak from Belaga, Betong, Kapit, Lawas, Limbang, Lundu, Marudi, Miri, Sibuan, Sri Aman, and Tatau districts (e.g., *S 8038, S 18862, S 21177, S 26550*, and *S 69174*). Also occurring in Brunei (e.g., *FMS 30418, Niga NN 153* and *Wong s.n.*) and Kalimantan (e.g., *bb. 2624, bb. 9431, Endert 5056, Kostermans 7144*, and *Kostermans 8896*).

Ecology. In mixed peat swamp forest both in the coastal swamps and, rarely, inland valleys; and in poorly drained *kerangas* forest, sandy hill crests, and in Sabah on ultrabasic rocks, at altitudes to 850 m, as scattered trees or locally frequent. Recorded from Mulu NP; vulnerable, possibly endangered.

5. *Anisoptera reticulata* P.S.Ashton

Fig. 2A–F, Plates 2A–B.

(Latin, *reticulatus* = netted; the intercostal venation of leaf blade)

Gard. Bull. Sing. 22 (1967) 260, *op. cit.* (1968) 5, *op. cit.* (1982) 333; Coode *et al.* (eds.) *op. cit.* 67; Newman *et al.* *op. cit.* 64. **Type:** *G.H.S. Wood SAN 15172*, Borneo, Sabah, Ulu Sipitang (holotype K; isotypes KEP, L, SAN).

Large tree, to 65 m tall, to 2 m diameter, with short rounded buttresses. **Bark** pale yellowish brown, vertically fissured and flaky. *Young parts at first, inflorescence, flower bud, ovary, stylopodium, and fruit calyx golden brown puberulent; parts otherwise glabrous*. **Leaves** thickly coriaceous, *drying yellowish brown below, shiny above, glabrous*; blade elliptic-

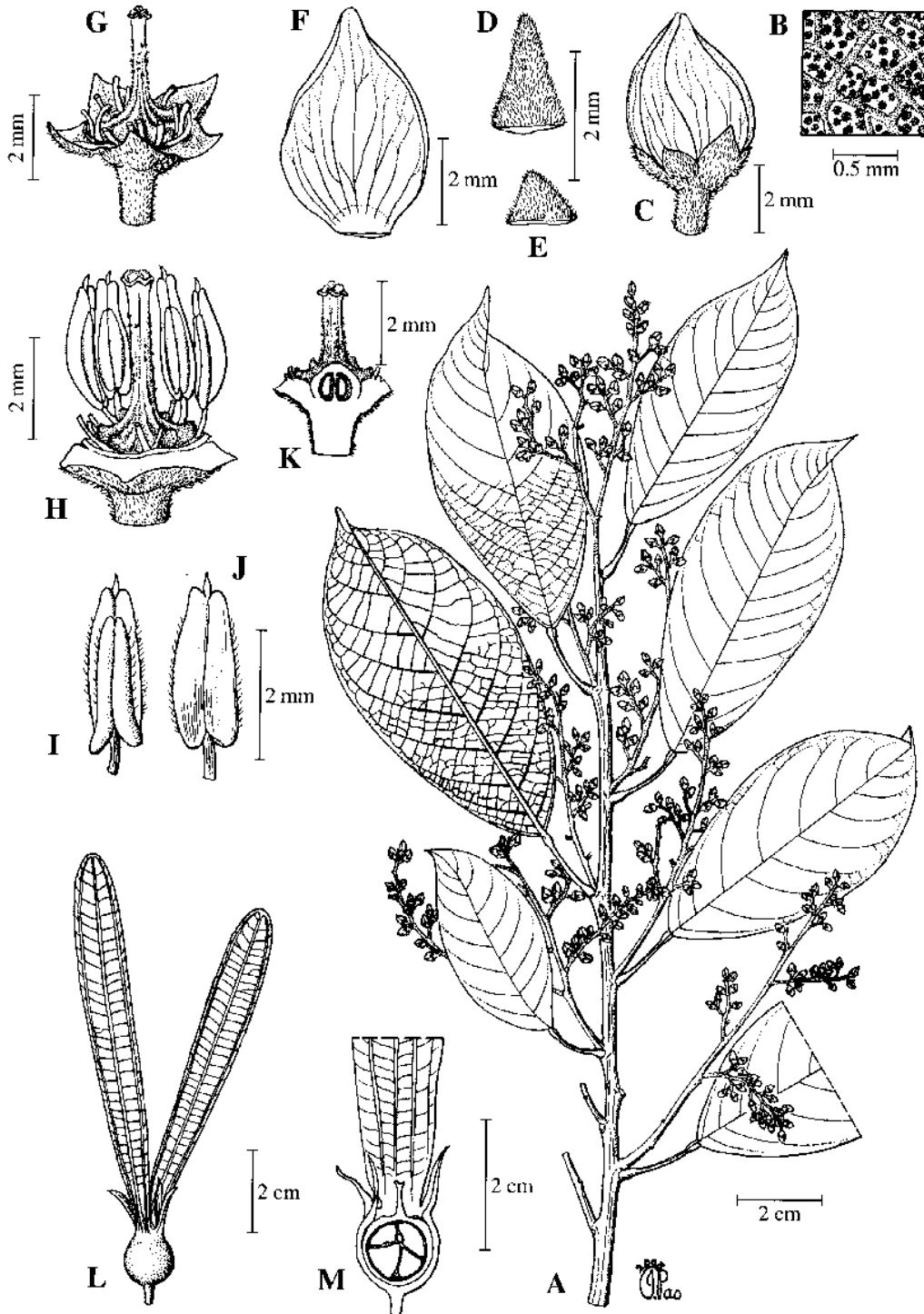


Fig. 1. *Anisoptera laevis*. A, flowering leafy twig; B, detail of venation and indumentum on lower leaf surface; C, flower bud; D, abaxial view of larger sepal; E, abaxial view of smaller sepal; F, adaxial view of petal; G, flower bud with petals and stamens removed; H, flower bud with sepals, petals removed; I, adaxial view of stamen; J, abaxial view of stamen; K, longitudinal section of gynoecium; L, fruit; M, longitudinal section of fruit. (A–K from SAN 15083, L–M from Ridley 6886.)

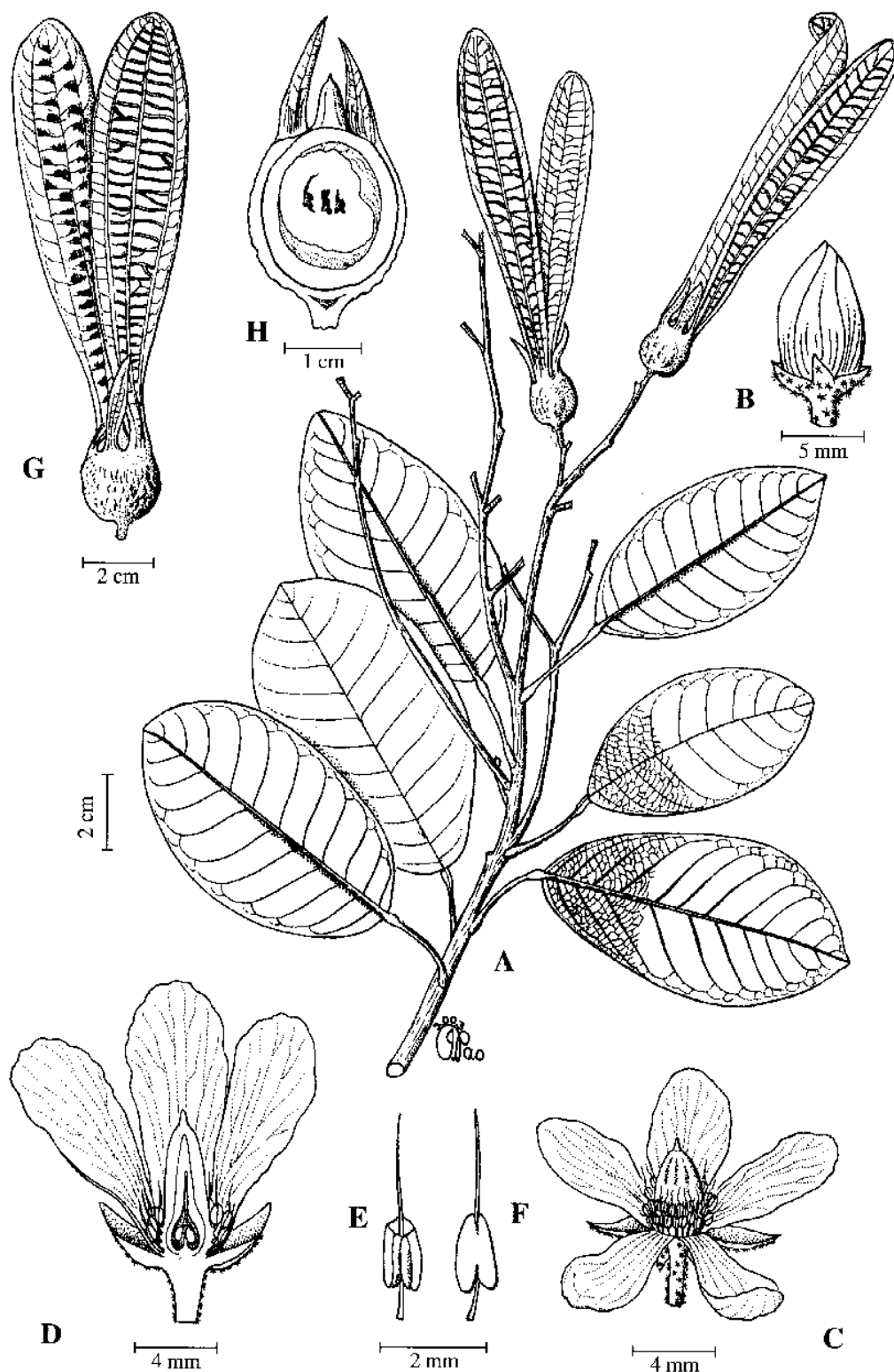


Fig. 2. *Anisoptera reticulata* (A–F) and *A. marginata* (G–H). A, fruiting leafy twig; B, flower bud; C, open flower; D, longitudinal section of open flower; E, adaxial view of stamen; F, abaxial view of stamen; G, mature fruit; H, longitudinal section of mature fruit. (A from SAN 92981, B–F from FRI 41363, G–H from Niga NN 153.)

obovate, 4.5–13 × 2.2–5 cm, base broadly cuneate, apex shortly abruptly acuminate; midrib flat or slightly sunken above, prominent below; *lateral veins 9–14 pairs, stout and elevated below; intercostal venation reticulate*; petiole 1.5–3.5 cm long, drying black. **Inflorescences** to 6 cm long. **Flowers:** buds spindle-shaped; corolla cream; *stamens c. 35, subequal, anthers oblong, tapering, connectival appendage filiform; stylopodium oblong, tapering at apex, densely puberulent; style and stigma short, trifid.* **Fruits:** calyx tube to 2 cm diameter; 2 longer calyx lobes lorate-spatulate, to 13 × 3 cm, constricted to c. 9 mm at base, 3 shorter ones linear-lanceolate, to 2 × 0.3 cm; stylopodium remnant oblong, to 4 × 3 mm, obtuse.

Vernacular name. Sabah—*pengiran gajah* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Kinabatangan, Labuk Sugut, Ranau, Sandakan, and Sipitang districts (e.g., *FRI 41363, SAN 15172, SAN 92981, SAN 75357, and SAN 100178*) and in Sarawak from Belaga, Lawas and Miri districts (e.g., *S 1503, S 66963, S 68906, and S 68908*). Also occurring in Brunei (e.g., *Wong WKM 1654*).

Ecology. Rare, in mixed dipterocarp forest on yellow sandy soils overlying Miocene sandstone, at altitudes to 400 m. Recorded from Mulu NP; endangered.

2. COTYLELOBIUM Pierre

(Greek, *kotyle* = a small cup, *lobos* = a pod; the receptacle)

resak (preferred name)

Fl. For. Coch. 3 (1889) *sub. t.* 235; Merrill, EB (1921) 408; Ridley, FMP 1 (1922) 239; Foxworthy, Malay. For. Rec. 10 (1932) 245; Slooten, Bull. Jard. Bot. Buitenz. 3, 10 (1929) 393, Bull. Jard. Bot. Buitenz. 3, 12 (1932) 43; Masamune, EPB (1942) 484; Symington, Malay. For. Rec. 16 (1943) 232; Ashton, MDB (1964) 56, MDBS (1968) 24, FM 1, 9 (1982) 340; Meijer & Wood, Sabah For. Rec. 5 (1964) 323; Burgess, TBS (1966) 226; Anderson, CLTS (1980) 110; PROSEA 5, 1 (1993) 139; Kessler & Sidiyasa, TBSA-EK (1994) 90; Coode *et al.* (eds.), CLBD (1996) 67. **Synonym:** *Dyerella* F.Heim, Rech. Dipt. (1892) 123.

Main canopy and emergent trees with dense even dome-shaped crowns; buttresses low, stout, rounded. **Bark** at first greyish, smooth, hoop-marked, becoming irregularly flaky to shaggy (in *C. lanceolatum*), flakes leaving scroll-marked surfaces; inner bark homogeneous pale brown; dammar and sapwood as in *Vatica*. **Twigs** slender, greyish brown tomentose, terete. Leaf buds small. **Stipules** fugaceous. **Leaves** epilose or tomentose below; blade oblong to ovate-lanceolate, margin revolute; *lateral veins slender, unraised above and hardly so below, arched, bifurcating towards the margin and anastomosing to form a looped intramarginal vein, with many shorter intermediates similarly bifurcating; intercostal venation reticulate, obscure; petiole short, not geniculate.* **Inflorescences** axillary or rarely terminal panicles. **Flowers:** buds ovoid-lanceolate; corolla cream, petals free, elliptic-oblong; *stamens to 15, in 3 whorls, filaments short and deltoid or filiform, connate at base, anthers linear oblong, latrorse, setose along the margins, connectival appendage slender, shorter than ovary; ovary free, globose, pubescent around base, style filiform, many times longer than ovary, stigma small, trifid.* **Fruits:** calyx with 2 long and 3 short lobes, the lobes united at base into a shallow cup. **Nuts** free from calyx base, round in cross-section.

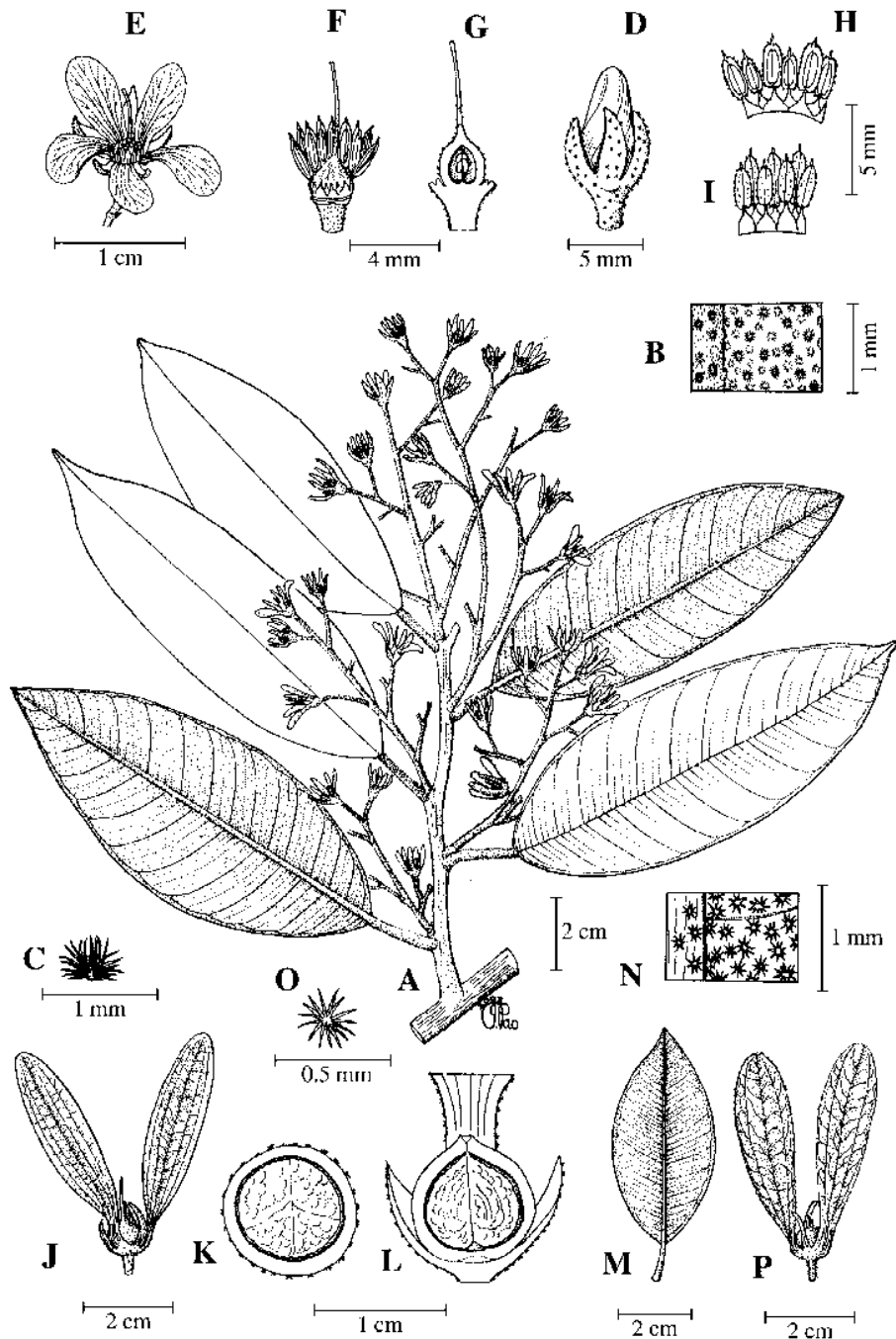


Fig. 3. *Cotylelobium burckii* (A–L) and *C. lanceolatum* (M–P). A, leafy twig bearing post-anthesis flowers and very young fruits; B, detail of indumentum on lower leaf surface; C, side view of tufted hairs; D, flower bud; E, open flower; F, open flower with sepals, petals and several stamens removed; G, longitudinal section of gynoecium; H, adaxial view of stamens; I, abaxial view of stamens; J, mature fruit; K, transverse section of mature fruit; L, longitudinal section of mature fruit; M, lower leaf surface; N, detail of indumentum on lower leaf surface; O, oblique top view of tufted hairs; P, mature fruit. (A–C from *Egon 610*, D–I from *S 37031*, J–L from *Wong WKM 937*, M–P from *bb. 29668*.)

Distribution. Five species distributed in Sri Lanka, Peninsular Thailand, Sumatra, Peninsular Malaysia, and Borneo; 3 species in Sabah and Sarawak.

Ecology. Locally common in mixed dipterocarp, *kerangas* and lower montane forests at altitudes to 1500 m, on humic yellow and white more or less sandy soils on well drained sites.

Use. *Cotylelobium melanoxyton* reaches commercial size, and its hard dark brown heartwood is used for heavy construction.

Notes. An interesting small genus with a curious disjunct distribution; its leaves recall those of the archaic dipterocarp of the ancient sandstone Guyana Highlands, *Pakaraimaea*. Species occurring in Sabah and Sarawak are sometimes difficult to distinguish, populations sometimes exhibiting one or more characters intermediate between two species; the commonest forms of such variation are noted under the relevant species.

Key to *Cotylelobium* species

(based on field characters)

1. Leaf blade sparsely puberulent or glabrescent, drying dull olive-brown.....**3. C. melanoxyton**

 Leaf blade densely tomentose below.....**2**
2. Leaf blade oblong-lanceolate, larger, 8–12 × 3–4.5 cm, drying dull olive-brown above, densely shortly evenly bright yellowish ochre tomentose below; intramarginal vein close to margin.....**1. C. burckii**
 Leaf blade narrowly ovate-lanceolate, smaller, 6–8 × 2.5–3 cm, drying dark greyish brown above, densely dark grey scabrid-tomentose below; intramarginal vein distant from the margin.....**2. C. lanceolatum**

1. *Cotylelobium burckii* (F.Heim) F.Heim (W. Burck, 1848–1910, botanist of Dipterocarpaceae and Sapotaceae)

Fig. 3A–L

Rech. Dipt. (1892) 122; Slooten, Bull. Jard. Bot. Buitenz. 3, 9 (1927) 78; Ashton, Gard. Bull. Sing. 20 (1963) 243, *op. cit.* (1964) 57, *op. cit.* (1968) 24, *op. cit.* (1982) 342; Anderson *op. cit.* 110; PROSEA *op. cit.* 142; Coode *et al.* (eds.) *op. cit.* 67. **Basionym:** *Vatica burckii* F.Heim, Bull. Mens. Soc. Linn. Paris 2 (July 1891) 956. **Type:** *Beccari PB 3260*, Borneo, Sarawak, Marop (holotype P-C). **Synonyms:** *Cotylelobium flavum* Pierre, Fl. For. Coch. 4 (Oct. 1891) t. 258A, Merrill *op. cit.* 408, Slooten *op. cit.* (1929) 396, Foxworthy *op. cit.* 246, Symington, Gard. Bull. S. S. 8 (1934) 36, Masamune *op. cit.* 484, Brown, FTSB (1955) 95; *C. asperum* Slooten *op. cit.* (1929) 401.

Main canopy tree, to 40 m tall, to 70 cm diameter. *Young parts, buds, leaf midrib below, petiole, inflorescence, and ovary densely shortly evenly persistently buff-pubescent. Leaves thickly coriaceous, drying dull olive-brown above, densely bright ochreous tomentose below; blade oblong-lanceolate, 8–12 × 3–4.5 cm, base broadly cuneate to obtuse, margin*

prominently revolute, apex with acumen to 0.7 cm long; lateral veins 10–12 pairs, hardly elevated, comparatively straight; *intramarginal vein close to the margin*; petiole 1.5–2 cm long. **Inflorescences** to 15 cm long, axillary or rarely terminal. **Flowers:** buds ovoid-lanceolate, to 10 × 4 mm, acute; calyx lobes linear, obtuse, 3 shorter lobes lanceolate, acute; petals narrowly oblong, glabrous; stamens inner 5 slightly longer than the others, connectival appendage *c.* ¼x as long as anther; ovary subglobose, densely tomentose, styles slender, 3–4 times as long as ovary. **Fruits:** calyx densely tomentose, 2 longer lobes *c.* 1.5 cm broad, 3 shorter ones linear, to 1.2 cm long.

Vernacular name. Sarawak—*resak durian* (preferred name).

Distribution. Endemic in Borneo; absent from Sabah. In Sarawak known from Bau, Bintulu, Kuching, Lawas, Marudi, Miri, Mukah, Sibul, and Sri Aman districts (e.g., *S 17870*, *S 37121*, *S 47027*, *S 66782*, *S 72947*, and *S 73349*). Also occurring in Brunei (e.g., *BRUN 70*, *FMS 32615*, *S 7805*, and *Wong WKM 935*) and C and SE Kalimantan (e.g., *bb. 19876*, *bb. 23501* and *bb. 29681*).

Ecology. Locally common in *kerangas* forest on deep white sand podsol on raised beaches behind present and Pleistocene coastlines, rare on sandstone, at altitudes to 300 m. Vulnerable owing to the destruction of its habitat, but well represented in Bako NP and occurring in Mulu NP.

2. *Cotylelobium lanceolatum* Craib

Fig. 3M–P

(Latin, *lanceolatus* = in the form of a lance; the shape of leaf blade)

Bull. Misc. Inform. Kew (1913) 113; Ashton *op. cit.* (1982) 343; PROSEA *op. cit.* 142; Coode *et al.* (eds.) *op. cit.* 67. **Type:** *East Asiatic Co. H 20171*, Thailand, Surat (holotype K). **Synonyms:** *Cotylelobium malayanum* Slooten *op. cit.* (1932) 43, Foxworthy *op. cit.* 247, Symington Gard. Bull. S. S. 9 (1938) 349, *op. cit.* (1943) 235, Browne *op. cit.* 95, Ashton *op. cit.* (1964) 58, Meijer & Wood *op. cit.* 324, Anderson *op. cit.* 111; *C. flavum auct. non Pierre*: Ridley *op. cit.* 239, Slooten *op. cit.* (1929) 396, *p.p.*, Foxworthy *op. cit.* 247.

Main canopy tree, to 45 m tall, to 1.2 m diameter. **Bark** eventually densely shaggy. *Young parts, buds, leaf venation below, petiole, and inflorescence densely greyish brown to rufous scabrid-pubescent; leaf undersurface and ovary evenly so.* **Leaves** thinly coriaceous, *drying dark greyish brown above, densely dark grey scabrid-tomentose below; blade narrowly ovate-lanceolate, 6–8 × 2.5–3 cm*, base broadly cuneate, margin slightly revolute, apex with acumen to 0.5 cm long; *lateral veins* 10–12 pairs, hardly raised below, *joining into a prominent looped intramarginal veins c. 2 mm from margin*; petiole 0.6–1 cm long. **Inflorescences** to 6 cm long, terminal or axillary. **Flowers:** buds ovoid, obtuse, to 8 × 3.5 mm; calyx densely buff-tawny tomentose outside, sparsely so within, lobes deltoid, unequal; petals narrowly oblong, obtuse, glabrous; inner stamens slightly longer than the rest, filaments triangular, anthers narrowly oblong, with prominent setose margin, connectival appendage short, slender; ovary subglobose, densely tomentose, style *c.* 3x as long as ovary. **Fruits:** calyx scabrid-tomentose; 2 larger lobes oblong, to 4.5 × 1.2 cm, 3 shorter ones broadly hastate, 1.2–2 × 0.4 cm.

Vernacular names. Sabah—*resak kelabu* (preferred name). Sarawak—*resak batu* (preferred name).

Distribution. Peninsular Thailand to eastern coastal area of Peninsular Malaysia, Anambas Is. and Borneo. Throughout Borneo where its habitat occurs. In Sabah known from Sandakan, Sipitang and Tawau districts (e.g., *SAN 18651*, *SAN 18652* and *SAN 39272*) and in Sarawak from Bau, Bintulu, Kuching, Lawas, Limbang, Marudi, Miri, Mukah, and Serian districts (e.g., *S 12583*, *S 24065*, *S 28068*, *S 32850*, *S 38295*, and *S 47628*). Also occurring in Brunei (e.g., *BRUN 414*, *BRUN 3045* and *BRUN 5779*) and SE Kalimantan (e.g., *bb. 24015*, *bb. 32387*, *Kostermans 6371*, *Kostermans 9554*, and *Kostermans 12512A*).

Ecology. Locally abundant in *kerangas* forest, on raised beach terraces, sandstone plateaux, and in W Sarawak on organic soils over limestone; locally abundant in lower montane *kerangas* forest on ridges, at altitudes to 1500 m. Common in Bako NP and occurring in Mulu NP; probably not vulnerable.

Notes. Collections from some lowland localities, such as the Bako NP, in Sarawak, have an even, hardly scabrous tomentum but are otherwise typical.

3. *Cotylelobium melanoxylo* (Hook.f.) Pierre (Greek, *melanos* = blackish, *xylon* = wood; the dark heartwood)

Fig. 4.

Fl. For. Coch. 3 (1889) t. 235; Merrill *op. cit.* (1921) 408; Slooten *op. cit.* (1927) 78, *op. cit.* (1929) 403, *op. cit.* (1932) 44; Masamune *op. cit.* 484; Symington *op. cit.* (1943) 236; Browne *op. cit.* 96; Ashton *op. cit.* (1964) 59, *op. cit.* (1968) 24, *op. cit.* (1982) 341; Meijer & Wood *op. cit.* 324; Burgess *op. cit.* 228; Anderson *op. cit.* 111; PROSEA *op. cit.* 143; Kessler & Sidiyasa *op. cit.* 90; Coode *et al.* (eds.) *op. cit.* 67. **Basionym:** *Anisoptera melanoxylo* Hook.f., Trans. Linn. Soc. 23 (1860) 160. **Type:** *Lowe s.n.*, Borneo, Sabah, Labuan, Lubok Danau (holotype K). **Synonyms:** *Vatica melanoxylo* (Hook.f.) Miq., Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 956; *V. beccariana* F.Heim *op. cit.* (1891) 955; *V. harmandii* F.Heim *op. cit.* (1891) 955; *Cotylelobium beccarii* (F.Heim) Pierre *op. cit.* (1891) t. 258B, Merrill *op. cit.* 408, Slooten *op. cit.* (1929) 405, Masamune *op. cit.* 484; *C. harmandii* (F.Heim) F.Heim *op. cit.* (1892) 122, Merrill *op. cit.* 408, Masamune *op. cit.* 484; *C. beccarianum* (F.Heim) F.Heim *op. cit.* (1892) 122; *C. leucocarpum* Slooten *op. cit.* (1929) 399, Masamune *op. cit.* 484; *V. leucocarpa* (Slooten) Foxw. *ex* Den Berger & Endert, Med. Proefst. Boschw. 11 (1925) 130.

Emergent tree, to 60 m tall, to 1.5 m diameter. *Young parts shortly more or less sparsely greyish brown puberulent, fugaceous except on inflorescence, buds, calyx base and ovary, and occasionally leaf undersurface.* **Leaves** thinly coriaceous, satiny below, *drying dull olive-brown*; blade lanceolate, oblong or ovate, 5–10 × 2–6 cm, base broadly cuneate or obtuse, margin slightly revolute, apex with acumen to 0.8 cm long; lateral veins 10–13 pairs, hardly raised below; intramarginal vein strongly looped, at *c.* 2 mm from margin; petiole 0.9–1.2 cm long. **Inflorescences** to 8 cm long, axillary. **Flowers:** buds ellipsoid, obtuse, to 6 × 3 mm; stamens subequal, filaments *c.* 3x the length of anthers, slender, tapering, connectival appendage *c.* ¼x the length of style; ovary ovoid, densely pubescent, style filiform, *c.* 3x as long as ovary. **Fruits:** 2 longer calyx lobes oblong, obtuse, *c.* 4.5 × 1.2 cm, 3 shorter ones hastate-acute, 0.8–1.4 × 0.2–0.3 cm. **Nuts** ovoid, *c.* 0.6 cm across, style remnant to 5 mm long.

Vernacular names. Sabah—*resak tempurung* (preferred name). Sarawak—*resak hitam* (preferred name).

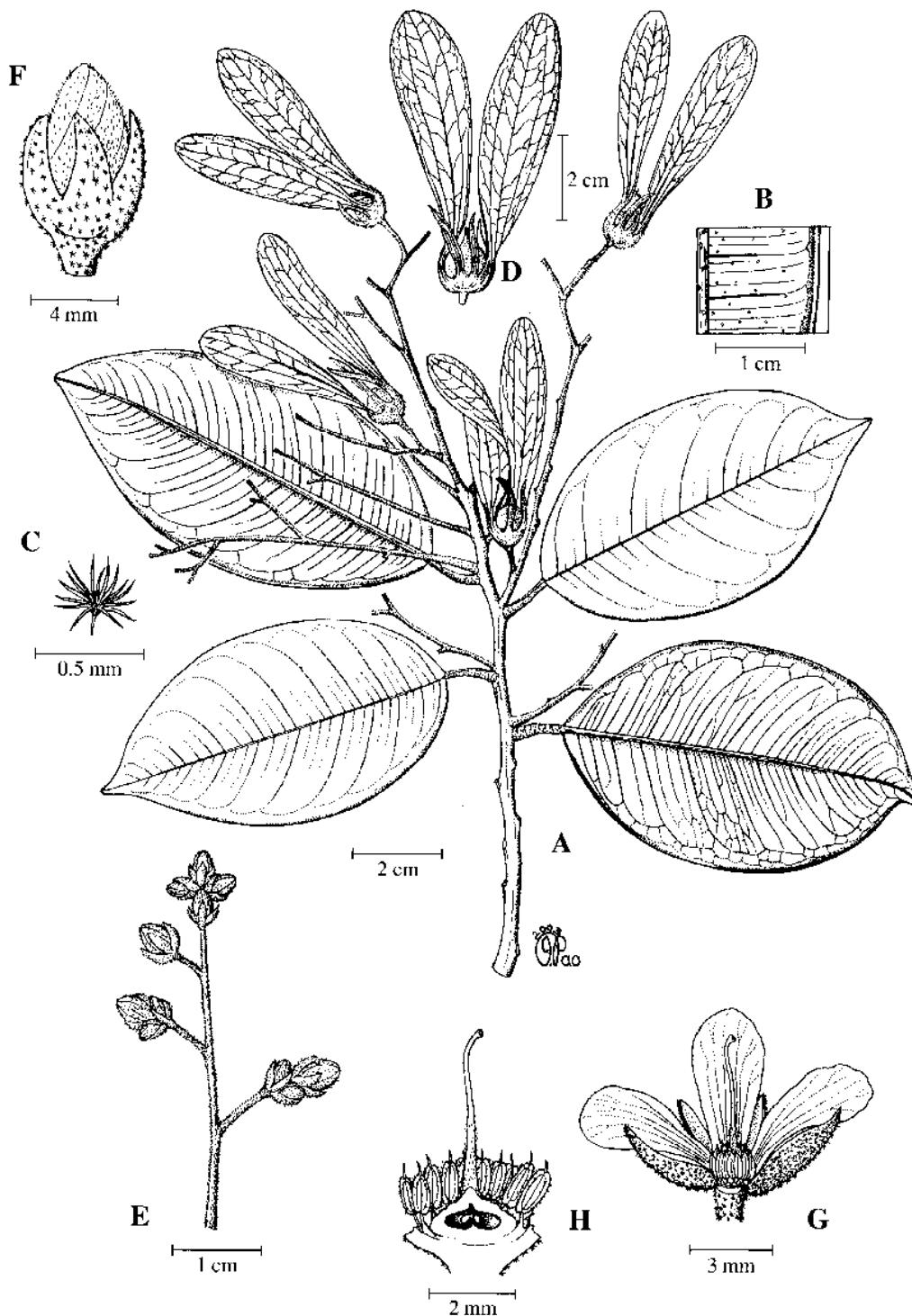


Fig. 4. *Cotylelobium melanoxylon*. A, fruiting leafy twig; B, detail venation on lower leaf surface; C, side view of tufted hairs; D, mature fruit; E, part of inflorescence bearing flower buds; F, flower bud; G, open flower with one sepal and two petals removed; H, longitudinal section of gynoecium and adaxial view of stamens. (A–C from SAN 56120, D from S 15886, E from SAN 57677, F–H from SAN 37642.)

Distribution. Sumatra, Peninsular Malaysia (NE Johor) and Borneo (widespread). In Sabah recorded from Beaufort, Kota Kinabalu, Kudat, Labuk Sugut, Sandakan, Sipitang and Tawau districts (e.g., *KEP 80303*, *SAN 15259*, *SAN 17264*, *SAN 38807*, and *SAN 57688*) and in Sarawak from Bintulu, Kuching, Lundu, Marudi, Miri, and Sibu districts (e.g., *S 11855*, *S 12475*, *S 15871*, *S 40315*, and *S 72955*). Also occurring in Brunei (e.g., *BRUN 292*, *BRUN 604*, *FMS 48302*, *NN 98*, and *S 1678*) and E Kalimantan (e.g., *Arifin & Ambriansyah B 1528*).

Ecology. Locally common in mixed dipterocarp forest on yellow sandy soils, and as a smaller, canopy tree, in *kerangas* on podsols; at altitudes below 400 m and usually not far from the coast. Well represented in Lambir and Mulu NPs, but vulnerable outside the parks system.

Notes. The leaf becomes glabrous except in eastern parts of Borneo from Sandakan southwards, where it may remain persistently sparsely puberulent below.

3. DIPTEROCARPUS Gaertn.f.

(Greek, *di* = two, *pteron* = wing, *karpos* = fruit; the two-winged fruit)

keruing (preferred name), *kesugoi* (Murut), *resak* (Iban), *sugoi* (Murut)

Fruct. 3 (1805) 50; Blume, Bijdr. Fl. Ned. Ind. (1825) 223; King, J. As. Soc. Beng. 62, 2 (1893) 89; Ridley, FMP 1 (1922) 211; Slooten, Bull. Jard. Bot. Buitenz. 3, 8 (1927) 263; Foxworthy, Malay. For. Rec. 10 (1932) 56; Symington, Malay. For. Rec. 16 (1943) 153; Browne, FTSB (1955) 102; Ashton, Gard. Bull. Sing. 20 (1963) 233, MDB (1964) 16, MDBS (1968) 6, Gard. Bull. Sing. 31 (1978) 5, FM 1, 9 (1982) 291; Backer & Bakhuizen f., FJ 1 (1964) 328; Meijer & Wood, Sabah For. Rec. 5 (1964) 230; Burgess, TBS (1966) 99; Anderson, CLTS (1980) 111; PROSEA 5, 1 (1993) 166; Kessler & Sidiyasa, TBSA-EK (1994) 91; Coode *et al.* (eds.), CLBD (1996) 67; Newman *et al.*, MDFB-MHHW (1998) 59.

Emergent or sometimes main canopy trees with irregular crowns arising from a few large twisted ascending branches; buttresses stout, generally low, concave. **Bark** pale or dark greyish to orange-brown, dotted with prominent pale warty lenticels, peeling off in irregular usually large flakes; inner bark warm brown, hard, homogeneous; dammar slow to harden, not usually as smears on bole but exuding from cut surfaces. **Sapwood** pale to dark orange-yellow, grading into rust to pinkish brown heartwood. **Twigs** with amplexicaul stipule scars. **Terminal (leaf) buds** prominent, with species-specific shape and indumentum. **Stipules** large, usually strap-shaped. **Leaves** aestivation plicate; coriaceous, never silvery below, more or less corrugated between the rather straight lateral veins; margin usually sinuate towards apex; lateral veins stout and usually prominent below, curved only near the margin; intercostal venation scalariform, usually well-spaced, rarely subreticulate; petiole usually long, prominently geniculate. **Inflorescences** racemose, terminal or axillary; rachis short, stout, zig-zag, few-flowered, unbranched or sparingly so. **Flowers** large; buds spindle-shaped; calyx united at base into a smooth, angled, tuberculate or flanged tube enclosing but free from ovary, with 5 valvate lobes; petals strap-shaped, cream generally with a pink median stripe, or pink; stamens 15–50, connate at base, falling in a group tardily, filaments compressed, slender tapering, anthers large, elongate, tapering into a short or prominent stout tapering connectival appendage; ovary ovoid, pubescent towards apex, tapering into a filiform style, stigma obscure. **Fruits** usually large; calyx united at base into a tube

enclosing at least the basal half of the nut; tube smooth or adorned with 5 species-specific ribs, tubercles, or flanges; *lobes valvate and not incrassate at base*, unequal, 2 longer ones aliform, oblong to spatulate and more or less distinctly 3-veined, and the other 3 short, or all subequal and short. **Nuts** *free within calyx tube*, apex pubescent with short style remnant; germination hypogeal; cotyledons without chlorophyll, intricately folded and trapped within calyx tube, the seedling escaping by elongation of the cotyledonary petioles.

Distribution. About 70 species, distributed from Sri Lanka and S India to Myanmar, Thailand, Indo-China, China (Yunnan), Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, and Lesser Sunda Is. (Bali and Sumbawa). Forty one species occur in Borneo of which 39 in Sabah and Sarawak.

Ecology. All inland lowland habitats in Borneo at altitudes to 900 m, but rare in mixed peat swamp forest. Light demanders as juveniles, they are particularly common on ridges, river banks, and in some *kerangas*, though some are specialists of other habitats. Individual species often occur in extensive populations, more or less without the presence of others.

Uses. Medium hardwoods which readily take preservatives; used for heavy construction, and formerly especially for railway sleepers. The resin was tapped, especially in seasonal climates and not widely in our area, for tallow, varnish and paint manufacture. The wood of *ensurai* (*D. oblongifolius*) was once esteemed for rice mortars.

Notes. Like *Vatica* but unlike most other dipterocarps, species of *Dipterocarpus* are sometimes difficult to identify on leaves alone. The leaf buds though are prominent, and their shape, and tomentum with that of the stipules, provide invaluable diagnostic characters. Fallen twigs with buds attached can nearly always be found.

Key to *Dipterocarpus* species
(based on flowering and/or fruiting specimens)

1. Calyx tube of mature fruit smooth (without ribs, tubercles or flanges).....2
Calyx tube of mature fruit ribbed, tuberculate or flanged.....10
2. Stamens at most 15.....3
Stamens at least 20.....4
3. Fruit calyx tube ellipsoid-globose, verrucose-lenticellate.....**39. D. verrucosus**
Fruit calyx tube ellipsoid, smooth.....**10. D. crinitus**
4. Fruit calyx lobes all short, equal.....**37. D. tempehes**
Fruit calyx lobes unequal, 2 large ones wing-like.....5
5. Stamens *c.* 25; short fruit calyx lobes less than 0.7 cm long, hardly recurved.....
.....**5. D. caudiferus**
Stamens *c.* 30; short fruit calyx lobes at least 0.8 cm long, becoming recurved and revolute.....6
6. Twigs and leaf buds densely ferruginous tomentose.....7
Twigs and leaf buds buff or golden tomentose, or glabrous.....8

DIPTEROCARPACEAE (ASHTON)

7. Leaf blade becoming glabrous.....**38. D. validus**
 Leaf blade persistently tomentose below.....**19. D. gracilis**
8. Leaf bud persistently pubescent outside.....**4. D. caudatus** (subsp. **penangianus**)
 Leaf bud glabrous outside.....9
9. Inside of stipules densely pubescent; lateral veins at most 11 pairs.....**23. D. kerrii**
 Stipules entirely glabrous; lateral veins at least 11 pairs.....**21. D. hasseltii**
10. Fruit calyx tube with prominent sharp or narrowly rounded ribs more or less confined to the distal half, terminating in boss-like tubercles.....**24. D. kunstleri**
 Fruit calyx tube either ribbed, angled or flanged, or tuberculate.....11
11. Mature fruit calyx tube with 5 swelling ribs or tubercles below the neck, otherwise spherical.....12
 Mature fruit calyx tube angled, ridged, ribbed, or flanged.....17
12. Mature fruit calyx tube ovoid.....**2. D. applanatus**
 Mature fruit calyx tube subglobose or globose.....13
13. Leaves with at most 16 pairs of lateral veins.....14..
14. Leaf blade pale ochreous-pubescent below.....**33. D. rigidus**
 Leaf blade glabrous.....15
15. Leaf bud and stipules outside glabrous, sometimes pruinose.....**9. D. costulatus**
 Leaf bud and stipules outside tomentose.....**18. D. globosus**
16. Fruit calyx lobes all short, subequal.....**12. D. elongatus**
 Fruit calyx lobes unequal, 2 larger ones wing-like.....**22. D. humeratus**
17. Fruit calyx tube with intricately folded flanges.....18
 Fruit calyx tube not flanged or if flanged, then the flanges straight or wavy but not intricately folded.....20
18. Twigs terete; leaf blade concave, venation tomentose below.....**25. D. lamellatus**
 Twigs compressed; leaf blade not concave, venation glabrous below.....19
19. Leaf blade ovate-lanceolate, prominently corrugated, margin prominently revolute, lateral veins at least 15 pairs.....**26. D. lowii**
 Leaf blade broadly ovate, hardly corrugated, margin hardly or not revolute, lateral veins at most 12 pairs.....**31. D. pachyphyllus**
20. Fruit calyx tube at least 1½x as long as broad, spindle-shaped or narrowly ellipsoid, or narrowly obovoid.....21

Fruit calyx tube less than 1½x times as long as broad, more or less globose or broadly ovoid though sometimes with flanges decurrent into pedicel and hence appearing ellipsoid.....	30
21. Fruit calyx tube angled or ribbed rather than flanged.....	22
Fruit calyx tube distinctly flanged.....	23
22. Leaf blade at least 15 cm long, broadly obovate to suborbicular.....	6. D. confertus
Leaf blade at most 12 cm long, narrowly elliptic-lanceolate.....	14. D. fagineus
23. Fruit calyx tube densely pale buff-pubescent, with very narrow undulate flanges.....	29. D. oblongifolius
Fruit calyx tube glabrous; flanges, if narrow, straight.....	24
24. Fruit calyx tube flanges at least 8 mm wide.....	25
Fruit calyx tube flanges at most 7 mm wide.....	27
25. Stamens <i>c.</i> 30.....	20. D. grandiflorus
Stamens <i>c.</i> 15.....	26
26. Young parts glabrous.....	17. D. glabrigemmatus
Young twig, bud, stipule outside and petiole pubescent.....	32. D. palembanicus
27. Fruit calyx tube flanges of constant width.....	28. D. nudus
Fruit calyx tube flanges widest in the distal half.....	28
28. Fruit calyx tube flanges more or less confined to distal half; leaf bud and leaf undersurface pubescent; stamens <i>c.</i> 25.....	3. D. borneensis
Fruit calyx tube flanges continuous from base; tomentum not as above; stamens, if known, <i>c.</i> 15.....	29
29. Leaf bud buff velutinous, leaf blade below sparsely so.....	15. D. fusiformis
Leaf bud outside and leaf blade glabrous.....	27. D. mundus
30. Fruit calyx tube persistently pubescent.....	31
Fruit calyx tube glabrescent.....	32
31. Leaf including petiole glabrous.....	16. D. geniculatus
Leaf below and petiole velutinous.....	7. D. conformis (subsp. borneensis)
32. Fruit calyx tube angled or ribbed rather than flanged.....	1. D. acutangulus
Fruit calyx tube truly flanged.....	33
33. Fruit calyx tube flanges exceeding 10 mm wide.....	34
Fruit calyx tube flanges less than 9 mm wide.....	35
34. Fruit calyx tube flanges not decurrent with pedicel, frequently undulate; leaf blade glabrous.....	36. D. sublamellatus
Fruit calyx tube flanges decurrent into pedicel; leaf blade densely tomentose below.....	35. D. stellatus

35. Leaves broadly obovate, apex obtuse or retuse.....**34. D. sarawakensis**
 Leaves narrowly elliptic-ovate, broadly elliptic-ovate to narrowly obovate, apex subacute, acute, acuminate to cuspidate.....36
36. Leaf blade broader, 10–15 cm wide; fruit calyx tube flanges not continuous to base.....
**8. D. coriaceus**
 Leaf blade narrower, 2–9.5 cm wide; fruit calyx tube flanges continuous to base.....37
37. Fruit calyx tube flanges broadest towards apex; leaf apex cuspidate.**11. D. cuspidatus**
 Fruit calyx tube flanges of constant width; apex of mature leaf blade not cuspidate....38
38. Mature leaf blade 10–19 × 4.5–9.5 cm.....**30. D. ochraceus**
 Mature leaf blade less than 10 × 4.5 cm.....**13. D. eurynchus**

Key to *Dipterocarpus* species

(based on field characters)

1. Leaf lateral veins more than 26 pairs.....2
 Leaf lateral veins less than 25 pairs.....3
2. Leaf blade at least 28 × 13 cm.....**12. D. elongatus**
 Leaf blade at most 25 × 12 cm.....**38. D. validus** (in part)
3. Petiole at most 1.3 cm long.....4
 Petiole at least 1.3 cm long.....6
4. Leaf apex retuse to obtuse; venation densely tawny long-tomentose below.....
**34. D. sarawakensis**
 Leaf apex acute or acuminate; venation sparsely pubescent or glabrescent below.....5
5. Leaf lateral veins at most 9 pairs. Trees of high shale ridges.....**13. D. eurynchus**
 Leaf lateral veins at least 9 pairs. Trees of flood plains.....**37. D. tempehes** (in part)
6. Leaf undersurface persistently (at least sparsely) tomentose.....7
 Leaf undersurface glabrous or becoming so.....23
7. Leaf blade prominently concave.....8
 Leaf blade not concave (though more or less corrugated).....9
8. Petiole less than 4 cm long.....**25. D. lamellatus**
 Petiole more than 5 cm long.....**6. D. confertus**
9. Leaf bud glabrous, drying black, or occasionally sparsely tomentose.....10
 Leaf bud persistently densely ochreous or brown tomentose.....11

10. Leaf lateral veins at least 12 pairs; leaf blade drying greyish brown.....
**5. D. caudiferus** (in part)
 Leaf lateral veins at most 11 pairs; leaf blade drying warm rust-brown.....
**17. D. glabrigemmatus**
11. Leaf blade densely evenly pale ochreous or pinkish brown tomentose below.....12
 Leaf blade sparsely pubescent, or rust-brown, or scabrid-tomentose below.....14
12. Leaf blade at most 12 × 7 cm, thinly coriaceous; lateral veins 15–18 pairs.....
**7. D. conformis** (subsp. **borneensis**)
 Leaf blade at least 13 × 8 cm, thickly coriaceous; lateral veins 12–16 pairs.....13
13. Tomentum pink. Trees of peat swamp forest.....**8. D. coriaceus**
 Tomentum ochre-yellow. Trees of mixed dipterocarp forest.....**33. D. rigidus**
14. Leaf blade with *c.* 20 pairs of lateral veins.....15
 Leaf blade with less than 18 pairs of lateral veins.....16
15. Leaf blade at least 20 × 12 cm; venation sparsely puberulent below...**22. D. humeratus**
 Leaf blade at most 15 × 10 cm; venation persistently rust-brown tomentose below.....
**19. D. gracilis**
16. Tomentum on twig and leaf bristle-like.....17
 Tomentum, where present, short and even.....19
17. Leaf apex with slender cuspidate acumen; lateral veins at most 9 pairs.....
**11. D. cuspidatus**
 Acumen of leaf apex, if present, broad and tapering; lateral veins at least 12 pairs.....18
18. Leaf blade elliptic, margin revolute, apex obtuse to shortly acuminate...**10. D. crinitus**
 Leaf blade ovate, margin not revolute, acumen prominent.....**35. D. stellatus**
19. Petiole at least 3 cm long.....**16. D. geniculatus**
 Petiole at most 2.6 cm long.....20
20. Twig stout; leaf bud ovoid-lanceolate. Trees of high hills.....**30. D. ochraceus**
 Twig slender; leaf bud falcate to linear-lanceolate. Trees of the lowlands.....21
21. Leaf blade broadly elliptic-obovate, prominently corrugated..**37. D. tempehes** (in part)
 Leaf blade narrowly elliptic to lanceolate, hardly corrugated.....22
22. Petiole at most 1.7 cm long.....**14. D. fagineus** (in part)
 Petiole at least 2 cm long.....**15. D. fusiformis**
23. Leaf bud glabrous outside, drying black.....24
 Leaf bud variously tomentose, drying yellowish, buff, brown or grey.....31
24. Leaf bud ovoid, broad and stout.....**1. D. acutangulus** (in part)
 Leaf bud long and slender (falcate).....25

25. Leaf lateral veins usually less than 11 pairs.....	26
Leaf lateral veins usually more than 11 pairs.....	27
26. Leaf blade narrowly elliptic to obovate, base narrowly obtuse.....	27. D. mundus
Leaf blade broadly elliptic, base cuneate.....	23. D. kerrii
27. Petiole at most 2 cm long. Trees of banks of upland rivers.....	
.....	29. D. oblongifolius (in part)
Petiole at least 2.5 cm long. Trees of mixed dipterocarp forest.....	28
28. Leaf blade broadly elliptic-ovate, thickly coriaceous and corrugated.....	9. D. costulatus
Leaf blade narrowly elliptic, thinly coriaceous and hardly corrugated.....	29
29. Intercostal venation widely scalariform to subreticulate.....	28. D. nudus
Intercostal venation densely regularly scalariform.....	30
30. Leaf buds at first hairy.....	5. D. caudiferus (in part)
Leaf buds always glabrous.....	21. D. hasseltii
31. Twigs at least 5 mm diameter apically; petioles at least 2 mm diameter; both stout.....	32
Twigs at most 5 mm diameter apically; petioles at most 2 mm diameter; both slender.....	36
32. Leaf lateral veins at least 15 pairs.....	33
Leaf lateral veins at most 15 pairs.....	35
33. Twigs compressed.....	26. D. lowii
Twigs terete.....	34
34. Leaf lateral veins at least 22 pairs; bud and stipules shaggy rust-brown tomentose.....	
.....	38. D. validus (in part)
Leaf lateral veins at most 17 pairs; bud and stipules shortly evenly buff-pubescent.....	
.....	20. D. grandiflorus
35. Petiole at least 3.5 cm long.....	2. D. applanatus
Petiole at most 2.5 cm long.....	18. D. globosus
36. Tomentum on petiole, leaf blade and leaf bud sparse, greyish brown.....	
.....	5. D. caudiferus (in part)
Tomentum on petiole, leaf blade and leaf bud yellowish, buff, golden, or dark or rust-brown; dense at least on leaf bud.....	37
37. Leaf lateral veins at least 16 pairs.....	38
Leaf lateral veins at most 14 pairs.....	39
38. Leaf bud densely pale yellowish long-tomentose.....	29. D. oblongifolius (in part)
Leaf bud densely minutely greyish-buff pubescent.....	24. D. kunstleri
39. Twigs compressed.....	31. D. pachyphyllus
Twigs terete.....	40

40. Leaf bud slender, more or less falcate, with apical tuft, tomentum otherwise very short41
 Leaf bud ellipsoid-ovoid to broadly ovoid, stout, densely buff or rust-brown long-tomentose.....44
41. Leaf bud minutely golden-brown pubescent, glistening due to the presence of minute radiating shiny stellate hairs; leaf blade broadly elliptic-ovate, drying pinkish brown.....**39. D. verrucosus**
 Leaf bud evenly greyish-buff pubescent, the hairs inclined towards the apex; leaf blade elliptic, lanceolate, or obovate, drying pale rust-brown or orange-brown.....42
42. Leaf blade broadly elliptic-obovate, prominently corrugated...**37. D. tempehes** (in part)
 Leaf blade narrowly elliptic, flat.....43
43. Leaf lateral veins at least 10 pairs.....**4. D. caudatus** (subsp. **penangianus**)
 Leaf lateral veins at most 10 pairs.....**14. D. fagineus** (in part)
44. Leaf bud densely buff long-tomentose.....**1. D. acutangulus** (in part)
 Leaf bud golden- to rust-tomentose or pale fulvous-hirsute.....45
45. Leaf lateral veins at least 12 pairs; leaf blade thinly coriaceous.....**32. D. palembanicus**
 Leaf lateral veins at most 12 pairs; leaf blade coriaceous.....46
46. Leaf bud rust- to dark-brown tomentose. Trees of *kerangas* forest.....**3. D. borneensis**
 Leaf bud pale fulvous-hirsute. Trees of mixed dipterocarp forest, especially on flat land**36. D. sublamellatus**

1. *Dipterocarpus acutangulus* Vesque

(Latin, *angulus* = angle, *acutus* = sharp; the ribs of fruit calyx tube)

C. R. Ac. Sci. Paris, 78 (1874) 626; Slooten *op. cit.* (1927) 321, Reinwardtia 5 (1961) 457; Masamune, EPB (1942) 485; Symington *op. cit.* (1943) 166; Browne *op. cit.* 107; Ashton *op. cit.* (1963) 240, *op. cit.* (1964) 22, *op. cit.* (1968) 11, *op. cit.* (1982) 322; Meijer & Wood *op. cit.* 235; Burgess *op. cit.* 99; Anderson *op. cit.* (1980) 111; PROSEA *op. cit.* 172; Coode *et al.* (eds.) *op. cit.* 66; Newman *et al.* *op. cit.* 76. **Type:** *Beccari PB 2913*, Borneo (holotype FI; isotype K). **Synonyms:** *Dipterocarpus tawaensis* Slooten *op. cit.* (1927) 313, Merrill, PEB (1929) 201, Masamune *op. cit.* 488; *D. helicopteryx* Slooten, Bull. Jard. Bot. Buitenz. 3, 16 (1940) 441.

Emergent tree, to 60 m tall, to 1.2 m diameter. **Bark** becoming pale buff-brown, flaky. *Young parts densely evenly buff-pubescent, persistent only on leaf bud, stipules and ovary.* **Twigs** *c. 3 mm diameter apically, terete*, with somewhat swollen nodes. *Leaf buds short, stout*, broadly ovoid, to 8 × 5 mm, *buff-pubescent but occasionally glabrous and drying black.* **Stipules** to 5 × 0.8 cm. **Leaves** coriaceous, drying yellowish brown, glabrous or almost so below; blade elliptic to ovate, 7–10 × 3–6 cm, base obtuse or cuneate, margin sinuate, apex with tapering acumen to 1 cm long; *lateral veins 7–12 pairs*, stout below; *petiole 1.5–2.5 cm long, to 2 mm diameter.* **Inflorescences:** rachis axillary, slender, terete, glabrous, to 6 cm long, *c. 1.5 mm diameter.* **Flower:** buds spindle-shaped, to 1.5 × 0.5 cm; calyx tube narrowly obconical, narrowly 5-winged, shorter sepal lobes vestigial; stamens 15, anthers *c. 6 mm long* including appendages, narrowly deltoid; style exceeding anthers, slender glabrous. **Fruits:** *calyx tube globose, to 2.5 cm diameter, glabrescent, base*

becoming impressed, 5-ribbed from base to apex; 2 longer calyx lobes to 10×2.5 cm, 3 shorter ones deltoid, to 0.5×0.5 cm, revolute.

Vernacular names. Sabah—*keruing merkah* (preferred name). Sarawak—*keruing beludu* (preferred name).

Distribution. Peninsular Malaysia (rare) and Borneo except southeastern parts. Widespread in Sabah and known from Beaufort, Kinabatangan, Kota Kinabalu, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Semporna, Sipitang, and Tawau districts (e.g., *SAN 15169*, *SAN 16183*, *SAN 18477*, *SAN 21408*, and *SAN 90469*) and in Sarawak from Bintulu, Kapit, Kuching, Lawas, Lundu, Miri, and Serian districts (e.g., *S 13372*, *S 15145*, *S 22062*, *S 23800*, and *S 46477*). Also occurring in Brunei (e.g., *BRUN 927*, *BRUN 985*, *BRUN 2637*, *BRUN 3348*, and *S 1669*) and Kalimantan (e.g., *bb. 10012* and *bb. 19811*).

Ecology. Locally common in mixed dipterocarp forest on yellow sandy and sandy clay soils, at altitudes below 400 m. Scattered also on inland shale and sandstone ridges, at altitudes to 1000 m. Well represented in Sarawak parks system and in Sepilok FR; elsewhere vulnerable.

Notes. A variable species in leaf size and texture; the leaf being larger and more coriaceous in W Sarawak than elsewhere where it may be difficult to distinguish from *D. globosus* (*q.v.*). The Kinabalu endemic, *D. ochraceus*, appears to be descended from it.

2. *Dipterocarpus applanatus* Slooten

Fig. 5.

(Latin, *applanatus* = flattened out; the leaf blade)

Bull. Jard. Bot. Buitenz. 3, 16 (1940) 443; Masamune *op. cit.* 485; Meijer & Wood *op. cit.* 237; Burgess *op. cit.* 99; Ashton *op. cit.* (1968) 11, *op. cit.* (1982) 310; Anderson *op. cit.* (1980) 111; PROSEA *op. cit.* 173; Newman *et al. op. cit.* 78. **Type:** *Puasa SAN 1720*, Borneo, Sabah, Sandakan district (holotype K).

Emergent tree, to 50 m tall, to 1.5 m diameter; buttresses prominent, to 3 m tall. **Bark** orange- and greenish-brown mottled, thinly flaky. *Leaf bud and stipule outside persistently evenly buff-tomentose; young twig, inside of stipules and base of inflorescence shortly buff-pubescent.* **Twigs** to 11 mm diameter apically, stout, terete, pale but for slightly depressed dark stipule scars. Leaf buds broadly ellipsoid to falcate, to 27×15 mm. **Stipules** to 5×2 cm. **Leaves** thickly coriaceous, somewhat undulate, *glabrous below*; blade broadly elliptic, $12\text{--}30 \times 9\text{--}20$ cm, base obtuse to subcordate, apex shortly abruptly acuminate; *lateral veins 11–15 pairs*, prominent below; intercostal venation remote, subreticulate; *petiole to 6 cm long, to 4 mm diameter, stout.* **Inflorescences:** axillary or ramiflorous, glabrous, to 12 cm long; rachis stout, unbranched, bearing to 5 flowers. **Flower** large, ellipsoid, to 4×1.5 cm; calyx tube ellipsoid, smooth, sepal lobes subequal, elliptic-oblong; stamens *c.* 50, anthers linear-lorate, *c.* 1.8 mm long with fleshy tapering connective appendage. **Fruits:** *calyx tube ovoid, to 5×4.5 cm, glabrous, with 5, to 8 mm wide sharp ribs most prominent distally, sometimes absent in basal half; 2 major calyx lobes to 19×4.5 cm, 3 minor ones suborbicular, to 1×1 cm, revolute.*

Vernacular names. Sabah—*keruing daun besar* (preferred name). Sarawak—*keruing arong* (preferred name).

Distribution. Endemic in Borneo with a disjunct range. In Sabah known from Kinabatangan, Sandakan and Tawau districts (e.g., *FMS 38844*, *SAN 17160*, *SAN 18752*, *SAN 19677*, and *SAN 39151*) and in Sarawak from Kuching and Serian districts (e.g., *S 8587*, *S 9489*, *S 15201*, *S 41016*, and *S 41017*). Also occurring in SE Kalimantan (e.g., *bb. 11675*, *bb. 18135* and *bb. 26595*).

Ecology. Local but sometimes abundant in mixed dipterocarp forest, on flat land, low hills and sometimes rocky slopes, on yellow sandy soils especially near the coast, at altitudes below 200 m. Vulnerable.

3. *Dipterocarpus borneensis* Slooten (of Borneo)

Bull. Jard. Bot. Buitenz. 3, 16 (1940) 445; Masamune *op. cit.* 485; Browne *op. cit.* 107; Ashton *op. cit.* (1964) 24, *op. cit.* (1968) 11, *op. cit.* (1982) 319; Anderson *op. cit.* (1980) 111; PROSEA *op. cit.* 174; Coode *et al.* (eds.) *op. cit.* 67; Newman *et al.* *op. cit.* 79. **Type:** *bb. 26417*, Borneo, Kalimantan, Pepas, Muara Tewe (holotype BO; isotype KEP).

Main canopy or shortly emergent tree, to 30 m tall, to 70 cm diameter, often with crooked trunk. **Bark** pale orange-brown to greyish brown, narrowly thinly flaking, becoming shaggy. *Young parts sparsely rust-brown pubescent; indumentum more or less persistent on ovary, leaf venation below and petiole, and dense and persistent on leaf bud and stipule outside.* **Twigs** 3–5 mm diameter apically, terete. *Leaf buds ovoid, to 7 × 3 mm.* **Stipules** to 4 × 0.5 cm. **Leaves** coriaceous, drying greyish brown, *sparsely pubescent to glabrous below*; blade broadly ovate to elliptic, 7–12 × 3–7 cm, base obtuse or broadly cuneate, margin frequently wavy towards apex, apex with tapering acumen to 0.8 cm long; *lateral veins 9–12 pairs*, slender but prominent below; *petiole 1.5–2.5 cm long, to 2 mm diameter, slender.* **Inflorescences** to 6 cm long, singly or rarely doubly branched. **Flower:** buds to 4 × 1 cm; *stamens c. 25*, anthers short, narrowly sagittate. **Fruits:** *calyx tube narrowly obovoid to ellipsoid, to 1.5 × 1 cm, glabrous, tapering at each end, with 5, c. 1 mm wide flanges in the distal half*; 2 major calyx lobes to 7.5 × 1.8 cm, 3 minor ones *c. 0.5 × 0.4 cm*, revolute and recurved.

Vernacular names. Sarawak—*keruing sindor* (preferred name), *resak kerangas* (Iban).

Distribution. Sumatra and Borneo. In Borneo, common and widespread in Sarawak and recorded from Bintulu, Kuching, Lawas, Lundu, Marudi, Samarahan, Serian, Sibuan, and Sri Aman districts (e.g., *S 9855*, *S 12492*, *S 13732*, *S 16222*, and *S 16236*) but absent in Sabah. Also occurring in Brunei (e.g., *BRUN 648*, *BRUN 830*, *FMS 34572*, *Niga 141*, and *S 2236*) and W and SE Kalimantan (e.g., *bb. 11344*, *bb. 16472*, *bb. 32384*, and *Kostermans 6888*).

Ecology. Locally abundant in *kerangas* forest, usually on deep podsol soils, on raised beaches and plateaux, at altitudes to 400 m; locally also on shallow peat. Common in Bako NP and occurring in Mulu NP, but vulnerable elsewhere owing to habitat destruction.

4. *Dipterocarpus caudatus* Foxw. (Latin, *caudatus* = tailed; the narrow acumen of the leaf apex)

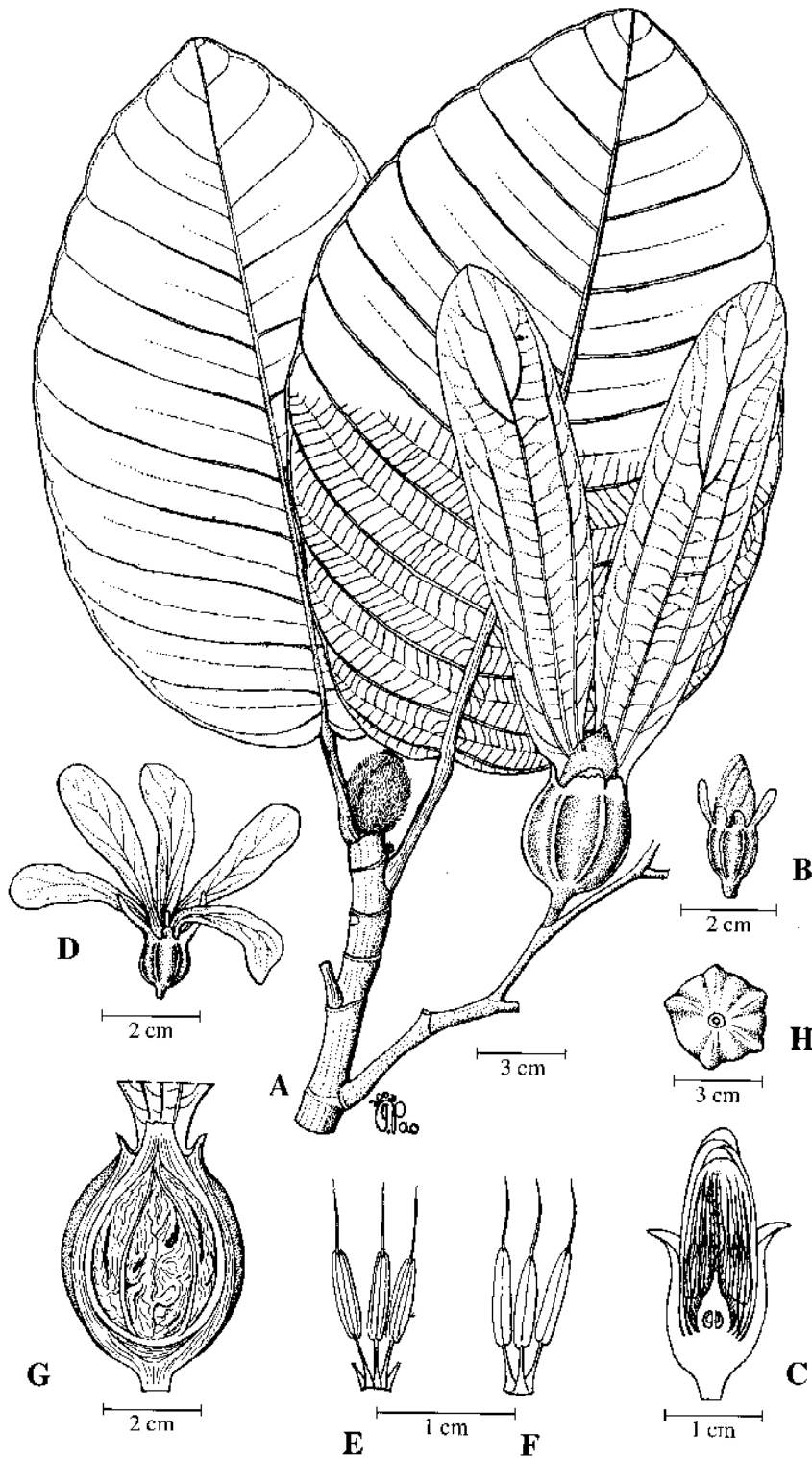


Fig. 5. *Dipterocarpus applanatus*. A, fruiting leafy twig; B, flower bud; C, longitudinal section of flower bud; D, open flower; E, adaxial view of stamens; F, abaxial view of stamens; G, longitudinal section of fruit; H, basal view of fruit calyx tube. (A and H from SAN 39151, B and D–F from S 41017, C from SAN 35868, G from FMS 35395.)

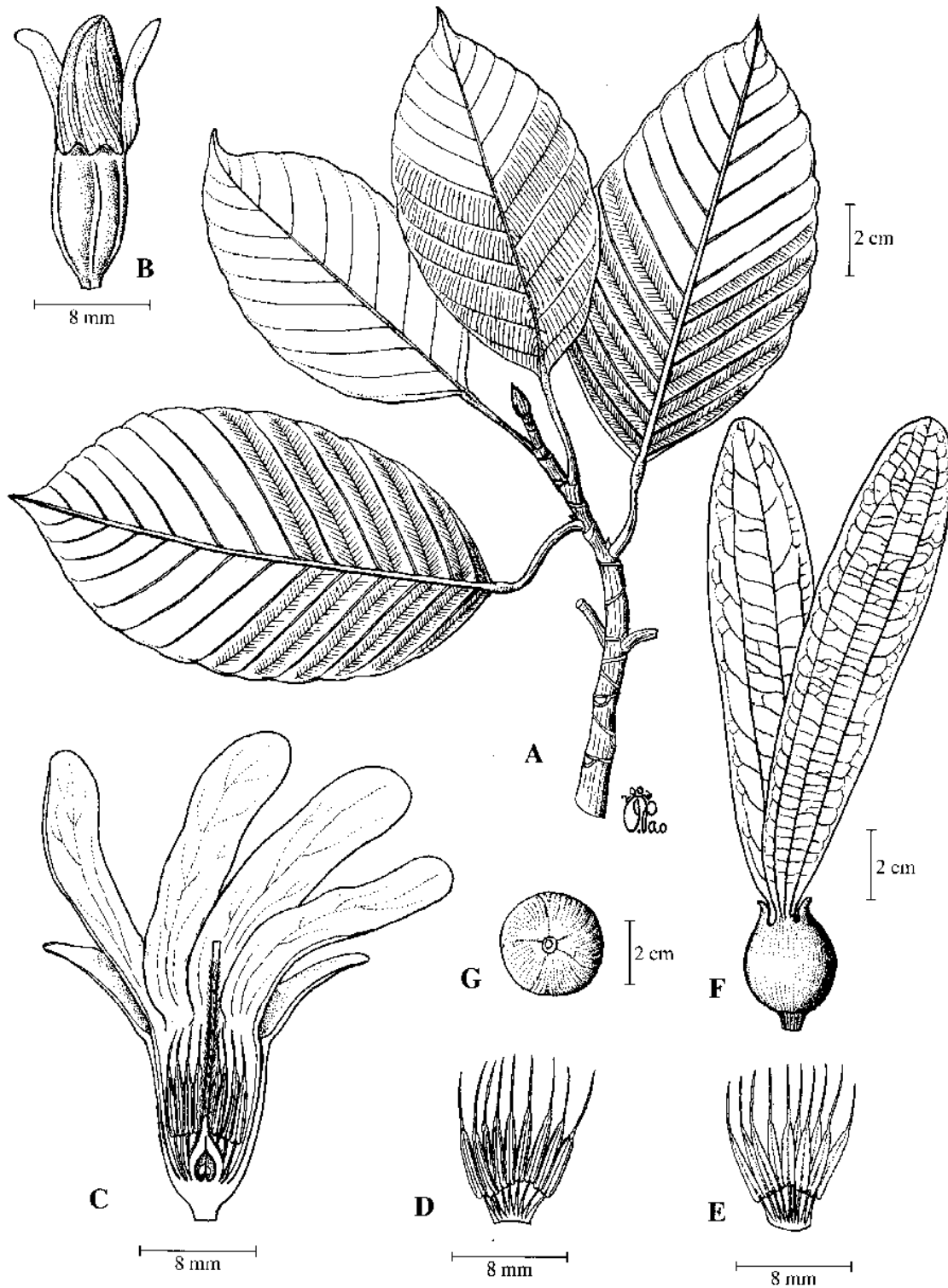


Fig. 6. *Dipterocarpus caudiferus*. A, leafy twig; B, flower bud; C, longitudinal section of open flower; D, adaxial view of stamens; E, abaxial view of stamens; F, fruit; G, basal view of fruit calyx tube. (A and F–G from *SAN 16847*, B from *FMS 38786*, C–E from *SAN 16335*.)

Philip. J. Sci. 13 (1918) Bot. 177, Philip. J. Sci. 67 (1938) Bot. 256; Ashton *op. cit.* (1978) 8, *op. cit.* (1982) 305. **Lectotype** (Ashton, 1978): *Alvarez FB 21193*, the Philippines, Luzon, Barrio Hibatac, Camarines (holotype K).

Distribution. Sumatra, Peninsular Malaysia, Singapore, Borneo, and the Philippines.

Notes. Two subspecies, viz. subsp. *caudatus* and subsp. *penangianus* are recognised. Of these, only subsp. *penangianus* occurs in Borneo.

subsp. **penangianus** (Foxw.) P.S.Ashton
(of Pulau Pinang, Peninsular Malaysia)

Gard. Bull. Sing. 31 (1978) 8, *op. cit.* (1982) 305; PROSEA *op. cit.* 174; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al.* *op. cit.* 80. **Basionym:** *Dipterocarpus penangianus* Foxw., *op. cit.* (1932) 72, Symington *op. cit.* (1943) 185, Ashton *op. cit.* (1964) 43. **Type:** *Haniff SFN 3484*, Peninsular Malaysia, Penang, Mt. Olivia (holotype SING; isotype K).

Emergent tree, to 50 m tall, to 1.2 m diameter. **Bark** orange-red, becoming pale orange-grey when exposed, irregularly flaky. *Young parts shortly sparsely fugaceous buff-puberulent; ovary, leaf bud and stipule outside densely persistently buff-pubescent.* **Twigs** terete, 1–3 mm diameter apically, slender. *Leaf buds linear-falcate, to 17 × 3 mm, tufted at apex.* **Stipules** *c.* 3.5 × 0.5 cm. **Leaves** *drying pale orange-brown, shiny above, glabrous or almost so below, flat; blade elliptic-lanceolate to elliptic-oblongate, 7–11 × 3.5–4 cm, base cuneate, margin frequently wavy distally, apex prominently narrowly acuminate, acumen to 2 cm long; lateral veins 10–12 pairs, well-spaced, hardly raised below; petiole 1.5–2.5 cm long, to 1 mm diameter, slender.* **Inflorescences** to 12 cm long, slightly compressed. **Flowers:** buds to 3 × 0.8 cm; *stamens c.* 30, anthers short, linear. **Fruits:** *calyx tube to 2 cm diameter, obturbinate and tapering into the short pedicel, smooth; 2 major calyx lobes to 14 × 3 cm, 3 minor ones to 0.8 × 0.4 cm, becoming recurved and revolute.*

Vernacular name. Sarawak—*keruing gasing* (preferred name).

Distribution. Sumatra (Karimun, Musala), coastal Peninsular Malaysia, Singapore, and Borneo. In Sabah recorded from Beaufort district (e.g., *SAN 15231*) and in Sarawak from Limbang, Marudi and Serian districts (e.g., *S 15204*, *S 23310*, *S 32208*, and *S 32329*). Also occurring in Brunei (e.g., *BRUN 5724*, *BRUN 5734*, *FMS 48205*, *KEP 80125*, and *S 1674*), but not known in Kalimantan.

Ecology. Local but common where it occurs, in mixed dipterocarp forests on dry ridges, at altitudes below 400 m, especially but not exclusively near the coast; formerly most abundant along the coastal hills on sandy soils, but also on the acid volcanic rocks of Ulu Arip, Balingian, and on high dacite ridges in the Hose mountains and Usun Apau in Sarawak. Endangered by land conversion.

5. *Dipterocarpus caudiferus* Merr.

Fig. 6.

(Latin, *cauda* = a tail, *ferre* = to bear; the narrow acumen of leaf apex)

Philip. J. Sci. 29 (1926) 398; Slooten *op. cit.* (1927) 302, *op. cit.* (1961) 459; Masamune *op. cit.* 485; Browne *op. cit.* 107; Ashton *op. cit.* (1963) 236, *op. cit.* (1964) 25, *op. cit.* (1968) 11, *op. cit.* (1982) 299; Meijer & Wood *op. cit.* 239; Burgess *op. cit.* 99; Anderson *op. cit.* (1980) 111; PROSEA *op. cit.*

175; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al.* *op. cit.* 81. **Type:** *Castro & Melegrito 1709*, Borneo, Banguay Is. (holotype K). **Synonyms:** *Dipterocarpus macrorrhinus* Slooten *op. cit.* (1927) 300; *D. kutaianus* Slooten *op. cit.* (1940) 437, Masamune *op. cit.* 483.

Immense emergent tree, to 65 m tall, to 1.5 m diameter, with tall columnar bole and prominent buttresses to 3.5 m tall. **Bark** pale pinkish grey, appearing smooth but thinly regularly vertically flaked. *Young parts more or less caducous sparsely silky greyish brown hispid, persistent on young trees.* **Twigs** c. 5 mm diameter apically, terete. *Leaf buds sparsely greyish brown hispid or glabrous, lanceolate, somewhat compressed, to 25 × 3 mm, occasionally drying black.* **Stipules** c. 7 cm long. **Leaves** thinly coriaceous, hardly to prominently corrugated, drying greyish brown, *glabrous or sparsely hispid with greyish brown hairs to 2 mm long; blade narrowly elliptic, 11–20 × 5–15 cm, base obtuse or cuneate, margin frequently sinuate distally, apex with slender acumen to 0.8 cm long; lateral veins 12–20 pairs, dense, slender but prominent below; intercostal venation slender, densely, regularly scalariform; petiole 3–4 cm long, slender, at most to 2 mm diameter, persistently hispid on the knee.* **Inflorescences** to 15 cm long, simple or singly branched. **Flowers:** buds to 5 × 0.8 cm; *stamens* c. 25, anthers narrowly oblong, tapering. **Fruits:** *calyx tube* globose or obturbinate, to 3.5 cm diameter, tapering into pedicel, *smooth; 2 major calyx lobes to 17 × 3 cm, 3 minor ones deltoid, to 0.6 × 0.7 cm, hardly recurved.*

Vernacular name. Sabah and Sarawak—*keruing putih* (preferred name).

Distribution. Endemic in Borneo, absent from south and southwest parts. Common throughout Sabah and recorded from most districts (e.g., *SAN 16335*, *SAN 17003*, *SAN 18603*, *SAN 19416*, *SAN 20949*, *SAN 27363*, and *SAN 134504*) and throughout Sarawak and recorded from Bau, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 1812*, *S 10159*, *S 13779*, *S 15504*, and *S 29681*). Also occurring in Brunei (e.g., *BRUN 331*, *BRUN 2639*, *BRUN 3025*, and *S 1662*) and E Kalimantan (e.g., *Kostermans 6630*, *Kostermans 13277*, *Kostermans 13960*, and *Kostermans 13978*).

Ecology. Locally common in mixed dipterocarp forest, at altitudes below 800 m, on well-structured clay soils; frequent on other clay soils, on shale, volcanic rocks and granodiorite. Common in G. Gading NP and locally so in Mulu NP; probably not endangered.

6. *Dipterocarpus confertus* Slooten

(Latin, *confertus* = crammed together; perhaps referring to the indumentum)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 322, Bull. Jard. Bot. Buitenz. 3, 17 (1941) 104, *op. cit.* (1961) 460; Merrill *op. cit.* (1929) 201; Foxworthy *op. cit.* (1932) 62; Masamune *op. cit.* 485; Browne *op. cit.* 108; Ashton *op. cit.* (1964) 26, *op. cit.* (1968) 12, *op. cit.* (1982) 315; Meijer & Wood *op. cit.* 242; Burgess *op. cit.* 99; Anderson *op. cit.* (1980) 111; PROSEA *op. cit.* 175; Kessler & Sidiyasa *op. cit.* 92; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al.* *op. cit.* 82. **Lectotype** (Slooten, 1941): *Elmer 21548*, Borneo, Sabah, Tawau district (hololectotype K; isolectotypes L, NY).

Medium-sized emergent tree, to 50 m tall, to 1.5 m diameter; bole rather short; crown fresh green from below, large-leafed and diffuse. **Bark** regularly vertically cracked and flaky. *Twigs at first, buds, stipule outside, petiole, midrib above, venation below, ovary, and calyx persistently long pale-fulvous tufted-hispid; leaf surface persistently or caducously so.*

Twigs to 10 mm diameter apically, stout. Leaf buds to 20 × 17 mm, large, broadly ovoid, obtuse or subacute. **Stipules** broadly ovate, *c.* 5 × 5 cm. **Leaves** *concave*, somewhat bullate, chartaceous, drying pale honey-brown and quickly decomposing; *blade broadly obovate to suborbicular*, (18–)22–35 × (14–)16–22 cm, base obtuse, generally subpeltate, apex obtuse or shortly acuminate; *lateral veins 9–12 pairs*, well-spaced; *petiole 5–6 cm long*, prominently articulated. **Inflorescences** to 7 cm long, simple or singly branched. **Flowers:** buds to 4 × 1 cm; stamens *c.* 25, anthers narrowly oblong, tapering. **Fruits:** *calyx tube narrowly obovoid*, *c.* 3 × 1.7 cm, tapering into pedicel, *5-ribbed*; 2 longer calyx lobes to 14 × 3 cm, glabrous within, 3 minor ones oblong, to 1.7 × 0.7 cm, recurved distally.

Vernacular name. Sabah and Sarawak—*keruing kobis* (preferred name).

Distribution. Endemic in Borneo; widespread except in the southwestern parts. Common in Sabah and known from Kinabatangan, Kudat, Ranau, Sandakan, and Sipitang districts (e.g., *SAN 15192*, *SAN 16372*, *SAN 16545*, *SAN A 3065*, and *SAN A 4676*) but less common in Sarawak and known from Kapit, Kuching, Lawas, Limbang, Miri, and Samarahan districts (e.g., *S 1830*, *S 13473*, *S 15762*, *S 19857*, *S 32353*, and *S 69176*). Also occurring in Brunei (e.g., *BRUN 441*, *FMS 30518* and *FMS 37111*) and E Kalimantan (e.g., *bb. 19283*, *bb. 24014*, *Kostermans 6212*, *Kostermans 6707*, and *Kostermans 7278*).

Ecology. Locally frequent in mixed dipterocarp forest on leached yellow clay soils, especially on undulating lands and low ridges, occasionally at altitudes to 800 m. Vulnerable.

7. *Dipterocarpus conformis* Slooten

(Latin, *conformis* = of a similar form; alluding the great similarity in vegetative characters with two other large-leafed species, *viz.* *D. concavus* and *D. confertus*)

Bull. Jard. Bot. Buitenz. 3, 17 (1941) 102. **Type:** *bb. 29177*, Sumatra, Aceh Province, Alur Buaya, Langsa (holotype BO).

Distribution. Sumatra and Borneo.

Notes. Two subspecies are recognised, *viz.* subsp. *conformis* which is confined to Aceh, N Sumatra and subsp. *borneensis* which is endemic in Borneo.

subsp. **borneensis** P.S.Ashton
(of Borneo)

Gard. Bull. Sing. 20 (1963) 28, *op. cit.* (1964) 28, *op. cit.* (1968) 12, *op. cit.* (1982) 321; Meijer & Wood *op. cit.* 244; Burgess *op. cit.* 99; Anderson *op. cit.* (1980) 111; PROSEA *op. cit.* 176; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al.* *op. cit.* 84. **Type:** *G.H.S Wood SAN 15102*, Borneo, Sabah, Sipitang district, Pangi (holotype L; isotypes KEP, SAN).

Medium-sized emergent tree, to 50 m tall, to 1.2 m diameter; crown densely symmetrical, pale greyish green from below. **Bark** becoming unevenly irregularly flaky. *Young parts densely pale pinkish brown velutinous, persistent except for leaf upper surface.* **Twigs** *c.* 3 mm diameter apically. Leaf buds ovoid, *c.* 8 × 4 mm, obtuse. **Stipules** ovate, *c.* 1.5 × 0.6

cm, concave. **Leaves** *thinly coriaceous, more or less corrugated but not concave; blade obovate, 9–12 × 5–7 cm*, base obtuse to subcordate, narrowly subpeltate, apex with acumen 0.4–0.8 cm long; *lateral veins 15–18 pairs*, slender but prominent and dense below; *petiole 1.7–2.5 cm long*, slender, rugose on drying. **Inflorescences** to 6 cm long, terminal or axillary, unbranched or singly branched. **Flowers:** buds to 3 × 0.8 cm; stamens *c.* 30, anther linear, short. **Fruits:** *calyx tube ellipsoid, c. 2.5 × 2 cm*, neck narrowed to 1.2 cm diameter, *persistently velutinous, with 5, c. 3 mm wide rigid incrassate flanges from base to apex*; 2 major calyx lobes to 10 × 2 cm, 3 minor ones ovate, to 0.8 × 0.8 cm, revolute.

Vernacular name. Sabah and Sarawak—*keruing beludu kuning* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort and Labuk Sugut districts (e.g., *SAN 15102*, *SAN 27582* and *SAN 97592*) and in Sarawak from Bintulu, Kapit, Lawas, and Limbang districts (e.g., *S 14358* and *S 32390*). Also occurring in Brunei (e.g., *BRUN 738*, *BRUN 2602* and *BRUN 5673*).

Ecology. Rare in mixed dipterocarp forest on clay soils over shale, generally in steep country, at altitudes below 800 m. Vulnerable, possibly endangered.

8. *Dipterocarpus coriaceus* Slooten

(Latin, *coriaceus* = with leathery texture; the leaf blade)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 331; Masamune *op. cit.* 485; Symington *op. cit.* (1943) 171; Browne *op. cit.* 108; Anderson, Gard. Bull. Sing. 20 (1963) 157, *op. cit.* (1980) 111; Ashton *op. cit.* (1968) 12, *op. cit.* (1982) 324; Newman *et al. op. cit.* 85. **Type:** *bb. 8154*, Borneo, SE Kalimantan, Tawai Baru, near Kuala Kapuas (holotype BO; isotype L).

Medium-sized emergent tree, to 40 m tall, to 1 m diameter; crown irregular, diffuse. **Bark** irregularly flaky. *Leaf under surface, petiole and twig shortly densely evenly persistently pinkish brown pubescent; leaf bud, stipule outside, midrib below, twig and petiole of young tree at first densely hairy with hairs to 2 mm long.* **Twigs** *c.* 10 mm diameter apically, stout. Leaf buds ovoid-deltoid *c.* 25 × 10 mm. **Stipules** narrowly ovate, *c.* 4 × 2 cm. **Leaves** *thickly coriaceous, prominently corrugated; blade broadly elliptic-ovate, 16–21 × 10–15 cm*, base obtuse to broadly cuneate, *apex subacute; lateral veins 14–16 pairs*, prominent below, sunken above; intercostal venation obscure; *petiole 4.5–6 cm long*, stout, prominently geniculate. **Inflorescences** and **flowers** unknown. **Fruits:** pedicels to 7 mm long, prominent; *calyx tube broadly ovoid, to 3 × 2.2 cm, glabrescent, with 5 stout flanges or ribs to 5 mm wide, tapering abruptly apically and gradually towards base*; 2 major calyx lobes to 14 × 2.5 cm, 3 minor ones elliptic, to 1.2 × 0.6 cm, hardly revolute.

Vernacular name. Sarawak—*keruing paya* (preferred name).

Distribution. E Sumatra, C Peninsular Malaysia, S and W Borneo. In Borneo, known in Sarawak from Kuching, Lundu, Mukah, Samarahan, Sibuluan, and Sri Aman districts (e.g., *S 555*, *S 556*, *S 9820*, and *S 14584*) and W and SE Kalimantan (e.g., *bb. 7450*, *bb. 8154* and *bb. 9442*).

Ecology. Very local; as scattered individuals or semi-gregarious populations in mixed peat swamp forest on the inner margins. Critically endangered.

9. *Dipterocarpus costulatus* Slooten

(Latin, *costulatus* = slightly-ribbed; the leaf blade)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 315, *op. cit.* (1941) 105; Masamune *op. cit.* 486; Symington *op. cit.* (1943) 174; Browne *op. cit.* 108; Meijer & Wood *op. cit.* 244; Ashton *op. cit.* (1968) 112, *op. cit.* (1982) 310; PROSEA *op. cit.* 177; Anderson *op. cit.* (1980) 112; Newman *et al. op. cit.* 87. **Type:** *Sahak CF 1908*, Peninsular Malaysia, Negeri Sembilan, Kuala Pilah, Senaling Inas FR (holotype KEP).

Emergent tree, to 50 m tall, to 1.2 m diameter. **Bark** pale greenish cream, patchily peeling but sustaining an overall smooth appearance. *Parts glabrous but for densely shortly buff-pubescent inner surface of stipules, bud scales, and ovary.* **Twigs** c. 7 mm diameter apically, at first somewhat compressed. *Leaf buds falcate*, to 30 × 6 mm, *drying black.* **Stipules** lorate, c. 16 × 2 cm. **Leaves** *thickly coriaceous, corrugated; blade broadly elliptic to ovate, 12–20 × 7–14 cm*, base cuneate, apex obtuse or shortly acuminate; *lateral veins 11–14 pairs*, prominent below; *petiole 3–6 cm long.* **Inflorescences** to 20 cm long, once branched. **Flowers:** buds to 3 × 5 cm; stamens c. 24, anther linear. **Fruits:** pedicels to 6 mm long, prominent; *calyx tube subglobose, to 1.5 × 2 cm, with 5 prominent flange-like median tubercles*; 2 major calyx lobes to 20 × 4 cm, 3 minor ones suborbicular, to 0.7 × 0.6 cm, revolute.

Vernacular name. Sabah and Sarawak—*keruing kipas* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah known from Tawau district, including Sebatik Is. (e.g., *FMS 38859*, *SAN 18470*, *SAN 18559*, *SAN 19643*, and *SAN 25026*) and in Sarawak from Kapit, Kuching and Lundu districts (e.g., *S 4798*, *S 15422*, *S 21451*, *S 23805*, and *S 43192*). Also occurring in W Kalimantan (e.g., *bb. 6271*).

Ecology. Common in Peninsular Malaysia but very local and uncommon in Sabah and Sarawak, on occasionally flooded alluvium and in the ecotone between mixed dipterocarp forest and *kerangas* forest, on sandy soils and shallow peat, at altitudes below 200 m. Highly vulnerable owing to forest conversion.

10. *Dipterocarpus crinitus* Dyer

(Latin, *crinitus* = having tufts of long weak hairs; the living plant parts)

Fl. Brit. Ind. 1 (Jan. 1874) 296, J. Bot. 12 (1874) 103 & 154; King *op. cit.* 90; Merrill, EB (1921) 398; Ridley *op. cit.* (1922) 214; Slooten *op. cit.* (1927) 288; Masamune *op. cit.* 486; Foxworthy *op. cit.* (1932) 66; Symington *op. cit.* (1943) 175; Browne *op. cit.* 108; Ashton *op. cit.* (1964) 29, *op. cit.* (1968) 13, *op. cit.* (1982) 299; Meijer & Wood *op. cit.* 246; Burgess *op. cit.* 99; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 177; Coode *et al. (eds.) op. cit.* 68; Newman *et al. op. cit.* 88. **Type:** *Maingay 196*, Peninsular Malaysia, Malacca (holotype K). **Synonym:** *Dipterocarpus hirtus* Vesque *op. cit.* (March 1874) 627.

Large emergent tree, to 60 m tall, to 2 m diameter; bole frequently misshapen; crown golden-green from below. **Bark** weathering pale greyish pink, irregularly patchily flaky; inner bark relatively thick, cream-coloured. *Plant parts tufted-setose with golden-brown*

bristle-like hairs c. 3 mm long, shorter on leaf blade; leaf upper surface fugeaceous pubescent. Twigs c. 3 mm diameter apically. Leaf buds oblong, c. 5 × 2 mm, obtuse. Stipules lanceolate, c. 3 × 0.5 cm. Leaves chartaceous, not concave, persistently folded between the veins; blade elliptic, 6–9 × 3–5 cm, base obtuse, margin revolute, apex obtuse or shortly acuminate; lateral veins 13–15 pairs, slender but prominent below; petiole 1.5–2.5 cm long, slender. Inflorescences to 12 cm long, singly branched, terminal or axillary. Flowers: stamens 15, anthers linear. Fruits subsessile; calyx tube ellipsoid, to 1.8 × 0.8 cm, smooth, 2 major calyx lobes to 8 × 1.5 cm, 3 minor ones deltoid, c. 0.3 cm long, acute.

Vernacular name. Sabah and Sarawak—*keruing mempelas* (preferred name).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Sabah recorded from Sipitang and Tawau districts (e.g., *SAN 15171*, *SAN 15287*, *SAN 26894*, and *SAN A 3296*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Lundu, Marudi, Miri, and Serian districts (e.g., *S 9478*, *S 10121*, *S 15125*, *S 16629*, and *S 23897*). Also occurring in Brunei (e.g., *BRUN 3137*, *BRUN 3268* and *BRUN 5043*) and W, C and SE Kalimantan (e.g., *Amiril P6. 247*, *bb. 27768*, *bb. 31415*, and *Kostermans 12765*).

Ecology. Common in mixed dipterocarp forest on sandy clay soils, at altitudes to 800 m. This species flowers sporadically outside mass flowering events, but seeds have high infertility though juveniles are common. Well represented in the parks system; vulnerable elsewhere.

11. *Dipterocarpus cuspidatus* P.S.Ashton

(Latin, *cuspidatus* = pointed at the end; the leaf blade)

Gard. Bull. Sing. 23 (1967) 261, *op. cit.* (1968) 13, *op. cit.* (1982) 324; Anderson *op. cit.* (1980) 112; Newman *et al. op. cit.* 90. **Type:** *Ilias S 15821*, Borneo, Sarawak, Bintulu district, Labang FR (holotype K; isotypes KEP, L).

Medium-sized emergent tree, to 50 m tall, to 1.2 m diameter. **Bark** rust-brown. *Leaf buds densely persistently long buff-tomentose; twig, petiole, midrib above and venation below sparsely pubescent with persistent pale greyish brown bristle-like hairs; parts otherwise glabrous. Twigs c. 1 mm diameter apically, very slender. Leaf buds oblong, c. 7 × 3 mm. Leaves chartaceous, hardly corrugated; blade narrowly elliptic-ovate, 6–11 × 2–4 cm, base obtuse or occasionally broadly cuneate, apex cuspidate, acumen to 2 cm long, slender, prominent; lateral veins 8–9 pairs, slender but prominent below as also the midrib; petiole 1.3–1.8 cm long, very slender. Inflorescences to 5 cm long, terminal or axillary, singly branched. Flowers unknown. Fruits: calyx tube subglobose, to 1.7 × 2 cm, with 5, c. 2.5 mm wide rigid flanges from base to apex, broadest towards apex, glabrescent; 2 major calyx lobes to 8 × 2 cm, 3 minor ones ovate, to 0.7 × 0.5 cm, obtuse, becoming revolute.*

Vernacular name. Sarawak—*keruing runcing* (preferred name).

Distribution. Endemic in Borneo and confined to Segan FR, Bintulu district, Sarawak (e.g., *S 15138*, *S 22061*, *S 22064*, and *S 27116*).

Ecology. Formerly scattered in mixed dipterocarp forest on sandy clay soils on low hills, at altitudes below 100 m. Endangered owing to land conversion and logging.

12. *Dipterocarpus elongatus* Korth.(Latin, *elongatus* = attenuated; the leaf shape)

Kruiddk. (1841) 62; Merrill *op. cit.* (1921) 398; Slooten *op. cit.* (1927) 272, *op. cit.* (1961) 473; Masamune *op. cit.* 486; Ashton *op. cit.* (1963) 237, *op. cit.* (1982) 312; PROSEA *op. cit.* 178; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al.* *op. cit.* 91. **Type:** *Korthals s.n.* (= RHL Sheet No. 91062130), Borneo, Kalimantan, Barito, Sg. Punin (holotype L). **Synonyms:** *Dipterocarpus apterus* Foxw., *op. cit.* (1932) 77, Masamune *op. cit.* 485; *D. megacarpus* Madani, Sandakania 2 (1993) 1.

Large emergent tree, to 60 m tall, to 1.7 m diameter; crown open, spreading; buttresses stout, to 3 m tall. **Bark** greyish pink, overall smooth but thinly irregularly flaky. *Twig, leaf bud, stipule outside, petiole, inflorescence and calyx at first densely very long rufous-brown tufted tomentose, the tufts separating and caducous as parts expand; ovary apex persistently tomentose.* **Twigs** to 1.5 cm diameter apically, terete, reddish brown, becoming cracked and thinly flake. Leaf buds falcate, to 60 × 15 mm. **Stipules** c. 15 × 2.5 cm. **Leaves** coriaceous, prominently corrugated, drying dark rust-brown below; *blade elliptic, 28–50 × 13–20 cm, base obtuse, apex shortly abruptly acuminate; lateral veins 25–38 pairs, dense, prominent below; intercostal venation distantly scalariform; petiole 5–7 cm long, c. 5 mm diameter, stout.* **Inflorescences** to 12 cm long, terminal or axillary, rarely branched. **Flowers** unknown. **Fruits:** *calyx tube ovoid becoming globose, to 5 × 5.5 cm, tomato-shaped with 5 distal swellings, constricted to c. 1.5 cm diameter at the neck, crowned by 5 subequal, obtuse, recurved lobes to 0.8 cm long.*

Vernacular names. Sarawak—*keruing latek* (preferred name), *kudan* (Murut), *ran* (Iban).

Distribution. E Sumatra, Peninsular Malaysia, Anambas Archipelago, and Borneo (except south and northwest parts). In Sabah known from Kinabatangan district (e.g., *SAN 133997* and *Wong et al. WKM 2342*) and in Sarawak from Bintulu district (e.g., *S 286, S 11736, S 15131, and S 27103*). Also occurring in Brunei (e.g., *BRUN 767, BRUN 2603, BRUN 5638, Coode 7081, and FMS 28683*) and W Kalimantan (e.g., *bb. 7855 and Kostermans 9566*).

Ecology. Now rare, but formerly probably quite common and locally gregarious. In the floodplains where the rivers come out from the hills, especially on sandy alluvium; occasional on narrow riverine terraces further inland, at altitudes below 300 m. The fruit float in water. Critically endangered.

13. *Dipterocarpus eurynchus* Miq.(Greek, *eu* = well, *rhynchos* = snout(ed); the sapling leaf acumen)

Fl. Ned. Ind., Suppl. (1862) 485; Slooten *op. cit.* (1927) 273, 302; Ashton *op. cit.* (1963) 238, *op. cit.* (1964) 30, *op. cit.* (1968) 14, *op. cit.* (1982) 324; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 179; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al.* *op. cit.* 92. **Type:** *Teijsmann HB 3255*, Sumatra, Bangka (holotype U). **Synonyms:** *Dipterocarpus eurynchoides* Scheff., *Nat. Tijd. Ned. Ind.* 31 (1870) 346; *D. appendiculatus* Scheff., *op. cit.* 347, Merrill *op. cit.* (1921) 397, Masamune *op. cit.* 485; *D. basilanicus* Foxw., *op. cit.* (1918) 179.

Medium-sized emergent tree, to 65 m tall, to 1 m diameter but usually smaller; bole frequently misshapen; crown distinctive when the old leaves turn coppery red before falling. **Bark** pale greyish brown, irregularly flaky and eventually shaggy. *Leaf buds densely persistently long buff-tomentose; twig, petiole and venation below sparsely but more or less*

persistently greyish pubescent, stipules and ovary apex persistently so. Twigs c. 2 mm diameter apically, much-branched. Leaf buds conical, to 10 × 3 mm. **Stipules** c. 3 × 0.8 cm. **Leaves** thinly coriaceous, drying dull yellow to pale orange-brown; *blade elliptic-obovate, 4–6(–10) × 2–3.5(–4.5) cm, base cuneate, apex subacute to shortly acuminate; lateral veins 8–9 pairs, ascending; petiole 0.6–0.9 cm long, slender. Inflorescences* to 6 cm, simple or singly branched. **Flowers** unknown. **Fruits:** *calyx tube subglobose, to 1.7 × 2 cm, glabrescent, with 5, rigid, c. 2.5 mm wide flanges from base to apex; 2 major calyx lobes to 8 × 2 cm, 3 minor ones ovate, to 0.7 × 0.5 cm, becoming revolute.*

Vernacular name. Sarawak—*keruing baran* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Sarawak known from Kapit, Limbang and Miri districts (e.g., *BRUN 3073, S 23818, S 23888, and S 60135*). Also occurring in Brunei (e.g., *BRUN 2600, BRUN 5235, BRUN 5254, and BRUN 5257*).

Ecology. In Sarawak and Brunei rare, scattered on high ridges of upper dipterocarp forest at 600–1000 m altitude. Occurring in Mulu NP but vulnerable elsewhere.

14. *Dipterocarpus fagineus* Vesque

(Latin, *fagineus* = like a beech (*Fagus*) tree; the leaves)

C. R. Ac. Sci. Paris 78 (March 1874) 625; King *op. cit.* 94; Merrill *op. cit.* (1921) 398; Ridley *op. cit.* (1922) 216; Slooten *op. cit.* (1927) 318; Symington, Bull. Misc. Inform Kew (1937) 318, *op. cit.* (1943) 177; Masamune *op. cit.* 486; Browne *op. cit.* 108; Ashton *op. cit.* (1968) 14, *op. cit.* (1978) 10; Anderson *op. cit.* (1980) 112; Newman *et al. op. cit.* 93. **Type:** *Beccari PB 3008*, Borneo, Sarawak, G. Matang (holotype P). **Synonyms:** *Dipterocarpus prismaticus* Dyer, J. Bot. 12 (April 1874) 104; *D. pseudofagineus* Foxw., *op. cit.* (1932) 82.

Medium-sized emergent tree, to 45 m tall, to 1 m diameter. **Bark** greyish brown, flaky. *Young twig, leaf bud, parts of flower exposed in bud, stipule outside, petiole, and inflorescence shortly evenly greyish brown pubescent, becoming glabrous on the inflorescence. Twigs* c. 2 mm diameter apically, terete. Leaf buds falcate, to 10 × 2.5 mm. **Stipules** to 2 × 0.3 cm. **Leaves** thinly coriaceous, flat, drying pale rust-brown, sparsely pubescent especially along midrib and lateral veins or glabrescent below; *blade narrowly elliptic to lanceolate, 4–9(–12) × 1.5–4(–5.5) cm, base cuneate, apex acuminate, acumen slender to 0.8 cm long; midrib flat above, prominent below; lateral veins 8–10 pairs, slender but elevated below; petiole 1.3–1.7 cm long, slender, to 2 mm diameter, prominently geniculate. Inflorescences* to 5 cm long, unbranched or singly branched. **Flowers:** buds c. 2 × 0.6 cm; stamens c. 15. **Fruits:** *calyx tube subglobose to ellipsoid, to 1 × 0.8 cm, tapering into a c. 6 mm long pedicel, with 5 slender acute ribs from base or distally only; 2 major calyx lobes to 8 × 1.5 cm; 3 shorter ones deltoid, to 0.6 × 0.5 cm.*

Vernacular name. Sarawak—*keruing pipit* (preferred name).

Distribution. Sumatra (Riau and Lingga Archipelagoes), Peninsular Malaysia, and Borneo. Rare in Sarawak, known only from Kapit, Kuching (G. Matang) and Simunjan (G. Gaharu) districts (e.g., *S 15539, S 43809 and S 57613*).

Ecology. Rare in mixed dipterocarp forest on hills. Conservation status unknown.

Notes. A clearly defined species outside Borneo but the Sarawak specimens, including the type, are hardly distinguishable from *D. acutangulus*, and bear close resemblance also to *D. borneensis*.

15. *Dipterocarpus fusiformis* P.S.Ashton

(Latin, *fusiformis* = spindle-shaped; the fruit calyx tube)

Gard. Bull. Sing. 31 (1978) 12, *op. cit.* (1982) 319; Kessler & Sidiyasa *op. cit.* 93; Newman *et al. op. cit.* 93. **Type:** Singh SAN 39170, Borneo, Sabah, Sandakan district, Mile 81, Labuk Road (holotype L; isotype SAN).

Large emergent tree. **Bark** greyish. *Young parts densely buff-velutinous; persistent on leaf buds, stipule outside and ovary apex; sparsely so on twig, leaf below and petiole; caducous elsewhere.* **Twigs** slender, c. 2 mm diameter apically. *Leaf buds linear-falcate, to 15 × 3 mm.* **Stipules** lanceolate, c. 3 × 0.6 cm. **Leaves** coriaceous, *hardly corrugated*, drying yellowish brown; *blade elliptic or narrowly ovate, 7–17 × 3–7 cm*, base cuneate or obtuse, apex prominently acuminate, acumen slender to 12 cm long; *lateral veins 13–17 pairs*, slender but prominent below; *petiole 2–2.6 cm long, slender.* **Inflorescences** and **flowers** unknown. **Fruits:** *calyx tube ellipsoid, to 2.8 × 1.8 cm, glabrous, with 5, to 6 mm wide incrassate flanges or narrow ridges continuous from base to apex but generally broadest distally; 2 major calyx lobes to 10 × 2.6 cm, 3 minor ones suborbicular, to 0.5 × 0.5 cm, subrevolute.*

Distribution. Endemic in Borneo. In Sabah recorded from Kinabatangan, Lahad Datu, Ranau, Sandakan, Semporna, and Tawau districts (e.g., SAN 15379, SAN 16952, SAN 17178, SAN 63787, SAN 97110, and SAN 100176). Also occurring in Kalimantan (e.g., Sidiyasa S 462).

Ecology. In mixed dipterocarp forest on well-structured and well-drained clay soils, on basic volcanic and shale substrates, at altitudes to 600 m. Endangered by land conversion.

16. *Dipterocarpus geniculatus* Vesque

(Latin, *geniculatus* = with bent knee; the petiole)

C. R. Ac. Sci. Paris 78 (March 1874) 626; Merrill *op. cit.* (1921) 398; Slooten *op. cit.* (1927) 317, *op. cit.* (1941) 99; Masamune *op. cit.* 486; Meijer & Wood *op. cit.* 248; Burgess *op. cit.* 900; Browne *op. cit.* 109; Ashton *op. cit.* (1968) 14, *op. cit.* (1982) 320; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 179; Newman *et al. op. cit.* 94. **Type:** Beccari PB 3034, Borneo, Sarawak (holotype P). **Synonym:** *Dipterocarpus angulatus* Dyer, J. Bot. 12 (April 1874) 104.

Emergent tree, to 60 m tall, to 2 m diameter; crown wide, large-leaved. **Bark** chocolate-brown, becoming irregularly, eventually shaggily flaked. *Young twig, leaf buds, stipule outside, ovary, fruit calyx tube, and inflorescence persistently densely evenly pale cream-pubescent with short hairs; fruit calyx lobes, petiole and leaf venation below sparsely more or less caducously so.* **Twigs** to 13 mm diameter apically, with rows of elongate lenticels and sinuate stipule scars. Leaf buds broadly ovoid, c. 25 × 20 mm. **Stipules** lanceolate, c. 6 × 2 cm. **Leaves** coriaceous, *weakly corrugated, shiny above, sparsely pubescent or glabrous below*, drying pale chocolate-brown; blade elliptic to obovate, base obtuse, apex

obtuse to shortly acuminate; *lateral veins 10–12 pairs*, prominent below, well-spaced; *petiole 3–10 cm long*, stout, *glabrous*. **Inflorescences** to 24 cm long, axillary, singly or occasionally doubly branched. **Flowers:** buds to 3.5×1 cm; stamens *c.* 30, anthers short, narrowly oblong. **Fruits:** *calyx tube glabrescent, obovoid-globose, c. 1.5×1.5 cm, tapering to pedicel, with 5 stout continuous ridges to 3 mm wide towards the undulate distal ends; 2 major calyx lobes $12–15 \times 2.5–4$ cm, 3 minor calyx lobes cordate, c. 1×1.5 cm, the sides recurved.*

Vernacular names. Sabah—*keruing tangkai panjang* (preferred name). Sarawak—*keruing kerubung* (preferred name).

Distribution. Endemic in Borneo.

Notes. In Sabah and Sarawak, two subspecies, *viz.* subsp. *geniculatus* and subsp. *grandis*, are recognised.

Key to subspecies

Twigs to 7 mm diameter apically. Leaf blade $7–12 \times 5–7$ cm; petiole 3–5 cm long. Two major fruit calyx lobes to 12×2.5 cm.....

subsp. **geniculatus**

Known in Sarawak from Belaga, Bintulu, Kuching, Lundu, and Miri districts (e.g., *S 11054, S 15144, S 16475, S 32411, S 68679*, and *SFN 36109*) and in W Kalimantan from the Lower Kapuas drainage (e.g., *bb. 8322*). In mixed dipterocarp forest on low hills and valleys on leached sandy and sandy and silty clay soils, at altitudes to 400 m; locally common. Vulnerable though locally frequent in Bako NP.

Twigs to 13 mm diameter apically. Leaf blade $20–35 \times 12–16$ cm; petiole to 10 cm long. Two major fruit calyx lobes to 15×4 cm.....

subsp. **grandis** P.S.Ashton

(Latin, *grandis* = large; the twig and associated organs)

Gard. Bull. Sing. 20 (1963) 240, *op. cit.* (1964) 11; Meijer & Wood *op. cit.* 248; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al. op. cit.* 95. Type: *Dzulkiplé S 1870*, Borneo, Brunei, Ladan Hills FR (holotype KEP).

Known from Sipitang district in Sabah (e.g., *SAN 15132* and *SAN A 4051*) and from Limbang and Miri districts in Sarawak (e.g., *S 1829* and *S 46505*). Also occurring in Brunei (e.g., *BRUN 3064, FMS 30586* and *FMS 35666*). As subsp. *geniculatus*, and on ultrabasic rocks in E Sabah. Vulnerable though common in Lambir NP.

17. *Dipterocarpus glabrigemmatus* P.S.Ashton

(Latin, *glabrus* = hairless, *gemmatus* = budded; the glabrous leaf buds)

Gard. Bull. Sing. 31 (1978) 11, *op. cit.* (1968) 19 ('32. *Dipterocarpus* sp. '), *op. cit.* (1982) 318. **Type:** *Jugah S 23849*, Borneo, Sarawak, Kapit district, Bt. Raya (holotype K; isotypes KEP, SAR).

Medium-sized to large tree. *Midrib and veins sparsely pubescent, ovary densely so; parts otherwise glabrous*. **Twigs** *c.* 3×2 mm apically, somewhat compressed and ribbed, shiny. *Leaf buds* ovoid, *c.* 6×4 mm, acute, *glabrous, drying black, occasionally sparsely tomentose*. **Leaves** *glabrous except on the midrib and veins, drying warm rust-brown, more*

or less corrugated; blade broadly ovate, 6–9 × 4.5–6 cm, base obtuse, margin prominently sinuate distally, apex with an acumen to 0.5 cm long; midrib prominent below; *lateral veins 10–11 pairs*, prominent below; *petiole 1.5–2.5 cm long*, slender, drying rugose. **Inflorescences** to 10 cm long, unbranched. **Flowers:** buds to 2.5 × 1.2 cm; *calyx tube broadly flanged*; *stamens c. 15*, anthers linear. **Fruits** unknown.

Distribution. Endemic in Borneo. Known in C Sarawak from Kapit district (e.g., *S 22339*, *S 23163*, *S 24224*, *S 24250*, and *Smythies s.n.*) and in C and E Kalimantan.

Ecology. In mixed dipterocarp forest on shale ridges, at altitudes to 600 m. Rare and endangered.

18. *Dipterocarpus globosus* Vesque

(Latin, *globosus* = spherical; the fruit calyx tube)

C. R. Ac. Sci. Paris 78 (March 1874) 627; Merrill *op. cit.* (1921) 398; Slooten *op. cit.* (1927) 304, *op. cit.* (1941) 98; Masamune *op. cit.* 486; Browne *op. cit.* 109; Ashton *op. cit.* (1964) 33, *op. cit.* (1968) 15, *op. cit.* (1982) 311; Burgess *op. cit.* 100; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 180; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al.* *op. cit.* 97. **Type:** *Beccari PB 2914*, Borneo, Sarawak, Matang (holotype P). **Synonyms:** *Dipterocarpus beccarianus* Vesque *op. cit.* 627; *D. beccarii* Dyer, J. Bot. 12 (April 1874) 103.

Large emergent tree, to 65 m tall, to 2 m diameter; buttresses to 3.5 m tall and wide, stout, concave, many. **Bark** pale greyish brown, cleanly vertically cracked and thinly flaking. *Young parts at first persistently shortly chestnut pubescent*; *leaf buds and stipule outside persistently densely long chestnut tomentose*. **Twigs** 5–8 mm diameter apically, stout. Leaf buds ovoid, *c. 1 × 0.8 cm*, acute. **Stipules** narrowly lanceolate, *c. 7 × 0.7 cm*, acute. **Leaves** thickly coriaceous, corrugated, *glabrous or glabrescent below*; blade broadly ovate, 10–14 × 7–9 cm, base broadly cuneate, margin sinuate, apex broadly acuminate, acumen to 0.4 cm long; midrib and veins below fugaceous puberulent; *lateral veins 12–14 pairs*, well-spaced, prominent below; *petiole 2–2.5 cm long, stout, at least 2 mm diameter*. **Inflorescences** to 8 cm long, axillary, singly branched. **Flowers** unknown. **Fruits:** *calyx tube subglobose or globose*, to 3.5 cm long and broad, *more or less 5-ribbed from the impressed base to the constricted apex, most prominent and slightly tuberculate distally*; 2 major calyx lobes to 15 × 3.5 cm, 3 minor ones deltoid, 0.4–0.5 cm long and broad, becoming recurved and revolute.

Vernacular name. Sabah and Sarawak—*keruing buah bulat* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Bintulu, Kuching, Lundu, Miri, Serian and Simunjan districts (e.g., *S 10058*, *S 21421*, *S 22052*, *S 27176*, and *S 27968*). Also occurring in Brunei (e.g., *BRUN 5540*, *FMS 30488*, *FMS 35531*, and *FMS 48175*).

Ecology. In mixed dipterocarp forest on deep yellow sandy soils, on coastal hills at altitudes below 400 m. One of the most abundant large dipterocarps on sandy coastal hills between Mukah (Sarawak) and Andulau forest (Brunei), including the Lambir Hills NP. Endangered outside parks system.

19. Dipterocarpus gracilis Blume(Latin, *gracilis* = slender; the twig and petiole)

Bijdr. Fl. Ned. Ind. (1825) 224; Fl. Java 2 (1829) 20; Slooten *op. cit.* (1927) 276, *op. cit.* (1940) 434; Masamune *op. cit.* 486; Symington *op. cit.* (1943) 177; Ashton *op. cit.* (1963) 235, *op. cit.* (1964) 35, *op. cit.* (1968) 15, *op. cit.* (1982) 301; Backer & Bakhuizen *f. op. cit.* 329; Meijer & Wood *op. cit.* 250; Burgess *op. cit.* 100; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 180; Kessler & Sidiyasa *op. cit.* 94; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al.* *op. cit.* 98. **Type:** *Blume 1256* (= RHL Sheet Nos. 902146–113, 114 & 118), Java, G. Parang (holotype L; isotype NY). **Synonyms:** *Dipterocarpus marginatus* Korth., *op. cit.* 64; *D. fulvus* Blume, Mus. Bot. Lugd.-Bat. 2 (1852) 37; *Anisoptera palembanica* Miq., *op. cit.* (1862) 191, 485; *D. bancanus* Burck, Ann. Jard. Bot. Buitenz. 6 (1887) 196; *D. skinneri* King *op. cit.* 91; *D. vanderhoevenii* Koord. & Valetton, Bull. Inst. Bot. Buitenz. 2 (1899) 3; *Shorea mollis* Boerl., Cat. Hort. Bog. 2 (1901) 110. (For other synonyms, cf. Ashton *op. cit.* (1982) 301).

Large emergent tree, to 50 m tall, to 1.5 m diameter; *crown rufous from below*. **Bark** reddish brown, becoming thinly patchily irregularly flaky. *Living exposed parts and ovary more or less densely rufous scabrid-tomentose, persistent except on leaf upper surface and calyx*. **Twigs** c. 3 mm diameter apically. Leaf buds narrowly conical, c. 10 × 3 mm, obtuse. **Stipules** narrowly lanceolate, c. 5 cm long. **Leaves** thinly coriaceous, *not concave*, drying rufous brown; *blade elliptic to ovate, 8–15 × 4–10 cm*, base obtuse, apex shortly acuminate; *lateral veins 12–20 pairs, dense; petiole 2–2.5 cm long, slender*. **Inflorescences** to 9 cm long, terminal or axillary, singly branched. **Flower:** buds c. 2.5 × 0.8 cm; *stamens c. 30*, anthers linear. **Fruits:** calyx glabrescent; *tube globose, c. 2 cm diameter, smooth; 2 major calyx lobes to 14 × 2.5 cm, 3 minor ones ovate, to 2.2 × 1 cm, becoming recurved and revolute*.

Vernacular name. Sabah and Sarawak—*keruing kesat* (preferred name).

Distribution. Andamans and Chittagong to the Philippines and W Java; throughout Borneo but not in the western parts. In Sabah recorded from Beaufort, Keningau, Kinabatangan, Kudat, Lahad Datu, Sandakan, Semporna, Sipitang, and Tawau districts (e.g., *SAN 15094*, *SAN 15510*, *SAN 16347*, *SAN 16406*, and *SAN 19141*) and in Sarawak from Belaga, Kapit, Lawas, Limbang, and Marudi districts (e.g., *S 1694*, *S 13986*, *S 16534*, *S 22260*, and *S 22735*). Also occurring in Brunei (e.g., *BRUN 3226*, *FMS 35591* and *SAN 17116*) and SE Kalimantan (e.g., *bb. 19800*).

Ecology. In mixed and upper dipterocarp forest on humus-rich clay soils, at altitudes to 800 m. Usually rare, as scattered trees, but occasionally locally common, especially on volcanic soils in E Sabah lowlands. Probably endangered.

20. Dipterocarpus grandiflorus (Blanco) Blanco

Plate 2C.

(Latin, *grandis* = large, *florus* = flower; with large flowers)

Fl. Filip. ed. 2 (1845) 314, Fl. Filip. ed. 3, 2 (1878) 218; King *op. cit.* 95; Merrill, Sp. Blancoan. (1918) 268, *op. cit.* (1921) 398, *op. cit.* (1929) 201; Slooten *op. cit.* (1927) 333; Masamune *op. cit.* 486; Symington *op. cit.* (1943) 178; Meijer & Wood *op. cit.* 252; Burgess *op. cit.* 100; Ashton *op. cit.* (1982) 317; PROSEA *op. cit.* (1993) 180; Newman *et al.* *op. cit.* (1998) 99. **Basionym:** *Mocanera grandiflora* Blanco, Fl. Filip. ed. 1 (1837) 451. **Neotype** (designated here); *Merrill Sp. Blancoan. 119* (= *US 903794*), the Philippines, Bataan Province, Luzon, Mt. Lamac (K; US). **Synonyms:** *Dipterocarpus blancoi* Blume *op. cit.* (1852) 35; *Vatica trigyna* Griff., Notul. 4 (1854) 514; *D.*

motleyanus Hook.f., Trans. Linn. Soc. 23 (1860) 159; *D. griffithii* Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 213; *D. pterygocalyx* Scheff., *op. cit.* 347.

Medium-sized, occasionally large, emergent tree, to 45 m tall, to 1.5 m diameter; crown dense, dark, irregular. **Bark** pale greyish to yellowish brown, appearing smooth but becoming irregularly flaky. *Leaf bud, outside of stipules, parts exposed in bud, ovary apex, and sometimes twig densely evenly pale buff-pubescent; parts otherwise glabrous.* **Twigs** terete, to 12 mm diameter apically, stout; internodes short, the leaves clustered round the ends. Leaf buds ovoid, acute, to 20 × 10 mm. **Stipules** oblong-lanceolate, to 18 × 5 cm. **Leaves** thickly coriaceous, hardly corrugated, *glabrous*, drying pinkish brown; blade broadly ovate, 10–18 × 5–12 cm, base obtuse to subcordate, apex with acumen to 1 cm long; *lateral veins 15–17 pairs*, prominent below, spreading; *petiole to 9 cm long, at least 2 mm diameter, stout.* **Inflorescences** to 18 cm long, unbranched, slender, borne in dense groups behind the leaves. **Flowers:** buds to 3.5 × 1.3 cm; *stamens c. 30*, anthers linear-lanceolate, tapering. **Fruits:** pedicel stout; *calyx tube glabrous, ellipsoid, to 7 × 3.5 cm, with 5, to 15 mm wide prominent coriaceous pruinose flanges from base to apex; 2 major calyx lobes to 22 × 3 cm, 3 minor ones elliptic, to 2 × 1.5 cm, subrevolute.*

Vernacular name. Sabah—*keruing belimbing* (preferred name).

Distribution. Andamans, Myanmar, Thailand, Vietnam, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo known only in Sabah and recorded from Kota Kinabalu, Kudat, Lahad Datu, Papar, Sandakan, and Semporna districts (e.g., *SAN 18854*, *SAN 19749*, *SAN 27192*, *SAN A 287*, and *SAN A 1247*).

Ecology. Locally common on dry ridges and low hills, at altitudes below 400 m, within 150 km of the coast; spreading inland, especially on ridges, in drier climates. Vulnerable.

21. *Dipterocarpus hasseltii* Blume

(J.C. van Hasselt, 1797–1823, a Dutch botanist)

Fl. Java 2 (1829) 22; Slooten *op. cit.* (1927) 280, *op. cit.* (1940) 436; Foxworthy *op. cit.* (1932) 67; Masamune *op. cit.* 486; Symington *op. cit.* (1943) 180; Backer & Bakhuizen *f. op. cit.* 329; Meijer & Wood *op. cit.* 255; Ashton *op. cit.* (1978) 8, *op. cit.* (1982) 306; PROSEA *op. cit.* 181; Kessler & Sidiyasa *op. cit.* 94; Newman *et al. op. cit.* 101. **Type:** *van Hasselt s.n.* (= *RHL Sheet Nos. 902146210–211*), Java, Banten, Menes (holotype L). **Synonyms:** *Dipterocarpus quinquegonus* Blume *op. cit.* (1852) 36; *D. balsamiferus* Blume *op. cit.* (1852) 37, Merrill *op. cit.* (1921) 397, Masamune *op. cit.* 485; *D. lampongus* Scheff., *op. cit.* 146; *D. subalpinus* Foxw. in Elmer, Leaflet. Philip. Bot. 6 (1913) 1950. (For other synonyms, cf. Ashton *op. cit.* (1982) 306).

Stately emergent tree, to 55 m tall, to 2 m diameter, with dense hemispherical crown and tall buttresses. **Bark** overall smooth, thinly flaky, greyish brown. *Parts exposed in flower bud and ovary apex buff-pubescent; veins below sparsely so, usually caducous; parts otherwise glabrous.* **Twigs** *c. 4 × 2 mm* apically, somewhat compressed, drying black. *Leaf buds falcate, to 20 × 5 mm, glabrous, drying black.* **Stipules** *lorate-lanceolate, c. 12 × 1 cm, glabrous.* **Leaves** *thinly coriaceous, hardly corrugated, glabrous*, drying dull greyish brown; *blade narrowly elliptic, 9–16 × 5–10 cm*, base cuneate, margin often prominently wavy, apex with acumen to 1 cm long; *lateral veins 11–14 pairs*, slender but prominent below, ascending; *intercostal venation densely regularly scalariform; petiole 2.5–4 cm long, slender.* **Inflorescences** to 10 cm long, axillary, hardly branched. **Flowers:** bud *c. 3 × 1 cm; stamens c. 30*, anthers linear, somewhat tapering. **Fruits:** pedicels to 3 mm long; *calyx tube*

globose, to 3 cm diameter, *smooth*; 2 major calyx lobes to 22×3 cm, 3 minor ones suborbicular, to 1.5×0.3 cm, somewhat revolute.

Vernacular name. Sabah—*keruing kerukup kecil* (preferred name).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, W Java, Nusa Tenggara (Bali Is.), Borneo, and the Philippines. In Borneo recorded from Kinabatangan, Pensiangan, Sandakan, and Tawau districts in Sabah (e.g., *FMS 55342*, *KEP 70522*, *SAN 15517*, *SAN 18464*, and *SAN 23596*) and E Kalimantan (e.g., *Kostermans 4886* and *Kostermans 4956*).

Ecology. In mixed dipterocarp forest on lower slopes and moist (but not swampy) valleys, especially on fertile soils over basic volcanic rock, at altitude to 500 m. Critically endangered owing to forest conversion.

22. *Dipterocarpus humeratus* Slooten

Fig. 7.

(Latin, *humerus* = shoulder; the articulated petiole)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 308; Ashton *op. cit.* (1963) 237, *op. cit.* (1964) 36, *op. cit.* (1968) 15, *op. cit.* (1982) 311; Meijer & Wood *op. cit.* 257; Burgess *op. cit.* 100; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 181; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al.* *op. cit.* 102. **Lectotype** (designated here): *bb. E 1150*, Sumatra, Palembang, Lematang Hilir, near G. Megang (hololectotype BO; isolectotype K).

Emergent tree, to 50 m tall, to 1 m diameter; buttresses to 2 m tall. **Bark** pinkish brown, irregularly flaking. *Young twig, petiole, midrib and vein below cream puberulent; leaf bud and stipule outside shaggily fulvous hispid; ovary and raceme golden-brown pubescent.* **Twigs** *c.* 1 cm diameter apically, stout, becoming thinly flaky. Leaf buds narrowly conical, to 50×15 mm, obtuse. **Stipules** narrowly lanceolate, *c.* 10×2 cm. **Leaves** thickly coriaceous, *corrugated*, drying chocolate-brown, *sparsely pubescent below; blade broadly ovate, $20\text{--}38 \times 12\text{--}23$ cm, base obtuse, apex obtuse to shortly acuminate; lateral veins *c.* 20 pairs, prominent, well-spaced; petiole $4\text{--}6$ cm long, stout, prominently geniculate.* **Inflorescences** to 21 cm long, terminal or axillary, hardly or not branched. **Flowers:** buds *c.* 5×2 cm; stamens *c.* 40, anthers linear, tapering. **Fruits** subsessile; *calyx tube globose, to 4×3.5 cm, with 5 obtuse tubercles distally; 2 major calyx lobes to 18×5 cm, 3 minor ones broadly ovate, to 1.5×1.5 cm, subcordate, with obtuse apex, revolute back to back.*

Vernacular names. Sabah—*keruing kerukup* (preferred name). Sarawak—*keruing latek bukit* (preferred name).

Distribution. Sumatra and Borneo. In Sabah known from Kinabatangan, Ranau, Sandakan, and Tawau districts (e.g., *FMS 48854*, *SAN 15393*, *SAN 18568*, and *SAN A 4142*) and in Sarawak from Lawas, Limbang and Tatau districts (e.g., *BRUN 805*, *S 24955* and *S 30229*). Also occurring in Brunei (e.g., *BRUN 329*, *BRUN 330* and *BRUN 2618*) and SE Kalimantan (e.g., *bb. 26595*).

Ecology. In mixed dipterocarp forest on well-drained clay soils; on low hills in eastern Sabah, and high shale ridges at 200–700 m altitude in Sarawak and Brunei. Occurring in Mulu NP; probably vulnerable elsewhere.

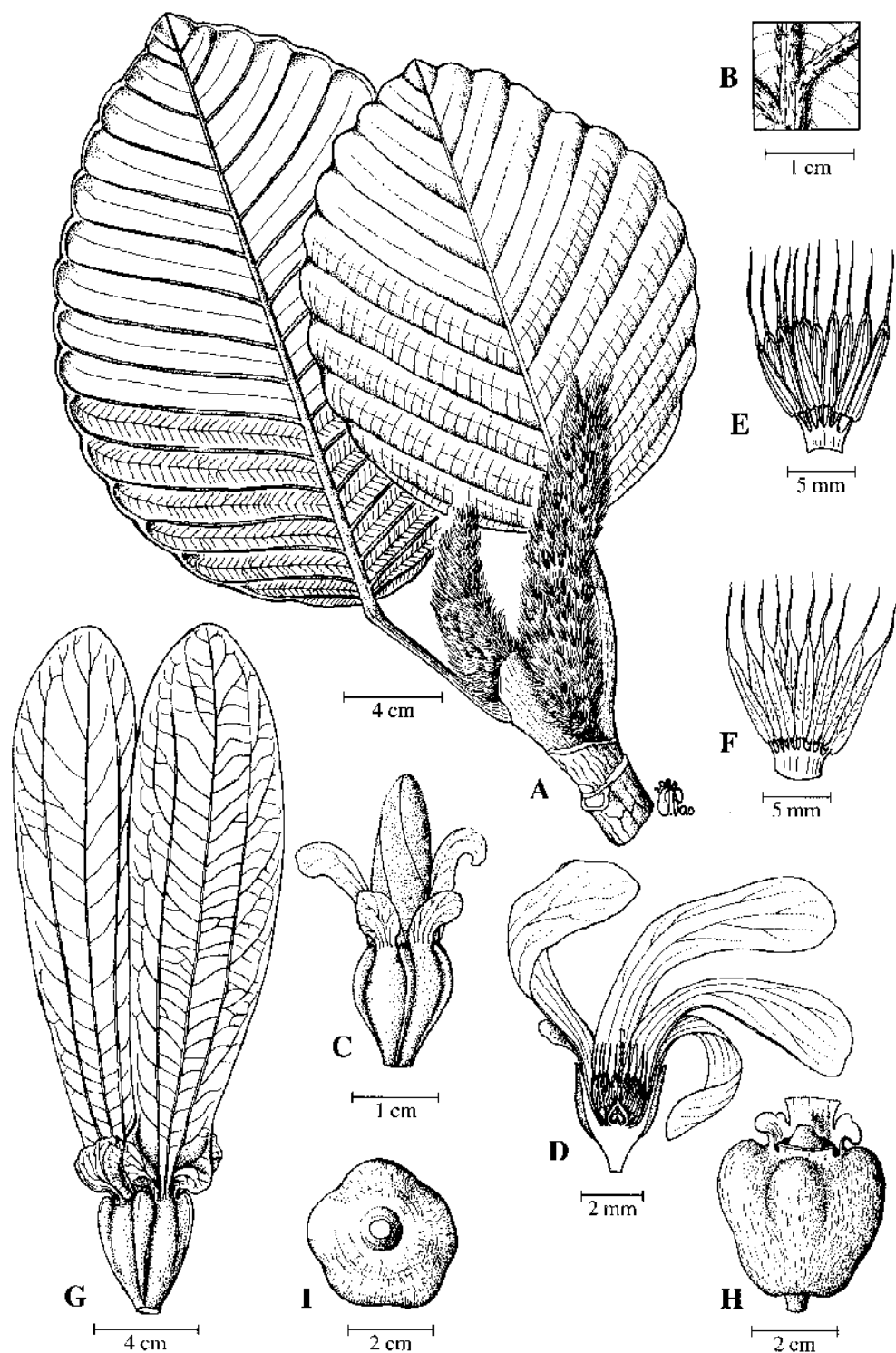


Fig. 7. *Diptercarpus humeratus*. A, leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, longitudinal section of open flower; E, adaxial view of stamens; F, abaxial view of stamens; G, side view of almost mature fruit; H, side view of mature fruit with the larger calyx lobes removed; I, basal view of mature fruit calyx tube. (A–B from *FMS* 48864, C from *SAN* 15393, D–F from *FMS* 38752, G from *SAN* 17327, H–I from *SAN* 31397.)

23. *Dipterocarpus kerrii* King

(A.F.G. Kerr, 1877–1942, introduced western medical practise to Siam, prodigious amateur botanist)

J. As. Soc. Beng. 62, 2 (1893) 93; Ridley *op. cit.* (1922) 215; Slooten *op. cit.* (1927) 295; Foxworthy *op. cit.* (1932) 69; Symington *op. cit.* (1943) 181; Meijer & Wood *op. cit.* 259; Burgess *op. cit.* 101; Ashton *op. cit.* (1982) 305; PROSEA *op. cit.* 182; Newman *et al. op. cit.* 103. **Lectotype** (designated here): *Kerr 7438/7349*, S Thailand, Pattani (hololectotype K). **Synonyms:** *Dipterocarpus obconicus* Foxw. in Elmer *op. cit.* (1913) 1951; *D. perturbanatus* Foxw., *op. cit.* (1918) 177; *D. cuneatus* Foxw., *op. cit.* (1918) 178.

Large emergent tree, to 50 m tall, to 1.2 m diameter; crown dense, compact, dark. **Bark** pale greyish to yellowish brown, thinly irregularly flaky. *Parts of petals exposed in bud, inside of bud scales and stipules, and ovary densely silky cream pubescent; parts otherwise glabrous.* **Twigs** c. 3 mm diameter apically, drying black. *Leaf buds lanceolate-falcate, to 12 × 3 mm, glabrous, drying black.* **Stipules** linear-lanceolate, c. 8 × 0.5 cm. **Leaves** coriaceous, drying dark chocolate-brown, *glabrous below; blade broadly elliptic, 8–13 × 3.3–7 cm, base cuneate, apex with acumen less than 0.5 cm long; lateral veins (7–)9–11 pairs, slender but prominent below, ascending; intercostal venation densely scalariform, very slender, hardly raised; petiole 2–2.8 cm long, slender.* **Inflorescences** to 8 cm long, unbranched or singly branched. **Flowers:** buds c. 2.5 × 1 cm; *stamens c. 30, anthers subauriculate, narrowly deltoid.* **Fruits:** pedicels to 3 mm long, stout; *calyx tube globose to turbinate, to 3.5 cm diameter, smooth; 2 major calyx lobes to 14 × 3 cm, 3 minor ones suborbicular, to 1 × 1 cm, subrevolute.*

Vernacular name. Sabah—*keruing gondol* (preferred name).

Distribution. Andamans, Myanmar, Peninsular Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo only known in the eastern parts of Sabah and recorded from Kinabatangan, Labuk Sugut and Sandakan districts (e.g., *SAN 16247, SAN 16329, SAN 16350, SAN 96959, and SAN 97202*).

Ecology. In mixed dipterocarp forest on well-drained clay soils on low hills, at altitudes to 400 m, near the coast in aseasonal climates. Locally frequent in scattered localities down the east coast of Sabah. Highly vulnerable, possibly endangered.

24. *Dipterocarpus kunstleri* King

(H.H. Kunstler, 1837–1887, King's plant collector in Perak)

J. As. Soc. Beng. 62, 2 (1893) 96; Ridley *op. cit.* (1922) 217; Slooten *op. cit.* (1927) 327; Symington *op. cit.* (1943) 182; Ashton *op. cit.* (1978) 10, *op. cit.* (1982) 309; PROSEA *op. cit.* 182; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al. op. cit.* 104. **Type:** *King's collector 3798*, Peninsular Malaysia, Perak, Larut (holotype K). **Synonyms:** *Dipterocarpus speciosus* Brandis, J. Linn. Soc. Bot. 31 (1895) 38; *D. exalatus* Slooten ex Wood, Gard. Bull. Sing. 17 (1960) 486, Slooten *op. cit.* (1961) 462, Ashton *op. cit.* (1964) 31, *op. cit.* (1968) 14, Meijer & Wood *op. cit.* 246, Burgess *op. cit.* 100, Anderson *op. cit.* (1980) 112.

Main canopy tree, to 40 m tall, to 1 m diameter; bole relatively short. **Bark** pale orange-brown, patchily thinly flaky. *Leaf venation puberulent or glabrous below; leaf buds and stipule outside persistently densely pale grey adpressed puberulent; parts otherwise glabrous.* **Twigs** slender, to 5 mm diameter apically, often slightly ribbed or compressed,

with prominent stipule scars. Leaf buds narrowly falcate, to 15×3.5 mm. **Stipules** linear, to 7×0.8 cm. **Leaves** chartaceous, *glabrous*, drying greyish brown below; blade elliptic to broadly lanceolate, $13\text{--}22 \times 7\text{--}10$ cm, base cuneate, apex shortly acuminate (mature trees); *lateral veins 16–18 pairs*, slender but prominent below, ascending; *petiole 2–3 cm long, slender, to 2 mm diameter*. **Inflorescences** to 22 cm long, singly branched, terminal or axillary. **Flowers:** buds *c.* 3.5×1.5 cm; stamens *c.* 30, anthers narrow, tapering. **Fruits:** *calyx tube* ellipsoid, to 5×2.5 cm, tapering gradually to the base and to the constricted neck, *5-ribbed or almost winged, the ribs c. 7 mm wide and 4 mm thick apically, either confined to the distal half or tapering to the base, terminating apically as obtuse tubercles*; 2 major calyx lobes to 11×1.5 cm, of variable length and sometimes subequal with minor lobes, 3 minor ones to 0.6×0.5 cm, recurved, thickened.

Vernacular names. Sabah—*keruing rapak* (preferred name). Sarawak—*keruing kuntum putih* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo known in Sabah from Beaufort, Kinabatangan, Lahad Datu, Papar, Ranau, Sandakan, Sipitang, and Tawau districts (e.g., *FMS 38783*, *SAN 16037*, *SAN 17177*, *SAN 21273*, *SAN 38149*, and *SAN 97486*) and in Sarawak from Kapit, Lundu, Limbang, Marudi and Miri districts (e.g., *S 1813*, *S 7959*, *S 22330*, *S 23330*, and *S 23351*). Also occurring in Brunei (e.g., *BRUN 138*, *BRUN 298*, *BRUN 903*, and *BRUN 3075*) and E and SE Kalimantan (e.g., *bb. 18424*, *bb. 20644*, *bb. 25609*, *Kostermans 7254*, and *Kostermans 9745*).

Ecology. Locally frequent in mixed dipterocarp forest on leached silty clay soils, mainly in moist valleys and lower hillsides, at altitudes to 400 m. Most abundant in E Sabah, in scattered localities elsewhere. Highly vulnerable though occurring in Bako and Mulu NPs.

25. *Dipterocarpus lamellatus* Hook.f.

(Latin, *lamellatus* = thinly plated; the fruit calyx tube flanges)

Trans. Linn. Soc. 23 (1860) 159; Merrill *op. cit.* (1921) 399; Slooten *op. cit.* (1927) 347; Masamune *op. cit.* 487; Meijer & Wood *op. cit.* 261; Burgess *op. cit.* 101; Ashton *op. cit.* (1982) 312; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al.* *op. cit.* 105. **Type:** *Motley 159*, Borneo, Labuan (holotype K).

Tall emergent tree, to 55 m, to 1.2 m diameter; crown golden from below. *Exposed living parts and ovary persistently yellowish brown scabrid-hirsute, leaf blade and fruit calyx sparsely so; parts otherwise densely scabrid-hirsute*. **Twigs** *terete*, *c.* 4 mm diameter apically. Leaf buds ovoid, to 9×7 mm, acute. **Stipules** lanceolate, *c.* 3×0.8 cm. **Leaves** chartaceous, *boat-shaped and concave*; blade elliptic, $13\text{--}16 \times 6\text{--}9$ cm, base narrowly obtuse, apex with abrupt, slender acumen to 0.8 cm long; *lateral veins 15–17 pairs*, slender but prominent below, shallowly sunken above; intercostal venation distinctly elevated below, evident above; *petiole 3–4 cm long, slender*. **Inflorescences** to 8 cm long, axillary, hardly branched. **Flowers** unknown. **Fruits:** pedicels to 4 mm long, slender; *calyx tube subglobose, to 1.8 cm long including the 5 densely convoluted flanges*; 2 major calyx lobes to 14×2.5 cm, 3 minor ones ovate, to 1.4×0.7 cm, revolute.

Vernacular name. Sabah—*keruing jarang* (preferred name).

Distribution. Endemic in Borneo; known only from Beaufort Hill FR and Labuan, in SW Sabah (e.g., *SAN 16251* and the type) and Ladan Hills, Tutong district in Brunei (e.g., *Wong 1652*).

Ecology. With *Shorea dispar* one of the rarest and most endangered of all dipterocarps. Found in mixed dipterocarp forest on yellow sandy soil on hills, at altitudes below 200 m, within 50 km of the coast. Probably extinct in Sabah due to the loss of its habitat.

26. *Dipterocarpus lowii* Hook.f.

Fig. 8.

(Sir Hugh Low, 1824–1905; Officer of the British East India Company, plant collector)

Trans. Linn. Soc. 23 (1860) 160; Merrill *op. cit.* (1921) 399, *op. cit.* (1929) 201; Slooten *op. cit.* (1927) 433; Masamune *op. cit.* 487; Symington *op. cit.* (1943) 183; Browne *op. cit.* 110; Ashton *op. cit.* (1964) 37, *op. cit.* (1968) 15, *op. cit.* (1982) 313; Meijer & Wood *op. cit.* 261; Burgess *op. cit.* 101; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 182; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al.* *op. cit.* 106. **Type:** *Lowe s.n.*, Borneo, Labuan (holotype K). **Synonym:** *Dipterocarpus undulatus* Vesque *op. cit.* 153.

Large emergent tree, to 55 m tall, to 2 m diameter; crown spreading, rather flat, diffuse, large-leaved; buttresses to 2.5 m tall, prominent. **Bark** chocolate-brown, thinly evenly flaky and vertically cracked. *Twigs, midrib and vein below more or less densely caducously pale golden-yellow pubescent; exposed parts of buds, ovary, stipule outside, and inflorescence persistently so. Twigs to 10 × 3 mm across apically, compressed, stout, with broad swollen stipule scars. Leaf buds conical to falcate, c. 15 × 9 mm, obtuse, pale golden-yellow pubescent. Stipules* deltoid, to 4 × 3 cm. **Leaves** thickly coriaceous, *prominently corrugated, drying pale brown and more or less glabrous below; blade ovate-lanceolate, 15–20 × 6–10 cm, base obtuse to cordate, margin prominently revolute, apex obtuse to narrow-acuminate with an acumen to 0.6 cm long; lateral veins 15–20 pairs, prominent and glabrous below; petiole 1.5–3 cm long, stout. Inflorescences* to 3 cm long, stout, terminal or axillary, simple or singly branched. **Flowers:** buds to 4 × 1.2 cm; stamens *c.* 30, anthers narrowly oblong. **Fruits:** *calyx tube globose, c. 4 × 4 cm, including the 5 intricately convoluted flanges; 2 major calyx lobes to 14 × 3.5 cm, 3 minor ones broadly ovate, to 2 × 2 cm, recurved and concurrent with flanges.*

Vernacular name. Sabah and Sarawak—*keruing sol/shol* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known in Sabah from Beaufort, Kinabatangan, Lahad Datu, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15013*, *SAN 15119*, *SAN 36004*, *SAN 37834*, and *SAN 40611*) and in Sarawak from Baram, Bintulu, Kuching, Lawas, Limbang, and Lundu districts (e.g., *S 1826*, *S 9097*, *S 10068*, *S 16944*, and *S 42981*). Also occurring in Brunei (e.g., *BRUN 3285*, *FMS 35657* and *Wong WKM 1610*) and C, SE and E Kalimantan (e.g., *Argent 9485*, *bb. 18329* and *Meijer 2552*).

Ecology. Local but common where it occurs, in mixed dipterocarp forest on low sedimentary hills on yellow sandy soils, at altitudes to 400 m. In many localities in Sabah and Sarawak, it also occurs on ultrabasic rocks. Locally frequent in Lambir and Mulu NPs, elsewhere vulnerable.

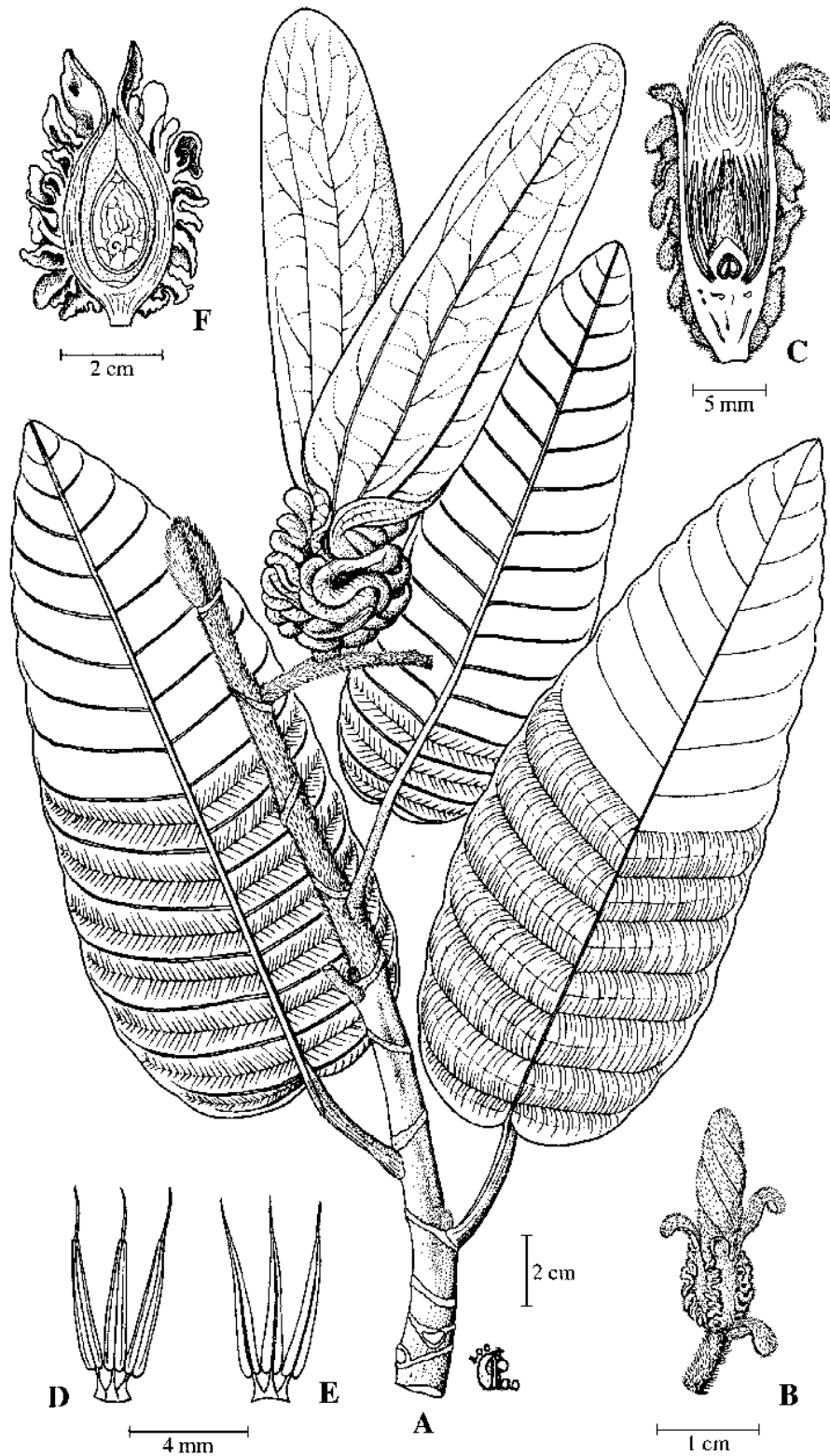


Fig. 8. *Dipterocarpus lowii*. A, fruiting leafy twig; B, flower bud; C, longitudinal section of flower bud; D, adaxial view of stamens; E, abaxial view of stamens; F, longitudinal section of fruit. (A from SAN 40611, B–E from S 10068, F from S 1826.)

27. *Dipterocarpus mundus* Slooten

(Latin, *mundus* = elegant; the neat appearance of the glabrous parts)

Bull. Jard. Bot. Buitenz. 3, 16 (1940) 446; Masamune *op. cit.* 487; Ashton *op. cit.* (1968) 15, *op. cit.* (1982) 319; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 183; Newman *et al. op. cit.* 107. **Lectotype** (here designated): *bb.* 26033, Kalimantan, Melawi, Bt. Ransah, Catit (holotype BO; isolectotype KEP).

Emergent tree, to 50 m tall, to 1 m diameter. *Parts glabrous but for the inner surface of stipules.* **Twigs** 2–3 mm diameter apically, slender. *Leaf buds linear-falcate, to 14 × 3 mm, glabrous outside, drying black.* **Stipules** linear, to 4 × 0.6 cm. **Leaves** thinly coriaceous, drying rich brown below; *blade narrowly elliptic to obovate, 5.5–16 × 2.5–7.5 cm, base narrowly obtuse, apex with tapering acumen to 0.8 cm long; lateral veins 8–10 pairs, slender but prominent below; petiole 1.6–3 cm long, slender.* **Inflorescences** to 6 cm long, axillary, unbranched. **Flowers:** buds to 2 × 0.8 cm; *stamens c. 15, anther narrowly oblong.* **Fruits:** pedicels *c. 3 mm long; calyx tube glabrous, narrowly ellipsoid or narrowly obovoid, to 3 × 1.2 cm, with 5, rigid flanges to 7 mm wide, widest in the distal half; 2 major calyx lobes to 11 × 2.7 cm, 3 minor ones broadly ovoid, to 0.8 × 0.8 cm, obtuse, somewhat recurved.*

Vernacular name. Sarawak—*keruing matang* (preferred name).

Distribution. Endemic in Borneo and known only from the central mountains of the Kapuas and Rajang hinterlands. In Sarawak recorded from Kapit and Miri districts (e.g., Ashton *s.n.*, *S* 19046, *S* 29648, *S* 29649, and *S* 57980). Also occurring in W Kalimantan (e.g., *bb.* 27022, *bb.* 28135 and *bb.* 29650).

Ecology. In Sarawak, scattered in mixed dipterocarp forest in small groups along the narrow sandstone and shale ridges of the Rajang Series, on shallow clay-rich soils, at 400–600 m altitude. Vulnerable.

28. *Dipterocarpus nudus* Vesque

(Latin, *nudus* = naked; the glabrous parts)

C. R. Ac. Sci. Paris, 78 (March 1874) 150; Merrill *op. cit.* (1921) 399; Slooten *op. cit.* (1927) 325; Masamune *op. cit.* 487; Browne *op. cit.* 110; Ashton *op. cit.* (1964) 38, *op. cit.* (1968) 16, *op. cit.* (1982) 320; Anderson *op. cit.* (1980) 113; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al. op. cit.* 108. **Type:** *Beccari PB 2905*, Borneo, Sarawak, G. Matang (holotype P). **Synonym:** *Dipterocarpus pentapterus* Dyer, J. Bot. 12 (April 1874) 106 & 152.

Emergent tree, to 50 m tall, to 1.3 m diameter; bole frequently malformed; crown dark and dense, somewhat flat. **Bark** typical. *Parts glabrous but for the buff-pubescent ovary apex and inner surface of stipules.* **Twigs** 2–3 mm diameter apically, slender. *Leaf buds linear-falcate, 15–30 × 2–3 mm, drying black.* **Stipules** linear, to 6 × 0.5 cm. **Leaves** thinly coriaceous, *hardly corrugated*, drying chocolate-brown below; *blade more or less narrowly elliptic, 11–14 × 4–6 cm, base cuneate or narrowly obtuse, margin undulate and somewhat sinuate distally, apex with slender acumen to 0.6 cm long; lateral veins (8–)11–14 pairs, dense, ascending, slender but prominent below; intercostal venation widely scalariform to subreticulate; petiole 2.5–4.5 cm long, slender.* **Inflorescences** to 18 cm long, terminal or axillary, singly branched, zig-zag. **Flowers:** buds to 4 × 0.9 cm, slender; *stamens c. 15, anther narrowly oblong, tapering.* **Fruits:** *calyx tube glabrous, narrowly ellipsoid to*

spindle-shaped, c. 2.5 × 1 cm, with 5, rigid flanges to 3 mm wide; 2 major calyx lobes to 9.5 × 3 cm, 3 minor ones c. 0.4 × 0.4 cm, obtuse, subrevolute.

Vernacular name. Sarawak—*keruing licin* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Bintulu, Kapit, Kuching, Mukah, Limbang, Lundu, Simunjan, Sri Aman, and Tatau districts (e.g., *S 6501, S 9481, S 9613, S 10303, S 13764, and S 29552*). Also occurring in Brunei (e.g., *BRUN 727, BRUN 773, BRUN 3095, and BRUN 3193*).

Ecology. Widespread but uncommon in mixed dipterocarp forest on hills, at altitudes to 600 m, on yellow sandy soils and on shallow shale derived silty clays. Vulnerable.

Notes. In the western part of its range this species has broader more coriaceous leaves, with narrowly obtuse base and 8–12 pairs of lateral veins (as compared with 12–14 pairs of lateral veins in its eastern range). They differ from one another almost as much as both do from *D. mundus*.

29. *Dipterocarpus oblongifolius* Blume

Plates 2D–F.

(Latin, *oblongus* = rather long, *folius* = leaf; with oblong leaves)

Mus. Bot. Lugd.-Bat. 2 (1852) 36; King *op. cit.* 95; Merrill *op. cit.* (1921) 399; Ridley *op. cit.* (1922) 216; Slooten *op. cit.* (1927) 338; Masamune *op. cit.* 487; Symington *op. cit.* (1943) 184; Browne *op. cit.* 110; Ashton *op. cit.* (1964) 39, *op. cit.* (1968) 16, *op. cit.* (1982) 317; Meijer & Wood *op. cit.* 364; Burgess *op. cit.* 101; Anderson *op. cit.* (1980) 113; PROSEA *op. cit.* 183; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al.* *op. cit.* 109. **Type:** *Korthals s.n.* (= *RHL Sheet Nos. 902146156–159*), Borneo, Kalimantan (holotype L). **Synonyms:** *Dipterocarpus stenopterus* Vesque *op. cit.* 625; *D. pulcherrimus* Ridl., Trans. Linn. Soc. Bot. 3 (1893) 283.

Stout trunked leaning tree, to 30 m tall, to 1.5 m diameter; bole elliptic in cross-section towards base, branching low; crown spreading, with hanging branch endings, dark green shiny leaves and conspicuous apple-red young leafy shoots. **Bark** pale greyish brown, thinly irregularly flaked. *Exposed living parts and ovary, leaf surface and veins above excepted, densely evenly pale cream-yellow pubescent, persistent only on stipule outside, calyx and ovary.* **Twigs** 2–3 mm diameter apically, slender. *Leaf buds linear, c. 20 × 3 mm, compressed, glabrous or densely tomentose, drying yellowish brown or black.* **Stipules** lorate, to 15 × 1.5 cm, obtuse. **Leaves** thinly coriaceous, *glabrous*, drying greyish brown; blade narrowly elliptic to lanceolate, 14–18(–25 in juveniles) × 4–7(–9) cm, base cuneate, apex tapering to 1 cm slender acumen; *lateral veins 16–20 pairs, slender; petiole 1.7–2 cm long, slender.* **Inflorescences** to 18 cm long, terminal or axillary, simple or singly branched. **Flowers:** buds *c. 4 × 1 cm*; stamens *c. 15*, anthers narrowly oblong, tapering. **Fruits:** pedicels to 2 mm long; *calyx tube densely pale buff-pubescent, narrowly ovoid to spindle-shaped, to 3 × 0.9 cm, only slightly constricted at neck, with 5, c. 1 mm wide wavy flanges from base to apex; 2 major calyx lobes to 12 × 1.5 cm, 3 minor ones narrowly deltoid, c. 1 × 0.3 cm, recurved.*

Vernacular names. Sabah—*keruing neram* (preferred name). Sarawak—*ensurai* (Iban), *gansurai* (Iban), *laran* (Kayan).

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo. In Sabah widespread and known from Beaufort, Beluran, Labuk Sugut, Ranau, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 5498*, *SAN 6726*, *SAN 24959*, *SAN 69924*, and *SAN 95397*) and in Sarawak from Belaga, Betong, Bintulu, Kapit, Lawas, Limbang, Marudi, Miri, Song, and Sri Aman districts (e.g., *S 15451*, *S 29568*, *S 56490*, *S 57497*, and *S 64888*). Also occurring in Brunei (e.g., *BRUN 353*, *BRUN 401*, *FMS 39607*, *KEP 80118*, and *Wong WKM 1156*) and Kalimantan (e.g., *bb. 20633*, *Kostermans 12664*, *Mogea 3548*).

Ecology. Gregarious along the banks of white water rivers, on stable soils over bedrock, below flood and above normal river level, at altitudes to 400 m. Frequently flowering and fruiting, the masses of pink calyces a glory of the inland rivers. Occurring in Mulu NP; decimated in many areas outside the park but not yet vulnerable.

30. *Dipterocarpus ochraceus* Meijer

Acta Bot. Neerl. 12 (1963) 351; Meijer & Wood *op. cit.* 26; Burgess *op. cit.* 100; Ashton *op. cit.* (1982) 325; Newman *et al. op. cit.* 110. **Type:** *Meijer SAN 24200*, Borneo, Sabah, Ranau district, Bt. Kulang (holotype K; isotypes KEP, L, SAN).

Medium-sized emergent (large for its habitat) tree, to 45 m tall, to 1.2 m diameter. **Bark** rust-brown, becoming coarsely irregular-flaky. *Young parts densely ochreous velutinous, persistent on buds, stipule outside and twigs; becoming sparse on petiole and venation below; caducous elsewhere.* **Twigs** c. 4 mm diameter apically, stout. *Leaf buds ovoid-lanceolate, to 20 × 8 mm.* **Leaves** coriaceous, corrugated, sparsely pubescent and drying pale yellowish brown below; *blade broadly elliptic-ovate, 10–19 × 4.5–9.5 cm, base cuneate or rarely obtuse, apex acute with acumen to 1.5 cm long; lateral veins 11–15 pairs, slender but prominent below; intercostal venation dense, elevated below; petiole 1.5–2.5 cm long.* **Inflorescences and flowers** unknown. **Fruits:** pedicels to 3 × 2 mm, prominent; *calyx tube glabrescent, broadly ellipsoid, to 1.8 × 1.5 cm, with 5, to 2 mm wide continuous rigid flanges; 2 major lobes to 8 × 1.5 cm, 3 minor ones ovate, to 0.6–3 × 0.6 cm, subrevolute.*

Vernacular name. Sabah—*keruing ranau* (preferred name).

Distribution. Endemic in Borneo; recorded only in Sabah from Bt. Kulung and Bt. Tampurango, Ranau district (e.g., *SAN 20670*, *SAN 22353*, *SAN 22371*, and the type).

Ecology. In scattered groups along ridges in upper dipterocarp forest, at 600–700 m altitude, on the ultrabasic and basic volcanic mountains of the Kinabalu flanks but mainly outside the National Park boundary. Endangered.

31. *Dipterocarpus pachyphyllus* Meijer

(Greek, *pachys* = thick, *phullon* = leaf; with thick leaf texture)

Acta Bot. Neerl. 12 (1963) 351; Meijer & Wood *op. cit.* 265; Burgess *op. cit.* 101; Ashton *op. cit.* (1964) 41, *op. cit.* (1968) 16, *op. cit.* (1982) 313; Anderson *op. cit.* (1980) 113; Coode *et al.* (eds) *op. cit.* 69; Newman *et al. op. cit.* 111. **Lectotype** (designated here): *G.H.S. Wood SAN 15100*, Borneo, Sabah, Padas Gorge (hololectotype K; isolectotypes KEP, L, SAN).

Emergent tree, to 45 m tall, to 1.2 m diameter; crown becoming flat; buttresses to 1 m tall. **Bark** pale chocolate-brown, vertically cracked and evenly flaky. *Young parts at first evenly shortly pale yellowish brown pubescent, fugaceous on all but exposed parts in bud, outside of stipules, ovary apex, and inflorescence.* **Twigs** to 4×2.5 mm apically, compressed, slender, with prominently raised stipule scars. Leaf buds linear-falcate, *c.* 18×4 mm. **Stipules** narrowly deltoid, *c.* 4×1.2 cm. **Leaves** thickly coriaceous, *hardly corrugated, drying yellowish brown and glabrous below*, somewhat shiny; *blade broadly ovate, 9–17 × 5–9* cm, base obtuse to subcordate, *margin hardly revolute*, apex with broad acumen to 1 cm long; *lateral veins 10–12 pairs*, distant, prominent below, coalescing to an indistinct intramarginal vein; *petiole 2–3.4* cm long, to 2 mm diameter, slender, prominently geniculate. **Inflorescences** to 5 cm long, terminal or axillary, simple. **Flowers:** buds to 1.5×0.5 cm; stamens 23–25, anther narrowly oblong. **Fruits:** *calyx pruinose, tube subglobose, to 2.5×2 cm, including the 5 tightly convoluted flanges*; 2 major calyx lobes to 13×3 cm, 3 minor ones broadly deltoid, to 1×1.5 cm, recurved.

Vernacular names. Sabah—*keruing daun tebal* (preferred name). Sarawak—*keruing sol padi* (preferred name).

Distribution. Endemic in Borneo. In Sabah widespread and known from Beaufort, Keningau, Kinabatangan, Lahad Datu, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *KEP 80471*, *SAN 15053*, *SAN 16433*, *SAN 16473*, and *SAN 93675*) and in Sarawak from Bintulu, Kapit, Marudi, Miri and Tatau districts (e.g., *Hotta 15812*, *S 22032*, *S 22043*, and *S 22715*). Also occurring in Brunei (e.g., *BRUN 365* and *S 1671*).

Ecology. Scattered in mixed dipterocarp forest on leached clay soils on low hills and slopes, at altitudes to 400 m. Occurring in Mulu NP, elsewhere vulnerable.

32. *Dipterocarpus palembanicus* Slooten (of Palembang, Sumatra)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 336; Symington *op. cit.* (1943) 185; Ashton *op. cit.* (1968) 16, *op. cit.* (1982) 318; PROSEA *op. cit.* 184; Newman *et al. op. cit.* 113. **Lectotype** (Ashton, 1978): *bb. T.134, Feb. 1924*, Sumatra, Palembang, Lematang Hilir, near G. Megang (holotype BO; isotypes KEP, L).

Emergent tree, to 50 m tall, to 1.2 m diameter; crown compact, dense, hemispherical. **Bark** at first rich orange-brown, becoming irregularly flaky. **Twigs** *terete, 2–3 mm diameter apically*, finely cracked and flaky. *Leaf buds ellipsoid-ovoid or broadly ovoid, c. 7×4 mm*, obtuse, *densely golden- to rust-tomentose*. **Stipules** narrowly hastate, to 3 cm long. **Leaves** *thinly coriaceous*, somewhat corrugated, *drying pinkish brown and glabrous below*; blade elliptic to ovate and $10–14 \times 5–9$ cm, or oblong-ovate and $7–11 \times 3–6$ cm, base obtuse or cuneate, margin sinuate, apex with slender acumen to 2 cm long; *lateral veins 12–14 pairs*, slender but prominent below, rather dense; intercostal venation dense; *petiole 2–3 cm or to 1.5 cm long, to 2 mm diameter*, pubescent. **Inflorescences** to 6 cm long, terminal or axillary, unbranched or singly branched. **Flowers:** buds *c.* 3.5×1.5 cm; *stamens c. 15*, anther linear-tapering. **Fruits:** *calyx glabrous, pruinose, tube narrowly ellipsoid, to 3.5×1.5 or 5.5×2 cm, tapering towards each end, with 5 broad thin flanges from base to apex, obtuse to subcordate at base or the flanges to 15 mm wide, undulate, auriculate at base and apex*; 2 major calyx lobes to 10×3.5 cm, revolute and subcordate at base, 3 minor ones broadly orbicular, to 0.5×1 cm, recurved and with revolute undulate margins.

Vernacular name. Sabah—*keruing palembang* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Singapore and Borneo.

Notes. Two subspecies, *viz.* subsp. *borneensis* and subsp. *palembanicus* are recognised in Borneo.

Key to subspecies

Twigs, leaf buds and stipules outside densely fulvous hispid; petiole, midrib above and leaf blade below densely short-pubescent, caducous on twigs and petiole, otherwise persistent. Leaf blade elliptic to ovate, 10–14 × 5–9 cm; petiole 2–3 cm long. Fruit calyx tube to 3.5 × 1.5 cm, flanges to 8 mm wide, obtuse to subcordate at base.....

subsp. **palembanicus**

As the species. In Borneo recorded from Kuching, Kapit and Miri districts in Sarawak (e.g., *S 22678*, *S 39095*, *S 46438*, *S 46529*, and *S 68426*). Locally frequent along ridges in mixed dipterocarp forest, at altitudes to 600 m. Occurring in Lambir NP, elsewhere vulnerable.

Twigs, petiole, midrib on both sides and lateral veins below densely reddish brown pubescent, caducous on twigs, persistent and long on leaf buds, stipules and petiole. Leaf blade oblong to ovate, 7–11 × 3–6 cm; petiole to 1.5 cm long. Fruit calyx tube to 5.5 × 2 cm, flanges to 15 mm wide, undulate, auriculate at base and apex.....

subsp. **borneensis** P.S. Ashton

(of Borneo)

Gard. Bull. Sing. 31 (1978) 12, *op. cit.* (1982) 319; Anderson *op. cit.* (1980) 113; PROSEA *op. cit.* 184; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al.* *op. cit.* 114. Type: *G.H.S. Wood SAN A 1747*, Borneo, Sabah, Beaufort district (holotype L; isotypes KEP, SAN).

Endemic in Borneo, and recorded from Beaufort, Kinabatangan, Labuk Sugut, Sandakan, and Tawau districts in Sabah (e.g., *SAN 16452*, *SAN 17772*, *SAN 26890*, and *SAN 28102*) and from Belaga, Bintulu and Kapit districts in Sarawak (e.g., *S 14719*, *S 15101*, *S 22204*, *S 23828* and *S 32309*). Also occurring in Brunei (e.g., *BRUN 2617* and *BRUN 5742*), and C and E Kalimantan (e.g., *Wilkie 94310*). In mixed dipterocarp forest on clay-rich soils over sedimentary rocks, on ridges, at altitudes to 600 m. Occurring in Lambir NP, elsewhere vulnerable.

33. *Dipterocarpus rigidus* Ridl.

(Latin, *rigidus* = stiff; the leaf blade)

J. Str. Br. Roy. As. Soc. 82 (1920) 171, *op. cit.* (1922) 217; Slooten *op. cit.* (1927) 347, *op. cit.* (1961) 463; Masamune *op. cit.* 488; Symington *op. cit.* (1943) 186; Browne *op. cit.* 110; Ashton *op. cit.* (1968) 16, *op. cit.* (1982) 310; Anderson *op. cit.* (1980) 113; PROSEA *op. cit.* 185; Newman *et al.* *op. cit.* 114. **Type:** *Foxworthy 1190*, Peninsular Malaysia, Johor, Endau, Sg. Maoung (holotype K).

Large emergent tree, to 50 m tall, to 1 m diameter; crown golden brown from below, dense.

Bark rust-brown, vertically cracked and shallowly patchily flaked. *Twig, petiole, midrib above, blade undersurface, petal outside, and ovary apex shortly densely evenly ochreous-yellow pubescent, blade above fugaceously so; leaf bud and stipule outside longer tomentose; parts otherwise glabrous.* **Twigs** c. 8 mm diameter apically, stout. Leaf buds conical, to 15 × 8 mm, acute. **Stipules** lorate, c. 7 × 1 cm. **Leaves** thickly coriaceous, corrugated; *blade ovate, 13–25 × 8–16 cm, base broadly cuneate, apex with broad acumen*

to 1 cm long; *lateral veins 12–16 pairs*, with midrib stoutly prominent below, somewhat sunken above; *petiole 3–6 cm long*. **Inflorescences** to 15 cm long, glabrescent, usually unbranched. **Flowers:** buds *c.* 3.5 × 1 cm; stamens *c.* 24, anthers linear-tapering. **Fruits:** pedicels *c.* 10 mm long, stout; *calyx tube subglobose, to 5 × 4.5 cm, with 5 distal tubercles becoming obscure at maturity*; 2 major calyx lobes to 18 × 5 cm, 3 minor ones suborbicular, to 0.8 × 0.8 cm, revolute.

Vernacular name. Sarawak—*keruing utap* (preferred name).

Distribution. Sumatra (including Riau and Lingga Archipelagoes), Peninsular Malaysia, Anambas Archipelago, and Borneo. In Sarawak known from Bintulu, Kuching, Lawas, and Lundu districts (e.g., *S 10063, S 15826, S 22056, S 27192, and S 42985*). Also occurring in C and W Kalimantan (e.g., *bb. 27741 and Yamada K 9536*).

Ecology. In Sarawak, locally common and confined to mixed dipterocarp forest on yellow sandy soils, on low hills not far from the coast. Endangered by forest conversion though present in Bako NP.

Notes. Specimens of juvenile trees of *D. costulatus* and *D. globosus* are sometimes tomentose and difficult to distinguish from those of this species.

34. *Dipterocarpus sarawakensis* F.G. Browne *ex* Slooten (of Sarawak)

Fig. 9.

Reinwardtia 5 (1961) 465; Ashton *op. cit.* (1964) 43, *op. cit.* (1968) 17, *op. cit.* (1982) 323; Anderson *op. cit.* (1980) 69; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al.* *op. cit.* 116. **Type:** Mead S 5, Borneo, Sarawak, Kuching district, Semengoh FR (holotype KEP).

Large emergent tree, to 55 m tall, to 1.2 m diameter; crown hemispherical, with the old leaves turning coppery red before falling. **Bark** orange-brown, irregularly flaked. *Twigs, parts exposed in bud, stipule outside, inflorescence, ovary apex, midrib on both surfaces, and venation below densely persistently golden-brown scabrid-tomentose; lateral veins above and intercostal venation below sparsely so; blade margin setose.* **Twigs** *c.* 3 mm diameter apically. Leaf buds ovoid, *c.* 8 × 3 mm, acute. **Stipules** narrowly ovate, *c.* 1.5 cm long. **Leaves** thinly coriaceous; *blade broadly obovate, 5.5–8 × 3.5–5 cm, flat, margin straight and revolute towards the cuneate base, sinuate towards the obtuse or retuse apex; lateral veins 7–8 pairs, distant, ascending; petiole 0.7–1 cm, stout.* **Inflorescences** to 7 cm long, unbranched or singly branched. **Flowers:** buds to 2.5 × 1.5 cm; *stamens c. 15*, anthers narrowly oblong, relatively short, stout. **Fruits** subsessile; *calyx glabrescent; tube spindle-shaped, to 2.5 × 1.3 cm, broadest towards base, tapering towards the ends, with 5 papery flanges to 8 mm wide distally, tapering to the base or somewhat above it, tapering abruptly apically and running into lobes*; 2 major calyx lobes to 9 × 2 cm, 3 minor ones narrowly ovate, to 1.5 × 0.5 cm, acute, revolute.

Vernacular name. Sarawak—*keruing layang* (preferred name).

Distribution. Peninsular Malaysia (East coast, one record) and Borneo. In Sarawak recorded from Bintulu, Kuching, Lundu, and Mukah districts (e.g., *S 9770*, *S 13713*, *S 18097*, *S 23749*, and *S 27194*). Also occurring in Brunei (e.g., *BRUN 928*, *BRUN 5154* and *FMS 37090*) and C Kalimantan.

Ecology. Scattered in mixed dipterocarp forest, rarely frequent in isolated localities on leached sandy and sandy clay soils, on low hills, at altitudes to 400 m. Recorded from Mulu NP but vulnerable, perhaps endangered elsewhere.

35. *Dipterocarpus stellatus* Vesque

(Latin, *stellatus* = star-like; the stellate hairs)

C. R. Ac. Sci. Paris, 78 (March 1874) 626; Merrill *op. cit.* (1921) 400; Slooten *op. cit.* (1927) 335, *op. cit.* (1961) 465; Masamune *op. cit.* 488; Browne *op. cit.* 111; Ashton *op. cit.* (1963) 239, *op. cit.* (1968) 17, *op. cit.* (1982) 323; Anderson *op. cit.* (1980) 113; Newman *et al. op. cit.* 118. **Lectotype** (designated here): *Beccari PB 2555/2907*, Borneo, Sarawak, Matang (hololectotype P). **Synonym:** *Dipterocarpus nobilis* Dyer, J. Bot. 12 (April 1874) 106.

Emergent tree, to 65 m tall, to 1 m diameter; *crown somewhat flat, diffuse*; buttresses to 1.5 m tall. **Bark** rich pinkish brown, appearing smooth, with irregular somewhat curled thin flakes. *Young twig, leaf bud, stipule outside, midrib on both surfaces, and petiole densely persistently long tufted rust-brown scabrid-tomentose, venation below sparsely so.* **Twigs** 2–7 mm diameter apically, ribbed and cracked, with prominent petiole scars. Leaf buds spherical, *c.* 7 × 5 mm. **Stipules** deltoid, *c.* 2 × 0.8 cm. **Leaves** thinly coriaceous, *not concave*; *blade ovate*, 10–25 × 5–16 cm, base cordate or obtuse, *margin not revolute, apex with tapering acumen 0.8–1.4 cm long; lateral veins 12–16 pairs, well-spaced; petiole 2–5 cm long.* **Inflorescences** 10–20 cm long, axillary, unbranched or singly branched. **Flowers:** buds to 6 × 2 cm; stamens *c.* 30; anther linear-tapering. **Fruits** sessile or on short stout pedicels; calyx pruinose, *tube glabrous, obturbinate, to 5 × 2 cm*, with the nut enclosed in the distal half and the base a slender cylinder, *with 5, to 12 mm wide thin undulate flanges from base to apex and concurrent with lobes*; 2 major calyx lobes to 12 × 3 cm, 3 minor ones deltoid, *c.* 1 × 1 cm, with undulate revolute margin.

Vernacular names. Sabah—*keruing bulu* (preferred name). Sarawak—*keruing gunung* (preferred name).

Distribution. Endemic in the northern parts of Borneo.

Notes. Two subspecies, *viz.* subsp. *parvus* and subsp. *stellatus*, are recognised.

Key to subspecies

Twigs to 7 mm diameter apically. Leaf blade 20–25 × 12–16 cm, base cordate, apex with acumen to 1.4 cm long; petiole 2–5 cm long. Inflorescences to 20 cm long.....

subsp. **stellatus**

In Sarawak recorded from Kuching, Lundu and Serian districts (e.g., *S 7992*, *S 8946*, *S 10182*, and *S 15383*). Also occurring in W Kalimantan (e.g., *Church et al. 1808* and

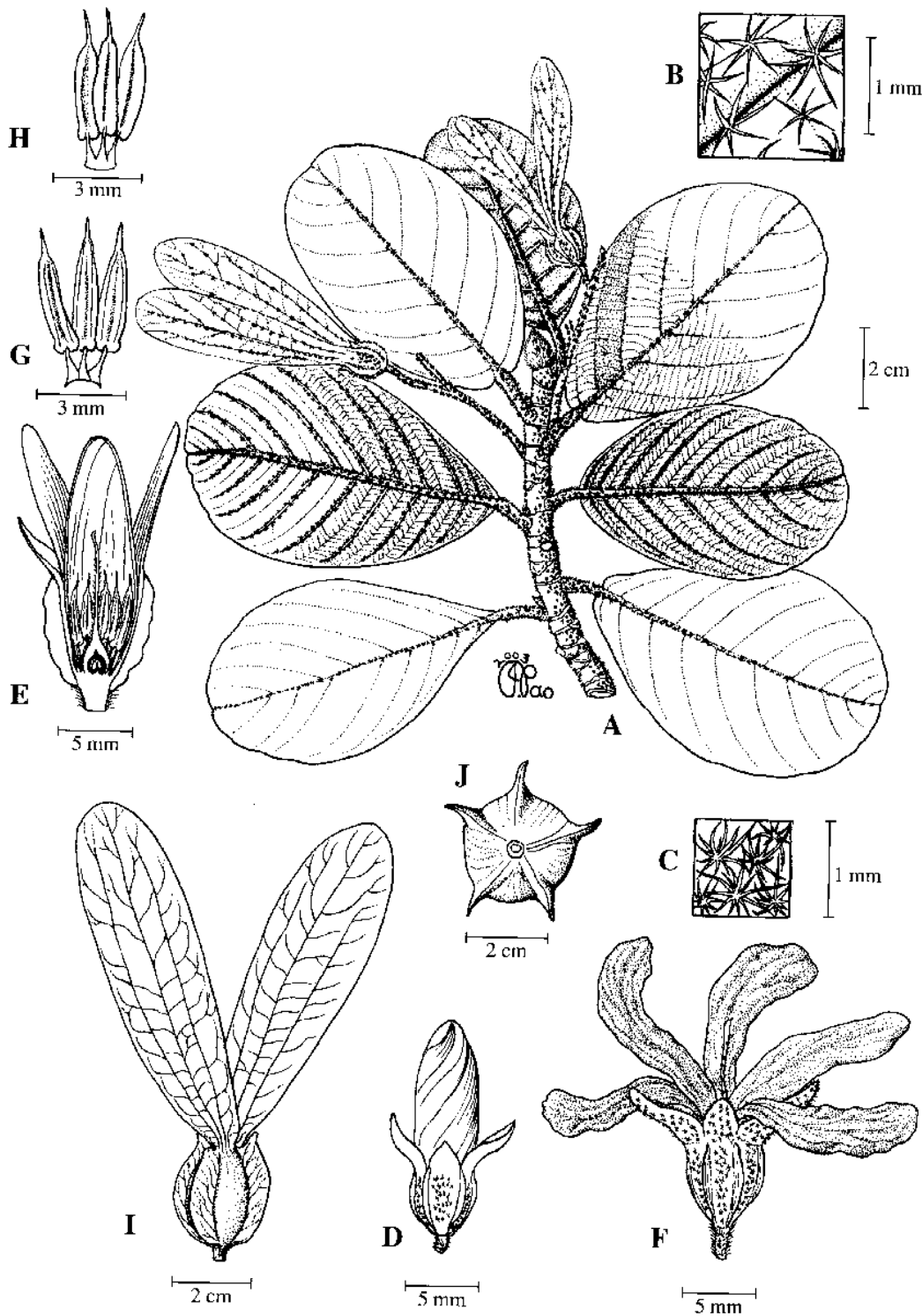


Fig. 9. *Diptercarpus sarawakensis*. A, fruiting (young) leafy twig; B, detail of indumentum on lower leaf surface; C, indumentum on leaf bud, inflorescence and young fruit; D, flower bud; E, longitudinal section of flower bud; F, open flower; G, adaxial view of stamens; H, abaxial view of stamens; I, mature fruit; J, basal view of mature fruit calyx tube. (A–C from SA 1288, D–H from S 23749, I–J from BRUN 5154.)

Church et al. 1814). Locally common in hill mixed dipterocarp and upper dipterocarp forests on sandy clay soils derived from sandstone and siliceous acid igneous rocks, at altitudes to 800 m. Recorded from G. Gading and Kubah NPs; probably not vulnerable. Twigs to 2 mm diameter apically. Leaf blade 10–15 × 5–7 cm, base obtuse, apex with acumen to 0.8 cm long; petiole at most 2 cm long. Inflorescences to 10 cm long.....

subsp. **parvus** P.S.Ashton

(Latin *parvus* = small; the vegetative and reproductive parts)

Gard. Bull. Sing. 20 (1963) 239, *op. cit.* (1964) 45, *op. cit.* (1968) 17, *op. cit.* (1982) 323; Meijer & Wood *op. cit.* 268; Burgess *op. cit.* 101; Anderson *op. cit.* (1980) 113; Coode *et al.* (eds.) *op. cit.* 70; Newman *et al.* *op. cit.* 119. Type: *Ashton BRUN 3176*, Borneo, Brunei, Bangar (holotype K; isotype KEP).

Recorded from Beaufort, Kinabatangan, Sandakan, Sipitang, and Tawau districts in Sabah (e.g., *SAN 15131*, *SAN 15403*, *SAN 24837*, and *SAN A 3126*) and from Belaga, Bintulu, Marudi and Miri districts in Sarawak (e.g., *S 3016* and *S 22057*). Also occurring in Brunei (e.g., *BRUN 3008* and *BRUN 3138*) and E Kalimantan (e.g., *Ambriansyah & Arifin Berau 1061*, *Ambriansyah & Arifin Berau 1089*, *Kessler et al. Berau 690*, and *Kessler et al. Berau 749*). Scattered in mixed dipterocarp forest, on ridges and undulating land, on clay soils derived from shale and acid volcanic rocks, at altitudes to 700 m. Occurring in Lambir and Mulu NPs but vulnerable and possibly endangered elsewhere.

36. *Dipterocarpus sublamellatus* Foxw.

(Latin, *sub* = somewhat, *lamellatus* = layered; the flanges of the fruit calyx tube)

Malay. For. Rec. 10 (1932) 92; Slooten *op. cit.* (1941) 108; Symington *op. cit.* (1943) 189; Meijer & Wood *op. cit.* 269; Ashton *op. cit.* (1968) 17, *op. cit.* (1982) 322; Anderson *op. cit.* (1980) 113; PROSEA *op. cit.* 185; Newman *et al.* *op. cit.* 119. **Type:** *Watson KEP 6061*, Peninsular Malaysia, Johor, Kluang-Mersing Road (holotype KEP).

Large emergent tree, to 70 m tall, to 3 m diameter; buttresses to 3 m tall and out. **Bark** dark orange-brown, thickly patchily flaky. *Leaf bud and stipule outside densely long pale fulvous hirsute* (rarely glabrous), *ovary shortly so, venation below sparsely caducously so; parts otherwise glabrous*. **Twigs** terete, c. 3 mm diameter apically, dark with prominent pale stipule scars. *Leaf buds ellipsoid-ovoid*, to 12 × 8 mm, subacute. **Stipules** lorate, to 4 × 0.8 cm, acute. **Leaves** coriaceous, corrugated, *drying chocolate-brown and glabrous below*; blade ovate to elliptic (young trees), 5–15 × 3.5–8 cm, base broadly cuneate, apex with short, slender acumen; *lateral veins 8–12 pairs*, ascending, prominent below; *petiole 1.5(–3) cm long, to 2 mm diameter, slender*. **Inflorescence:** axillary; rachis to 5 cm long, hardly or not branched, somewhat compressed, few-flowered. **Flowers:** buds to 3.5 × 1 cm; stamens c. 24, anther linear-tapering. **Fruits** sessile; *calyx tube glabrescent, globose, to 3 × 3 cm, with 5, to 15 mm wide thickened but undulate flanges tapering into the lobes and auriculate at base*; 2 major calyx lobes to 12 × 3 cm, 2 minor ones suborbicular, to 0.5 × 0.7 cm, revolute.

Vernacular name. Sabah and Sarawak—*keruing kerut* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo recorded in Sabah from Sebatik Is., Tawau district (e.g., *SAN 19627*) and in Sarawak from Bintulu, Kapit and Kuching districts (e.g., *S 6539*, *S 6542*, *S 18428*, and *Sinclair 10296*). Also occurring in Kalimantan (e.g., *Argent 94109*, *Suzuki K 9745* and *Wilkie 94314*).

Ecology. Locally common, on low hills but mostly on periodically flooded sandy clay alluvium, sometimes with shallow peat, at altitudes below 400 m. Vulnerable owing to land conversion.

37. *Dipterocarpus tempehes* Slooten

(*tempehes* = a local name in E Kalimantan)

Reinwardtia 5 (1961) 468; Meijer & Wood *op. cit.* 270; Burgess *op. cit.* 101; Ashton *op. cit.* (1968) 18, *op. cit.* (1982) 297; Anderson *op. cit.* (1980) 113; PROSEA *op. cit.* 185; Kessler & Sidiyasa *op. cit.* 95; Newman *et al. op. cit.* 120. **Type:** *Rutten 126*, Borneo, Kalimantan, Bulungan, Sg. Sajau (holotype U).

Main canopy, occasionally low emergent tree, to 45 m tall, to 1.2 m diameter; buttresses to 2 m tall, 3 m out. **Bark** yellowish brown and dark greenish brown, thinly irregularly flaking. *Twig, parts exposed in leaf bud, outside of stipules and petals, raceme, ovary apex, and petiole shortly densely persistently pale buff-puberulent; leaf venation below and stipule inside sparsely so; venation above caducously so.* **Twigs** terete, 2–4 mm diameter apically, slender, stipule scars darker than twig. *Leaf buds falcate*, to 12 × 3 mm. **Stipules** lorate, to 8 × 1.2 cm. **Leaves** thickly coriaceous, *corrugated*, drying warm rust-brown, *sparsely pubescent or glabrous below; blade broadly elliptic to obovate*, 6–12 × 3.5–8 cm, base broadly cuneate, *apex acute to shortly abruptly acuminate; lateral veins 9–12 pairs*, ascending, prominent below; *petiole 1–2 cm long*, to 2 mm diameter. **Inflorescences** to 2.5 cm long, axillary, unbranched. **Flowers:** buds to 3 × 0.8 cm; *stamens c. 30*, anthers narrowly oblong, tapering. **Fruits** subsessile; calyx glabrous; *tube turbinate*, to 4 × 4 cm, lenticellate, *smooth, with 5 vestigial lobes round the protruding nut apex*.

Vernacular names. Sabah—*keruing asam* (preferred name). Sarawak—*keruing tempayan* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Labuk Sugut, Lahad Datu, Sandakan, and Tawau districts (e.g., *SAN 17792*, *SAN 17794* and *SAN 37891*) and in Sarawak from Bintulu, Kuching, Lawas, and Lundu districts (e.g., *S 14583*, *S 15823*, *S 16580*, *SA 554*, and *SA 659*). Also occurring in S and E Kalimantan (e.g., *Argent & Amiril 93104*, *bb. 10543*, *bb. 17840*, *Kostermans 5274*, and *Kostermans 6211*).

Ecology. Local, but where occurring often common, on clay-rich periodically flooded alluvium, at altitudes below 300 m. Vulnerable, possibly endangered by forest conversion.

38. *Dipterocarpus validus* Blume

(Latin, *validus* = mighty; a big tree)

Mus. Bot. Lugd.-Bat. 2 (1852) 36; Merrill *op. cit.* (1921) 400; Slooten *op. cit.* (1927) 272; Masamune *op. cit.* 488; Ashton *op. cit.* (1963) 237, *op. cit.* (1982) 301; PROSEA *op. cit.* 185; Newman *et al. op. cit.* 122. **Type:** *Korthals s.n.*, Borneo, Kalimantan, G. Sakumbang (holotype L). **Synonyms:** *Dipterocarpus warburgii* Brandis *op. cit.* 32, Slooten *op. cit.* (1927) 305, *op. cit.* (1961) 473, Meijer & Wood *op. cit.* 273, Burgess *op. cit.* 101; *D. affinis* Brandis *op. cit.* 31; *D. lasiopodus* Perkins, *Fragm. Fl. Philip.* (1904) 22; *D. woodii* Merr., *op. cit.* (1926) 399, Slooten *op. cit.* (1927) 303.

Emergent tree, to 50 m tall, to 1.8 m diameter; crown rather flat, diffuse, large-leaved; buttresses to 2.5 m tall. *Twig, leaf bud, stipule outside, petiole, base of inflorescence, and ovary apex densely persistently evenly long rufous-tomentose, becoming distinctly tufted as the twig and petiole expand; lateral veins and midrib below, and rest of inflorescence sparsely puberulent. Twigs terete, c. 8 mm diameter apically, rather stout.* Leaf buds lanceolate-falcate, to 90×13 mm. **Stipules** lorate, to 20×3 cm. **Leaves** thinly coriaceous, corrugated, *drying warm brown and glabrous below; blade elliptic-oblong to ovate, 15–25 × 7.5–12 cm (to 40×20 cm in juveniles), base cuneate to obtuse (narrowly peltate in young trees), margin undulate, prominently sinuate distally, apex acute to narrowly acuminate with acumen to 1 cm long; midrib elevated above; lateral veins 22–28 pairs, slender but prominent below, dense, shallowly sunken above; petiole 3.5–5 cm long, at least 2 mm diameter, stout.* **Inflorescences** to 14 cm long, hardly or not branched, axillary. **Flowers:** buds to 3×0.9 cm; *stamens c. 30*, anthers slender, tapering, auriculate. **Fruits:** *calyx tube turbinate and tapering into pedicel, to 4×3.5 cm, smooth; 2 major calyx lobes to 25×3.5 cm, 3 minor ones suborbicular, to 0.8×0.6 cm, becoming recurved and revolute.*

Vernacular name. Sabah—*keruing kosugoi* (preferred name).

Distribution. Borneo and the Philippines. In Borneo recorded from Kuala Penyu, Kudat, Kinabatangan, Lahad Datu, Ranau, Tawau, and Tenom districts in Sabah (e.g., *SAN 16402*, *SAN 19551*, *SAN A 2140*, *SAN A 2492*, and *SAN A 4224*) and SE and E Kalimantan (e.g., *bb. 19783* and *Kostermans 6775*).

Ecology. Locally abundant, sometimes gregarious, in lower floodplains behind the mangrove, and near river banks further inland; occasional on low hills on clay-rich soils, at altitudes to 200 m. Endangered by forest conversion.

39. *Dipterocarpus verrucosus* Foxw. ex Slooten

(Latin, *verrucosus* = warty; the lenticellate fruit calyx tube)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 293; Merrill *op. cit.* (1929) 201; Foxworthy *op. cit.* (1932) 71; Masamune *op. cit.* 488; Symington *op. cit.* (1943) 31; Browne *op. cit.* 111; Ashton *op. cit.* (1964) 46, *op. cit.* (1968) 19; Meijer & Wood *op. cit.* 272; Burgess *op. cit.* 101; Anderson *op. cit.* (1980) 113; PROSEA *op. cit.* 186; Coode *et al.* (eds.) *op. cit.* 70; Newman *et al.* *op. cit.* 123. **Lectotype** (designated here): *Mitchell CF 0313*, Peninsular Malaysia, Selangor, Kajang, Bangi FR (hololectotype KEP; isolectotypes K, L).

Large emergent tree, to 60 m tall, to 1.5 m diameter; crown compact, hemispherical. **Bark** orange-brown, thinly irregularly flaking. *Twig, petiole, midrib and vein below, and flower calyx densely caducously adpressed golden-brown lustrous puberulent; leaf bud and inflorescence densely, stipule sparsely, persistently so. Twigs c. 2 mm diameter apically, terete or slightly compressed, stipule scars somewhat swollen. Leaf buds falcate or occasionally conical, to 12×3 mm, with terminal tuft. Stipules narrowly oblong, to 8×0.8 cm, obtuse. Leaves coriaceous, glabrous, almost flat, drying distinctive pinkish red below and slightly glazed; blade broadly elliptic-ovate, $6–12 \times 3.5–6$ cm, base cuneate, apex subacute to broadly acuminate with acumen to 0.5 cm long; lateral veins 9–14 pairs, well-spaced, not prominent; intercostal venation well-spaced, somewhat sinuate; petiole 1.3–2 cm long, to 2 mm diameter. Inflorescences to 9 cm long, axillary, unbranched or singly branched. Flowers: buds to 2.5×1.2 cm; *stamens c. 15*, anthers filiform-tapering. Fruits subsessile; calyx tube ellipsoid-globose, tapering at base, $1.5–1.8 \times 0.6–0.8$ cm, verrucose-lenticellate; 2 major calyx lobes to 8×1.5 cm, 3 minor ones deltoid, to 0.3 cm long, acute.*

Vernacular name. Sabah and Sarawak—*keruing merah* (preferred name).

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo. In Sabah known from Lahad Datu, Semporna, Sipitang and Tawau districts (e.g., *SAN 15197*, *SAN 17175*, *SAN 18466*, *SAN 43697*, and *SAN 129564*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Lawas, Limbang, Lundu, Miri, Semarahan, Serian, and Sri Aman districts (e.g., *S 14454*, *S 20291*, *S 22325*, *S 67568*, and *S 76735*). Also occurring in Brunei (e.g., *BRUN 3388* and *BRUN 5743*) and W, C and E Kalimantan (e.g., *Kostermans 13277* and *Wilkie 94305*).

Ecology. A species of shale and volcanic ridges and low hills, at altitudes below 800 m. Curiously rare, even missing in most parts of Borneo but locally common along the high ridges of the Limbang (Sarawak), southernmost Crocker Range (Sabah), and Amo district (Brunei). Occurring in Mulu NP but vulnerable.

4. **DRYOBALANOPS** Gaertn.f.

(Greek, *dryas* = a nymph associated with oaks, *balanops* = acorn; the acorn-like nut)

kapur (preferred name)

Fruct. 3 (1805) 49; Foxworthy, Malay. For. Rec. 10 (1932) 103; Slooten, Bull. Jard. Bot. Buitenz. 3, 12 (1932) 1; Symington, Malay. For. Rec. 16 (1943) 191; Wyatt-Smith, Malay. For. 18 (1955) 145; Browne, FTSB (1955) 111; Ashton, MDB (1964) 48, MDBS (1968) 20, FM 1, 9 (1982) 371; Meijer & Wood, Sabah For. Rec. 5 (1964) 276; Burgess, TBS (1966) 117; Anderson, CLTS (1980) 114; PROSEA, 1 (1993) 186; Coode *et al.* (eds.), CLBD (1996) 70; Newman *et al.*, MDFD-MHHW (1998) 125. **Synonyms:** *Pterygium* Correa, Ann. Mus. Nat. Hist. Paris 8 (1806) 397, *p.p.*; *Baillonodendron* F.Heim, Bull. Mens. Soc. Linn. Paris 2 (1890) 867.

Very large emergent trees (except *D. keithii*) with immense cauliflower-shaped crowns, the minor branches numerous, the twigs bunched; buttresses narrowly rounded, often large hardly branching plank. **Bark** yellowish brown, becoming irregularly flaky, sometimes shaggy; inner bark pale brown, uniform, finely fibrous. **Sapwood** pale yellowish brown, darkening gradually toward heartwood. *Parts smelling more or less intensely aromatic of camphor.* Leaf buds small, ovoid, more or less compressed. **Twigs** slender, more or less ribbed owing to the decurrent leaf traces. **Stipules** linear, small, early caducous. **Leaves** coriaceous; blade lanceolate, ovate or oblong, apex prominently slender-acuminate; midrib obscurely sunken above, slender but prominent below; *lateral veins very many, very slender and parallel, almost straight, fusing into a straight intramarginal vein at or close to the margin, equal and without intermediates* (*D. keithii*, *D. oblongifolia* excepted), *unraised* (*D. keithii* excepted); *intercostal venation obscure* (*D. keithii* excepted); *petiole slender, channelled above, not geniculate.* **Inflorescences** *paniculate*, terminal or axillary, lax, few-flowered; bracts and bracteoles minute, fugaceous. **Flowers:** *buds spindle-shaped*, ellipsoid, lanceolate or ovoid, acute or obtuse; sepals equal or subequal, imbricate, united at base into an obconical tube tapering into pedicel; *petals white or cream*, broadly elliptic, subacute, *glabrous, hardly contorted in bud, connate at base and falling more or less in a rosette;* *stamens c. 30* (c. 40 in *D. oblongifolia*), *glabrous, subequal or unequal, epipetalous, filaments broad and compressed, connate at base, broad at base, tapering and filiform distally, anthers bright yellow, large, linear, latrorse, connectival appendage small, stout, slightly or hardly exceeding the length of anthers;* ovary small, ovoid, glabrous, *without stylopodium, style filiform, to 3x the length of ovary, stigma minute.* **Fruits:** *calyx with*

incrassate basal cup partially enclosing but free from the nut, 5 lobes equal to subequal, becoming valvate, obtuse, short or wing-like, subrotate. Nuts large, with short apiculate style remnant; pericarp woody, thin, splitting into 3 equal valves at germination; cotyledons reniform, epigeal, on long slender hypocotyl; first two pairs of leaves opposite with short intervening internode. Saplings of Massart's model, that is with more or less horizontal, that is plagiotropic, branches with distichous leaf arrangement clustered in false whorls owing to intermittent growth of the vertical leader (compare, e.g., with *Diospyros*).

Distribution. Confined to W Malesia; seven species in Sumatra, Peninsular Malaysia and Borneo; all occurring in Sabah and Sarawak.

Ecology. Frequently characteristically semi-gregarious, among the most abundant species of the emergent canopy trees, dominating the skyline of the forests they inhabit (*D. keithii* excepted). In mixed dipterocarp, *kerangas* and coastal mixed peat swamp forests on a variety of soils, at altitudes below 800 m. The species flower more frequently than other dipterocarps, and their saplings are generally abundant below parent trees. They are both relatively shade tolerant and relatively fast growing in response to light; characteristics which may help explain the frequent abundance of mature trees.

Uses. The timber, which differs in density and strength between species, is an important moderately heavy and durable construction timber. The camphor obtained from the wood of *D. aromatica* attracted early Arab traders, then being worth more than its weight in gold in the Middle East and used for incense and perfume.

Key to *Dryobalanops* species
(based on all diagnostic characters)

1. Fruit calyx lobes shorter than the nut.....**6. D. oblongifolia** (subsp. **oblongifolia**)
Fruit calyx lobes spatulate or oblong-spatulate, longer than the nut.....2
2. Leaf blade usually longer than 14 cm; lateral veins distinctly unequal, raised below, obscure and sunken above; margin revolute throughout.....**4. D. keithii**
Leaf blade shorter than 12 cm; lateral veins subequal, unraised or hardly so below, not sunken above; margin only partially or not revolute.....3
3. Fruit calyx lobes 0.8–2 cm wide; calyx base fused into a cup to 2 cm diameter and at least 0.5 cm deep.....4
Fruit calyx lobes to 1.3 cm wide; calyx base fused into a cup not more than 0.8 cm diameter nor deeper than 0.5 cm.....5
4. Leaf blade narrowly lanceolate, margin revolute at base.....**5. D. lanceolata**
Leaf blade broadly ovate, not revolute at base.....**1. D. aromatica**
5. Leaf blade 5–8 × 1–3 cm, glabrous.....**2. D. beccarii**
Leaf blade 5–11 × 2–4 cm, more or less tomentose below.....6

6. Tomentum persistent, even, dark golden-brown. Style 3–4x the length of ovary. Nuts ellipsoid-ovoid, to 2 × 1.3 cm.....**3. D. fusca**
 Tomentum more or less caducous, flocculent, rufous. Style 2x the length of ovary. Nuts ovoid, to 1 × 0.6 cm.....**7. D. rappa**

Key to *Dryobalanops* species

(based on field characters)

1. Leaf lateral veins unequal, distinctly raised below, sunken above; leaf margin narrowly revolute throughout. In forest on clay soils in moist valleys.....**4. D. keithii**
 Leaf lateral veins subequal, more or less unraised below; leaf margin at most partially revolute. In other types of habitats.....2
2. Leaf blade more or less tomentose below (saplings sometimes excepted).....3
 Leaf blade glabrous.....4
3. Tomentum persistent, even, dark golden-brown. In *kerangas* forest.....**3. D. fusca**
 Tomentum at least partially flocculent, rufous, caducous. In peat swamp forest.....
**7. D. rappa**
4. Leaf blade oblong, or narrowly lanceolate.....5
 Leaf blade ovate-lanceolate to oblong-lanceolate.....6
5. Leaf blade narrowly lanceolate, margin revolute at base. In mixed dipterocarp forest on clay soils.....**5. D. lanceolata**
 Leaf blade oblong, margin not revolute at base. In hill forest on moist clay soils and seasonal swamp forest.....**6. D. oblongifolia** (subsp. **oblongifolia**)
6. Leaf blade oblong-lanceolate to ovate-lanceolate, thinly coriaceous; lateral veins distinctly paler than blade with distinct fine intramarginal vein visible within margin. Bark dark yellowish tawny. In mixed dipterocarp forest on shallow well-drained soils.....**2. D. beccarii**
 Leaf blade broadly ovate, thickly coriaceous; lateral veins not paler than blade, indistinct; intramarginal vein obscure. Bark warm rust-brown. In mixed dipterocarp forest on deep yellow sands.....**1. D. aromatica**

1. *Dryobalanops aromatica* Gaertn.f., *nom. cons.*

Plates 3A–B.

(Latin, *aromaticus* = spice-like; the smell of the dammar)

Fruct. 3 (1805) 49; Merrill, EB (1921) 401; Foxworthy *op. cit.* 105; Slooten *op. cit.* (1932) 7; Masamune, EPB (1942) 489; Symington, *op. cit.* (1943) 194; Wyatt-Smith *op. cit.* 148; Browne *op. cit.* 114; Ashton, Gard. Bull. Sing. 20 (1963) 241, *op. cit.* (1964) 49, *op. cit.* (1968) 375, *op. cit.* (1982) 375; Meijer & Wood *op. cit.* 278; Burgess *op. cit.* 118; Anderson *op. cit.* (1980) 114; Coode *et al.* (eds.) *op. cit.* 70; Newman *et al.* *op. cit.* 130. **Type:** *Miller s.n.*, Sumatra, Tapanuli (holotype BM). **Synonyms:** *Arbor camphorifera* Rumph., Herb. Amb. Cap. 82 (1755) 67; *Pterigium teres* Correa, Ann. Mus. Hist. Nat. Paris 10 (1807) 159; *Dryobalanops camphora* Colebr., As. Res. 12 (1816) 535; *Shorea camphorifera* (Rumph.) Roxb., Fl. Ind. ed. Carey 2 (1832) 616; *Dipterocarpus dryobalanops* Steudel, Nom. Bot. ed. 2, 1 (1840) 518; *Dipterocarpus teres* (Correa) Steudel *op. cit.* 518; *Dryobalanops junghuhnii* Becc., Nelle For. Born. (1902) 554; *Dryobalanops vriesii* Becc. *op. cit.* 554;

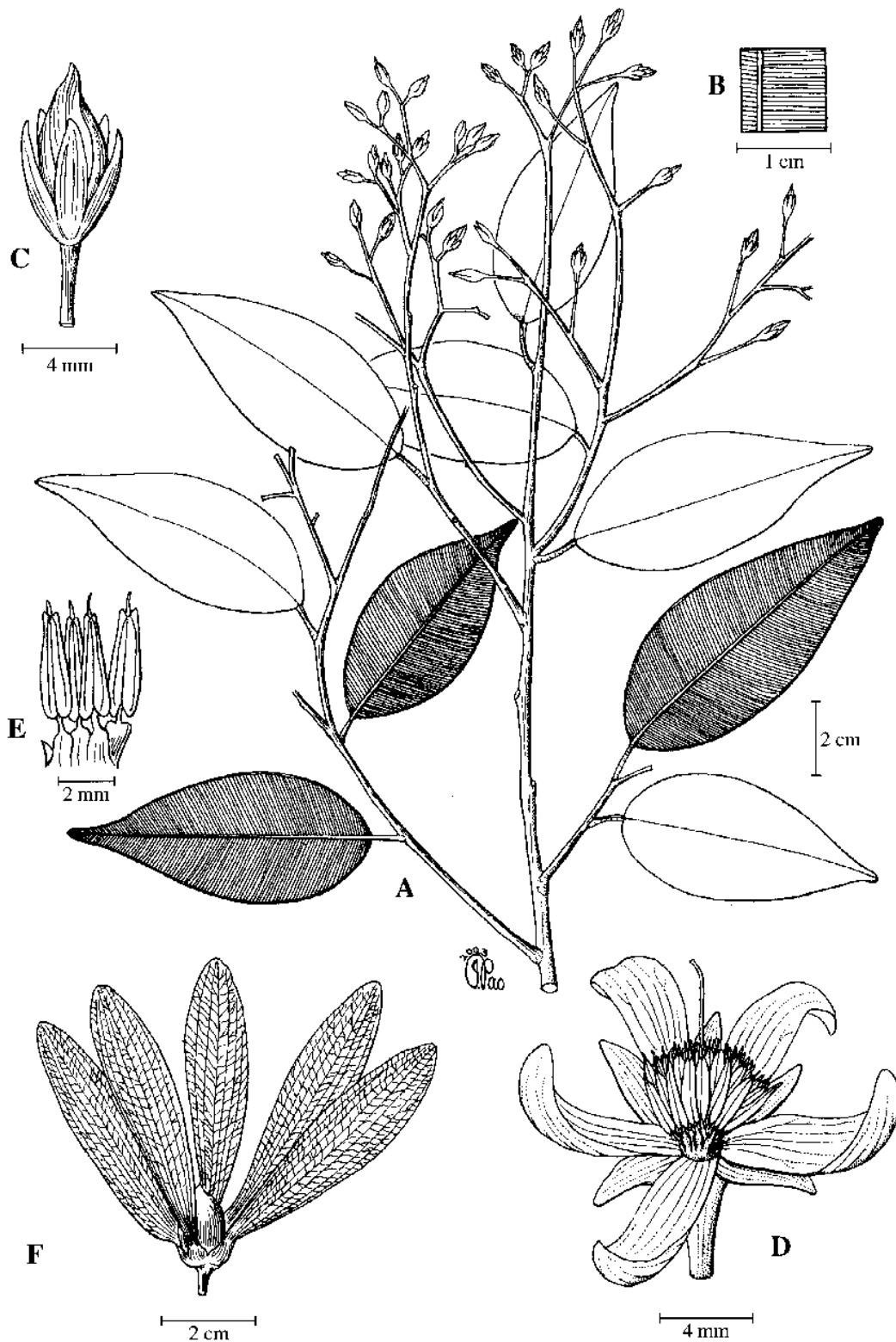


Fig. 10. *Dryobalanops beccarii*. A, flowering leafy twig; B, detail of venation on lower leaf surface; C, flower bud; D, open flower; E, adaxial view of stamens; F, mature fruit. (A–B from *S* 23922, C from *SAN* 36331, D–E from *S* 7612, F from *S* 8591.)

Dryobalanops sumatrensis (J.F. Gmelin) Kosterm., *Blumea* 33 (1988) 346 (based on *Laurus sumatrensis* J.F. Gmelin, *Syst. Veg.* (1791 & 1796) 650).

Immense tree, to 65 m tall, to 2 m diameter. **Bark** warm pale rust-brown, becoming evenly flaky, later shaggy. All parts strongly aromatic. *Young exposed fleshy parts yellowish lepidote, caducous.* **Twigs** c. 1 mm diameter apically, smooth, terete, slender. **Leaves** thickly coriaceous, glabrous; blade broadly ovate (sometimes broader than long), 4–6 × 2–4 cm, base cuneate to obtuse, margin at most only partially revolute, apex with slender acumen to 1.5 cm long; lateral veins subequal, indistinct, not paler than the blade; intramarginal veins obscure; petiole 0.5–1 cm long. **Inflorescences** to 7 cm long; axis angular on drying. **Flowers:** buds spindle-shaped, to 9 × 4 mm; sepals glabrous, lanceolate, obtuse; petals more or less oblong, acute; stamens shorter than the style, filaments slender, tapering, anthers linear, connective appendage linear, somewhat exceeding anther apex; style c. 2x the length of ovary, glabrous. **Fruits** glabrous; calyx base cup-shaped, 0.6–0.8 cm deep, 0.8–1.5 cm diameter, becoming constricted at the rim; lobes spatulate, obtuse, 4–6 × 0.8–2 cm, tapering to 3–5 mm wide at base. **Nuts** ovoid with a short style remnant, to 3 × 1.5 cm, with a constriction at the calyx cup rim.

Vernacular names. Sabah—*kapur barus* (preferred name). Sarawak—*kapur peringgi* (preferred name), *kapur ranggi* (Iban), *keladan* (Iban).

Distribution. Sumatra (including Musala, Lingga and Singkep Is.), Peninsular Malaysia and Borneo. In Borneo recorded in Sabah from Labuk Sugut, Papar and Sipitang districts (e.g., *FMS 35242*, *FMS 35441*, *SAN 15148*, *SAN 50639*, and *SAN A 3298*) and in Sarawak from Bintulu, Kapit, Lawas, Limbang, and Miri districts (*S 1790*, *S 4842*, *S 15104*, *S 22054*, and *S 46493*). Also occurring in Brunei (e.g., *BRUN 508*, *BRUN 3001*, *FMS 34573*, and *Niga NN 228*).

Ecology. Locally the most abundant emergent trees in mixed dipterocarp forest on deep humic yellow sandy soils with a propensity for ridges, at altitudes below 400 m. Vulnerable though abundant in Lambir NP and recorded from Mulu NP.

Notes. The leaves of juveniles are indistinguishable from those of *D. beccarii*, except by the stronger aroma when crushed, being less coriaceous, with distinct venation and visible intramarginal vein.

2. *Dryobalanops beccarii* Dyer

Fig. 10, Plate 3C.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

J. Bot. 12 (April 1874) 100; Beccari *op. cit.* (1902) 572; Merrill *op. cit.* 401; Slooten *op. cit.* (1932) 36; Masamune *op. cit.* 489; Wyatt-Smith *op. cit.* 149; Browne *op. cit.* 115; Ashton *op. cit.* (1963) 242, *op. cit.* (1964) 51, *op. cit.* (1968) 22, *op. cit.* (1982) 375; Meijer & Wood *op. cit.* 280; Burgess, *op. cit.* 118; Anderson, *op. cit.* (1980) 114; PROSEA, *op. cit.* 191; Kessler & Sidiyasa, TBSA-EK (1994) 95; Coode *et al.* (eds.) *op. cit.* 70; Newman *et al.* *op. cit.* 131; Chua & Saw, *Gard. Bull. Sing.* (2003) 1. **Lectotype** (Slooten, 1932): *Beccari PB 2553*, Borneo, Sarawak, Matang (holotype K; isotype PC). **Synonym:** *Dryobalanops oocarpa* Slooten *op. cit.* (1932) 33, Wyatt-Smith *op. cit.* 155.

Large emergent tree, to 65 m tall, to 2 m diameter. **Bark** becoming dark yellowish tawny, prominently irregularly flaky but rarely shaggy. Parts only faintly aromatic. *Exposed young fleshy parts fugaceous puberulent, otherwise entirely glabrous.* **Twigs** to 1 mm diameter apically, slender, terete, smooth. **Leaves** *thinly coriaceous, glabrous; blade ovate-lanceolate to oblong-lanceolate, 5–8 × 1–3 cm, base cuneate, margin at most only partially revolute, often wavy, apex with slender acumen to 1.7 cm long; lateral veins subequal, usually paler than blade and distinctly visible albeit hardly or not raised; intramarginal vein distinct, c. 1 mm within margin;* petiole 0.7–1 cm long, very slender. **Inflorescences** to 10 cm long, irregularly doubly branched; axis wrinkled on drying. **Flowers:** buds spindle-shaped, to 10 × 4 mm, acute; sepals equal, narrowly deltoid, subacute; petals broadly elliptic, obtuse; stamens subequal, almost 2/3x the length of style, anthers narrowly oblong, acute, connectival appendage short, erect, slightly exceeding anther; style 2–3x the length of ovary. **Fruits:** *calyx at base with obconical cup to 0.8 cm diameter, to 0.5 cm deep, tapering into pedicel and without constricted rim; calyx lobes narrowly oblong-spatulate, subacute, to 6.5 × 0.8 cm, tapering to 2 mm wide at base.* **Nuts** ovoid to globose, acute, to 1.4 cm diameter and long, seated on the small calyx cup thereby pushing the lobes out to a rotate angle.

Vernacular names. Sabah—*kapur merah* (preferred name). Sarawak—*kapur bukit* (preferred name), *keladan* (Iban).

Distribution. Peninsular Malaysia (SE Johor) and Borneo (excepting the southern and southwestern parts). In Borneo, localised in Sabah and recorded from Beaufort, Kinabatangan, Kudat, Labuk Sugut, Pitas, Sandakan, and Sipitang districts (e.g., *KEP 38720, KEP 80252, SAN 36331, SAN 121326, and SAN A 4341*) but widespread in Sarawak and recorded from Bau, Bintulu, Kapit, Kuching, Lundu, and Miri districts (e.g., *S 367, S 9479, S 23867, S 28991, and S 39768*). Also occurring in Brunei (e.g., *BRUN 3377 and BRUN 5282*) and W, E and S Kalimantan (e.g., *bb. 26578, bb. 29733, Kostermans 5995, and Kostermans 6782*).

Ecology. In mixed dipterocarp forest, locally among the most abundant emergent trees, elsewhere scattered; on shallow leached soils over both sandstone and shale on high narrow ridges, at altitudes to 700 m. Particularly abundant on coastal sandstone formations, including near the mouths of Sabah east coast rivers but also on seasonally swamped alluvium there; locally common on the high narrow inland ridges from G. Menuku, the Klingkang Range, Bako and Mulu NPs in Sarawak to the Crocker Range in W Sabah. Though its habitat is greatly reduced by logging, the species is probably not yet vulnerable.

3. *Dryobalanops fusca* Slooten

(Latin, *fuscus* = dark-coloured; the indumentum)

Bull. Jard. Bot. Buitenz. 3, 12 (1932) 39; Masamune *op. cit.* 489; Wyatt-Smith *op. cit.* 150; Ashton *op. cit.* (1968) 22, *op. cit.* (1982) 377; Anderson *op. cit.* (1980) 114; PROSEA *op. cit.* 191; Newman *et al. op. cit.* 133. **Lectotype** (designated here): *bb. 11468*, Borneo, Kalimantan, Sambas, Paloh (hololectotype BO).

Emergent tree, to 60 m tall, to 1.5 m diameter; bole frequently misshapen; crown distinctly coppery from below. **Bark** becoming dark golden-brown, irregularly coarsely flaking. *Exposed fleshy parts, leaf blade, flower and fruit excepted, densely shortly evenly persistently pale rufous-brown tomentose; blade undersurface similarly golden-brown*

tomentose. **Twigs** *c.* 1–2 mm diameter apically, slender, much-branched. **Leaves** coriaceous; blade broadly lanceolate, 5–10 × 2–4 cm, base obtuse to broadly cuneate, margin not or only partially revolute, apex subcaudate with acumen to 1.5 cm long; lateral veins subequal, more or less unraised below; intercostal venation obscured by tomentum; petiole 0.5–1 cm long. **Inflorescences** singly branched; axis terete, to 5 cm long. **Flowers:** buds lanceolate, to 12 × 3 mm; sepals equal, narrowly lorate-deltoid, obtuse; petals lanceolate; stamens reaching below style apex, filaments *c.* 2/3x the length of anthers, anthers narrowly oblong, tapering, connectival appendage erect, extending somewhat above anther apex; style 3–4x the length of ovary. **Fruits** glabrous; pedicels to 6 mm long, prominent; calyx cup shallow, to 0.3 cm deep, to 0.7 cm diameter; calyx lobes spatulate, obtuse, to 6 × 1.3 cm, tapering to 4 mm wide at base. **Nuts** ellipsoid-ovoid, apiculate, to 2 × 1.3 cm.

Vernacular name. Sarawak—*kapur empedu* (preferred name).

Distribution. Endemic in Borneo; recorded from Bintulu and Lundu districts in Sarawak (e.g., *S* 2451, *S* 7999, *S* 9625, and *S* 18629) and from W Kalimantan (e.g., *bb.* 8895, *bb.* 11352 and *bb.* 14514).

Ecology. Locally once the commonest emergent tree in *kerangas* forest, usually on raised beaches, at altitudes to 200 m. Rare and endangered.

4. *Dryobalanops keithii* Symington

Fig. 11.

(H.G. Keith, 1899–?, one time Conservator of Forests in Sandakan)

Gard. Bull. S. S. 10 (1939) 379; Slooten, Bull. Jard. Bot. Buitenz. 3, 16 (1940) 449, Reinwardtia 5 (1961) 475; Masamune *op. cit.* 489; Wyatt-Smith *op. cit.* 151; Meijer & Wood *op. cit.* 283; Burgess *op. cit.* 118; Ashton *op. cit.* (1982) 373; PROSEA *op. cit.* 191; Newman *et al. op. cit.* 134. **Type:** *Keith FMS 44382*, Borneo, Sabah, Tawau district, Tiaggau, Kalabakan (holotype KEP; isotype KEP).

Main canopy to low emergent tree, to 40 m tall, to 2 m diameter; bole frequently misshapen; buttresses small and few. **Bark** smooth or eventually thinly flaky, pale ochreous-brown. *Outside of calyx and inflorescence fugaceous puberulent; parts otherwise glabrescent.* **Twigs** at first *c.* 2 mm diameter apically, verrucose-lenticellate, becoming smooth. **Leaves** coriaceous; blade narrowly oblong, lanceolate or oblanceolate, 14–33 × 5–10 cm, base obtuse to cordate, margin narrowly revolute throughout, apex with slender acumen to 1 cm long; lateral veins unequal, many and parallel but well-spaced, with prominent intermediate veins, arched within margin forming a distinct intramarginal vein, slender but prominently raised below, obscurely sunken above; intercostal venation visible but indistinct, reticulate; petiole 0.7–1.2 cm long, stout. **Inflorescences** terminal or subterminal-axillary, singly or doubly branched, to 14 cm long. **Flowers:** buds ellipsoid, to 10 × 4 mm, acute; sepals narrowly deltoid, subacute; petals ovate, acute; stamens subequal, slightly shorter than style, filaments *c.* half the length of anthers, anthers linear, tapering, connectival appendage acicular, short but distinctly exceeding anther apex; style *c.* 2.5x the length of ovary. **Fruits:** pedicels to 4 mm long; calyx tube obconical, shallow, to 0.6 cm deep, 1 cm diameter; calyx lobes broadly spatulate, obtuse, to 4 × 2 cm, tapering to *c.* 8 mm wide above the cup. **Nuts** depressed ovoid, apiculate, to 1.6 × 1.5 cm.

Vernacular name. Sabah—*kapur gumpait* (preferred name).

Distribution. Endemic in Borneo; recorded from Kinabatangan, Sandakan, Tawau, and Tenom districts in Sabah (e.g., *FMS 44430*, *SAN 18732*, *SAN 97485*, and *SAN A 2587*) and from the extreme NE of Kalimantan (e.g., *bb. 17944* and *bb. 18159*).

Ecology. Once locally abundant trees on well-drained but moist clay soils on low hills, at altitudes to 250 m, never far from streams and often on their banks. Vulnerable owing to forest conversion.

5. *Dryobalanops lanceolata* Burck

(Latin, *lanceolatus* = shaped like the head of a spear; the leaf blade)

Ann. Jard. Bot. Buitenz. 6 (1887) 244; Merrill *op. cit.* 401; Slooten *op. cit.* (1932) 28; Keith *op. cit.* 37; Masamune *op. cit.* 489; Wyatt-Smith *op. cit.* 152; Browne *op. cit.* 116; Ashton *op. cit.* (1964) 52, *op. cit.* (1968) 22, *op. cit.* (1982) 374; Meijer & Wood *op. cit.* 285; Burgess *op. cit.* 118; Anderson *op. cit.* (1980) 70; PROSEA *op. cit.* 191; Coode *et al.* (eds.) *op. cit.* 70; Newman *et al.* *op. cit.* 135. **Type:** *Cult. in Hort. Bog. Sub VIIIID 58* (from Beccari via Martin), Borneo, Sarawak, Bintulu district, Ulu Kemena (holotype BO). **Synonym:** *Dryobalanops kayanensis* Becc., *op. cit.* 551.

Tall emergent tree, to 80 m tall, to 2.5 m diameter; bole tall, columnar; crown immense, like a rising thunder cloud; buttresses concave. **Bark** dark leaden green, thinly irregularly flaking. *Leaf buds and stipules fugaceous puberulent; parts otherwise glabrous.* **Twigs** c. 1.5 mm diameter apically, slender, smooth, pale lenticellate. **Leaves** thinly coriaceous, *glabrous*, drying reddish brown; *blade narrowly lanceolate, 7–10 × 2–3.5 cm*, base cuneate, *margin revolute at base only*, apex with slender acumen to 1 cm long; *lateral veins subequal, unraised below*; petiole c. 1 cm long, slender. **Inflorescences** terminal or axillary, simple or singly branched; axis ribbed, to 6 cm long. **Flowers:** buds spindle-shaped, to 12 × 5 mm, obtuse; sepals subequal, lanceolate, obtuse; petals lanceolate, acute, glabrescent; stamens subequal, shorter than the style, anthers linear, connectival appendage hardly exceeding anther apex; style c. 3x the length of ovary, glabrous. **Fruits:** calyx impressed at pedicel, *the base united into a shallow cup with waisted rim, to 2 cm diameter, to 0.5 cm deep*, with a hollow tubercle at the base of each lobe; *calyx lobes spatulate, obtuse, to 9 × 2 cm*, tapering to 3–5 mm wide at base. **Nuts** ovoid to globose, subacute, to 2 cm long and broad.

Vernacular names. Sabah and Sarawak—*kapur paji* (preferred name). Sarawak—*paji* (Iban), *sesuan* (Murut).

Distribution. Endemic in Borneo. Common and widespread in Sabah, particularly in the eastern parts and recorded from Kudat, Lahad Datu, Papar, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15189*, *SAN 17844*, *SAN 18004*, *SAN 27281*, and *SAN 83425*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Limbang, Marudi, Miri, Sibuan, Sri Aman, and Tatau districts (e.g., *S 1286*, *S 1428*, *S 15592*, *S 22410*, and *S 32386*). Also occurring in Brunei (e.g., *BRUN 311*, *FMS 34562* and *FMS 39604*), and E and SE Kalimantan (e.g., *bb. 22866*, *bb. 29394*, *Kostermans 5406*, and *Kostermans 6209*).

Ecology. In mixed dipterocarp forest on clay-rich soils, mostly on lower slopes but occasionally to 700 m altitude; most abundant, becoming the dominant emergent on deep moist but well-aerated soils on calcareous shale and basic igneous rocks, therefore threatened outside strictly managed parks. The saplings are shade tolerant, surviving many years and expanding extensive horizontal to slightly pendent plagiotropic branches with only slight extension of the leader shoots; but once a gap is formed young *paji* grow in

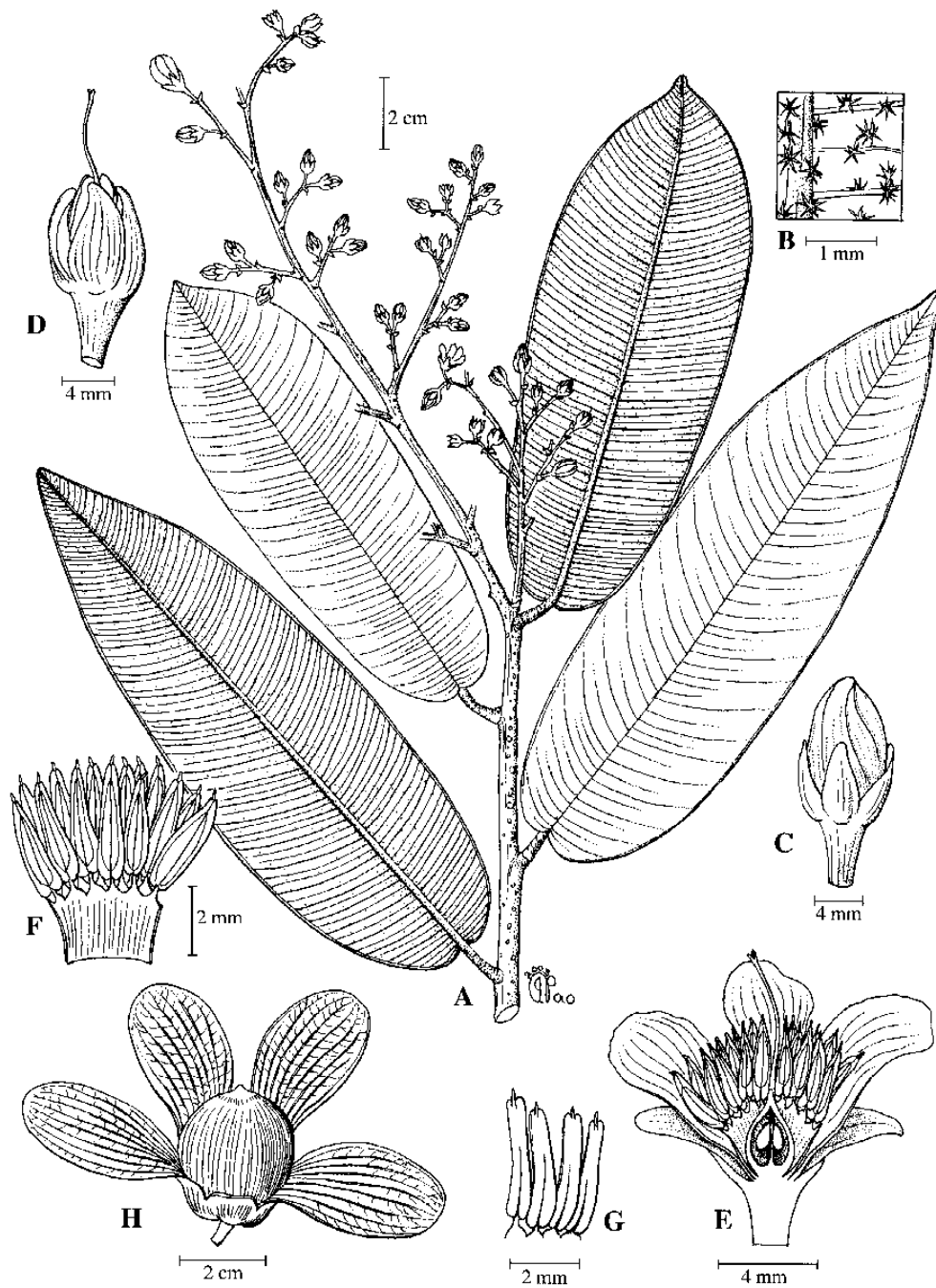


Fig. 11. *Dryobalanops keithii*. A, flowering leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, post-anthesis flower; E, longitudinal section of open flower; F, adaxial view of stamens; G, abaxial view of stamens; H, ripe fruit with one calyx lobe removed. (A–D from SAN 18732, E–G from FMS 55279, H from SAN 123771.)

height at comparable rates to the fastest pioneers. Common in Sepilok FR and Danum Valley Conservation Area, Sabah and locally so in Lambir and Mulu NPs, Sarawak; vulnerable elsewhere owing to land conversion.

6. *Dryobalanops oblongifolia* Dyer

Fig. 12, Plate 3D.

(Latin, *oblongus* = rather long, *folium* = leaf; the leaf shape)

J. Bot. 12 (1874) 100; Foxworthy *op. cit.* 118; Slooten *op. cit.* (1932) 22; Symington *op. cit.* (1943) 196; Wyatt-Smith *op. cit.* 153, *p.p.*; Browne *op. cit.* 116; Ashton *op. cit.* (1968) 23, Gard. Bull. Sing. 31 (1978) 25, *op. cit.* (1982) 373. **Type:** *Beccari PB 2533*, Borneo, Sarawak, Matang (holotype K).

Distribution. Sumatra, Peninsular Malaysia and Borneo.

Notes. Two subspecies are recognised, *viz.* subsp. *oblongifolia* and subsp. *occidentalis* P.S.Ashton, with the former occurring in Borneo and the latter in Sumatra and Peninsular Malaysia.

subsp. *oblongifolia*

Beccari, Nelle For. Born. (1902) 550; Merrill *op. cit.* 401; Masamune *op. cit.* 489; Browne *op. cit.* 116; Ashton *op. cit.* (1968) 23, *op. cit.* (1978) 26, *op. cit.* (1982) 373; Anderson *op. cit.* (1980) 114; PROSEA *op. cit.* 192; Newman *et al. op. cit.* 136. **Synonyms:** *Baillonodendron malayanum* F.Heim, *op. cit.* (1890) 867; *Dryobalanops abnormis* Slooten *op. cit.* (1940) 449.

Emergent tree, to 60 m tall, to 2 m diameter. **Bark** dark yellowish brown, flaky, occasionally becoming shaggy. **Inflorescence** densely evenly rufous-pubescent; *young shoots fugaceous pale fulvous-pubescent; parts otherwise glabrescent.* **Twigs** *c.* 2 mm diameter apically, smooth, shiny. **Leaves** thinly coriaceous, frequently undulate, *glabrous*, drying rust-brown, paler above than below; *blade oblong*, 6–20 × 4.5–5(–6.5) cm, base broadly cuneate to obtuse, *margin not revolute at base*, apex cuspidate with acumen to 1.5 cm long; *lateral veins subequal, distinct but only slightly elevated below*, with visible branching intermediate veins; petiole 0.5–1.2 cm long. **Inflorescences** terminal or axillary, singly branched, to 14 cm long. **Flowers:** buds ovoid, to 8 × 5 mm, *glabrous*; sepals ovate, acute; petals oblong; stamens *c.* 40, unequal, reaching to below the style apex, filaments *c.* half the length of anthers, broadly lorate, anthers linear, connectival appendage more or less erect, exceeding anther apex; style 2–3x as long as ovary, *glabrous*. **Fruits** subsessile; *calyx lobes shorter than the nut, incrassate, deltoid, acute, often reflexed, to 0.5 × 0.7 cm*, bordering a massive incrassate basal cup to 1.5 cm deep and diameter. **Nuts** ellipsoid to obovoid, to 3.5 × 2.7 cm, more or less mucronate, prominently lenticellate.

Vernacular names. Sarawak—*kapur kelansau* (preferred name), *kelansau* (Iban).

Distribution. Endemic in Borneo. Recorded in Sarawak from Kapit, Kuching, Lundu, Mukah, and Serian districts (e.g., *S 4432*, *S 18628*, *S 19652*, and *S 27008*). Also occurring in W, C and E Kalimantan (e.g., *bb. 16952*, *bb. 30212*, *bb. 31221*, and *Wilkie 94309*).

Ecology. Locally common in mixed dipterocarp forest, on sandy clay soils, on undulating land, in valleys and on slopes, at altitudes to 600 m; frequently as small groups of mature individuals but not seen to dominate the canopy over large areas. Vulnerable, though occurring in Kubah NP.

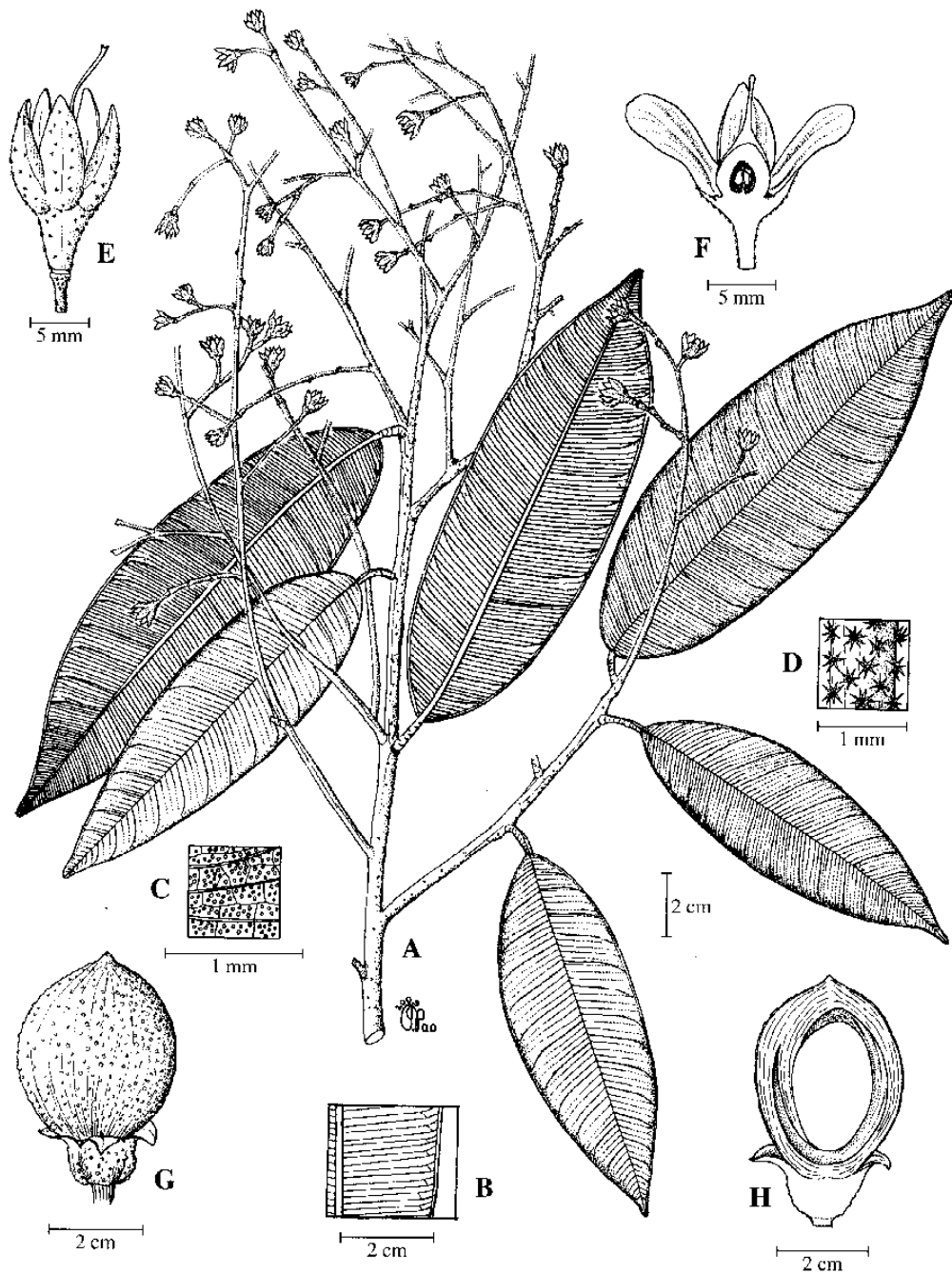


Fig. 12. *Dryobalanops oblongifolia* subsp. *oblongifolia*. A, flowering leafy twig; B, detail of venation on lower leaf surface; C, detail of indumentum on lower leaf surface; D, detail of indumentum on inflorescence and flowers; E, post-anthesis flower; F, longitudinal section of post-anthesis flower; G, mature fruit; H, longitudinal section of mature fruit. (A–F from *S* 23993, G–H from *S* 41496.)

7. *Dryobalanops rappa* Becc.

(from an Iban word—*kerapa* = a shallow swamp; the habitat)

Nelle For. Born. (1902) 572; Merrill *op. cit.* 401; Slooten *op. cit.* (1932) 41; Keith *op. cit.* 37; Masamune *op. cit.* 489; Browne *op. cit.* 116; Wyatt-Smith *op. cit.* 155; Anderson, Gard. Bull. Sing. 20 (1963) 157, *op. cit.* (1980) 114; Ashton *op. cit.* (1963) 242, *op. cit.* (1964) 53, *op. cit.* (1968) 23, *op. cit.* (1978) 25, *op. cit.* (1982) 377; Meijer & Wood *op. cit.* 289; Burgess *op. cit.* 118; PROSEA *op. cit.* 192; Coode *et al.* (eds.) *op. cit.* 70; Newman *et al.* *op. cit.* 137. **Type:** *Beccari s.n.*, Borneo, Sarawak, Kuching (holotype FI).

Emergent tree, to 55 m tall, to 1.5 m diameter. **Bark** becoming rufous-brown, shaggily flaky. *Exposed fleshy parts, leaf blade above, flower and fruit, and sapling excepted, densely powdery more or less persistently rufous-tomentose.* **Twigs** c. 1.5 mm diameter apically, smooth but for minute warty lenticels. **Leaves** coriaceous, drying mauve-brown above, *rufous to greyish tomentose below; blade ovate-lanceolate, 6–11 × 2.5–4 cm*, base obtuse, *margin only partially revolute*, apex with slender acumen to 1 cm long; *lateral veins subequal, unraised below*; petiole 0.6–1 cm long, stout. **Inflorescences** terminal or axillary, doubly branched, to 8 cm long. **Flowers:** buds ellipsoid, to 10 × 5 mm, acute; sepals narrowly deltoid, obtuse; petals cream, lanceolate; stamens reaching to below style apex, filaments c. 2/3x the length of anthers; anthers narrowly oblong, connectival appendage erect, extending somewhat above anther apex; *style c. 2x as long as ovary*, glabrous. **Fruits:** *calyx with shallow basal cup to 0.8 cm diameter, to 0.3 cm deep; calyx lobes thinly coriaceous, linear-spatulate, to 5 × 0.6 cm*, subacute, tapering to 3.5 mm wide at base. **Nuts** *ovoid, to 1 × 0.6 cm, mucronate.*

Vernacular name. Sabah and Sarawak—*kapur paya* (preferred name).

Distribution. Endemic in Borneo. Recorded in Sabah from Beaufort, Papar and Sipitang districts (e.g., *FMS 41106, FMS 49021, SAN 27991, SAN 78005, and SAN A 1704*), and in Sarawak from Bintulu, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, Sematan and Sibul districts (e.g., *Haviland 2226, S 1270, S 1504, S 4850, and S 11242*). Also occurring in Brunei (e.g., *BRUN 5105, BRUN 5106, FMS 28696, FMS 30640, and Wong WKM 917*).

Ecology. In coastal mixed peat swamp forest, particularly over sands behind the sea beach but also on clay, and in lower montane *kerangas*, at altitudes to 900 m. Vulnerable, though occurring in Mulu NP

5. HOPEA Roxb., *nom. cons.*

(John Hope, 1725–1786, the first Regius Keeper of the Royal Botanic Garden, Edinburgh)

luis (Iban), *selangan* (Malay)

Pl. Corom. 3 (1811) 7; King, J. As. Soc. Beng. 62, 2 (1893) 125; Ridley, FMP 1 (1922) 234; Foxworthy, Malay. For. Rec. 10 (1932) 113; Symington, Malay. For. Rec. 16 (1943) 108; Browne, FTSB (1955) 116; Ashton, Gard. Bull. Sing. 20 (1963) 254, MDB (1964) 89, MDBS (1968) 37, Gard. Bull. Sing. 31 (1978) 28, FM 1, 9 (1982) 391; Meijer & Wood, Sabah For. Rec. 5 (1964) 203; Backer & Bakhuizen *f.*, FJ 1 (1964) 330; Burgess, TBS (1965) 128; Anderson, CLTS (1980) 114; PROSEA, 5, 1 (1993) 238 & 255; Kessler & Sidiyasa, TBSA-EK (1994) 96; Coode *et al.* (eds.), CLBD (1996) 71; Newman *et al.*, MDFB-MHHW (1998) 139. **Synonyms:** *Neisandra* Rafin., Sylv. Tell. (1838) 163; *Petalandra* Hassk., Cat. Hort. Bog. (1858) 104; *Balanocarpus* Bedd., For. Man. Bot. (1873) 236 *bis*;

Hancea Pierre, For. Fl. Coch. 4 (1891) sub t. 244; *Pierrea* auct. non Hance: Heim, Bull. Mens. Soc. Linn. Paris 2 (1891) 958; *Diotocarpus* Dunn, Bull. Misc. Inform. Kew (1920) 337.

Main canopy and subcanopy, occasionally low emergent trees, with narrow buttresses, often flying buttresses, sometimes stilt roots. **Bark** variously smooth, chocolate-brown mottled, or flaky or fissured; inner bark uniform pale yellowish brown, finely fibrous. **Sapwood** variously moderately soft to very hard, cream-white to straw yellow; heartwood pale to dark chocolate-brown. **Twigs** generally slender, terete, smooth, brown, with short inconspicuous stipule scars. Leaf buds generally minute. **Stipules** linear, early caducous except in juveniles. **Leaves** small or medium-sized, occasionally large; venation pinnate, without intramarginal veins, either 'hopea-type', i.e. with all lateral veins more or less parallel and reaching the leaf margins, without intermediates, and with scalariform intercostal venation (in sect. *Hopea*, e.g., *H. nervosa* and *H. rudiformis*), or 'dryobalanoid', i.e. with many fine but arched and unequal lateral veins and obscurely reticulate intercostal venation (in sect. *Dryobalanoides* subsect. *Dryobalanoides*), or 'subdryobalanoid', i.e. intermediate between these (in sect. *Dryobalanoides* subsect. *Sphaerocarpaceae*); petiole rarely geniculate. **Inflorescences** paniculate, slender, terminal or axillary or ramiflorous when frequently fascicled. **Flowers** secund; buds small, ovoid or globose; 2 outer sepals ovate, acute or obtuse, thickened, 3 inner ones suborbicular, thin at margins, frequently mucronate; petals oblong, strongly contorted, connate at base forming a basal cup with rotate twisted lobes, falling in a rosette; stamens 10, 15 or to 38 (*H. plagata*), attached to the base of the petals and falling with them, filaments broad at base, tapering and filiform distally, anthers broadly ellipsoid to globose, more or less tapering apically, connectival appendage usually at least twice the length of anther, very slender, glabrous or minutely tuberculate; ovary glabrous or pubescent, ovoid and without stylopodium or with stylopodium and variously pyriform, cylindrical or hourglass-shaped, style columnar, long (if without stylopodium) or more or less short (if with stylopodium), stigma obscure. **Fruits** relatively small, usually glabrous; 2 outer calyx lobes generally spatulate and enlarged, the 3 inner ones remaining as broad as long, embracing the base of the nut and generally shorter than it at maturity; frequently all 5 sepals short; all sepals expanded and thickened around the base of the nut and appressed to it. **Nuts** ovoid, generally glabrous, apiculate with the distinct floral stylopodium, when present, persisting; pericarp splitting at germination irregularly or occasionally into 3 valves.

Distribution. About 104 species, distributed from Sri Lanka and S India to S China, and southeastward throughout Malesia (the Lesser Sunda Is. excepted), to New Guinea; 43 species occur in Sabah and Sarawak.

Ecology. Main and subcanopy trees of lowland forests at altitudes below 800 m, rarely to 1600 m. In mixed and upper dipterocarp, *kerangas* and mixed peat swamp forests, and a few species on limestone karst; several are confined to river banks. Most, especially those with short fruit sepals, occur in tightly clustered groups with their juveniles, sometimes extending to form semi-gregarious populations.

Notes. *Hopea* is not difficult for the field worker to recognise on account of the characters italicised in the description given above. From the related genus *Shorea* (see there) most *Hopea* differ in being of the main canopy or subcanopy, with stilt roots and flying buttresses (virtually absent in *Shorea*), more slender twigs, smaller flowers and of course the two-winged usually smaller and generally glabrous fruit. However, the great variability in ovary, leaf, bark and mature habit make this one of the most diverse dipterocarp genera. Two sections, each with two subsections are recognised according to the characters indicated in

the systematic key; but these entities have greater floral diversity than do the sections of *Shorea*, and several species with intermediate characters exist; the boundaries are therefore to an extent arbitrary. Curiously, molecular evidence (Kamiya *et al.*, *Tropics* 7 (1998) 195–207; Dayanandan *et al.*, *Amer. J. Bot.* 86 (1999) 1182–1190) indicates that the genus is indeed monophyletic, but nested between the sections of the vast genus *Shorea* along with *Parashorea* and *Neobalanocarpus* (a monotypic genus of Peninsular Malaysia).

Hopea species generally have smooth, often hoop-marked, or flaky bark; but some dryobalanoid species, viz. *H. beccariana*, *H. cernua*, *H. coriacea*, *H. mengerawan*, and *H. treubii* may have deeply v-section fissured chocolate brown bark in large trees. Curiously, this seems not to be always the case, as populations occur in *H. beccariana* and *H. coriacea*, in which large individuals are present, in which the bark remains at most irregularly cracked.

Key to *Hopea* species

(based on flowering and/or fruiting specimens)

1. Leaf venation hopea-type or subdryobalanoid.....2
 Leaf venation dryobalanoid (sect. **Dryobalanoides** subsect. **Dryobalanoides**).....4
2. Ovary and stylopodium not or only slightly constricted in between; leaf blade oblong-lanceolate, ovate-lanceolate, lanceolate, ovate to narrowly elliptic or suborbicular.....3
 Ovary and stylopodium hourglass-shaped, distinctly constricted at base of stylopodium; leaf blade generally narrowly oblong (sect. **Hopea** subsect. **Pierrea**).....37
3. Flowers remote on inflorescence; bracts subsistent (sect. **Dryobalanoides** subsect. **Sphaerocarpace**).....20
 Flowers dense on inflorescence; bracts fugaceous (sect. **Hopea** subsect. **Hopea**).....28
4. Ovary without a distinct stylopodium, ovoid with long filiform or columnar style.....5
 Ovary with distinct stylopodium, style short.....15
5. Shorter fruit calyx lobes concealing ripe nut.....6
 Shorter fruit calyx lobes not or hardly concealing ripe nut (ripe nut apex exposed).....9
6. Leaf margin revolute.....7
 Leaf margin not revolute.....8
7. Leaf blade to 5 cm wide, elliptic to ovate, thinly coriaceous; stamens 15–18.....
 **8. H. cernua**
 Leaf blade 6–10 cm wide, broadly ovate to suborbicular, thickly coriaceous; stamens at most 15.....**9. H. coriacea**

8. Fruit pedicel to 7 mm long; calyx lobe base prominently tuberculate.....**19. H. longirostrata**
 Fruit pedicel to 2 mm long; calyx lobe base incrassate but not tuberculate.....**15. H. fluvialis**
9. Leaf lateral veins at least 14 pairs, indistinct below.....10
 Leaf lateral veins less than 14 pairs, distinct below.....11
10. Leaf base cuneate.....**21. H. mengerawan**
 Leaf base obtuse.....**23. H. micrantha**
11. Fruit calyx lobes short, subequal; leaf lateral veins at most 6 pairs.....**17. H. kerangasensis**
 Fruit calyx lobes unequal, 2 larger ones spatulate; leaf lateral veins at least 8 pairs.....12
12. Nut to 1.5 cm long, cylindrical-oblong.....**42. H. vesquei**
 Nut shorter than 1.1 cm, ovoid.....13
13. Fruit calyx lobes larger, 2 longer ones tapering to 5 mm above the saccate base, 3 shorter ones shorter than the nut; leaf midrib acute on both surfaces, drying black.....**11. H. dryobalanoides**
 Fruit calyx lobes smaller, 2 longer ones tapering to 1.5–3 mm above the saccate base, 3 shorter ones concealing the nut; leaf midrib terete, not drying black.....14
14. Leaf blade lanceolate; petiole at most 1 cm long; twig apex persistently puberulent.....**14. H. ferruginea**
 Leaf blade ovate; petiole at least 1.2 cm long; twig glabrescent.....**18. H. latifolia**
15. Leaf midrib obscure, sunken above.....**16. H. griffithii**
 Leaf midrib evident, more or less raised above.....16
16. Stamens *c.* 10; leaf blade broadly elliptic-obovate.....**40. H. treubii**
 Stamens *c.* 15; leaf blade ovate to lanceolate.....17
17. Ovary and stylopodium pyriform or hourglass-shaped.....18
 Ovary and stylopodium cylindrical.....19
18. Leaf blade broadly ovate; petiole 1.2–1.7 cm long.....**4. H. beccariana**
 Leaf blade narrowly ovate-lanceolate; petiole at most 1 cm long.....**12. H. dyeri**
19. Margin of leaf blade base prominently revolute.....**2. H. altocollina**
 Margin of leaf blade base not revolute.....**30. H. pedicellata**
20. Leaf venation hopea-type.....21
 Leaf venation subdryobalanoid.....23
21. Fruit calyx lobes short, subequal.....**1. H. aequalis**
 Fruit calyx lobes unequal, 2 larger ones spatulate.....22

22. Leaf lateral veins at most 13 pairs; blade dull below..... **34. H. rudiformis**
 Leaf lateral veins 13–15 pairs; blade not dull, drying dark chocolate-brown below.....
 **25. H. nervosa**
23. Fruit calyx lobes unequal, 2 larger ones spatulate..... **24. H. montana**
 Fruit calyx short, subequal.....24
24. Leaf blade oblong-lanceolate or ovate-lanceolate, at least 7 cm long.....25
 Leaf blade ovate, at most 6 cm long.....27
25. Petiole at least 0.7 cm long; leaf blade coriaceous, drying honey-brown.....
 **22. H. mesuoides**
 Petiole at most 0.6 cm long; leaf blade chartaceous, drying grey or tawny brown.....26
26. Leaf blade undulate or more or less flat on drying, with obtuse base.....
 **38. H. sphaerocarpa**
 Leaf blade wrinkled on drying, base more or less cuneate..... **35. H. rugifolia**
27. Stamens *c.* 10; leaf blade at most 2.5 cm long..... **41. H. vaccinifolia**
 Stamens *c.* 15; leaf blade at least 2.5 cm long..... **5. H. bracteata**
28. Stamens *c.* 10.....29
 Stamens 15 or more.....30
29. Leaf lateral veins at most 8 pairs; domatia obscure, glabrous, or absent.....
 **10. H. depressinerva**
 Leaf lateral veins at least 10 pairs; domatia evident, pubescent..... **36. H. sangal**
30. Style as long as ovary..... **7. H. centipeda**
 Style very short (shorter than ovary).....31
31. Stamens at least 32..... **32. H. plagata**
 Stamens at most 15.....32
32. Leaf base obtuse; domatia pore-like, prominently swollen..... **26. H. nutans**
 Leaf base cuneate; domatia not prominently swollen.....33
33. Leaf lateral veins at most 5 pairs..... **31. H. pentanervia**
 Leaf lateral veins at least 6 pairs.....34
34. Leaf base distinctly unequal..... **3. H. andersonii**
 Leaf base equal to subequal.....35
35. Inflorescence glabrous..... **20. H. megacarpa**
 Inflorescence densely persistently buff-pubescent.....36
36. Ovary and stylopodium ovoid..... **28. H. ovoidea**
 Ovary and stylopodium cylindrical, truncate..... **37. H. semicuneata**

37. Leaf blade broadly ovate, base equal; inflorescence solitary.....**43. H. wyatt-smithii**
 Leaf blade narrowly oblong, elliptic to lanceolate, base unequal, obtuse to subcordate at
 least on one side; inflorescence usually more than 1 in each leaf axil.....38
38. Fruit calyx lobes short, subequal; leaf blade pale, often silvery below.....
**29. H. pachycarpa**
 Fruit calyx lobes unequal, 2 larger ones spatulate; leaf blade not silvery below.....39
39. Leaf blade prominently bullate between the intercostal venation.....**6. H. bullatifolia**
 Leaf blade not bullate or only slightly so.....40
40. Base of fruit calyx lobes auriculate.....**33. H. pterygota**
 Base of fruit calyx lobes not auriculate.....41
41. Leaf lateral veins more prominent above than below; blade thickly coriaceous, drying
 pale pinkish brown below.....**27. H. obscurinerva**
 Leaf lateral veins more prominent below than above; blade thinly coriaceous, drying
 chocolate- or greenish-brown below.....42
42. Leaf blade (mature trees) smaller, 10–27 × 3–5.5 cm, drying chocolate-brown; lateral
 veins 12–21 pairs.....**39. H. tenuinervula**
 Leaf blade larger, 27–46 × 8–15 cm, drying greenish brown; lateral veins 16–30 pairs...
**13. H. enicosanthoides**

Key to *Hopea* species
 (based on field characters)

1. Leaf venation dryobalanoid or subdryobalanoid.....2
 Leaf venation hopea-type.....29
2. Bark fissured or densely flaky; stilt roots few or none.....3
 Bark smooth or cracked to patchily flaky only; stilt roots present at least on young
 trees.....9
3. Leaf blade at least 6 cm wide, thickly coriaceous.....**9. H. coriacea** (in part)
 Leaf blade at most 5.5 cm wide, not thickly coriaceous.....4
4. Bark surface dark or chocolate brown, fissured.....5
 Bark surface tawny brown, powdery flaky or hoop-marked or patchily cracked or
 v-section fissured.....7
5. Leaf lateral veins raised below, drying blackish.....**8. H. cernua** (in part)
 Leaf lateral veins unraised below, not drying blackish.....6
6. Petiole at most 1.1 cm long, stout.....**21. H. mengerawan**
 Petiole at least 1.2 cm long, slender.....**4. H. beccariana**

7. Leaf blade broadly elliptic-obovate, apex shortly acuminate.....**40. H. treubii**
 Leaf blade narrowly ovate to lanceolate, apex not acuminate.....8
8. Leaf lateral veins prominent below; leaf margin revolute at base.....**2. H. altcollina**
 Leaf lateral veins obscure below; leaf margin not revolute at base.....
**30. H. pedicellata** (in part)
9. Midrib obscure, sunken above.....10
 Midrib evident, more or less raised above.....17
10. Leaf venation dryobalanoid; intercostal venation obscure below.....11
 Leaf venation subdryobalanoid; intercostal venation evident below (except *H. montana*)
12
11. Leaf lateral veins at least 9 pairs, without domatia.....**16. H. griffithii**
 Leaf lateral veins at most 6 pairs, with pubescent axillary domatia.....
**17. H. kerangasensis**
12. Leaf larger, 8–14 cm long.....**22. H. mesuoides**
 Leaf blade smaller, 1–10 cm long.....13
13. Intercostal venation obscure below.....**24. H. montana**
 Intercostal venation distinct below.....14
14. Leaf blade elliptic to narrowly or broadly ovate.....15
 Leaf blade broadly lanceolate to oblong-lanceolate.....16
15. Leaf blade 2.5–6 × 0.7–2 cm; petiole 0.2–0.4 cm long. In forest on clay soils.....
**5. H. bracteata**
 Leaf blade 1–2.5 × 0.4–1.2 cm; petiole to 0.2 cm long. In forest on white sand
 podsols.....**41. H. vaccinifolia**
16. Leaf blade obtuse at base, not wrinkled on drying.....**38. H. sphaerocarpa**
 Leaf blade cuneate at base, wrinkled on drying.....**35. H. rugifolia**
17. Leaf venation subdryobalanoid; inner bark plum-red.....**43. H. wyatt-smithii** (in part)
 Leaf venation dryobalanoid; inner bark pale brown or pink.....18
18. Leaf blade suborbicular; main lateral veins at most 4 pairs.....**9. H. coriacea** (in part)
 Leaf blade ovate, elliptic, lanceolate or oblong-lanceolate; main lateral veins at least 5
 pairs.....19
19. Midrib sharp below, tending to dry black.....20
 Midrib terete below, not drying black.....22
20. Young twigs glabrous; inner bark pale brown.....**19. H. longirostrata**
 Young twigs pubescent; inner bark pinkish brown.....21

DIPTEROCARPACEAE (ASHTON)

21. Leaf blade coriaceous; main lateral veins *c.* 15 pairs, not drying black.....
**30. H. pedicellata** (in part)
 Leaf blade chartaceous; main lateral veins at most 12 pairs, drying black.....
**11. H. dryobalanoides** (in part)
22. Leaf base equal to subequal.....23
 Leaf base unequal, blade twisted slightly to one side.....25
23. Leaf base obtuse.....**23. H. micrantha**
 Leaf base cuneate.....24
24. Leaf lateral veins slightly raised below, drying paler than the blade.....
**11. H. dryobalanoides** (in part)
 Leaf lateral veins indistinct, hardly raised below, drying not paler than the blade.....
**18. H. latifolia**
25. Basal pair of lateral veins continuing up leaf margin for one third of its length.....
**15. H. fluvialis**
 Basal pair of lateral veins short.....26
26. Leaf lateral veins distinctly raised below.....**8. H. cernua** (in part)
 Leaf lateral veins somewhat or not raised below.....27
27. Leaf blade broadly ovate, thickly coriaceous, base subobtuse; bark surface with short
 shallow surface fissures.....**42. H. vesquei**
 Leaf blade narrowly ovate-lanceolate, thinly coriaceous to coriaceous, base cuneate;
 bark smooth becoming thinly flaky.....28
28. Leaf lateral veins at most 12 pairs.....**12. H. dyeri**
 Leaf lateral veins *c.* 14 pairs.....**14. H. ferruginea**
29. Bark scaly, vertically cracked or flaky.....30
 Bark smooth.....39
30. Leaf lateral veins at most 5 pairs.....**31. H. pentanervia**
 Leaf lateral veins at least 6 pairs.....31
31. Leaf base markedly unequal.....32
 Leaf base subequal to equal.....35
32. Leaf blade more than 3x as long as wide; lateral veins 12–21 pairs.....
**39. H. tenuinervula**
 Leaf blade less than 2½x as long as wide; lateral veins 7–12 pairs.....33
33. Leaf lateral veins with pubescent axillary domatia.....**3. H. andersonii**
 Leaf lateral veins without or with a few glabrous domatia.....34
34. Leaf lateral veins 8–11(–12) pairs, domatia, if present, pore-like; leaf bud glabrous.....
**32. H. plagata**

- Leaf lateral veins 7–8(–10) pairs, domatia canaliculate; leaf bud puberulent.....
**28. H. ovoidea** (in part)
35. Leaf lateral veins 10–12 pairs; bark surface dark brown with conspicuous white
 dammar coxcombs.....**36. H. sangal**
 Leaf lateral veins less than 10 pairs; bark surface brown, dammar exudations not
 conspicuous.....36
36. Leaf blade broadly ovate, thickly coriaceous, greyish lepidote below.....**26. H. nutans**
 Leaf blade lanceolate, narrowly elliptic or narrowly ovate-elliptic, chartaceous to thinly
 coriaceous, undulate, not pale lepidote below.....37
37. Leaf lateral veins sharply raised below, domatia obscure or absent.....
**10. H. depressinerva**
 Leaf lateral veins not sharply raised below, with prominent axillary domatia.....38
38. Domatia canaliculate.....**28. H. ovoidea** (in part)
 Domatia pore-like.....**37. H. semicuneata**
39. Leaf base equal.....40
 Leaf base markedly unequal or subequal.....44
40. Leaf lateral veins at most 8 pairs.....41
 Leaf lateral veins at least 11 pairs.....42
41. Leaf blade broadly ovate, midrib prominent above; inner bark bright plum-red.....
**43. H. wyatt-smithii** (in part)
 Leaf blade narrowly ovate-lanceolate, midrib flat above; inner bark yellowish brown....
**20. H. megacarpa**
42. Leaf lateral veins at least 16 pairs.....**1. H. aequalis**
 Leaf lateral veins at most 15 pairs.....43
43. Leaf blade dull below; lateral veins 11–13 pairs.....**34. H. rudiformis**
 Leaf blade drying chocolate-brown below, not dull; lateral veins 13–15 pairs.....
**25. H. nervosa**
44. Leaf lateral veins at most 9 pairs, midrib sunken above; stilt-rooted river bank tree.....
**7. H. centipeda**
 Leaf lateral veins at least 10 pairs, midrib raised above; not as above.....45
45. Leaf lateral veins and midrib more prominent above than below.....**27. H. obscurinerva**
 Leaf lateral veins and midrib more prominent below than above.....46
46. Leaf blade distinctly bullate between intercostal veins.....**6. H. bullatifolia**
 Leaf blade flat to somewhat convex between veins above.....47
47. Leaf blade larger, 27–46 × 8–15 cm, base cordate.....**13. H. enicosanthoides**
 Leaf blade smaller, 12–28 × 4–9 cm, base not cordate.....48

48. Leaf blade drying reddish brown, lateral veins sunken above; young parts glabrescent...
**33. H. pterygota**
 Leaf blade drying greyish green, lateral veins flat above; young parts pubescent, white
 pruinose or silvery lepidote.....**29. H. pachycarpa**

1. *Hopea aequalis* P.S.Ashton

(Latin *aequalis* = equal; the fruit calyx lobes)

Gard. Bull. Sing. 22 (1967) 271, *op. cit.* (1968) 46, *op. cit.* (1982) 409; Anderson *op. cit.* (1980) 114.
Type: *Ilias S 15881*, Borneo, Sarawak, Bintulu district, Nyabau FR (holotype K; isotypes KEP, L).
Synonym: *Hopea* 'sp. nov. aff. *H. pachycarpa*' Meijer & Wood *op. cit.* 229.

Subcanopy tree, to 20 m tall, to 20 cm diameter, with narrow buttresses, flying buttresses and stilt roots. **Bark** smooth. *Living surfaces glabrous but for the puberulent midrib above.* **Twigs** c. 2 mm diameter apically. **Leaves** chartaceous, drying greyish brown above, yellowish brown below; *blade oblong-lanceolate*, 13–25 × 5.5–8 cm, *base equal, obtuse*, apex acuminate, acumen to 1 cm long, tapering; midrib shallowly furrowed but evident above, slender and prominent below; *venation hopea-type; lateral veins 16–20 pairs*, slender but prominent below; intercostal venation densely scalariform, hardly raised; petiole 1.5–1.8 cm long, c. 2 mm diameter. **Inflorescences** to 9 cm long, axillary, unbranched or singly branched; rachis c. 1 mm diameter; *flowers remote; bracts subpersistent.* **Flowers** unknown. **Fruits:** *calyx lobes subequal, ovate, subacute, saccate, to 1.8 × 1.6 cm.* **Nuts** ovoid, to 2.3 × 1.5 cm, acute, frequently resin-coated.

Vernacular name. Sabah—*selangan sama* (preferred name).

Distribution. Endemic in Borneo; uncommon. In Sabah once recorded from Sandakan district (*SAN 38797*) and in Sarawak known from Nyabau FR, Bintulu district (the type) and from Bt. Mersing, Tatau district (e.g., *S 22493*). Also occurring in Brunei (*Cowley 137*).

Ecology. In mixed dipterocarp forest on low hills and near streams, at altitude below 100 m. Critically endangered owing to its disappearing habitat.

2. *Hopea altocollina* P.S.Ashton

(Latin, *altus* = high, *collinus* = concerning hills; inhabitant of hill sites)

Gard. Bull. Sing. 22 (1967) 272, *op. cit.* (1968) 46, *op. cit.* (1982) 409; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 244; Newman *et al. op. cit.* 145. **Type:** *Ashton BRUN 1030*, Borneo, Sarawak, Limbang district, Bt. Antu, Ulu Sembayang (holotype K; isotypes KEP, L).

Tall main canopy or low emergent tree, to 50 m tall, to 1.8 m diameter; bole tall; buttresses thin, convex, to 4 m tall; crown evenly hemispherical with many ascending branches. **Bark** tawny brown, *shallowly fissured and powdery oblong-flaky. Perianth sericeous outside; parts otherwise glabrous.* **Twigs** c. 2 mm diameter apically. **Leaves** thinly coriaceous, drying yellowish brown with dark midrib below; *blade lanceolate*, 7–10 × 3–4.5 cm, *base obtuse, with revolute margin and appearing cuneate, apex caudate, with tapering acumen to 1 cm long; midrib slender, slightly raised above and below; venation dryobalanoid; main lateral veins c. 16 pairs, elevated below;* petiole 1–1.3 cm long, slender, somewhat geniculate. **Inflorescences** to 8 cm long, terminal or in axillary pairs, singly branched.

Flowers: petals oblong, cream; *stamens* *c.* 15, connectival appendage *c.* 2x as long as anther; *ovary and stylopodium cylindrical, with punctate obtuse apex and short style.*
Fruits: pedicels to 2 mm long; calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 4.5 × 0.8 cm, tapering to 3 mm wide above the saccate base, 3 shorter ones suborbicular, obtuse, to 0.4 × 0.4 cm, shorter than the nut. **Nuts** ovoid, to 0.7 × 0.5 cm, apiculate.

Vernacular name. Sarawak—*luis gunung* (preferred name).

Distribution. Endemic in Borneo; recorded in Sabah from Ulu Mendalong, Sipitang district (e.g., *SAN 16736*) and in Sarawak from Bintulu, Kapit, Limbang, Marudi, and Tatau districts (e.g., *S 21267, S 22461, S 36185, S 49026, and S 68645*).

Ecology. In upper dipterocarp forest; locally common on clay-rich soils, at 800–1000 m altitude. Vulnerable owing to logging.

3. *Hopea andersonii* P.S.Ashton

(J.A.R. Anderson, former Forest Officer in Sarawak and Brunei)

Gard. Bull. Sing. 22 (1967) 272, *op. cit.* (1968) 46, *op. cit.* (1982) 425; PROSEA *op. cit.* 258. **Type:** *Anderson S 11096*, Borneo, Sarawak, Bau district, Kuching road (holotype K; isotypes KEP, L).

Medium-sized canopy tree, to 40 m tall, to 1.5 m diameter, with even hemispherical crown; buttresses to 4 m tall, prominent, convex, *c.* 4 cm thick. **Bark** fawn-brown or coppery brown, *vertically cracked and oblong flaky or thinly flaky.* **Sapwood** cream; heartwood coffee-brown. *Parts of flower exposed in bud and ovary densely pale greyish puberulent; fruit calyx caducously so; living surfaces otherwise glabrous.* **Twigs** *c.* 1 mm diameter apically, slender. **Leaves** coriaceous, drying tawny with venation dark reddish brown below or pale greyish brown; *blade lanceolate-falcate to elliptic or narrowly elliptic-lanceolate, 5–14 × 2–6 cm, base distinctly unequal, obtuse adaxially, cuneate abaxially, apex acuminate, acumen to 2 cm long, slender, frequently falcate; midrib evident but flat above, prominent below; venation hopea-type; lateral veins 9–12 pairs, arched, slender, elevated below, with prominent pored, not swollen, pubescent, axillary domatia;* intercostal venation hardly elevated; petiole 0.5–1 cm long. **Inflorescences** to 12 cm, terminal or in axillary fascicles, singly branched, *branches with to 9 dense secund flowers; bracts fugaceous.* **Flowers:** buds ellipsoid, to 3 × 2 mm; petals oblong, cream; *stamens c.* 15, anthers ellipsoid, connectival appendage to 2½x the length of anther; *ovary and stylopodium cylindrical, slightly constricted medially, style short columnar.* **Fruits:** pedicels to 3 mm long, slender; calyx lobes unequal, 2 longer lobes oblong, obtuse, to 6 × 2 cm, tapering to 3 mm wide above the saccate base, 3 shorter ones to 0.4 × 0.3 cm, shorter than the nut. **Nuts** ovoid, to 0.8 × 0.5 cm, glabrous, retaining the truncate apical stylopodium and mucronate style remnant.

Vernacular names. Sabah—*selangan* (preferred name). Sarawak—*luis somit* (preferred name).

Distribution. Endemic in Borneo.

Notes. Two subspecies, subsp. *andersonii* and subsp. *basalticola*, are recognised in Sabah and Sarawak.

Key to subspecies

Bark becoming fawn-brown, vertically cracked and oblong-flaky. Leaf blade lanceolate-falcate to elliptic, drying tawny with venation dark reddish brown below.....

subsp. **andersonii**

Endemic in Sarawak and recorded from Bau, Kuching, Marudi, Serian, and Sri Aman districts (e.g., *S 10038*, *S 10353*, *S 16182*, *S 22876*, and *S 32661*). Locally frequent on limestone karst, at altitudes to 400 m. Not vulnerable.

Bark coppery brown, thinly flaky. Leaf blade frequently narrowly elliptic-lanceolate, drying pale greyish brown.....

subsp. **basalticola** P.S.Ashton

(Latinised English, *basalt* (a volcanic rock), *-cola* = growing; growing on basalt-derived soil)

Gard. Bull. Sing. 22 (1967) 273, *op. cit.* (1982) 426. **Type:** *Sibat S 25005*, Borneo, Sarawak, Tatau district, Bt. Mersing, Anap (holotype K; isotypes KEP, L).

Endemic in Borneo; recorded in Sabah from Kinabatangan and Tawau districts (e.g., *FMS 35387*, *SAN 23278* and *SAN 28649*), and in C Sarawak from Marudi, Miri and Tatau districts (e.g., *S 13798*, *S 23481* and *S 25040*). Also occurring in E Kalimantan (e.g., *bb. 13232*, *Kostermans 5431* and *Kostermans 6006*). In mixed dipterocarp forest on deep friable clay soils, over base-rich rocks, at altitudes to 400 m. Vulnerable.

4. Hopea beccariana Burck

Plate 3E.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Ann. Jard. Bot. Buitenz. 6 (1887) 240; Merrill, EB (1921) 401; Masamune, EPB (1942) 489; Symington *op. cit.* (1943) 122; Browne *op. cit.* 120; Ashton *op. cit.* (1964) 95, *op. cit.* (1968) 48, *op. cit.* (1982) 407; Meijer & Wood *op. cit.* 207; Burgess *op. cit.* 128; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 244; Coode *et al.* (eds.) *op. cit.* 71; Newman *et al.* *op. cit.* 145. **Type:** *Beccari PB 1177*, Borneo, Sarawak (holotype BO). **Synonyms:** *Hancea beccariana* (Burck) Pierre *op. cit.* (1891) t. 244; *Hopea nicholsonii* F.Heim *op. cit.* (1891) 973; *Hopea intermedia* King *op. cit.* 126, *p.p.*; *Balanocarpus ovalifolius* Ridl., J. Fed. Mal. Str. Mus. 10 (1920) 130, *p.p.*

Canopy or shortly emergent tree, to 45 m tall, to 1.6 m diameter, with diffuse hemispherical crown and short stout buttresses. **Bark** generally becoming deeply v-section fissured, dark chocolate-brown. **Sapwood** yellowish brown; heartwood chocolate-brown, hard. *Exposed young living parts and ovary apex caducous puberulent, more or less waxy glaucescent; parts otherwise glabrous.* **Twigs** c. 1 mm diameter apically, slender. **Leaves** thinly coriaceous, drying pale yellowish brown including venation; *blade broadly ovate, 5–8 × 2.2–4.5 cm, base cuneate, frequently subequal, margin flat, apex caudate, acuminate to 1.5 cm long; midrib slender, elevated on both surfaces; venation dryobalanoid, indistinct, hardly raised, drying not blackish; main lateral veins c. 8 pairs; intercostal venation obscure, reticulate; petiole 1.2–1.7 cm long, slender, somewhat geniculate.* **Inflorescences** to 7 cm long, generally axillary, singly branched, branches with to 5 secund flowers. **Flowers:** buds small, ellipsoid, subsessile; petals linear, cream; *stamens c. 15, connectival appendage c. 2x as long as anther; ovary and stylopodium hourglass-shaped, tapering into short style.* **Fruits:** calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 3.5 × 1 cm, tapering to 2 mm above the saccate base, 3 shorter ones ovate, acute, to 0.7 cm long, shorter than nut. **Nuts** broadly ovoid, to 0.9 × 0.5 cm, with 1 mm short tapering style remnant.

Vernacular names. Sabah—*selangan penak* (preferred name). Sarawak—*cengal pasir* (preferred name).

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo. In Sabah widespread and recorded from Keningau, Kinabatangan, Kota Kinabalu, Kota Merudu, Kudat, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Semporna, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15483*, *SAN 18545*, *SAN 25334*, *SAN 38703*, *SAN 47353*, and *SAN 100048*) and in Sarawak from Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, and Serian districts (e.g., *S 12375*, *S 15212*, *S 15786*, *S 25480*, and *S 37808*). Also occurring in Brunei (e.g., *BRUN 540*, *FMS 35452* and *S 5830*).

Ecology. Locally frequent in mixed dipterocarp forest, on dry, usually deep and sandy soils on ridges. Especially in the coastal hills but occasionally at altitudes to 1200 m. Occurring in Lambir NP; vulnerable owing to land conversion and logging.

Notes. The leaves closely resemble those of *H. latifolia* which however retains smooth bark. They are distinguished when dry from those of *H. dryobalanoides* by their sandy buff-brown colour and pale lateral veins and midrib below.

5. *Hopea bracteata* Burck

(Latin, *bractea* = a thin metal plate; the subpersistent bracts)

Ann. Jard. Bot. Buitenz. 6 (1887) 239; Ashton *op. cit.* (1964) 97, *op. cit.* (1968) 48, *op. cit.* (1978) 31, *op. cit.* (1982) 414; Meijer & Wood *op. cit.* 229; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 245; Coode *et al.* (eds.) *op. cit.* 71. **Type:** *Teysmann HB 8265*, Borneo, W Kalimantan (holotype BO). **Synonyms:** *Balanocarpus curtisii* King *op. cit.* 158; *B. bracteatus* (Burck) Merr. *op. cit.* (1921) 407; *Hopea minima* Symington, Gard. Bull. S. S. 10 (1939) 337.

Subcanopy, occasionally low canopy tree, to 35 m tall, to 60 cm diameter, with flying buttresses and *stilt roots*; crown frequently persistently monopodial, with somewhat pendent branches in juveniles. **Bark smooth.** *Young twig, buds and petiole shortly persistently greyish puberulent; floral sepals fimbriate; parts otherwise glabrous.* **Twigs** *c.* 0.7 mm diameter apically, very slender. **Leaves** chartaceous, drying dull greyish green; *blade elliptic to narrowly ovate, 2.5–6 × 0.7–2 cm*, base cuneate, subequal, apex acuminate, acumen to 1.5 cm long; *midrib obscurely sunken above, slender and elevated below; venation subdryobalanoid; main lateral veins c.* 11 pairs; *intercostal venation reticulate, distinct below; petiole 0.2–0.4 cm long, slender.* **Inflorescences** racemose, terminal or in axillary pairs, to 9 cm long, slender, remotely irregularly singly or doubly branched, *ascending branches zigzag bearing to 5 remote flowers; bracts subpersistent; bracteoles* deltoid, to 2 mm across, subpersistent. **Flowers:** buds small, broadly ovoid, subsessile; petals oblong, deep wine-red, strongly contorted; *stamens c.* 15, anthers subglobose, connectival appendage *c.* 2x as long as anther; *ovary and stylopodium cylindrical, truncate, style short.* **Fruits:** *calyx lobes subequal, ovate, obtuse, to 0.5 × 0.5 cm*, concealing all but the apex of nut. **Nuts** ovoid, to 0.9 × 0.6 cm, with minutely truncate apex.

Vernacular names. Sabah—*selangan* (preferred name). Sarawak—*luis padi* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Sabah known from Keningau, Kinabatangan, Labuk Sugut, Nabawan, Ranau, Sandakan, and Tawau districts (e.g., *Kamaruddin KMS 3433*, *SAN 38944*, *SAN 83076*, *SAN 83408*, *SAN 128811*, and *SAN 130025*); locally abundant throughout Sarawak and recorded from Belaga, Bintulu, Kuching, Lundu, Miri, and Serian districts (e.g., *S 13347*, *S 18305*, *S 27172*, *S 43517*, and *S 49885*). Also occurring in Brunei (e.g., *BRUN 322*, *BRUN 328*, *BRUN 435*, *FMS 30618*, and *S 5713*).

Ecology. Very local but often abundant in mixed dipterocarp forest on both clay and sandy soils, at altitudes to 650 m. Locally common in Lambir NP but vulnerable elsewhere.

6. *Hopea bullatifolia* P.S.Ashton

(Latin, *bullatus* = blistered, *folius* = a leaf; the quilted leaf blade)

Gard. Bull. Sing. 22 (1967) 274, *op. cit.* (1968) 48, *op. cit.* (1982) 433; Anderson *op. cit.* (1980) 115. **Type:** *Mashor SA 522*, Borneo, Sarawak, Belaga district, Sg. Danum (holotype K; isotype KEP).

Subcanopy tree, to 20 tall, to 20 cm diameter; buttresses low, thin. **Bark** smooth. *Young exposed parts including petiole and midrib below densely evenly persistently tawny pubescent, venation and lamina below sparsely so; parts otherwise apparently glabrous.* **Twigs** c. 2 mm diameter apically. **Leaves** thinly coriaceous, *prominently bullate between the intercostal veins*, drying chocolate-brown and darker above, *not silvery below; blade oblong*, 16–34 × 4.5–9 cm, *base markedly unequal, subcordate*, apex with slender acumen to 1 cm long; *midrib prominent on both surfaces; venation hopea-type; lateral veins 17–26 pairs*, slender but prominent below, sunken above, often anastomosing within margin; intercostal venation scalariform, lax, raised below, sunken above; petiole 0.3–0.6 cm long, stout. **Inflorescence** and **flower** unknown. **Fruits** subsessile; *calyx lobes unequal, 2 longer lobes spatulate*, obtuse, to 8 × 1.5 cm, tapering to 3 mm above the saccate base, 3 shorter ones to 1.5 cm long, lanceolate, enclosing and hiding the nut. **Nuts** ovoid, to 1 × 0.7 cm, apiculate.

Vernacular name. Sarawak—*luis melencur* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Belaga, Kapit, Lubok Antu, Sibul, Song, Sri Aman, and Tatau districts (e.g., *S 17730*, *S 43453*, *S 45130*, *S 69663*, and *SFN 35726*). Also occurring in S Kalimantan.

Ecology. Rare, in mixed dipterocarp forest on low shale hills, at altitudes to 200 m. Probably endangered.

7. *Hopea centipeda* P.S.Ashton

(Latin, *centi-* = hundred, *pes* = a foot; the stilt roots)

Fig. 13.

Gard. Bull. Sing. 22 (1967) 274, *op. cit.* (1968) 48, *op. cit.* (1982) 423; Anderson *op. cit.* (1980) 115; Coode *et al.* (eds.) *op. cit.* 71. **Type:** *Murthy & Ashton S 23342*, Borneo, Sarawak, Marudi district, Ulu Dapoi, Tinjar (holotype K; isotypes KEP, L). **Synonym:** *Hopea acuminata auct. non. Merr.:* Ashton *op. cit.* (1964) 94, Coode *et al.* (eds.) *op. cit.* 71.

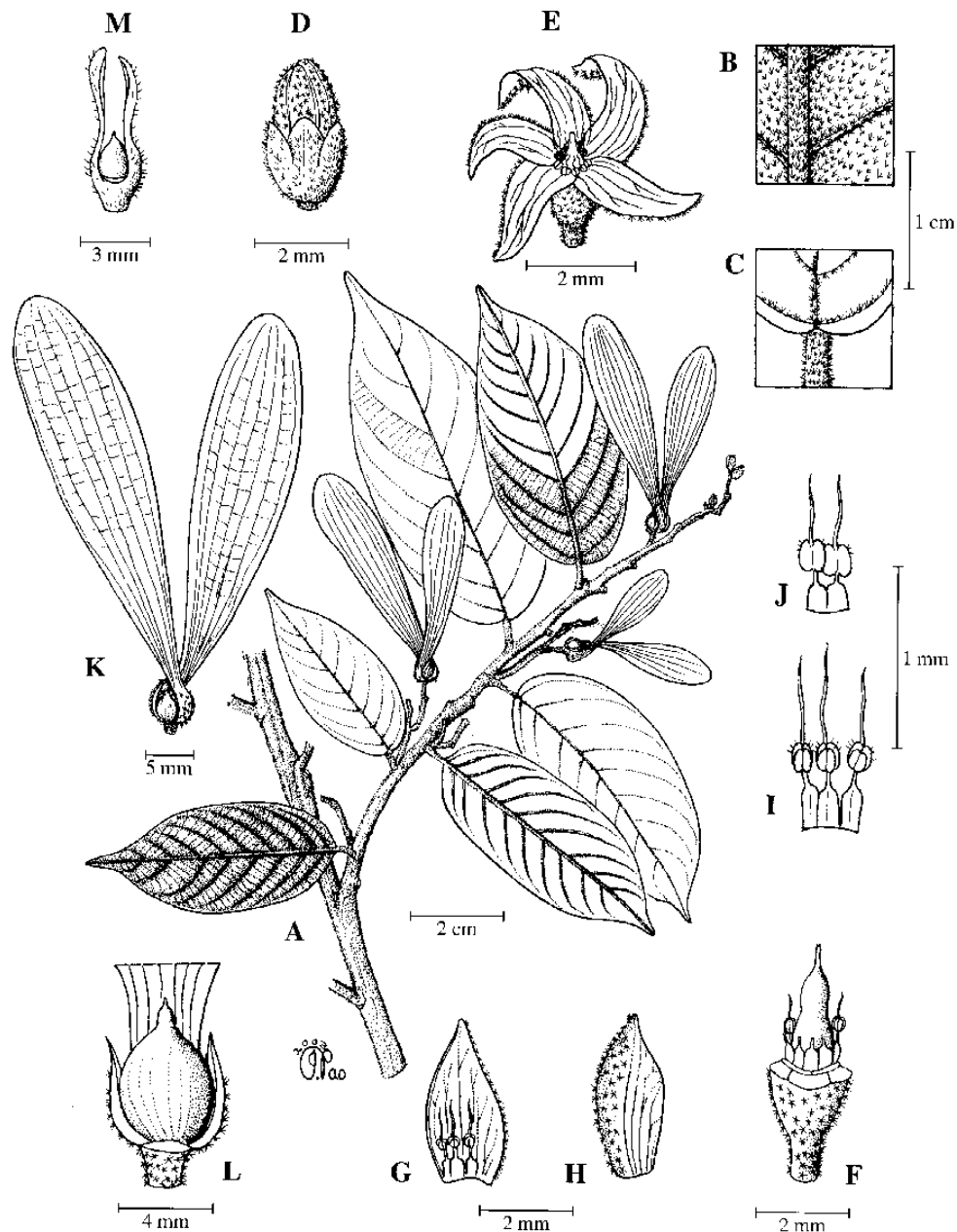


Fig. 13. *Hopea centipeda*. A, fruiting leafy twig; B, detail of indumentum on lower leaf surface; C, detail of indumentum on upper leaf surface; D, flower bud; E, open flower; F, gynocium; G, adaxial view of petal with stamens; H, abaxial view of petal; I, adaxial view of stamens; J, abaxial view of stamens; K, fruit; L, partially exposed nut; M, fruit with the large calyx lobes removed. (A–C and K–L from SAN 124740, D–J and M from S 23342.)

Canopy tree, to 30 m tall, to 60 cm diameter, often remaining monopodial with pendent branches and diffuse foliage; *bole with abundant flying buttresses and stilt roots to 3 m*; **Sapwood** soft, pale. **Bark** smooth. *Young leaf shoots including leaf venation below and petiole, inflorescence and parts of flower exposed in bud persistently shortly greyish brown puberulent; parts otherwise glabrous.* **Twigs** c. 1 mm diameter apically, slender. **Leaves** chartaceous, drying pale yellowish grey; *blade lanceolate, 5.5–9 × 1.5–3.5 cm, base subequal, cuneate, apex caudate, acumen to 1.5 cm long; midrib prominent below, narrow and sunken above; venation hopea-type; lateral veins 7–9 pairs, prominent below, somewhat arched, with prominent tomentose axillary domatia; intercostal venation slender, subscalariform; petiole 0.4–0.7 cm long, slender.* **Inflorescences** to 2 cm long, axillary, *flowers dense; bracts fugaceous.* **Flowers:** buds lanceolate, to 6 × 2 mm; petals cream to pink at base, oblong; *stamens c. 15, anthers subglobose, connectival appendage c. 3x the length of anther; ovary and stylopodium pyriform, style prominent, as long as ovary and equal to stylopodium.* **Fruits:** pedicel c. 1 mm long, slender; calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 3 × 0.8 cm, tapering to 1.5 mm above the saccate base, 3 shorter ones ovate, to 0.4 × 0.3 cm. **Nuts** ovoid, to 0.4 × 0.3 cm, apiculate.

Vernacular name. Sarawak—*luis daun berbulu* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Nabawan and Tawau districts (e.g., *SAN 62794* and *SAN 124740*) and in Sarawak from Belaga, Bintulu, Kapit, Marudi, and Miri districts (e.g., *S 22649*, *S 22682*, *S 23010*, *S 23012*, and *S 43577*). Also occurring in Brunei (e.g., *BRUN 125*, *BRUN 127* and *S 5750*).

Ecology. Locally common along the banks of swift-flowing rivers, on shale and silt, at altitudes to 300 m. Frequently flowering and fruiting. Vulnerable.

8. *Hopea cernua* Teijsm. & Binn.

(Latin, *cernuus* = slightly drooping; the flowers)

Nat. Tijd. Ned. Ind. 29 (1867) 252; Merrill *op. cit.* (1921) 402; Masamune *op. cit.* 490; Ashton *op. cit.* (1968) 49, *op. cit.* (1978) 28, *op. cit.* (1982) 398; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 245; Kessler & Sidiyasa *op. cit.* 97; Coode *et al.* (eds.) *op. cit.* 71; Newman *et al.* *op. cit.* 147. **Lectotype** (designated here): *Binnendijk s.n.*, Sumatra (hololectotype K). **Synonyms:** *Hancea cernua* (Teijsm. & Binn.) Pierre *op. cit.* (1891) t. 244; *Hopea argentea* Meijer, Act. Bot. Neerl. 12 (1963) 348, Meijer & Wood *op. cit.* 207, Burgess *op. cit.* 128, Ashton *op. cit.* (1968) 47.

Canopy tree, to 40 m tall, to 80 cm diameter, *with prominent flying buttresses and stilt roots.* **Bark** becoming cracked and eventually v-section fissured, chocolate-brown; *inner bark pale brown.* *Leaf bud, young twig and petiole fugaceous greyish brown puberulent; parts otherwise glabrous.* **Twigs** c. 1 mm diameter apically, slender. **Leaves** thinly coriaceous, often somewhat silvery lepidote below, drying greyish tawny with the veins often darker below; *blade elliptic to ovate, 5–15 × 2–5 cm, base cuneate, unequal, margin frequently narrowly shallowly revolute, apex with acumen to 0.6 cm long; midrib terete below, slender and elevated above, not drying black; venation dryobalanoid, slender but generally distinctly elevated below, often with a few axillary pubescent pore-like domatia; main lateral veins 10–12 pairs, distinctly raised below, basal pairs short, drying blackish; petiole 0.7–0.9 cm long, slender.* **Inflorescences** terminal or axillary, singly branched, to 3 cm long. **Flowers:** buds spindle-shaped, to 5 × 4 mm, relatively large; petals lanceolate, cream; *stamens 15–18, anthers subglobose, connectival appendage 2–3x the length of anther; ovary ovoid, without stylopodium, style columnar, c. 1½x as long as ovary, villous*

towards base. **Fruits:** pedicels *c.* 2 mm long; calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 6.5 × 1.2 cm, tapering to 4 mm above the saccate but rather broad, 0.5 × 5 mm base, 3 shorter ones lanceolate, to 1.5 cm long, concealing the nut. **Nuts** ovoid, to 0.7 × 0.5 cm, apiculate.

Vernacular names. Sabah—*selangan urat* (preferred name). Sarawak—*luis timbul* (preferred name).

Distribution. Sumatra and Borneo. Throughout Sabah and recorded from Kinabatangan, Lahad Datu, Ranau, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 16367*, *SAN 22090*, *SAN 23260*, *SAN 24252*, *SAN 35861*, and *SAN A 4049*) and in Sarawak known from Bau, Bintulu, Kapit, Kuching, Lundu, Miri, and Serian districts (*S 15448*, *S 24040*, *S 25647*, *S 32660*, and *S 60129*). Also occurring in Brunei (e.g., *BRUN 2359* and *BRUN 2532*) and E Kalimantan (e.g., *Kostermans 6032*, *Kostermans 13838*, *Sidiyasa 439*, and *Sidiyasa 539*).

Ecology. In forest on organic soils over limestone in the lowlands and in upper dipterocarp forest, at 1000–1650 m altitude; also on igneous rocks. Very local, vulnerable.

9. *Hopea coriacea* Burck

(Latin, *coriaceus* = leathery; the leaf blade)

Ann. Jard. Bot. Buitenz. 6 (1887) 237; Merrill *op. cit.* (1921) 402; Masamune *op. cit.* 490; Ashton *op. cit.* (1978) 28, *op. cit.* (1982) 398; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 260; Coode *et al.* (eds.) *op. cit.* 71; Newman *et al. op. cit.* 148. **Type:** *Teijsmann s.n.*, Borneo, Kalimantan (holotype BO; isotype L). **Synonyms:** *Hopea kelantanensis* Symington, J. Malay. Br. Roy. As. Soc. 19 (1941) 144; *H. garangbuaya* P.S.Ashton, Gard. Bull. Sing. 19 (1962) 256, *op. cit.* (1964) 101, *op. cit.* (1968) 51.

Large canopy or low emergent tree, to 45 m tall, to 1.5 m diameter; crown dense hemispherical; buttresses to 1.5 m tall, to 8 cm thick, concave or convex; *stilt roots few or none*. **Bark** smooth to flaky or deeply v-section fissured, greyish to chocolate-brown; *inner bark pale brown or pink*. **Sapwood** straw-yellow, hard; heartwood dark chocolate-brown. *Parts glabrous but for pubescent parts of petals exposed in bud*. **Twigs** *c.* 2 mm diameter apically, stout. **Leaves** thickly coriaceous, drying pale chocolate-brown below, yellowish brown above; *blade broadly ovate or suborbicular, 11–16 × 6–10 cm*, base equal, obtuse, *margin revolute*, apex acuminate, acumen to 1.2 cm long, narrow; *midrib* prominently terete below, *slightly elevated though stout above*; *venation dryobalanoid*, sharply elevated below, strongly arched; *main lateral veins 8–11 pairs or sometimes at most 4 pairs*, with short intermediates; *intercostal venation scalariform*, distinctly elevated below; *petiole 2–2.5 cm long, stout*. **Inflorescences** terminal or in axillary pairs, to 9 cm long, singly branched, branchlets bearing to 6 secund flowers. **Flowers:** buds ellipsoid, to 3 × 2.5 mm, large, distinctly pedicellate; petals lanceolate, to 1.3 cm long, cream; *stamens c. 15*, anthers oblong, connectival appendage 2–3x the length of anther, tuberculate towards base; *ovary ovoid, style as long as ovary, columnar*, setose towards base and onto ovary apex, *stylopodium obscure*. **Fruits:** calyx lobes unequal, 2 longer lobes to 7 × 1.5 cm, hardly tapering to the narrowly auriculate saccate base, 3 shorter ones ovate to lanceolate, to 2 × 1.2 cm, *concealing the nut*, similar at base. **Nuts** narrowly ovoid, to 1.8 × 0.9 cm, with to 2 cm long filiform style remnant, often resinous.

Vernacular name. Sarawak—*garang buaya* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Borneo known in Sarawak from Bintulu, Limbang, and Lundu districts (e.g., *S 10395*, *S 12610*, *S 18340*, *S 18855*, and *S 66799*). Also occurring in Brunei (e.g., *BRUN 713*, *BRUN 2006A*, *BRUN 3347*, and *S 5768*) and Kalimantan (e.g., the type, *bb. 7699* and *bb. 35251*).

Ecology. In mixed dipterocarp forest and along the banks of small rivers, on yellow sandy soils, at altitudes below 400 m. Rare and critically endangered by logging and forest conversion.

10. *Hopea depressinerva* P.S.Ashton

(Latin, *depressus* = sunken, *nervus* = nerve/vein; the sunken veins on leaf upper surface)

Gard. Bull. Sing. 22 (1967) 275, *op. cit.* (1968) 50, *op. cit.* (1982) 420; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 260. **Type:** *Anderson S 15439*, Borneo, Sarawak, Lundu district, Bt. Gebong (holotype K; isotypes KEP, L).

Subcanopy or canopy tree, to 25 m tall, to 50 cm diameter. **Bark** brown, becoming cracked along lines of lenticels; damar exudation not conspicuous. Parts glabrescent but for densely buff-pubescent inflorescence and parts of flower exposed in bud. **Twigs** 1–2 mm diameter apically, slender. **Leaves** thinly coriaceous, undulate, drying pale greyish brown, not pale lepidote below; blade lanceolate to narrowly elliptic, 5–13 × 2–5 cm, base cuneate, equal, apex with slender acumen to 1.5 cm long; venation *hopea*-type; lateral veins 6–8 pairs, slender but distinctly raised below, obscure and sunken above, domatia obscure or absent; intercostal venation densely scalariform, slender, not elevated; petiole 1.1–1.3 cm long, slender. **Inflorescences** terminal or axillary, to 7 cm long, singly branched, branchlets bearing to 5 secund dense flowers; bracts fugaceous. **Flowers:** buds ellipsoid, to 3 × 2 mm; petals elliptic, pink; stamens c. 10, anthers subglobose, connectival appendage c. 2x the length of anther; ovary and stylopodium cylindrical, truncate, style short. **Mature fruits** unknown; calyx lobes unequal, 2 larger lobes aliform.

Distribution. Endemic in Borneo; known so far from G. Pueh and Bt. Gebong, Lundu district in W Sarawak (e.g., *S 395*, *S 15516* and the type).

Ecology. Very local, apparently uncommon in mixed dipterocarp forest on deep sandy loam soils over granodiorite, at altitudes to 500 m. Conservation status unknown, but likely vulnerable.

11. *Hopea dryobalanoides* Miq.

(Greek, *dryobalanoides* = resembling *Dryobalanops*; the leaf venation)

Fig. 14.

Fl. Ned. Ind., Suppl. (1862) 492; Symington *op. cit.* (1939) 345; Browne *op. cit.* 120; Ashton *op. cit.* (1963) 259, *op. cit.* (1964) 50, *op. cit.* (1968) 50, *op. cit.* (1982) 402; Meijer & Wood *op. cit.* 209; Burgess *op. cit.* 129; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 246; Kessler & Sidiyasa *op. cit.* 97; Coode *et al.* (eds.) *op. cit.* 71; Newman *et al.* *op. cit.* 149. **Type:** *Teijsmann s.n.*, Sumatra, Pariaman, Padang (holotype U). **Synonyms:** *Hancea dryobalanoides* (Miq.) Pierre *op. cit.* t. 244; *Hopea sarawakensis* F.Heim *op. cit.* (1891) 971; *Hopea borneensis* F.Heim *op. cit.* (1891) 972.

Large canopy or low emergent tree, to 45 m tall, to 1.3 m diameter; buttresses to 2 m tall, thin, concave, spreading; stilt roots present on young trees. **Bark** becoming fawn brown, vertically cracked and powdery thinly oblong flaky, with coxcombs of glassy dammar; inner

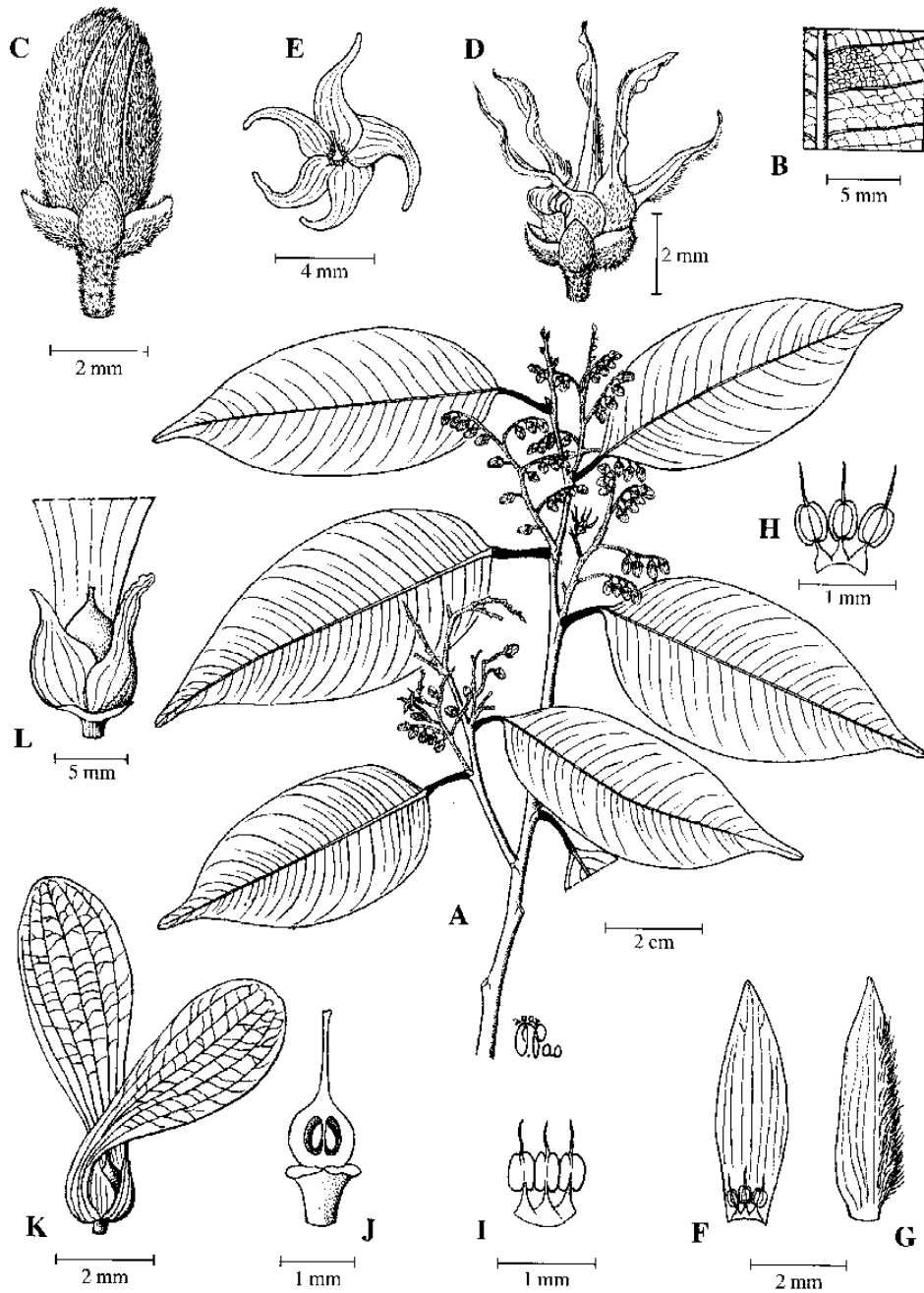


Fig. 14. *Hopea dryobalanoides*. A, flowering leafy twig; B, detail of venation on lower leaf surface; C, flower bud; D, side view of open flower; E, top view of open flower; F, adaxial view of petal with stamens; G, abaxial view of petal; H, adaxial view of stamens; I, abaxial view of stamens; J, longitudinal section of gynoecium; K, fruit; L, fruit with the large calyx lobes removed. (A–J from SAN 15186, K–L from SAN 100048.)

bark pale brown or pink. Young parts including leaf below, petiole, inflorescence and parts of flower exposed in bud densely greyish brown fugaceous-puberulent. **Twigs** c. 1 mm diameter apically, slender, drying blackish. **Leaves** chartaceous or thinly coriaceous, drying dull leaden brown below; blade ovate-lanceolate, 5–12 × 1.5–4.5 cm, base cuneate, equal to subequal, apex subcaudate, acumen to 2 cm long; midrib raised and terete or sharp on both surfaces, more so below, drying black or not; venation dryobalanoid; main lateral veins 8–12 pairs, with a few short intermediates, slender but distinct and somewhat elevated below, arched, drying paler or darker than the blade, sometimes with a few small glabrous pore-like axillary domatia; petiole 0.5–1 cm long, slender, drying blackish. **Inflorescences** terminal or in axillary pairs, lax, singly branched, branchlets to 5 cm long, bearing to 6 flowers. **Flowers:** buds small, broadly ovoid; petals lanceolate, cream-yellow; stamens c. 15, anther subglobose, connectival appendage c. 2x the length of anther; ovary ovoid, stylopodium obscure, style filiform, as long as ovary, villous towards base. **Fruits:** pedicels to 2 mm long; calyx lobes unequal, 2 longer lobes strongly twisted, spatulate, subacute, to 6.5 × 1.5 cm, tapering to 5 mm above the saccate base, 3 shorter ones broadly ovate, obtuse or subacute, to 0.8 × 0.6 cm, shorter than the nut. **Nuts** broadly ovoid, to 1 × 0.8 cm, with to 1.5 mm filiform style remnant.

Vernacular names. Sabah—*selangan daun kapur* (preferred name). Sarawak—*mata kucing hitam* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah widespread and recorded from Beaufort, Kinabatangan, Kota Kinabalu, Kudat, Labuk Sugut, Lahad Datu, Ranau, Semporna, Tawau, and Tenom districts (e.g., *SAN 16837*, *SAN 19335*, *SAN 22654*, *SAN 22849*, and *SAN 24514*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu, Miri, Serian, Sibul, and Tatau districts (e.g., *S 7972*, *S 15249*, *S 22476*, *S 28172*, and *S 43827*). Also occurring in Brunei (e.g., *BRUN 3376*, *BRUN 5230* and *BRUN 5376*) and E Kalimantan (e.g., *Kostermans 13518*, *Kostermans 13867* and *Sidiyasa 707*).

Ecology. Locally abundant in mixed dipterocarp forest on clay-rich soils, especially on intermediate to basic igneous and volcanic rocks but also sedimentaries, at altitudes to 600 m. Well represented in Kinabalu NP, Sepilok FR and Danum Valley Conservation Area in Sabah and Lambir and Mulu NPs in Sarawak; not vulnerable.

Uses. Formerly a major source of *damar mata kucing*, yielding a high quality resin.

Notes. One of the largest of the dryobalanoid *Hopea* species, with flaky bark and prominent thin buttresses. The leaf dries a distinctive greenish grey with distinct curved lateral veins, black drying midrib below and long black petiole (cf. *H. beccariana*).

12. *Hopea dyeri* F. Heim

(J.T. Thiselton-Dyer, 1824–1928, a British botanist, one time Director of the Royal Botanic Gardens, Kew)

Bull. Mens. Soc. Linn. Paris 2 (1891) 972; Merrill *op. cit.* (1921) 402; Symington *op. cit.* (1939) 353; Masamune *op. cit.* 490; Browne *op. cit.* 120; Ashton *op. cit.* (1964) 99, *op. cit.* (1968) 50, *op. cit.* (1982) 407; Meijer & Wood *op. cit.* 210; Burgess *op. cit.* 129; Anderson *op. cit.* (1980) 116; PROSEA *op. cit.* 246; Coode *et al.* (eds.) *op. cit.* 71. **Type:** *Beccari PB 2962*, Borneo, Sarawak, Matang (holotype P). **Synonym:** *Hopea intermedia* King *op. cit.* 126, p.p.

Medium-sized canopy tree, to 40 m tall, to 65 cm diameter; crown narrowly hemispherical; bole frequently misshapen, with low narrow buttresses and a few stilt roots. **Bark** smooth, becoming patchily flaky, sometimes with yellowish dammar exudations; inner bark pale brown or pink. **Sapwood** yellowish. *Bud, stipules, inflorescence, outside of petals and domatia sparsely or densely greyish brown puberulent; twig, petiole and parts of calyx exposed in bud caducously so.* **Twigs** c. 1 mm diameter apically, slender, much-branched. **Leaves** coriaceous, frequently lepidote below, drying greyish brown; blade ovate-lanceolate, 2.7–7 × 1.2–2.5 cm, base unequal, cuneate, margin often slightly revolute, apex caudate, acuminate to 1.5 cm long; midrib terete and raised on both surfaces, more so above, not drying black; venation dryobalanoid; main lateral veins 8–12 pairs with many intermediates, distinct and somewhat elevated below, the longest subequal, basal pairs short; petiole 0.5–0.8 cm long, slender. **Inflorescences** terminal or axillary, to 3 cm long, singly or doubly shortly branched, branchlets bearing to 4 flowers. **Flowers:** buds small, ovoid; petals narrowly lanceolate, cream; *stamens* c. 15, anthers subglobose, connectival appendage c. 3x the length of anther; *ovary and stylopodium pyriform*, villous towards apex, style short. **Fruits:** calyx lobes unequal, 2 longer lobes spatulate, narrowly obtuse, to 2.5 × 1 cm, tapering to 2.5 mm above the saccate base, 3 shorter ones ovate, acute to subacuminate, to 0.7 × 0.4 cm, shorter than the nut. **Nuts** ovoid, to 0.9 × 0.4 cm, with vestigial stylopodium and subacute style remnant.

Vernacular names. Sabah—*selangan daun halus* (preferred name). Sarawak—*luis palit* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Sabah recorded from Keningau, Labuk Sugut, Ranau, Sandakan, Sipitang, and Tawau districts (e.g., SAN 19452, SAN 21506, SAN 41082, SAN 66241, and SAN 99285) and in Sarawak from Bintulu, Kapit, Kuching, Lawas, Lubok Antu, Miri, Samarahan, and Serian districts (e.g., S 15219, S 23962, S 24655, S 41114, and S 69631). Also occurring in Brunei (e.g., BRUN 876, BRUN 3068 and BRUN 3180) and C and E Kalimantan (e.g., bb. 24781 and Ridsdale PBU 593).

Ecology. Locally common in mixed dipterocarp forest on sandy and sandy clay soils, on low hills and along sandstone ridges, occasionally at altitudes to 1000 m but usually lower. Occurring in Kubah NP, Sarawak; regeneration abundant; probably not vulnerable.

Notes. This species one of a group of small-leaved and small-fruited dryobalanoid-veined *Hopea* species, also notably including *H. ferruginea*, *H. micrantha* and *H. vesquei*, which can be difficult to identify on field characters alone. The leaf of *H. micrantha* is obtuse at base, but that of the others is cuneate, and the leaf dries pink not coppery brown. The twigs and petioles of *H. vesquei* are densely persistently puberulent, but the leaf is shorter and broader with unequal base, and more coriaceous than the other species. Variability in leaf size and texture of *H. dyeri* as recognised here suggests that fertile material of *H. vesquei* may yet to be found east of Batang Lupar (Sarawak).

13. *Hopea enicosanthoides* P.S.Ashton

(Greek, resembling *Enicosanthum*, Annonaceae; the leaf)

Gard. Bull. Sing. 22 (1967) 276, *op. cit.* (1968) 50, *op. cit.* (1982) 436; Anderson *op. cit.* (1980) 116. **Type:** Ashton S 18116, Borneo, Sarawak, Bintulu district, Ulu Labang (holotype K; isotypes KEP, L).

Small tree, to 18 m tall, to 20 cm diameter; crown monopodial, with pendent branches and leaves; buttresses low, thin; stilt roots few. **Bark** smooth. *Young parts including petiole and base of midrib above more or less caducous tawny pubescent.* **Twigs** c. 3 mm diameter apically, often somewhat compressed, ribbed below the petiole insertion. **Leaves** *thinly coriaceous, somewhat convex between the veins above, drying greenish to rust-brown; blade very large, oblong, 27–46 × 8–15 cm, base unequal, cordate, apex with slender acumen to 2.5 cm long; midrib evident but furrowed above, prominent below; venation hopea-type; lateral veins 16–30 pairs, slender but prominent below; intercostal venation densely scalariform, evident but unraised below; petiole 0.5–0.8 cm long, stout.* **Inflorescences** *in axillary pairs or ramiflorous, slender, lax, to 12 cm long, singly branched, branchlets bearing to 5 flowers.* **Flowers:** unknown. **Fruits** *sessile; calyx lobes unequal, 2 longer lobes broadly spatulate, obtuse, to 13 × 3 cm, tapering to 6 mm above the saccate base, 3 shorter ones lanceolate, acute, to 2 cm long, similar at base, concealing the nut.* **Nuts** *ovoid, to 1 × 0.6 cm, with 2 mm long filiform style remnant.*

Vernacular name. Sarawak—*luis selukai* (preferred name).

Distribution. Endemic in Borneo and known only from Bintulu, Kapit and Miri districts in Sarawak (e.g., *S 1467, S 1470, S 13200, S 18304, S 37686, and S 69631*).

Ecology. On the banks of sluggish eutrophic rivers and moist slopes by streams, at altitudes below 100 m, locally abundant; but killed by prolonged immersion in turbid water. Probably endangered.

14. *Hopea ferruginea* Parijs

(Latin, *ferrugineus* = rust-coloured; the indumentum)

In Fedde, Rep. 33 (1933) 243; Symington op. cit. (1939) 349, op. cit. (1943) 125; Masamune op. cit. 490; Meijer & Wood op. cit. 211; Burgess op. cit. 129; Ashton op. cit. (1982) 404; PROSEA op. cit. 247; Coode et al. (eds.) op. cit. 71. Type: bb. 14459, Sumatra, Jambi (holotype BO; isotype L).

Medium-sized canopy tree, to 40 m tall, to 70 cm diameter, *with thin buttresses and stilt roots.* **Bark** *smooth, becoming thinly flaky,* with clear globular dammar exudations; *inner bark pale brown or pink. Young twigs, petiole, midrib above, inflorescence, and parts of flower exposed in bud sparsely but persistently greyish to rust-brown puberulent, or glabrescent.* **Twigs** *c. 1 mm diameter apically, slender, blackish.* **Leaves** *thinly coriaceous, drying greyish brown; blade narrowly ovate-lanceolate, 4.5–7.5 × 1.5–4 cm, base cuneate, unequal, shortly decurrent, apex caudate, acumen to 1.5 cm long; midrib terete, slender, elevated on both surfaces, not drying black; venation dryobalanoid; main lateral veins c. 14 pairs, basal pairs short, with many subequal intermediates, somewhat raised below, with prominent axillary domatia in juveniles; petiole 0.6–1 cm long, slender.* **Inflorescences** *axillary, to 2 cm long, with short branchlets bearing to 4 secund flowers.* **Flowers:** *buds ellipsoid, to 3 × 2 mm; petals lanceolate, pale yellow; stamens c. 15, anther subglobose, connectival appendage c. 2x the length of anther; ovary ovoid, stylopodium obscure, style columnar, as long as ovary, villous towards base or glabrous.* **Fruits:** *pedicels to 2 mm long, very slender; calyx lobes unequal, 2 longer lobes spatulate, narrowly obtuse, to 3 × 0.5 cm, tapering to 1.5 mm above the saccate base, 3 shorter ones ovate-acuminate, to 0.8 × 0.4 cm, closely clasping and concealing the ripe nut.* **Nuts** *ovoid, to 0.7 × 0.4 cm, apiculate.*

Vernacular name. Sabah—*selangan mata kucing* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo common and widespread. In Sabah recorded from Kinabatangan, Kota Belud, Kudat, Lahad Datu, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 15358*, *SAN 19380*, *SAN 26590*, and *SAN 67737*) and in Sarawak from Lawas, Limbang and Miri districts (e.g., *Nooteboom 2332*, *S 31527* and *S 39619*). Also occurring in Brunei (e.g., *BRUN 3375*) and E Kalimantan (e.g., *bb. 14974*).

Ecology. In mixed dipterocarp forest on clay-rich soils and along ridges in upper dipterocarp forest, at altitudes to 750 m. Locally common and occurring in Kinabalu NP, but vulnerable.

Notes. Sterile specimens of this species is not easily distinguishable from those of *H. dyerii* (see there).

15. *Hopea fluvialis* P.S.Ashton

(Latin, *fluvialis* = pertaining to rivers; the natural habitat)

Gard. Bull. Sing. 19 (1962) 254, *op. cit.* (1964) 100, *op. cit.* (1968) 51, *op. cit.* (1982) 399; Anderson *op. cit.* (1980) 116; PROSEA *op. cit.* 247; Coode *et al.* (eds.) *op. cit.* 71. **Type:** *Flemmich FMS 34523*, Brunei, Belait district, Sg. Melayan (holotype KEP).

Medium-sized leaning riverbank tree, to 25 m tall, to 80 cm diameter, *with or without low buttresses and stilt roots*. **Bark** smooth; *inner bark pale brown or pink*. **Sapwood** whitish, relatively soft. *Young parts shortly densely greyish brown puberulent; indumentum persistent on twig, bud, stipule, inflorescence and petiole, caducous elsewhere*. **Twigs** c. 1.5 mm diameter apically. **Leaves** chartaceous to thinly coriaceous, drying greyish brown; *blade ovate-lanceolate, somewhat falcate, 7–12 × 2.8–4.8 cm, base unequal, cuneate, margin not revolute, apex subcaudate, acumen to 1.5 cm long; midrib stout, terete, hardly raised below, more prominently so above, not drying black; venation dryobalanoid; main lateral veins c. 10 pairs with many long intermediates, the basal pair extending to one third the length of the blade margin; intercostal venation evident below, reticulate; petiole 0.7–1 cm long*. **Inflorescences** in axillary clusters of 3, or rarely terminal, to 6 cm long, singly or doubly branched, branchlets bearing to 7 secund flowers. **Flowers:** buds to 5 × 3 mm; petals lanceolate, cream; stamens c. 15, anthers subglobose, connectival appendage c. 2x the length of anther; *ovary ovoid, stylopodium obscure, style columnar tapering, as long as ovary*. **Fruits** erect; *pedicels to 2 mm long, slender; calyx lobes unequal, 2 longer lobes broadly spatulate, obtuse, to 5 × 1 cm, subauriculate and hardly tapering into the saccate base, 3 shorter ones unequal, lanceolate, acute, 1–2.5 cm long and concealing the nut*. **Nuts** narrowly ovoid, to 1.1 × 0.6 cm, tapering to a short apiculus.

Vernacular name. Sarawak—*luis air* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Kinabatangan, Labuk Sugut and Sandakan districts (e.g., *SAN 37886*, *SAN 94100* and *SAN 99580*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Marudi, Miri, and Tatau districts (e.g., *S 3433*, *S 15577*, *S 23489*, *S 25024*, and *S 41429*). Also occurring in Brunei (e.g., *BRUN 3394*, *BRUN 5668*, *FMS 34492*, *Forman 1165*, and *Prance 30711*) and Kalimantan (e.g., *bb. 20448*).

Ecology. Locally common in forest on clay-rich river banks, both fast and sluggish, at altitudes to 200 m. Fruiting frequently. Common in Mulu NP; probably not vulnerable.

16. *Hopea griffithii* Kurz

(W. Griffith, 1810–1845, surgeon in the British East India Company at Malacca, Peninsular Malaysia)

J. As. Soc. Beng. 42, 2 (1873) 60; Symington *op. cit.* (1939) 343, *op. cit.* (1943) 127; Ashton *op. cit.* (1968) 51, *op. cit.* (1982) 406; Anderson *op. cit.* (1980) 116; PROSEA *op. cit.* 248; Coode *et al.* (eds.) *op. cit.* 72; Newman *et al. op. cit.* 150. **Type:** *Griffith 717*, Myanmar, Mergui, Tennaserim (holotype CAL; isotype K). **Synonym:** *Hancea griffithii* (Kurz) Pierre *op. cit.* t. 248.

Canopy tree, to 40 m tall, to 60 cm diameter, with even hemispherical crown and *thin, flying buttresses and stilt roots to 1 m tall*. **Bark** smooth becoming cracked in older trees. *Parts glabrous but for pubescent parts of petals exposed in bud*. **Twigs** c. 1 mm diameter apically, slender, much-branched. **Leaves** coriaceous, shiny and drying purplish brown above, tawny brown below; blade ovate to lanceolate, 4–9 × 1.7–4.5 cm, base cuneate, margin frequently subrevolute, apex subcaudate, acumen to 1.5 cm long; *midrib obscure, sunken above, prominent below; venation dryobalanoid, with the veins hardly evident; main lateral veins c. 9 pairs, with shorter intermediates, without domatia; intercostal venation obscure, reticulate; petiole 0.8–1.5 cm long, slender*. **Inflorescences** terminal or axillary, to 2.5 cm long, singly branched, branchlets bearing to 5 second flowers. **Flowers:** buds ellipsoid, to 2 mm long; petals lanceolate, dark red; stamens c. 15, anthers broadly ellipsoid, connectival appendage c. 2x the length of anther; *ovary and stylopodium stoutly pyriform, papillose towards apex, tapering abruptly to the short columnar style*. **Fruits:** pedicels c. 1 mm long; calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 3 × 0.5 cm, tapering to 2 mm above the saccate base; 3 shorter ones linear, to 0.8 × 0.1 cm. **Nuts** ovoid, to 0.7 × 0.5 cm, apiculate.

Vernacular name. Sarawak—*luis jantan* (preferred name).

Distribution. Peninsular Myanmar, Peninsular Thailand, Peninsular Malaysia, and Borneo. In Borneo, rare in Sabah and known from Kota Marudu and Ranau districts (e.g., *SAN 25334* and *SAN 100048*) but widespread in Sarawak with most records in the west, from Kapit, Kuching, Lundu, Serian, and Simunjan districts (e.g., *S 9338*, *S 10052*, *S 22267*, *S 32534*, and *S 37154*). Also occurring in Brunei (e.g., *BRUN 786*, *BRUN 3362* and *BRUN 5249*) and W Kutei in NE Kalimantan (e.g., *bb. 8205*, *bb. 20133* and *Hallier 2225*).

Ecology. In mixed dipterocarp forests on leached yellow clay soils, at altitudes to 500 m. Locally common. Vulnerable.

17. *Hopea kerangasensis* P.S.Ashton

(from Iban word—*kerangas* = a type of soil not suitable for cultivating rice; the natural habitat)

Gard. Bull. Sing. 22 (1967) 277, *op. cit.* (1968) 52, *op. cit.* (1982) 401; Anderson *op. cit.* (1980) 116. **Type:** *Yakup S 8944*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype K; isotype L).

Subcanopy or small canopy tree, to 30 m tall, to 35 cm diameter; crown diffuse, at first remaining monopodial; *buttresses, flying buttresses and a few stilt roots to 1 m tall*. **Bark** smooth. *Twig, petiole, midrib above, domatia below, bud, and inflorescence more or less densely persistently tawny puberulent, more or less caducous*. **Twigs** c. 0.5 mm diameter apically, very slender. **Leaves** chartaceous, drying purplish brown above, deep tawny below; blade ovate, 1.5–4.5 × 1–3 cm, base broadly cuneate, apex caudate, acumen to 1 cm long; *midrib shallowly sunken above, slender but prominent below; venation dryobalanoid; main lateral veins c. 6 pairs with short intermediates, slightly sunken above, slender but distinctly raised below, with prominent pubescent domatia; intercostal venation obscure, reticulate; petiole 0.3–0.5 cm long, slender*. **Inflorescences** axillary, to 1.2 cm long, singly branched, branchlets bearing to 3 distichous flowers. **Flowers:** buds ovoid, to 1.5 × 1 mm; petals lanceolate, cream; stamens c. 15, anthers subglobose, connectival appendage 2–3x the length of anther; *ovary ovoid, stylopodium obscure, style columnar, tapering, as long as ovary*. **Fruits:** pedicels c. 1 mm long; *calyx lobes subequal, ovate, to 0.6 × 0.5 cm, acute, saccate, appressed against the nut*. **Nuts** exposed above calyx towards apex, ovoid, to 0.8 × 0.5 cm, subacute.

Vernacular name. Sarawak—*luis kerangas* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah recorded from Bt. Tawai, Kinabatangan district (e.g., *SAN 39349*) and in Sarawak from Bau, Kuching, Lundu, and Simunjan districts (e.g., *S 2274, S 14926, S 15530, S 21299, and S 29030*). Also occurring in C Kalimantan (e.g., *bb. 14959 and bb. 16033*).

Ecology. Locally abundant in mixed dipterocarp forest on leached clay-rich soils and in *kerangas* on podsols, at altitudes below 300 m. Endangered.

18. *Hopea latifolia* Symington

(Latin, *latus* = wide, *folius* = leaf; with broad leaves)

Gard. Bull. S. S. 10 (1939) 360, *op. cit.* (1943) 131; Ashton *op. cit.* (1964) 102, *op. cit.* (1968) 52, *op. cit.* (1982) 404; Anderson *op. cit.* (1980) 116; PROSEA *op. cit.* 249. **Type:** *Mohamad FMS 8149*, Peninsular Malaysia, Pahang, Kuantan, Telok Siseh (holotype KEP).

Main canopy tree, to 40 m tall, to 70 cm diameter, *with small thin buttresses and stilt roots*. **Bark** smooth; *inner bark pale brown or pink*. **Twigs** c. 1 mm diameter apically, slender, *glabrescent*. **Leaves** thinly coriaceous, drying pale brown including venation; *blade ovate, 5–8 × 2.2–4.5 cm, base cuneate, frequently subequal, margin not revolute, apex caudate, acumen to 1.5 cm long; midrib slender, terete, elevated on both surfaces; venation dryobalanoid, veins indistinct and hardly raised, drying not blackish; main lateral veins c. 8 pairs; intercostal venation obscure, reticulate; petiole 1.2–1.7 cm long, slender, somewhat geniculate*. **Inflorescences** axillary or rarely terminal, greyish caducous puberulent, to 4 cm long, singly or doubly branched, branchlets bearing to 5 distichous flowers. **Flowers:** buds small, ovoid; petals ovate, cream; stamens c. 15, anthers globose, connectival appendage as long as anther; *ovary ovoid, stylopodium obscure, style columnar, villous towards base, as long as ovary*. **Fruits** subsessile; *calyx lobes unequal, 2 longer lobes spatulate, to 6 × 1.4 cm, narrowly obtuse, tapering to 3 mm above the saccate base, 3 shorter ones ovate, acute, to 0.9 × 0.7 cm, hardly concealing the nut*. **Nuts** broadly ovoid, to 0.8 × 0.7 cm, with c. 2 mm long filiform style remnant.

Vernacular name. Sarawak—*luis daun bulat* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Borneo known in Sabah from Labuk Sugut district (e.g., *SAN 90497*) and in Sarawak from Kuching, Serian and Tatau districts (e.g., *S 7614*, *S 9340*, *S 16631*, *S 44906*, and *S 64962*). Also occurring in Brunei (e.g., *BRUN 3179* and *BRUN 3338*) and E Kalimantan (e.g., *Kostermans 6752*).

Ecology. Locally common in mixed dipterocarp forest on leached sandy clay soils, on low hills at altitudes to 400 m. Well represented in Bako NP but elsewhere vulnerable.

Notes. For differences from *H. beccariana* see there.

19. *Hopea longirostrata* P.S.Ashton

(Latin, *longus* = long, *rostratus* = beaked; the tapering fruit base and long pedicel)

Gard. Bull. Sing. 22 (1967) 277, *op. cit.* (1968) 52, *op. cit.* (1982) 399; Anderson *op. cit.* (1980) 116. **Type:** *Ashton S 17742*, Borneo, Sarawak, Belaga district, Ulu Belaga (holotype K; isotypes KEP, L).

Subcanopy tree, to 14 m tall; buttresses thin, low. **Bark** smooth, becoming patchily thinly flaky; inner bark pale brown. All parts glabrous. **Twigs** c. 2 mm diameter apically. **Leaves** coriaceous, drying greyish brown; blade ovate-elliptic, 7–9 × 3–5 cm, base obtuse, margin not revolute, apex subcaudate, acumen to 1.5 cm long; midrib slender but prominent above, sharply elevated below, tending to dry black; venation dryobalanoid, unraised and more or less obscure, arched; main lateral veins c. 12 pairs, with subequal intermediates; petiole 0.7–1 cm long, slender, geniculate, drying black. **Flowers** unknown. **Infructescences** terminal or in axillary clusters of 3, to 4 cm long, singly branched, branchlets bearing to 5 second fruits. **Fruits:** base tapering; pedicels to 7 mm long; calyx lobes unequal, 2 longer lobes spatulate, to 2.4 × 0.6 cm, tapering to 3 mm and ending abruptly in a small incrassate central tubercle, 3 shorter ones linear to spatulate, to 1.5 cm long, similar at base, concealing the nut. **Nuts** ovoid, to 0.6 × 0.4 cm, with to 2 mm long slender style remnant.

Distribution. Endemic in Borneo and confined to Ulu Tubau, Bintulu district and Ulu Belaga, Belaga district in Sarawak (e.g., *S 18191* and the type).

Ecology. Rare and endangered, in small groups in mixed dipterocarp forest on clay-rich soils, at c. 300 m altitude.

20. *Hopea megacarpa* P.S.Ashton

(Greek, *mega* = huge, *karpos* = fruit; the large nut)

Gard. Bull. Sing. 22 (1967) 278, *op. cit.* (1968) 53, *op. cit.* (1982) 426; Anderson *op. cit.* (1980) 116. **Type:** *Daud & Tachun SFN 35625*, Borneo, Sarawak, Kapit district, Nanga Pelagus (holotype K; isotype KEP).

Subcanopy tree, to 15 m tall, to 20 cm diameter. **Bark** smooth; inner bark yellowish brown. Young twig, petiole and venation below sparsely caducous puberulent; leaf bud persistently so; parts otherwise glabrous. **Twigs** c. 1 mm diameter apically, slender, sparingly branched, dark brown. **Leaves** thinly coriaceous, undulate, drying pale brown; blade narrowly ovate-lanceolate, 6–12 × 1.5–5 cm, base equal, cuneate, apex caudate, acumen to 2 cm long, slender; midrib prominent and terete below, flat to somewhat raised and slender above; venation hopea-type; lateral veins 6–7 pairs, slender, raised below, ascending and arched; domatia not prominently swollen; intercostal venation densely scalariform, slender and unraised; petiole c. 0.6 cm long, slender. **Inflorescences** axillary, lax, to 3 cm long, singly branched, branchlets bearing to 3 dense flowers; bracts fugaceous. **Flowers:** buds subglobose, to 4 × 3 mm; petals elliptic-oblong, pale pink; stamens c. 15, anthers oblong, connectival appendage c. 3x the length of anther; ovary and stylopodium cylindrical, subtruncate, style short. **Fruits:** pedicels c. 3 mm long, broadening into receptacle; calyx lobes unequal, 2 longer lobes narrowly spatulate, acute, to 10 × 1.3 cm, tapering to c. 5 mm above the subauriculate saccate base, 3 shorter ones ovate, to 2 × 0.9 cm, similarly subauriculate, concealing the nut. **Nuts** ovoid, to 1.2 × 1 cm, with mucronate minutely truncate apex.

Distribution. Endemic in Borneo. Known in Sarawak only from Kapit district (e.g., S 639, S 14743, S 29085, S 29490, and S 41546). Also occurring in SE Kalimantan (e.g., Suzuki K 9754).

Ecology. Locally gregarious understory trees of mixed dipterocarp forest on sandy clay soils, at altitudes below 500 m. Vulnerable, probably endangered.

21. *Hopea mengerawan* Miq.

(Sumatran vernacular name)

Fl. Ned. Ind., Suppl. (1862) 491; Ridley *op. cit.* (1922) 238; Foxworthy *op. cit.* 137; Symington *op. cit.* (1939) 361, *op. cit.* (1943) 132; Ashton *op. cit.* (1968) 53, *op. cit.* (1982) 400; Anderson *op. cit.* (1980) 116; PROSEA *op. cit.* 249; Kessler & Sidiyasa *op. cit.* 98; Newman *et al. op. cit.* 151. **Type:** Teijsmann s.n. (= *U sub. No. 035930*), Sumatra, Palembang, Muara Enim (holotype U; isotypes BO, L). **Synonym:** *Hancea mengerawan* (Miq.) Pierre *op. cit. t.* 243.

Large main canopy or low emergent tree, to 45 m tall, to 1 m diameter; crown hemispherical; buttresses to 5 cm thick, flying buttresses to 1.5 m tall; stilt roots sometimes present. **Bark** becoming deeply narrowly v-section fissured, dark chocolate-brown and grey-mottled. **Sapwood** honey-yellow, hard; heartwood dark brown. **Twig, petiole and leaf** below caducous lepidote; parts of petal exposed in bud sericeous; parts otherwise glabrous. **Twigs** c. 2 mm diameter apically. **Leaves** coriaceous, drying warm chocolate-brown below, golden-brown above; blade oblong-lanceolate, 6–12 × 2.5–5 cm, base cuneate, apex with tapering acumen to 1.5 cm long; midrib stout, prominent on both surfaces; venation dryobalanoid, veins evident but hardly elevated below, drying not blackish; main lateral veins c. 14 pairs, with many short to subequal intermediates; petiole 0.9–1.1 cm long, stout. **Inflorescences** terminal or axillary, stout, to 3 cm long, singly branched, branchlets bearing to 6 second flowers. **Flowers:** buds ovoid, to 3 × 2 mm; petals oblong-lanceolate, pale yellow; stamens c. 15, anthers subglobose, connectival appendage 2–3x the length of anther; ovary ovoid, stylopodium obscure, style columnar, villous in basal half, c. 2x the length of ovary. **Fruits:** pedicels c. 2 mm long; calyx lobes unequal, 2 longer lobes narrowly spatulate, narrowly obtuse, to 7 × 1.2 cm, tapering to c. 3 mm above the saccate base, 3

shorter ones ovate, acute, to 0.6 × 0.5 cm, appressed to but not concealing the nut apex.
Nuts narrowly ovoid, to 1 × 0.5 cm, with prominent terminal filiform style remnant.

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Sabah recorded from Lahad Datu, Sandakan and Tawau districts (e.g., *SAN 16981, SAN 23267, SAN 32508, and SAN 39302*) and in Sarawak from Bintulu and Mukah districts (e.g., *S 15577 and S 23247*). Also occurring in W, E and S Kalimantan (e.g., *bb. 24523, Kostermans 6657, Kostermans 6745, Kostermans 12513, and Sidiyasa 605*).

Ecology. In mixed dipterocarp forest near the base of low hills, on sandy soils often with impeded drainage, at altitudes below 200 m. Inexplicably rare and critically endangered throughout Borneo, with records based on few collections from isolated localities.

22. *Hopea mesuoides* P.S.Ashton

(Latin = resembling *Mesua*, Guttiferae)

Gard. Bull. Sing. 22 (1967) 279, *op. cit.* (1968) 54, *op. cit.* (1982) 413; Anderson *op. cit.* (1980) 116; Coode *et al.* (eds.) *op. cit.* 72. **Type:** *Ilias S 15551*, Borneo, Sarawak, Bintulu district, Segan FR (holotype K; isotypes KEP, L). **Synonym:** *Hopea subalata auct. non* Symington: Ashton *op. cit.* (1964) 110.

Subcanopy to low canopy tree, to 30 m tall, to 50 cm diameter, with persistently monopodial diffuse crown and pendent branches; buttresses thin and low, *flying buttresses and stilt roots present*. **Bark** smooth. *Leaf bud, flower parts exposed in bud and stipule pale yellowish brown puberulent, indumentum persistent except on calyx; other parts glabrous.* **Twigs** c. 1.5 cm diameter apically, slender, sparingly branched. **Leaves** coriaceous, *drying pale chocolate-brown below, yellowish brown above; blade ovate-lanceolate, 8–14 × 2.5–5 cm, base obtuse, equal, margin more or less narrowly revolute, apex caudate, acumen to 1.5 cm long; midrib slender but prominent below, obscure and sunken above; venation subdryobalanoid; main lateral veins c. 11 pairs, slender and distinctly raised below, arched, with short intermediates; intercostal venation evident below, reticulate; petiole 0.7–1 cm long, slender.* **Inflorescences** axillary, slender, to 4 cm long, lax, singly branched; *bracts c. 1 mm long, subpersistent.* **Flowers:** buds small, ovoid; petals oblong, dark red; stamens c. 15, anthers subglobose, connectival appendage 2–3x the length of anther; *ovary and stylopodium cylindrical, truncate, papillose at apex, style short.* **Fruits:** pedicels c. 1 mm long; base impressed; *calyx lobes subequal, ovate, chartaceous, erose near the subacute apex, to 1.4 × 1.2 cm, appressed to the nut.* **Nuts** subglobose, apex protruding above calyx, crowned by persistent truncate stylopodium.

Distribution. Endemic in Borneo. Recorded in Sarawak from Bintulu, Limbang, Marudi, Miri, and Tatau districts (e.g., *S 11247, S 25058, S 27123, S 31839, and S 32314*) and in Brunei from Amo, Belait and Tutong districts (e.g., *BRUN 879, BRUN 5674 and FMS 34451*).

Ecology. In mixed dipterocarp forest on yellow sandy clay soil and *kerangas* forest on podsols, on low hillslopes, at altitudes to 200 m. Locally abundant, forming dense groups with abundant juveniles. Vulnerable owing to its accessible habitat.

23. *Hopea micrantha* Hook.f.

(Greek, *mikro-* = small, *anthos* = a flower; with small flowers)

Trans. Linn. Soc. 23 (1860) 161; Merrill *op. cit.* (1921) 402; Symington *op. cit.* (1939) 355; Masamune *op. cit.* 490; Browne *op. cit.* 121, *p.p.*; Ashton *op. cit.* (1964) 103, *op. cit.* (1968) 54, *op. cit.* (1982) 401; Meijer & Wood *op. cit.* 213; Burgess *op. cit.* 129; Anderson *op. cit.* (1980) 116; Coode *et al.* (eds.) *op. cit.* 72. **Lectotype** (Symington, 1939): *Motley 215*, Borneo, Labuan (hololectotype K). **Synonym:** *Hancea micrantha* (Hook.f.) Pierre *op. cit.* t. 243.

Canopy tree, to 30 m tall, to 30 cm diameter, rarely to 40 m tall, to 80 cm diameter; buttresses small, narrow; *stilt roots many*. **Bark** smooth; *inner bark pale brown or pink*. *Young parts, leaf blade excepted, pale brown fugaceous puberulent*. **Twigs** *c.* 1 mm diameter apically, slender. **Leaves** thinly coriaceous, drying reddish brown below with the midrib darker, greyish brown above; *blade oblong-lanceolate*, 6–8 × 2.5–3 cm, base equal, obtuse, apex caudate, acumen to 1.5 cm long; *midrib evident, slightly raised above, terete and prominent below, not drying black; venation dryobalanoid, hardly raised below; main lateral veins c. 14 pairs*, with shorter intermediates, arched; petiole 0.7–1 cm long, slender. **Inflorescences** terminal or axillary, to 1 cm long, singly branched, branchlets bearing to 5 secund flowers. **Flowers:** buds small, ovoid; petals linear, pale pink; stamens *c.* 15, anthers broadly oblong, connectival appendage *c.* 1½x the length of anther; *ovary ovoid, stylopodium obscure, style columnar, c. 1½x the length of ovary*. **Fruits** subsessile; calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 5 × 1.2 cm, tapering to 2 mm above the saccate base, 3 shorter ones broadly ovate to suborbicular, subacute or obtuse, to 0.5 × 0.5 cm, shorter than the nut. **Nuts** ovoid, to 1 × 0.6 cm, with slender style remnant to 1.5 mm long.

Vernacular names. Sabah—*selangan lunas* (preferred name). Sarawak—*luis kerangas* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Sipitang district (e.g., *SAN 16264*), formerly also in Labuan (e.g., the type); and in Sarawak from Bintulu, Limbang, and Marudi districts (e.g., *S 951*, *S 1113*, *S 8267*, and *S 15893*). Also occurring in Brunei (e.g., *BRUN 512*, *BRUN 5526* and *Kirkup DK 748*).

Ecology. Very local, but there common, in *kerangas* forest on podsols, at altitudes below 100 m. Critically endangered.

24. *Hopea montana* Symington

(Latin, *montanus* = growing on mountains; the natural habitat)

J. Mal. Br. Roy. As. Soc. 19, 2 (1941) 141, *op. cit.* (1943) 133; Meijer & Wood *op. cit.* 214; Burgess *op. cit.* 129, 136; Ashton *op. cit.* (1982) 413; PROSEA *op. cit.* 250. **Type:** *Symington FMS 32257*, Peninsular Malaysia, Perak, G. Korbu (holotype KEP).

Subcanopy or canopy tree, to 35 m tall, to 1 m diameter; bole often crooked; buttresses thin, *flying buttresses and stilt roots present*. **Bark** smooth or patchily cracked. *Parts entirely glabrous*. **Twigs** *c.* 1 mm diameter apically, slender, blackish. **Leaves** thinly coriaceous, drying pale chocolate-brown; *blade ovate-lanceolate*, 6.5–9 × 2.2–4 cm, base equal, abruptly cuneate, apex cuspidate, acumen to 1 cm long; *midrib obscure, sunken above, slender but raised below as also the veins; venation subdryobalanoid*; main lateral veins *c.* 14 pairs, with many short intermediates; *intercostal venation obscure*; petiole 0.9–1.1 cm

long, slender. **Inflorescences** terminal or axillary, to 2 cm long, lax, slender, hardly branched, *with small deltoid subpersistent bracts*. **Flowers** (mature) unknown. **Fruits:** pedicels *c.* 2 mm long, expanding into receptacle; *calyx lobes unequal, 2 longer lobes spatulate*, subacute, to 5×1.2 cm, tapering to 2 mm above the saccate thickened base, 3 shorter ones ovate to lanceolate, to 1×0.3 cm, concealing the nut. **Nuts** ovoid, to 0.7×0.5 cm, with minutely truncate apex bearing a central apiculus.

Vernacular name. Sabah—*selangan bukit* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, recorded in Sabah from Kota Belud, Sipitang and Tambunan districts (e.g., *KEP 80317*, *SAN 16280*, *SAN 17002*, and *SAN 40258*).

Ecology. Rare but locally frequent in upper dipterocarp forest on hillslopes on clay-rich soils, at 900–1200 m altitude. Probably vulnerable as the habitat is mostly outside the National Park boundary.

25. *Hopea nervosa* King

(Latin, *nervosus* = bearing nerves; the many prominent leaf lateral veins)

J. As. Soc. Beng. 62, 2 (1893) 124; Ridley *op. cit.* (1922) 236; Foxworthy *op. cit.* 129; Symington *op. cit.* (1943) 185; Ashton *op. cit.* (1964) 104, *op. cit.* (1968) 54, *op. cit.* (1982) 410; Meijer & Wood *op. cit.* 215; Burgess *op. cit.* 129; Anderson *op. cit.* (1980) 116; PROSEA *op. cit.* 250; Coode *et al.* (eds.) *op. cit.* 72. **Type:** *King's Collector 3690*, Peninsular Malaysia, Perak, Larut (holotype CAL; isotype K).

Medium-sized subcanopy or low canopy tree, to 30 m tall, to 1 m diameter; buttresses thin, flying buttresses to 2 m tall; stilt roots present. **Bark** *smooth*, greyish brown. **Sapwood** pale, soft. *Young parts including midrib throughout caducously greyish puberulent*. **Twigs** *c.* 1 mm diameter apically, slender, sparsely branched. **Leaves** thinly coriaceous, *drying warm chocolate-brown below; blade narrowly ovate to lanceolate, 9–18 × 4–7 cm, base equal, broadly cuneate*, apex with tapering acumen to 1.4 cm long; midrib slender but prominent and terete below, narrowly sunken above; *venation hopea-type; lateral veins 13–15 pairs*, slender but prominent below; intercostal venation very slender, dense, sinuate-scalariform, unraised; petiole 1–1.2 cm long. **Inflorescences** terminal or in axillary pairs, lax, to 9 cm long, singly branched, *branchlets bearing to 5 remote flowers; bracts deltoid, subpersistent*. **Flowers:** buds subglobose, to 3 mm diameter; petals narrowly oblong, purplish with paler tips; stamens *c.* 15, anthers subglobose, connectival appendage *c.* 2x the length of anther; *ovary and stylopodium broadly cylindrical, truncate, style short*. **Fruits** sessile; *calyx lobes unequal, 2 longer lobes spatulate*, to 12×1.8 cm, narrowly obtuse, thinly coriaceous, strongly twisted, tapering to 3 mm above the saccate base, 3 shorter ones lanceolate, acute, to 1.5 cm long, more or less concealing the nut. **Nuts** broadly ovoid, to 1×1 cm, with apiculate minutely truncate apex.

Vernacular names. Sabah—*selangan jangkang* (preferred name). Sarawak—*luis jangkang* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Borneo recorded in Sabah from Kinabatangan and Sandakan districts (e.g., *FMS 35404*, *SAN 23305*, *SAN 34254*, *SAN 38954*, and *SAN 39016*) and in Sarawak from Belaga, Kapit, Lundu, and Tatau districts

(e.g., *S 14380*, *S 25010*, *S 29072*, *S 43557*, and *S 50182*). Also occurring in Brunei (e.g., *BRUN 790*, *FMS 35671* and *Wong WKM 1922*) and E Kalimantan (e.g., *Kostermans 4109*, *Kostermans 4342*, *Kostermans 4394*, and *Kostermans 13981*). Particularly common in W Sarawak and E Sabah, elsewhere scattered.

Ecology. In mixed dipterocarp forest, locally common on well-structured deep clay soils on slopes and low hills on intermediate and basic igneous rocks, more scattered on sedimentaries, at altitudes to 400 m. Occurring in G. Gading and Mulu NPs; elsewhere vulnerable owing to forest conversion.

26. *Hopea nutans* Ridl.

(Latin, *nutans* = nodding; the flowers)

FMP 1 (1922) 235; Foxworthy *op. cit.* 123; Symington *op. cit.* (1943) 136; Browne *op. cit.* 125; Ashton *op. cit.* (1964) 104, *op. cit.* (1968) 54, *op. cit.* (1982) 424; Meijer & Wood *op. cit.* 217; Burgess *op. cit.* 135; Anderson *op. cit.* (1980) 117; PROSEA *op. cit.* 263; Coode *et al.* (eds.) *op. cit.* 72; Newman *et al.* *op. cit.* 153. **Lectotype** (designated here): *Henbrey KEP 417*, Peninsular Malaysia, Pahang, Kuantan (hololectotype K; isolectotype KEP).

Canopy tree, to 40 m tall, to 1.2 m diameter; crown diffuse-irregular; bole often misshapen; buttresses low. **Bark** greyish brown, becoming coarsely irregularly flaky; dammar exudations not conspicuous. **Sapwood** yellowish brown; heartwood warm brown, hard. *Young parts, leaf blade excepted, sparsely pale brown puberulent; leaf blade below more or less sparsely greyish lepidote.* **Twigs** to 2 mm diameter apically, relatively stout, much-branched. **Leaves** thickly coriaceous, drying greyish; *blade broadly ovate, 8–13 × 4.5–8.5 cm, base obtuse, subequal, margin more or less revolute, apex broadly tapering, with acumen to 1 cm long; midrib stout, somewhat raised on both surfaces; venation hopea-type; lateral veins 7–10 pairs, relatively stout, somewhat raised below, arched, usually with a few large glabrous swollen pore-like domatia; intercostal venation slender but distinct, subscalariform; petiole 1–1.5 cm long, fairly stout.* **Inflorescences** terminal or axillary, to 7 cm long, *branchlets bearing to 5 secund dense flowers; bracts fugaceous.* **Flowers:** buds broadly ellipsoid, to 4 × 2 mm; petals linear, cream; *stamens c. 15, anthers subglobose, connectival appendage c. 2x the length of anther, scabrous towards apex; ovary and stylopodium subcylindrical, style short.* **Fruits:** subsessile; calyx lobes unequal, 2 longer lobes oblong, broad, obtuse, thinly coriaceous, to 8 × 1.5 cm, tapering to 2.5 cm above the saccate base, 3 shorter ones ovate, acute, to 1 cm long. **Nuts** ovoid to 1.5 × 0.8 cm, acute.

Vernacular name. Sabah and Sarawak—*giam* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Sabah known from Lahad Datu and Semporna districts (e.g., *FMS 44588* and *SAN 26123*) and in Sarawak from Kuching and Lundu districts (e.g., *S 6311*, *S 10120*, *S 10255*, *S 49868*, and *S 57896*). Also occurring in Brunei (e.g., *S 1668*, *S 1953* and *S 5801*) and NE Kalimantan.

Ecology. Local, uncommon in coastal hill mixed dipterocarp forest on sandy soils, frequently with impeded drainage, ultrabasic soil and limestone outcrops. Occurring in Bako and Mulu NPs but endangered elsewhere.

27. *Hopea obscurinerva* P.S.Ashton

(Latin, *obscurus* = indistinct, *nervus* = nerve; the indistinct venation on the leaf undersurface)

TFSS 5 (2004) 479. **Type:** *Mohtar S 51417*, Borneo, Sarawak, Bintulu district, Ulu Tubau (holotype KEP; isotype SAR).

Small subcanopy tree, to 10 m tall, *c.* 15 cm diameter, with low thin buttresses. **Bark** smooth. *All parts glabrous.* **Twigs** *c.* 2 mm diameter apically, sparsely branched, warm brown, somewhat shiny. **Stipules** linear, to 3 mm long, not at first caducous. **Leaves** *thickly coriaceous, not bullate, drying warm pinkish brown below, yellowish brown and somewhat shiny above; blade oblong-lanceolate, 15–26 × 5–8 cm, base markedly unequal, obtuse to subcordate, apex with slender acumen to 1.5 cm long; midrib prominent above, less so below; venation hopea-type; lateral veins 11–14 pairs, with a few intermediates, ascending, arched, prominently raised above, hardly elevated below; intercostal venation obscure, densely scalariform; petiole 0.4–0.6 cm long, c. 0.3 cm diameter, stout, drying black.* **Inflorescences and flowers** unknown. **Fruits** (young): pedicels 1–2 mm long; *base of fruit impressed; calyx lobes unequal, 2 longer lobes narrowly spatulate, at least 4 × 0.8 cm, not auriculate, 3 shorter ones narrowly deltoid, to 1.2 × 0.5 cm.* **Nuts** ovoid, glabrous, surmounted by a *c.* 3 mm long, spindle-shaped stylopodium remnant.

Distribution. Endemic in Borneo and known to date only from the lower Tubau drainage in Sarawak (e.g., *S 18195* and the type).

Ecology. In mixed dipterocarp forest on clay soil, at *c.* 300 m altitude. Endangered.

28. *Hopea ovoidea* P.S.Ashton

(Latin, *ovoideus* = egg-shaped; the ovary)

Gard. Bull. Sing. 31 (1978) 34, *op. cit.* (1982) 426. **Type:** *Elmer 21428*, Borneo, Sabah, Tawau district (holotype K; isotype L).

Canopy tree, to 1 m diameter; buttresses prominent, thin. **Bark** flaky, brown. **Sapwood** hard. *Leaf bud, inflorescence, and parts of flower exposed in bud densely persistently pale buff-pubescent; parts otherwise glabrescent.* **Twigs** *c.* 1 mm diameter apically, slender. **Leaves** *chartaceous and undulate, drying pale greyish brown; blade elliptic to narrowly ovate, 9–13 × 3–6.5 cm, base unequal or subequal, cuneate, shortly decurrent, apex with slender, tapering acumen to 2 cm long; midrib slender but distinctly raised on both surfaces; venation hopea-type; lateral veins 7–8(–10) pairs, slender but distinctly elevated below, arched, often with a few glabrous pore-like canaliculate domatia; intercostal venation scalariform, distinctly elevated below; petiole 1–1.5 cm long, slender.* **Inflorescences** in axillary pairs or terminal, pendent, to 13 cm long, singly branched, lax, *branchlets bearing to 7 secund flowers; bracts fugaceous.* **Flowers:** buds ovoid, to 3 × 2 mm; petals lanceolate, cream; *stamens c. 15, anthers narrowly elliptic, connectival appendage 1½–2x the length of anther; ovary and stylopodium ovoid, tomentose, style c. ½x the length of ovary, glabrous.* **Fruits** unknown.

Distribution. Endemic in Borneo; known only from Lahad Datu, Sandakan and Tawau districts in Sabah (e.g., *SAN 21690, SAN A 2489* and *SAN A 4829*).

Ecology. Rare and endangered (possibly extinct), in mixed dipterocarp forest on low coastal hills.

29. *Hopea pachycarpa* (F.Heim) Symington

Fig. 15.

(Greek, *pachy-* = thick, *karpos* = fruit; the large and thick fruit)

Gard. Bull. S. S. 8 (1934) 30; Masamune *op. cit.* 491; Browne *op. cit.* 125; Ashton *op. cit.* (1964) 105, *op. cit.* (1967) 271, *op. cit.* (1968) 54, *op. cit.* (1978) 35, *op. cit.* (1982) 432; Anderson *op. cit.* (1980) 117; Coode *et al.* (eds.) *op. cit.* 72. **Basionym:** *Pierrea pachycarpa* F.Heim *op. cit.* (1891) 958. **Type:** *Beccari PB 3314*, Borneo, Sarawak, Marop (holotype P). **Synonyms:** *Balanocarpus pubescens* Ridl. *op. cit.* (1922) 247; *Hopea laxa* Symington *op. cit.* (1934) 33; *H. resinosa* Symington, Gard. Bull. S. S. 8 (1935) 278.

Subcanopy tree, to 40 m tall, to 80 cm diameter, with pendent leaves and twigs; crown dark, irregular; buttresses low, thin; stilt roots present. **Bark** smooth. *Young twig, leaf bud, stipules outside, foliar domatia, and petiole densely persistently pale fawn-pubescent or whitish-pruinose or silvery lepidote; inflorescence fugaceously so; floral sepals fimbriate; parts otherwise glabrous.* **Twigs** c. 2 mm apically, sparingly branched. **Leaves** thinly coriaceous, *drying greyish green, more or less silvery lepidote below; blade flat, elliptic to lanceolate, 13–22 × 4–7 cm, base unequal, cuneate to obtuse, margin often narrowly revolute, apex with a slender acumen to 1 cm long; midrib stout, terete, raised on both surfaces; venation hopea-type; lateral veins (10–)13–17 pairs, slender but raised below, flat above, arched and running concurrently up margin, with small tomentose axillary domatia; intercostal venation slender, densely scalariform, sinuate; petiole 0.7–1 cm long, stout.* **Inflorescences** *in axillary pairs or ramiflorous, rarely branched.* **Flowers:** buds broadly ellipsoid, to 4 × 2.5 mm; petals cream; stamens c. 15, anthers subglobose, connectival appendage 2–3x the length of anther; *ovary small, ovoid, style and stylopodium spindle-shaped, glandular-papillose towards tapering apex.* **Fruits** large, impressed at base; *calyx lobes subequal, ovate, subacute, to 2 × 1.5 cm, thickened, saccate, appressed to the nut.* **Nuts** ovoid-globose, to 1.5 cm diameter, acute, concealed in calyx except for the apex, usually resin-coated.

Vernacular name. Sarawak—*merkoyong* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo recorded in Sabah from Keningau and Pensiangan districts (e.g., *SAN 128204, SAN 136792, SAN 139662, and SAN 139667*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Lundu, Miri, Serian, Simunjan, Sri Aman, and Tatau districts (e.g., *S 13572, S 15408, S 22406, S 36881, S 43206, and S 43834*). Also occurring in Brunei (e.g., *BRUN 168, BRUN 3345 and BRUN 5647*) and Kalimantan (e.g., *Burley & Tukirin 762, Hansen 1374 and Kessler et al. Berau 19*).

Ecology. Locally abundant in mixed dipterocarp forest on moist lower slopes and streamsides, on clay-rich soils, on both sedimentary and intermediate and basic igneous rocks, at altitudes below 400 m. Occurring in G. Gading and Mulu NPs but vulnerable elsewhere.

30. *Hopea pedicellata* (Brandis) Symington

(Latin, *pedicellatus* = with prominent stalk; the flowers)

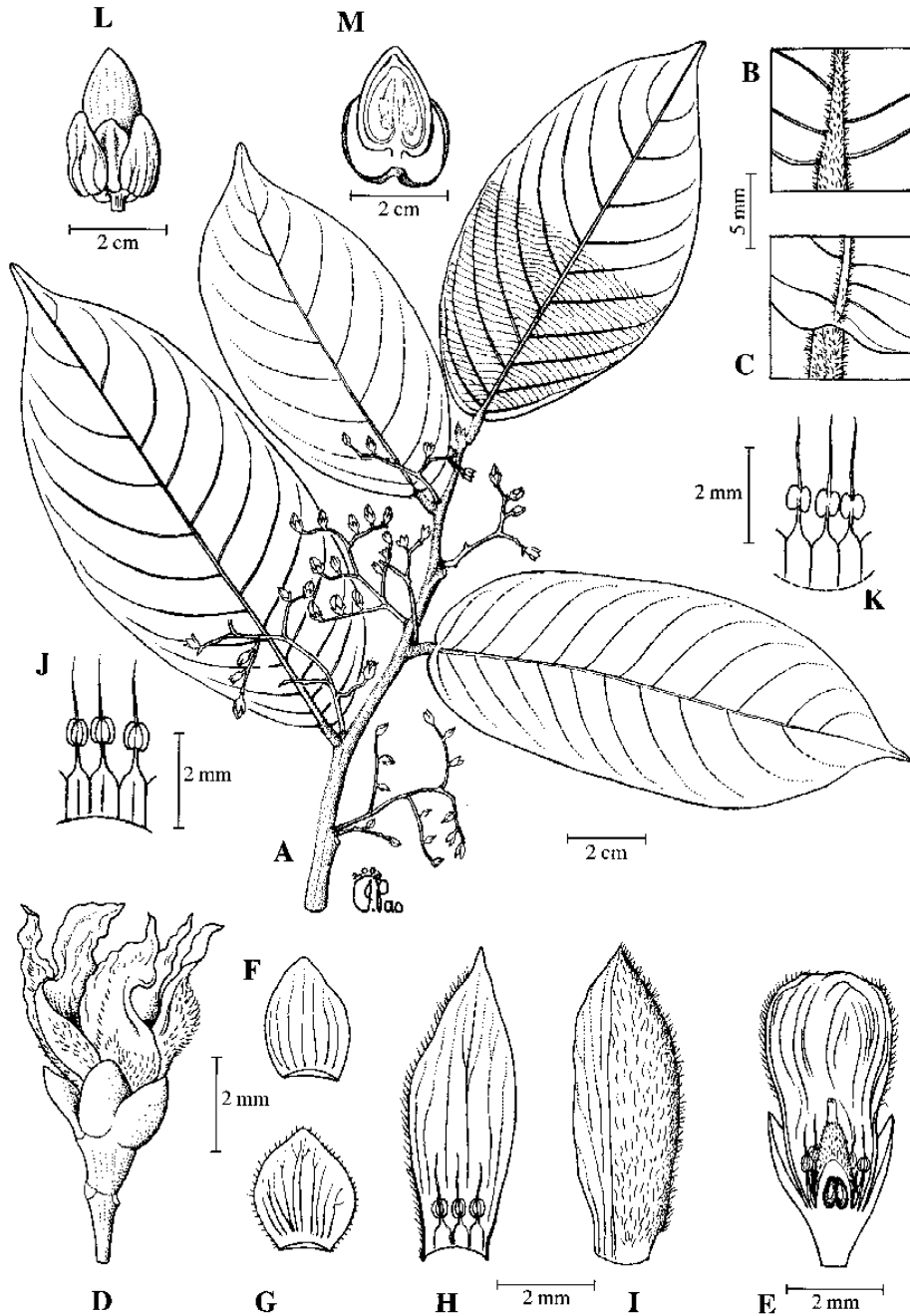


Fig. 15. *Hopea pachycarpa*. A, flowering leafy twig; B, detail of indumentum on lower leaf surface; C, detail of indumentum on upper leaf surface; D, open flower; E, longitudinal section of opening flower; F, adaxial view of outer sepal; G, adaxial view of inner sepal; H, adaxial view petal with stamens; I, abaxial view of petal; J, adaxial view of stamens; K, abaxial view of stamens; L, fruit; M, longitudinal section of fruit. (A–K from *S 21300*, L–M from *S 36881*.)

Gard. Bull. S. S. 9 (1938) 327, *op. cit.* (1943) 138; Ashton *op. cit.* (1968) 54, *op. cit.* (1978) 30, *op. cit.* (1982) 408; Anderson *op. cit.* (1980) 117; PROSEA *op. cit.* 252; Coode *et al.* (eds.) *op. cit.* 72. **Basionym:** *Hopea griffithii* Kurz var. *pedicellata* Brandis, J. Linn. Soc. Bot. 31 (1895) 69, *p.p.* **Lectotype** (Ashton, 1978): *Curtis 167*, Peninsular Malaysia, Penang (holotype K). **Synonym:** *Hopea siamensis* F. Heim, Bot. Tidsskr. 25 (1902) 46.

Small canopy tree, to 40 m tall, to 60 cm diameter; bole often crooked; buttresses low, thin; *stilt roots present*. **Bark** dark brown, smooth, hoop-marked or sometimes patchily cracked; inner bark pinkish brown; dammar exudations glassy. *Young twig and inflorescence caducously, petiole, leaf bud, stipules and domatia persistently greyish brown puberulent.* **Twigs** *c.* 1 mm diameter apically, slender, much-branched. **Leaves** *thinly coriaceous to coriaceous; blade flat, ovate-lanceolate, 4–9 × 1–3.5 cm, base cuneate, margin flat, apex subcaudate, acumen to 1.5 cm long; midrib slender but raised on both surfaces or sharp below and tending to dry black; venation dryobalanoid, hardly elevated, indistinct; main lateral veins c. 8–12(–15) pairs, not drying black, with many subequal intermediates, obscure below; petiole 0.6–0.8 cm long.* **Inflorescences** terminal or axillary, to 4 cm long, singly branched, branchlets bearing to 7 secund flowers. **Flowers:** buds ovoid, to 2.5 × 2 mm; petals oblong-lanceolate, pale yellow; *stamens c. 15*, anthers oblong, connectival appendage *c.* 2x the length of anther; *ovary and stylopodium cylindric-conical, attenuate, truncate, punctate in the distal half, style short.* **Fruits:** pedicels 2 mm long; calyx lobes unequal, 2 longer lobes spatulate, to 3 × 0.5 cm, tapering to 2 mm above the saccate base, 3 shorter ones ovate, to 0.3 × 0.3 cm, appressed to the nut. **Nuts** ovoid, to 0.6 × 0.4 cm, abruptly acute, exceeding calyx.

Vernacular name. Sarawak—*mata kucing bukit* (preferred name).

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo. In Sabah recorded from Kota Belud district (e.g., *SAN 76269*, young buds, tentative) and in Sarawak from Belaga, Bintulu, Miri, Serian, Simunjan, and Tatau districts (e.g., *S 15213*, *S 17023*, *S 18351*, *S 25017*, and *S 64525*). Also occurring in Nunukan Is. in Kalimantan.

Ecology. Uncommon and scattered in distant localities in mixed dipterocarp forest on undulating land and ridges, at altitudes to 600 m. Vulnerable.

31. *Hopea pentanervia* Symington *ex* Wood (Greek, *penta-* = five, *nervius* = nerved; the leaf blade)

Gard. Bull. Sing. 17 (1960) 495; Browne *op. cit.* 126, Anderson, Gard. Bull. Sing. 20 (1963) 157, *op. cit.* (1980) 117; Ashton *op. cit.* (1964) 106, *op. cit.* (1968) 55, *op. cit.* (1982) 425; Meijer & Wood *op. cit.* 219, Burgess *op. cit.* 135; PROSEA *op. cit.* 263, Coode *et al.* (eds.) *op. cit.* 72, Newman *et al.* *op. cit.* 154. **Type:** *Tready S 1257*, Borneo, Sarawak, Miri district, Baram (holotype KEP; isotype SAR).

Canopy tree, to 35 m tall, to 1 m diameter; crown irregular, with large twisted branches; buttresses to 1 m tall, *c.* 4 cm thick. **Bark** *vertically cracked and oblong-flaked*, warm dark brown and grey-mottled. **Sapwood** straw yellow, hard; heartwood chocolate-brown. *Young parts puberulent; all parts glabrescent but for the fimbriate flower sepals and pubescent parts of petals exposed in bud.* **Leaves** coriaceous, drying yellowish brown; *blade ovate, 5–10 × 3.2–5 cm, base equal, obtuse or broadly cuneate, margin somewhat revolute, apex with slender, tapering acumen to 1.5 cm long; midrib slender, raised below, flat above; venation hopea-type; lateral veins c. 5 pairs, slender but prominent below, arched, with small glabrous pore-like domatia; intercostal venation densely scalariform, evident; petiole*

0.6–1.1 cm long. **Inflorescences** terminal or in axillary pairs, lax, to 8 cm long, singly branched, *branchlets bearing to 6 dense secund flowers; bracts fugaceous*. **Flowers:** buds ellipsoid, *c.* 1.5 mm long; petals lanceolate, cream; *stamens c. 15*, anthers subglobose, connectival appendage *c.* 3x the length of anther; *ovary and stylopodium cylindrical, truncate, style short*. **Fruits** subsessile; calyx lobes unequal, 2 longer lobes spatulate, obtuse, chartaceous, to 5 × 1.2 cm, tapering to 3 mm above the saccate base, 3 shorter ones ovate, acute, appressed to the nut. **Nuts** ovoid, to 0.4 × 0.35 cm, acute.

Vernacular names. Sabah—*selangan lima urat* (preferred name). Sarawak—*cengal paya* (preferred name).

Distribution. Endemic in Borneo, occurring throughout SW and E Sabah and recorded from Beaufort, Keningau, Kinabatangan, Labuk Sugut, Papar, Sandakan, and Sipitang districts (e.g., *SAN 25467*, *SAN 38766*, *SAN 96930*, *SAN 130223*, and *SAN 138822*) and in Sarawak from Betong, Bintulu, Kuching, Lawas, Limbang, Marudi, Miri, and Sibu districts (e.g., *S 260*, *S 1530*, *S 18387*, *S 23288*, and *S 24651*). Also occurring in Brunei (e.g., *BRUN 5007*, *Coode 7649* and *FMS 35467*).

Ecology. Locally frequent on shallow peat, usually over sand, in mixed peat swamp forest and the ecotone of *kerangas*, and in *kerangas* on podsols on terraces and low hills, at altitudes to 400 m; on ultrabasic rocks in E Sabah; usually near the coast. Occurring in Mulu NP, elsewhere endangered.

32. *Hopea plagata* (Blanco) Vidal

(Latin, *plagata*, wounded; the wound-like domatia)

Synopsis (1883) *t.15A*; Merrill, Spec. Blancoan. (1918) 2691; Ashton *op. cit.* (1978) 32, *op. cit.* (1982) 423, PROSEA *op. cit.* 264; Newman *et al. op. cit.* 155. **Basionym:** *Mocanera plagata* Blanco, Fl. Filip. ed. 1 (1837) 447. **Neotype** (designated here): *Merrill Sp. Blancoan. 109 (= US 903784)*, the Philippines, Luzon, Rizal Province, Langhaya (K, US). **Synonyms:** *Dipterocarpus plagatus* (Blanco) Blanco, Fl. Filip. ed. 2 (1845) 311; *Anisoptera plagata* (Blanco) Blume, Mus. Bot. Lugd. Bat. 2 (1852) 42; *Hopea dasyrrhachis auct. non* Slooten: Ashton *op. cit.* (1968) 49.

Large canopy tree, to 35 m tall, to 1 m diameter; crown irregular; buttresses to *c.* 1 m tall, thin. **Bark** becoming dark greyish brown flaky. **Sapwood** hard, yellow; heartwood brown. *Parts entirely glabrous*. **Twigs** *c.* 1 mm diameter apically, much-branched, dark brown. **Leaves** coriaceous, sometimes sparsely stellate-lepidote below, drying dark greyish brown; *blade elliptic-lanceolate to ovate-falcate, 6–12 × 2.5–7 cm, base markedly unequal, cuneate to obtuse, apex with tapering acumen to 1.5 cm long; midrib stoutly prominent on both surfaces; venation hopea-type; lateral veins 8–11(–12) pairs, slender but elevated below, usually with glabrous pore-like domatia; intercostal venation densely scalariform, hardly elevated; petiole 0.6–1.6 cm long*. **Inflorescences** solitary, axillary or terminal, to 3 cm long, singly branched, *branches bearing to 6 dense secund flowers; bracts fugaceous*. **Flowers:** buds ellipsoid, to 3 × 2 mm; petals lanceolate, cream; *stamens c. 35*, anthers elongate, tapering, connectival appendage equal in length to anther, acicular; *ovary ovoid, stylopodium obscure, style short, broad*. **Fruits:** pedicels *c.* 2 mm long; calyx lobes unequal, 2 longer lobes broadly oblong-spatulate to suborbicular, to 4.5 × 2 cm, tapering to 3 mm above the saccate base, 3 shorter ones ovate, to 0.7 × 0.4 cm, shorter than the nut. **Nuts** narrowly ovoid, to 1 × 0.7 cm, acute.

Distribution. Borneo and the Philippines. In Sabah recorded from Kinabatangan, Kota Kinabalu, Lahad Datu, Sandakan, Semporna, Tawau, and Tenom districts (e.g., *KEP 80469*, *SAN 9414*, *SAN 15042*, *SAN 20178*, and *SAN 43093*) and in Sarawak from Marudi district (e.g., *BRUN 3203*, *S 22568*, *S 24037* and *S 30767*).

Ecology. Scattered in mixed dipterocarp forest, apparently mostly on coastal hills in Sabah; also very local on humic soils over limestone, at low altitudes and in lower montane forest at 900–1100 m altitude. Well represented in Mulu NP but vulnerable in Sabah.

33. *Hopea pterygota* P.S.Ashton
(Greek, *pterygotos* = winged; the fruit)

Fig. 16.

Gard. Bull. Sing. 22 (1967) 280, *op. cit.* (1968) 55, *op. cit.* (1982) 434; Anderson *op. cit.* (1980) 117; Coode *et al.* (eds.) *op. cit.* 73. **Type:** *Smythies S 15206*, Borneo, Sarawak, Simunjan district, G. Gaharu (holotype K; isotypes KEP, L).

Small monopodial hardly buttressed tree, to 10 m tall, to 10 cm diameter, with pendent twigs and leaves. **Bark** smooth, soft, whitish. *Young vegetative parts densely pale tawny pubescent; indumentum caducous on leaf below, petiole and twig, persistent on buds, stipules and also parts of petal exposed in bud; reproductive parts otherwise glabrous.* **Twigs** c. 2 mm diameter apically, sparingly branched. **Leaves** thinly coriaceous, *drying reddish brown below; blade flat, oblong-lanceolate to oblanceolate, 12–28 × 5–9 cm, base markedly unequal, obtuse to subcordate, apex subcaudate, acumen to 2 cm long; midrib prominent on both surfaces, more so below; venation hopea-type; lateral veins 12–21 pairs, slender, prominent below, sunken above, dense; intercostal venation scalariform, not dense, slightly elevated; petiole 0.3–0.8 cm long, stout.* **Inflorescences** in axillary clusters of 4 or ramiflorous, slender, lax, singly branched, branches bearing to 8 secund flowers. **Flowers:** buds ellipsoid, to 3 × 2 mm; petals linear; stamens c. 15, anthers subglobose, connectival appendage very slender, 3–4x the length of anther; *ovary narrowly ovoid, stylopodium and style spindle-shaped, somewhat shorter than ovary.* **Fruits:** pedicels c. 1 mm long; *calyx lobes unequal, 2 longer lobes spatulate, to 10 × 1.5 cm, chartaceous, tapering to c. 4 mm then expanding to 7 mm wide paired auricles at the saccate base, 3 shorter ones lanceolate-deltoid, acute, to 1.2 cm long, similarly auriculate.* **Nuts** ovoid, to 0.7 × 0.5 cm, acute, concealed within auricles.

Distribution. Endemic in Borneo; found throughout Sarawak and recorded from Belaga, Kapit, Marudi, Miri, Mukah, Serian, Sibuan, Song, Sri Aman, and Tatau districts (e.g., *S 23612*, *S 25022*, *S 29630*, *S 36567*, *S 57666*, and *S 64844*). Also occurring in Brunei.

Ecology. Locally gregarious, on a wide range of soils over acid and basic volcanic rocks, shale, and also white sand podsol terrace; on well-drained sites, in mixed dipterocarp forest, *kerangas*, and on ridges in the lower levels of upper dipterocarp forest, at 700–800 m altitude. Locally abundant in Lambir and Mulu NPs; not yet vulnerable.

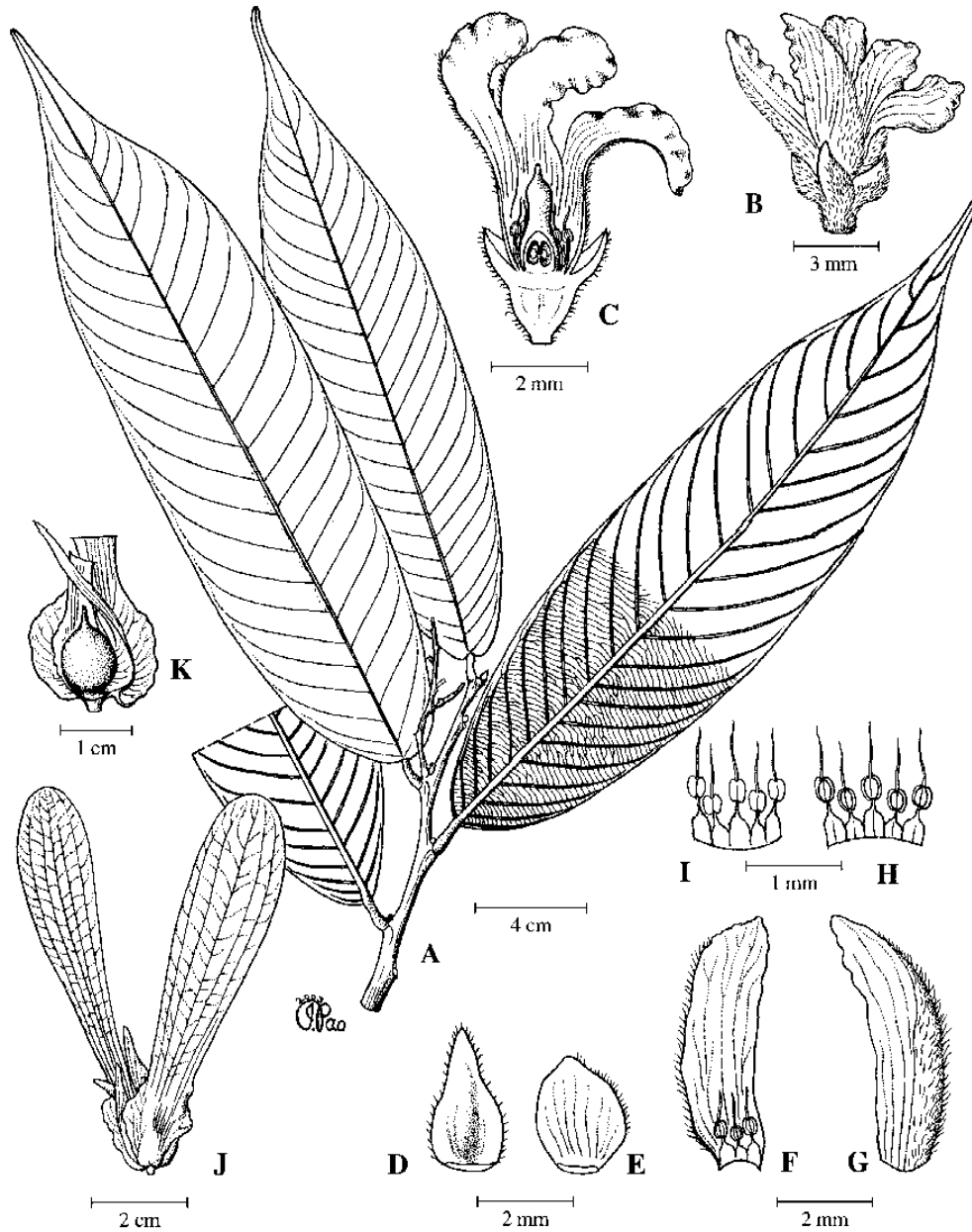


Fig. 16. *Hopea pterygota*. A, fruiting leafy twig; B, open flower; C, longitudinal section of open flower; D, adaxial view of outer sepal; E, adaxial view of inner sepal; F, adaxial view of petal with stamens; G, abaxial view of petal; H, adaxial view of stamens; I, abaxial view of stamens; J, fruit; K, exposed nut. (A and J–K from S 29630, B–I from S 66783.)

34. *Hopea rudiformis* P.S.Ashton

Fig. 17.

(Latin, *rudis* = the gladiatorial sword, *formis* = shape; the leaf shape)

Gard. Bull. Sing. 31 (1978) 30, *op. cit.* (1982) 409; Kessler & Sidiyasa *op. cit.* 99. **Type:** *Kostermans 4394*, Borneo, Kalimantan, Balikpapan, Sg. Wain (holotype L; isotypes BO, K).

Subcanopy to low canopy tree, to 35 m tall, to 40 cm diameter; crown more or less persistently monopodial; buttresses to 1 m tall, thin; flying buttresses and stilt roots present. **Bark** greyish, *smooth*. **Sapwood** pale, soft. *Fleshy exposed parts pale tawny puberulent; indumentum persistent on young twigs, buds and petals; sparse on inflorescence; caducous on leaf venation below and calyx.* **Twigs** *c.* 2 mm diameter apically, ribbed, sparingly branched. **Leaves** thinly coriaceous, *more or less sparsely greyish stellate-lepidote below thereby appearing dull; blade ovate to broadly lanceolate, 6.5–14 × 3.5–7.5 cm, base equal, broadly cuneate, margin narrowly revolute, apex tapering, downcurved, acumen to 1.5 cm long; midrib and veins obscure and sunken above, slender but prominent below; venation hopea-type; lateral veins 11–13 pairs, arched; intercostal venation densely scalariform, obscure; petiole 0.8–1.3 cm long.* **Inflorescences** in axillary pairs, to 3.5 cm long, singly branched, *branchlets bearing to 3 remote flowers; bracts subpersistent.* **Flowers:** buds ovoid, to 3 × 2 mm; petals oblong, deep purplish red; stamens *c.* 15, anthers broadly oblong, connectival appendage slightly longer than anther; *ovary ovoid, surmounted by indistinct tapering stylopodium and short columnar style.* **Fruits:** pedicels to 2 mm long; *calyx lobes unequal, 2 longer lobes broadly spatulate, to 9 × 2 cm obtuse, tapering to 3 mm broad above the saccate base, 3 shorter ones ovate, to 0.8 × 0.8 cm, subacute, appressed to nut and enclosing it.* **Nuts** ovoid-globose, to 0.8 × 0.8 cm, terminating in a minutely truncate stylopodium remnant.

Vernacular name. Sabah—*selangan jangkang* (Dusun).

Distribution. Endemic in Borneo. In Sabah, recorded from Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan, Tenom, and Tawau districts (e.g., *SAN 18563*, *SAN 25471*, *SAN 29672*, *SAN 53121*, and *SAN 124401*). Also known in E Kalimantan (e.g., *bb. 25152*, *Kostermans 4109*, *Kostermans 4549*, and *Kostermans 13981*).

Ecology. In lowland forest on undulating land on clay-rich soil, sometimes in freshwater swamps, at altitudes to 500 m; locally common. Vulnerable owing to forest conversion.

35. *Hopea rugifolia* P.S.Ashton

(Latin, *rugosus* = wrinkled, *folius* = leaf; the wrinkled dried leaf)

Gard. Bull. Sing. 54, 2 (2002) 213. **Type:** *Wong WKM 1414*, Borneo, Brunei, Temburong district, Bt. Belalong south ridge (holotype K; isotype BRUN). **Synonym:** *Hopea sphaerocarpa auct. non* (F.Heim) P.S.Ashton: Coode *et al.* (eds.) *op. cit.* 73.

Small monopodial understory tree, to 20 m tall, to 20 cm diameter, with low buttresses and stilt roots. **Bark** *smooth*. *Young parts densely evenly minutely greyish brown puberulent; indumentum persisting sparsely on leaf venation below, midrib above at base, and petiole; elsewhere glabrescent.* **Leaves** *chartaceous, drying greyish brown and wrinkled; blade broadly lanceolate, 5–9 × 2–3.5 cm, base broadly cuneate, apex with slender acumen to 1.5 cm long; midrib slender but elevated below, obscure and sunken above; venation subdryobalanoid; main lateral veins c. 10 pairs, slender but sharply raised below; intercostal*

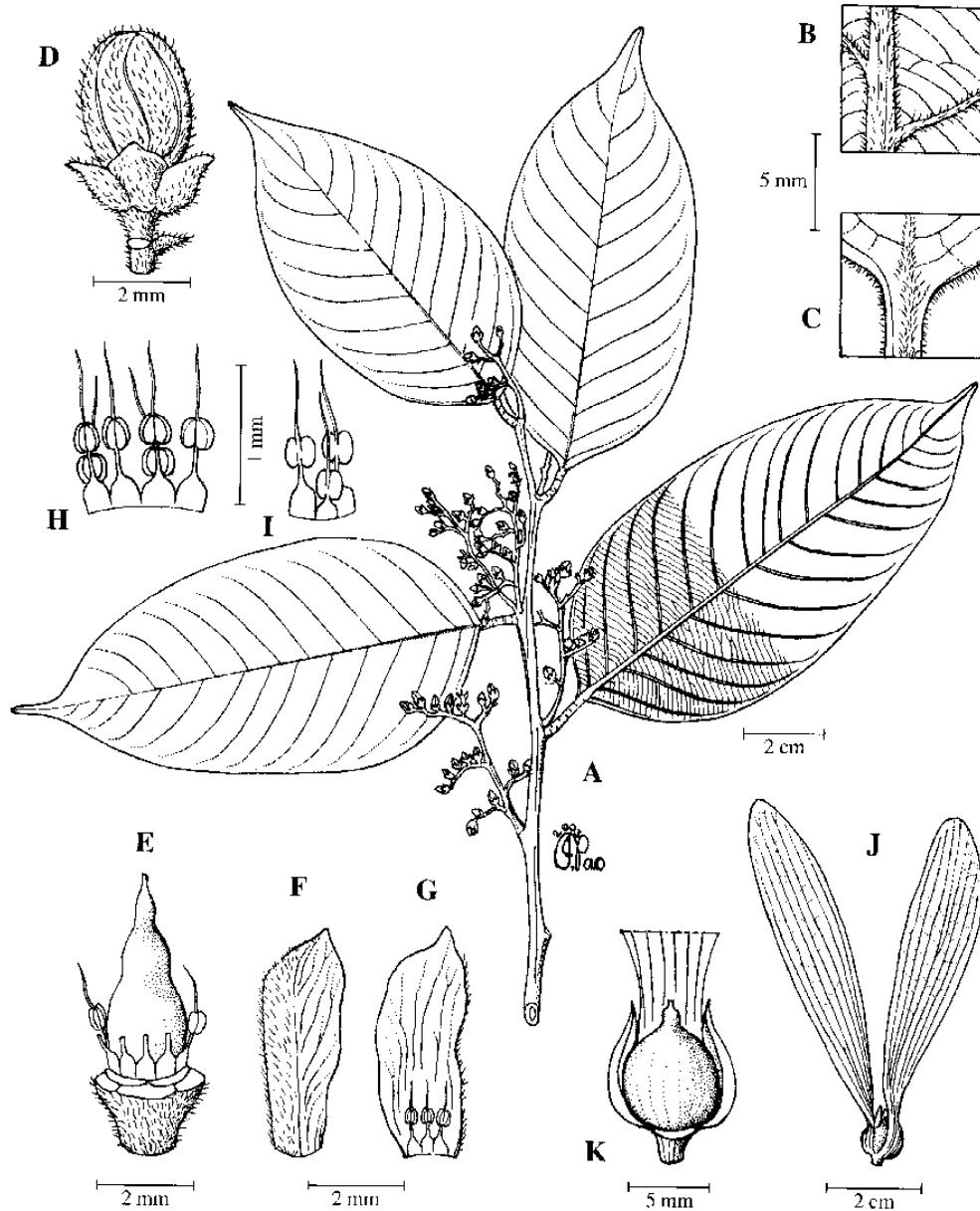


Fig. 17. *Hopea rudiformis*. A, flowering leafy twig; B, detail of indumentum on lower leaf surface; C, detail of indumentum on upper leaf surface; D, flower bud; E, gynoecium; F, abaxial view of petal; G, adaxial view of petal with stamens; H, adaxial view of stamens; I, abaxial view of stamens; J, fruit; K, exposed nut. (A–I from *FMS 38775*, J–K from *S 73781*.)

venation densely scalariform, evident below; petiole to 0.4 cm long, slender. **Inflorescences** in axillary pairs, slender, lax, to 4 cm long, singly branched, branchlets bearing to 6 remote distichous flowers; bracts deltoid, to 1 mm long, subpersistent. **Flowers:** buds broadly ovoid, to 2 × 1.5 mm; petals oblong, purple; stamens *c.* 15, anther ellipsoid, connectival appendage *c.* 2x the length of anther; ovary and stylopodium narrowly cylindrical, truncate, medially constricted, style short conical. **Fruits:** pedicels to 5 mm long, slender; calyx lobes subequal, ovate, to 0.8 × 0.7 cm, acute, appressed to nut. **Nuts** broadly ovoid, to 1 × 0.8 cm, with to 2 mm prominent stylopodium remnant.

Distribution. Endemic in Borneo; so far known only from Miri (Lambir NP) and Tatau (Bt. Mersing) districts in Sarawak (e.g., *S* 25028 and *S* 46439), and Temburong district in Brunei (e.g., the type).

Ecology. In mixed dipterocarp and upper dipterocarp forest on friable fertile clay soils, at 100–800 m altitude. Well represented in Lambir NP but vulnerable elsewhere.

36. *Hopea sangal* Korth.

(from Dayak name in Kalimantan)

Kruidk. (1841) 75; Symington *op. cit.* (1934) 18, *op. cit.* (1943) 141; Keith *op. cit.* 41; Masamune *op. cit.* 491; Browne *op. cit.* 121; Ashton *op. cit.* (1963) 260, *op. cit.* (1964) 108, *op. cit.* (1968) 56, *op. cit.* (1982) 420, Meijer & Wood *op. cit.* 222; Burgess *op. cit.* 129; Anderson *op. cit.* (1980) 117; PROSEA *op. cit.* 253; Coode *et al.* (eds.) *op. cit.* 73; Newman *et al.* *op. cit.* 156. **Type:** Korthals *s.n.* (= RHL Sheet No. 933193), Borneo (holotype L; isotypes BO, U). **Synonyms:** *Dryobalanops sericea* Korth. *op. cit.* 72; *Hopea sericea* (Korth.) Blume *op. cit.* (1852) 35; *Petalandra micrantha* Hassk., Hort. Bog. Desc. (1852) 105; *H. fagifolia* Miq. *op. cit.* 490; *Doona micrantha* (Hassk.) Burck *op. cit.* 233; *Doona javanica* Burck *op. cit.* 235; *H. hasskarliana* F.Heim, Rech. Dipt. (1892) 64; *H. javanica* (Burck) F.Heim *op. cit.* (1892) 64; *H. curtisii* King *op. cit.* 124; *H. globosa* Brandis *op. cit.* 61; *H. lowii* Dyer *ex Brandis op. cit.* 63; *H. minutiflora* C.E.C. Fischer, Bull. Misc. Inform. Kew (1927) 207.

Medium-sized canopy tree, to 40 m tall, to 1.3 m diameter; bole often misshapen; buttresses low, thin. **Bark** vertically cracked and scaly, becoming conspicuous dark brown with contrasting cream-white opaque dammar coxcombs. **Sapwood** pale, soft. **Inflorescence**, parts of perianth exposed in bud and domatia densely whitish buff-puberulent; indumentum persistent on inflorescence and domatia; parts otherwise glabrous. **Twigs** *c.* 1 mm diameter apically, slender, much-branched. **Leaves** chartaceous, drying wrinkled, dull sooty greyish brown; blade ovate, 5.5–10 × 3.5–5 cm, base equal, broadly cuneate, apex caudate, acumen to 1.2 cm long; midrib flat, evident above, slender and prominent below; venation hopea-type; lateral veins 10–12 pairs, slender but prominent below, often with small pale pubescent domatia; intercostal venation densely scalariform, indistinct; petiole 0.5–1 cm long, slender. **Inflorescences** terminal or axillary, lax, to 7 cm long, singly or doubly branched, branchlets bearing to 7 dense secund flowers; bracts fugaceous. **Flowers:** buds ellipsoid-ovoid, to 2 × 1.5 mm; petals oblong-lanceolate, cream; stamens *c.* 10, anthers oblong, connectival appendage as long as anther; ovary and stylopodium shortly broadly cylindrical, truncate, more or less puberulent, style *c.* 2/3x the length of ovary and stylopodium. **Fruits:** pedicels *c.* 1 mm long; calyx lobes unequal, 2 longer lobes oblong-spatulate, obtuse, to 7 × 1.5 cm, tapering to 4 mm above the saccate base, 3 shorter ones ovate, obtuse, to 0.5 × 0.4 cm, shorter than the nut. **Nuts** ovoid, to 0.7 × 0.4 cm, with minutely subtruncate apiculate apex, often sparsely puberulent.

Vernacular name. Sabah and Sarawak—*gagil* (preferred name).

Distribution. Myanmar, Peninsular Thailand, Sumatra, Peninsular Malaysia, Java, Bali, and Borneo. Widespread throughout Sabah and recorded from Kinabatangan, Kudat (including Banggi Is.), Labuk Sugut, Lahad Datu, Ranau, Sandakan, Semporna, Tawau, and Tenom districts (e.g., *SAN 15417*, *SAN 17904*, *SAN 21690*, *SAN 37573*, and *SAN 74317*) and in Sarawak from Bau, Belaga, Bintulu, Kuching, Lundu and Tatau districts (e.g., *S 922*, *S 13190*, *S 18440*, *S 43527*, and *S 49872*). Also occurring in Brunei (e.g., *BRUN 3378*, *FMS 30544* and *FMS 39619*) and Kalimantan (e.g., *bb. 34337* and *Endert 2117*).

Ecology. Scattered in mixed dipterocarp forest on friable fertile clay-rich soils, on intermediate and basic igneous rocks and also shales and clays, at altitudes to 500 m. Vulnerable though occurring in G. Gading and Mulu NPs.

37. *Hopea semicuneata* Symington

(Latin, *semi-* = half, *cuneatus* = wedge-shaped; the leaf base)

Gard. Bull. S. S. 8 (1934) 24, *op. cit.* (1943) 143; Masamune *op. cit.* 491; Meijer & Wood *op. cit.* 224; Burgess *op. cit.* 135; Ashton *op. cit.* (1968) 56, *op. cit.* (1982) 426; Anderson *op. cit.* (1980) 117; PROSEA *op. cit.* 264; Newman *et al. op. cit.* 157. **Type:** *Awang FMS 4526*, Peninsular Malaysia, Pahang, Temerloh (holotype KEP). **Synonym:** *Hopea diversifolia* Miq., *op. cit.* 451, *p.p.*

Large canopy or low emergent tree, to 50 m tall, to 2 m diameter; bole tall, frequently misshapen; crown diffuse, small, hemispherical; buttresses to 7 m tall, 5 m long, *c.* 10 cm thick. **Bark** becoming vertically cracked and oblong-flaked, fawn-brown, with opaque white dammar coxcombs; inner bark pinkish brown. **Sapwood** straw yellow, hard; heartwood dark brown. **Inflorescences and parts of flower exposed in bud** densely pale buff-pubescent; indumentum caducous on calyx, otherwise persistent; young twigs and petioles fugaceous puberulent; parts otherwise glabrous. **Twigs** *c.* 1 mm diameter apically. **Leaves** chartaceous, frequently undulate, drying greyish brown below, purplish brown above, curling up; blade elliptic to ovate-lanceolate, 6.5–14 × 2–7 cm, base narrowly or broadly cuneate, subequal, apex tapering, acumen slender, to 2.5 cm long; midrib prominent, stout below, evident but hardly raised or somewhat sunken above; venation *hopea*-type; lateral veins 6–9 pairs, ascending, arched, slender but prominent below, narrowly sunken above, often with prominent pustular domatia; intercostal venation densely scalariform; petiole 0.6–1.2 cm long, slender. **Inflorescences** terminal or axillary, to 7 cm long, singly branched, branchlets bearing to 7 dense secund flowers; bracts fugaceous. **Flowers:** buds ellipsoid, to 2 × 1 mm; petals lanceolate, cream; *stamens c.* 15, anthers ellipsoid, connectival appendage *c.* 3x the length of anther; ovary and stylopodium cylindrical, truncate, more or less medially constricted, apical platform papillose, style short, columnar. **Fruits:** pedicels *c.* 2 mm long; calyx lobes unequal, 2 longer lobes broadly lorate, 9.5 × 2.2 cm, obtuse, tapering to *c.* 4 mm above the saccate base, 3 shorter ones broadly ovate, to 0.4 × 0.6 cm, subacute, shorter than the nut. **Nuts** subglobose, to 0.6 × 0.5 cm, shortly apiculate.

Vernacular name. Sabah—*selangan batu jantan* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, very local and generally uncommon. In Sabah recorded from Beaufort, Keningau, Kinabatangan, Kudat, Lahad Datu, Sandakan, and Tawau districts (e.g., *SAN 15205*, *SAN 16422*, *SAN 17718*, *SAN 36463*, and *SAN 96656*) and in Sarawak from Bintulu, Kapit and Lundu districts (e.g., *S 1815*, *S 9643* and *S 17722*).

Ecology. Uncommon in mixed dipterocarp forest, on clay-rich periodically flooded alluvium, at altitudes below 200 m. Endangered.

Notes. Material from Kudat, Lahad Datu and Sandakan districts differs in the smaller somewhat chartaceous leaf, wrinkling on drying but otherwise conforms with the species.

38. *Hopea sphaerocarpa* (F.Heim) P.S.Ashton

(Greek, *sphaero-* = round, *karpos* = fruit)

Gard. Bull. Sing. 20 (1963) 258, *op. cit.* (1968) 56, *op. cit.* (1982) 411; Anderson *op. cit.* (1980) 117. **Basionym:** *Balanocarpus sphaerocarpus* F.Heim *op. cit.* (1892) 77, Merrill *op. cit.* (1921) 407, Masamune *op. cit.* 483. **Type:** *Beccari PB 3021*, Borneo, 'Sarawak' (holotype P).

Small tree, to 10 m, to 10 cm diameter; crown remaining monopodial; with low, thin buttresses and flying buttresses and stilt roots. **Bark** smooth. *Young parts, including sometimes leaf venation but excluding inflorescence, tawny puberulent; indumentum caducous on calyx, more or less persistent elsewhere.* **Twigs** c. 0.5 mm diameter apically, slender, sparsely branched. **Leaves** chartaceous, undulate, more or less flat, drying tawny brown below, dark purplish above; *blade ovate to oblong-lanceolate, 3.5–10 × 1.4–4.5 cm, base obtuse to subcordate, apex with slender acumen to 1 cm long; midrib slender, sunken above, elevated below; venation subdryobalanoid; lateral veins 9–11 pairs, slender but elevated below, with short indistinct intermediates; intercostal venation densely scalariform, slender but evident below; petiole 0.3–0.6 cm long, slender.* **Inflorescences** in axillary pairs or occasionally terminal, very slender, lax, to 10 cm long, singly branched, *branchlets zigzag, bearing to 6 remote distichous flowers; bracts linear, to 2 mm long, subpersistent.* **Flowers:** buds subglobose, to 2 mm diameter; petals elliptic-oblong, dark crimson-red; stamens c. 15, anthers subglobose, connectival appendage 3–5x the length of anther; *ovary and stylopodium cylindrical, truncate, somewhat constricted medially, style short, narrowly conical.* **Fruits:** pedicels to 4 mm, long; *calyx lobes subequal, ovate, to 0.8 × 0.7 cm, acute, appressed to the nut.* **Nuts** broadly ovoid, to 1 × 0.8 cm, apex exposed with prominent truncate stylopodium remnant.

Distribution. Endemic in Borneo. In Sarawak recorded from Bau, Kuching, Lundu, and Sri Aman districts (e.g., *S 15004*, *S 29455*, *S 37849*, *S 49928*, and *S 68433*).

Ecology. Local, but often in dense populations; in mixed dipterocarp forest on leached sandy clay soils, at altitudes below 200 m. Critically endangered.

Notes. An apparently related entity has been collected in young fruit on G. Gading, Lundu district (*S 12601* and *S 15570*). It differs in its 12–15 pairs of steeply arching lateral veins. Confirmation of its status must await flowering material.

39. *Hopea tenuinervula* P.S.Ashton

(Latin, *tenuis*, slender, *nervulus*, a little nerve; the slender intercostal veins)

Gard. Bull. Sing. 22 (1967) 281, *op. cit.* (1968) 57, *op. cit.* (1982) 435; Anderson *op. cit.* (1980) 117; Coode *et al.* (eds.) *op. cit.* 73. **Type:** *Ariffin S 9616*, Borneo, Sarawak, Lundu district (holotype K; isotype KEP). **Synonym:** *Hopea philippinensis* auct. non Dyer: Ashton *op. cit.* (1964) 107.

Subcanopy tree, to 30 m tall, to 35 cm diameter; buttresses and stilt roots to 1 m tall, thin. **Bark** thinly powdery reddish brown mottled, *flaky*. *Young vegetative parts and perianth outside densely pale tawny puberulent; indumentum persistent on buds, stipules, petals, and somewhat so on veins and midrib on both surfaces, elsewhere caducous.* **Twigs** to 2 mm diameter apically, dark, sparingly branched. **Leaves** *thinly coriaceous, not bullate, drying dark chocolate-brown below, paler above; blade narrowly ovate to lanceolate, 10–27 × 3–5.5 cm, base markedly unequal, obtuse, margin narrowly revolute, apex with slender acumen to 1 cm long; midrib stout and raised on both surfaces; venation hopea-type; lateral veins dense, 12–21 pairs, slender but prominent below, arched and running concurrent to margin before terminating; intercostal venation very slender and not elevated, densely sinuate-scalariform; petiole 0.3–0.7 cm long, stout.* **Inflorescences** *in axillary pairs, rarely terminal, lax, to 8 cm long, singly branched, branchlets bearing to 4 secund flowers; bracts deltoid, to 1 mm long, subsistent.* **Flowers:** buds ellipsoid, to 4 × 2 mm; petals oblong-lanceolate, pale yellow; stamens *c.* 15, anthers oblong-ellipsoid, connectival appendage *c.* 2x the length of anther; *ovary ovoid, stylopodium and style as long as ovary, hourglass-shaped.* **Fruits** *subsessile; calyx lobes unequal, 2 longer lobes spatulate, narrowly obtuse, to 10 × 1.7 cm, tapering to 2 mm above the saccate base, not auriculate, 3 shorter ones lanceolate, to 3 × 0.7 cm, slightly flanged along margin, concealing the nut. Nuts ovoid, to 1.2 × 0.8 cm, shortly apiculate.*

Vernacular names. Sabah—*selangan daun serong* (preferred name). Sarawak—*luis daun serong* (preferred name).

Distribution. Endemic in Borneo. In Sabah only known from Gaya Is., Kota Kinabalu district (e.g., *SAN 38708, SAN 46596* and *SAN 135353*) and in Sarawak from Kuching, Lundu and Sibu districts (e.g., *S 11091, S 12614, S 14812, S 25452, and S 37782*). Also occurring in Brunei (e.g., *BRUN 2624, BRUN 3290* and *S 1187*) and E and C Kalimantan (e.g., *bb. 17854* and *Ridsdale PBU 49*).

Ecology. Very local, but there often in dense populations, in mixed dipterocarp forest on leached sandy and sandy clay soils, at altitudes to 400 m. Endangered.

40. *Hopea treubii* F. Heim

(M. Treub, 1851–1910, sometime Director of the Bogor Botanic Gardens, Indonesia)

Bull. Mens. Soc. Linn. Paris 2 (1891) 955; Merrill *op. cit.* (1921) 403, Masamune *op. cit.* 492; Ashton *op. cit.* (1964) 111, *op. cit.* (1968) 57, *op. cit.* (1982) 406; PROSEA *op. cit.* 254; Coode *et al.* (eds.) *op. cit.* 73. **Type:** *Beccari PB 2895*, Borneo, Sarawak, Matang (holotype P).

Canopy tree, to 40 m tall, to 80 cm diameter, with irregular crown supported by a few large ascending twisted branches; buttresses and flying buttresses low. **Bark** *becoming densely v-section fissured, tawny brown.* **Sapwood** straw yellow, hard; heartwood dark warm brown. *Parts of petals exposed in bud pubescent; parts otherwise glabrous.* **Twigs** to 1.5 mm diameter apically. **Leaves** coriaceous, drying yellowish brown; *blade broadly elliptic to obovate, 5–8 × 3–5.5 cm, base cuneate, margin more or less revolute, apex shortly broadly bluntly acuminate; midrib stout, somewhat raised on both surfaces; venation dryobalanoid; main lateral veins elevated below, prominently arched, with long intermediates; petiole c. 1 cm long, rather stout.* **Inflorescences** terminal or in axillary pairs or ramiflorous, rigid, slender, ascending, to 8 cm long, singly branched, branchlets bearing to 7 secund flowers. **Flowers:** buds ellipsoid, to 2.5 mm long, on prominent pedicels; petals narrowly lanceolate,

lemon-yellow; *stamens* *c.* 10, anthers broadly oblong, connectival appendage *c.* 2x the length of anther; *ovary and stylopodium cylindrical, subtruncate*, papillose at apex, *style short*. **Fruits:** pedicels to 3 mm long, slender; calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 3.5 × 0.7 cm, tapering to 2 mm wide above the saccate base, 3 shorter ones ovate, to 0.8 × 0.2 cm, appressed to but shorter than the nut. **Nuts** narrowly ovoid, to 1.1 × 0.5 cm, acute.

Vernacular name. Sarawak—*luis daun tebal* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Bau, Belaga, Kuching, Lundu, and Simunjan districts (e.g., *Chew CWL 1163, S 9482, S 10134, S 28979, S 43972*, and *S 68718*). Also occurring in Brunei (e.g., *BRUN 620, BRUN 3262, BRUN 3283, BRUN 5432*, and *Coode et al. MC 7103*).

Ecology. Scattered in mixed dipterocarp forest on leached yellow sands, on both sandstone and the Arip, Mukah, rhyolite, at altitudes to 400 m. Very local, highly vulnerable though frequent in Bako NP and recorded from Mulu NP.

41. *Hopea vacciniifolia* Ridl. ex P.S.Ashton

(Latin, *vaccinium* = the bilberry, *folius* = a leaf; the tiny *Vaccinium*-like leaves)

Gard. Bull. Sing. 19 (1962) 258, *op. cit.* (1964) 112, *op. cit.* (1968) 57, *op. cit.* (1982) 414; Anderson *op. cit.* (1980) 117; Coode *et al.* (eds.) *op. cit.* 73. **Type:** *Hose 583*, Borneo, Sarawak, Marudi district (holotype K).

Understorey monopodial tree, to 15 m tall, to 15 cm diameter, with flying buttresses and stilt roots. **Bark smooth.** *Young twig, leaf bud, stipules and petiole densely shortly persistently greyish brown puberulent; parts of petals exposed in bud sericeous; flower sepals fimbriate; other parts glabrous.* **Twigs** to 0.5 mm diameter apically, very slender, much horizontally branched, with persisting distichous leaf arrangement. **Leaves** chartaceous, drying greenish grey; *blade elliptic to broadly ovate, 1–2.5 × 0.4–1.2 cm*, base equal; *midrib slender more or less slightly elevated below, obscure and sunken above; venation subdryobalanoid; lateral veins 6 pairs, indistinct, hardly elevated, with short slender intermediates, arched; intercostal venation reticulate, evident below; petiole to 0.2 cm long, slender.* **Inflorescences** in axillary pairs, slender, to 1.3 cm long, singly branched, *branchlets bearing to 3 remote flowers; bracts deltoid, to 1 mm long, subpersistent.* **Flowers:** buds sessile; petals oblong, strongly contorted, rotate distally, dark red; *stamens c.* 10, anthers subglobose, connectival appendage *c.* 2x the length of anther; *ovary and stylopodium cylindrical, truncate*, puberulent on apical platform, style short. **Fruits:** *calyx lobes subequal, ovate, to 0.4 × 0.35 cm*, obtuse or acute, appressed round the base of the nut. **Nuts** ovoid, to 0.8 × 0.6 cm, minutely truncate.

Vernacular names. Sabah—*selangan* (preferred name). Sarawak—*luis ribu* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Marudi district (e.g., *BRUN 5664* and *S 33*). Also occurring in Brunei (e.g., *BRUN 140, BRUN 3035, FMS 30614*, and *FMS 35567*).

Ecology. Locally abundant, in dense clusters, on the giant podsols of the Pleistocene sea beach, in tall *kerangas* forest, at low altitudes. Critically endangered throughout its range.

42. *Hopea vesquei* F. Heim

(J. Vesque, 1848–1895, a Luxemburg botanist at the Paris Herbarium)

Bull. Mens. Soc. Linn. Paris 2 (1891) 971; Merrill *op. cit.* (1921) 403; Masamune *op. cit.* 492; Browne *op. cit.* 122; Ashton *op. cit.* (1968) 57, *op. cit.* (1982) 401; Anderson *op. cit.* (1980) 118; PROSEA *op. cit.* 254. **Type:** *Beccari PB 2550*, Borneo, ‘Sarawak’ (holotype P).

Subcanopy to low canopy tree, to 30 m tall, to 30 cm diameter; buttresses to 80 cm tall, thin; *stilt roots present*. **Bark** becoming patchily cracked; *inner bark pale brown or pink*. *Twigs, leaf bud, stipules, petiole, inflorescence, and parts of flower exposed in bud densely greyish brown puberulent; parts otherwise glabrous*. **Twigs** *c.* 1 mm diameter apically, much-branched. **Leaves** *thickly coriaceous; blade broadly ovate, 3.5–6 × 1.5–3.5 cm, base subobtusate, unequal, apex with slender acumen to 1 cm long; midrib stout, raised on both surfaces, not drying black; venation dryobalanoid; main lateral veins 10–13 pairs, slender, hardly elevated but distinct below, with shorter intermediates, basal pair short; intercostal venation obscure, reticulate; petiole 0.6–0.7 cm long, slender*. **Inflorescences** terminal or axillary, solitary, to 3 cm long, singly branched, branchlets bearing to 5 secund flowers. **Flowers:** buds ellipsoid, to 3 × 2 mm; petals lanceolate, pale cream-yellow; stamens *c.* 15, anthers subglobose, connectival appendage slightly longer than anther; *ovary ovoid, stylopodium obscure, style columnar, c. 1½x the length of ovary*. **Fruits:** pedicels to 2 mm long; *calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 3.4 × 0.8 cm, tapering to c. 2 mm above the saccate base, 3 shorter ones ovate, acute, to 0.4 × 0.4 cm, clasping the base of the nut*. **Nuts** *cylindrical, to 1.5 × 0.3 cm, tapering to c. 1 mm filiform style remnant*.

Vernacular name. Sarawak—*luis tebal* (preferred name).

Distribution. Endemic in Borneo. Known only in W Sarawak from Kuching, Lundu and Miri districts (e.g., *S 3021, S 6363, S 9306, S 12498, and S 15171*).

Ecology. Local, but there common in mixed dipterocarp forest on usually shallow yellow sandy soil, at altitudes below 200 m. Locally common in Bako and Lambir NPs but elsewhere highly vulnerable.

Notes. Difficult to distinguish from *H. dyeri* without flowers or ripe fruit (*cf.* Meijer & Wood *op. cit.* 226).

43. *Hopea wyatt-smithii* Wood ex P.S. Ashton

(J. Wyatt-Smith, 1917–2002, former Silviculturist at the Forest Research Institute, Malaysia)

Gard. Bull. Sing. 19 (1962) 260, *op. cit.* (1964) 113, *op. cit.* (1968) 58, *op. cit.* (1982) 429; Meijer & Wood *op. cit.* 227; Burgess *op. cit.* 129; Anderson *op. cit.* (1980) 118; Coode *et al.* (eds.) *op. cit.* 73. **Type:** *G.H.S. Wood SAN 15061*, Borneo, Sabah, Beaufort district (holotype K; isotypes KEP, SAN).

Subcanopy tree, to 25 m tall, to 30 cm diameter, *with prominent flying buttresses and stilt roots*. **Bark** smooth; *inner bark plum-red*. *Parts glabrous but for sericeous parts of petals exposed in bud and stylopodium*. **Twigs** *c.* 1 mm diameter apically, slender, sparsely branched. **Leaves** thinly coriaceous, sparsely greyish lepidote below, drying greyish below, pale tawny-brown above; *blade broadly ovate to elliptic*, 9–14 × 5.5–9 cm, *base equal*, broadly cuneate or sometimes obtuse, apex caudate, acumen to 2 cm long; *midrib slender but evident and raised above, acutely elevated below*; *venation hopea- or subdryobalanoid-type*; *lateral veins 4–8 pairs*, with the main ones irregularly spaced owing to occasional prominent intermediates, slender, elevated below, arched but the basal 2–3 pairs at first decurrent with midrib, straight; intercostal venation evident but unraised, scalariform, lax; petiole 1.2–1.7 cm long, slender. **Inflorescences** *solitary*, terminal or axillary, to 6 cm long, singly branched, branchlets bearing to 6 secund flowers; bracts deltoid, to 1 mm long, not at first caducous. **Flowers**: buds subglobose, to 3 mm diameter; petals oblong-lanceolate, dark red; stamens *c.* 15, anthers broadly oblong, connectival appendage *c.* 2x the length of anther; *ovary and stylopodium hourglass-shaped*, tapering into short style. **Fruits** subsessile; calyx lobes subequal, ovate, subacute, to 1 × 0.8 cm, clasping the nut. **Nuts** broadly ovoid, to 1.2 × 1.2 cm, acute, the apical ¼ exposed.

Vernacular names. Sabah—*selangan daun bulat* (preferred name). Sarawak—*luis putih* (preferred name).

Distribution. Endemic in Borneo. Recorded in Sabah from Beaufort, Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan, and Tawau districts (e.g., *SAN 16467*, *SAN 22634*, *SAN 28633*, and *SAN 44228*) and in Sarawak from Kapit, Limbang and Lubok Antu districts (e.g., *S 692*, *S 32275* and *S 32288*). Also occurring in Brunei (e.g., *BRUN 885*, *FMS 35475* and *S 5589*).

Ecology. In small groups of individuals, on clay-rich soils in mixed dipterocarp forest on moist slopes and low hills, at altitudes to 200 m. Rare and critically endangered by forest conversion.

6. PARASHOREA Kurz

(Greek, *para-* = similar to; resembling *Shorea*)

urat mata (preferred name)

J. As. Soc. Beng. 39, 2 (1870) 65; Slooten, Bull. Jard. Bot. Buitenz. 3, 8 (1927) 370; Symington, Malay. For. Rec. 16 (1943) 97; Masamune, EPB (1942) 492; Browne, FTSB (1955) 126; Ashton, MDB (1964) 82, MDBS (1968) 38, FM I, 9 (1982) 379; Meijer & Wood, Sabah For. Rec. 5 (1964) 190; Burgess, TBS (1966) 140; Anderson, CLTS (1980) 118; PROSEA 5, 1 (1993) 325; Newman *et al.*, MDFB-LHW (1996) 66.

Emergent trees, *with stout slightly concave hardly branched buttresses*; crown dense, hemispherical or dome-shaped, the leaves crowded towards the surface (except *P. macrophylla*). **Bark** *mauve-grey to purplish brown*, becoming narrowly shallowly fissured and flaky, *the fissures and buttress ridges densely whitish corky lenticellate*; inner bark fibrous, warm brown; dammar exudations opaque pale yellowish cream. **Sapwood** pale whitish to yellowish; heartwood pale to chocolate-brown. *Leaf buds often prominent, ovoid or falcate*. **Stipules** linear to hastate, falling early. **Leaves** *drying mauve-grey, undersurface*

greyish to silvery, persistently so in juveniles (except *P. parvifolia* and *P. tomentella*); juvenile leaves often peltate; blade oblong-ovate, often asymmetric; midrib evident above; lateral veins without intermediates, rather straight, not joining into intramarginal veins, dense with plicate folds remaining evident in the open leaf (except *P. parvifolia*); intercostal venation scalariform (except *P. parvifolia*); petiole mostly weakly geniculate. **Inflorescences** paniculate, terminal or axillary. **Flowers:** buds lanceolate; sepals narrow, hardly imbricate; petals falling separately; stamens 15 in 3 whorls, exceeding ovary in bud, filaments short, dilated at base, abruptly tapering, anthers with 4 pollen sacs, narrowly oblong, connectival appendage short or stout columnar; ovary small, ovoid, pubescent, with or without stylopodium, style long, filiform. **Fruits:** pedicels short; mature calyx lobes valvate, all long, spatulate, but unequal with 3 longer and broader than the other 2, pushed apart by the ripening nut. **Nuts** globose to ellipsoid, more or less pubescent and white corky lenticellate; style caducous. Germination as in *Shorea* but seedling leaves linear.

Distribution. About 14 species; S Myanmar, Thailand, Indo-China and southernmost parts of China to Sumatra, Borneo and the Philippines. Six species occurring in Sabah and Sarawak; throughout but absent in Sarawak west of Sri Aman district.

Ecology. In mixed (and in Indo-Burmese seasonal wet evergreen) dipterocarp forest on clay soils, especially fertile and moist places, at altitudes to 1400 m. Usually scattered but some species in some areas locally abundant.

Uses. *Parashorea macrophylla*, *P. malaanonan* and *P. tomentella* are light hardwoods traded in Sabah as white *seraya*; the last two were among the most important export timbers from E Sabah, now largely exhausted. The other species are medium hardwoods. All are generally mixed with red meranti consignments.

Key to *Parashorea* species

1. Leaf blade at least 30 cm long; lateral veins at least 23 pairs; twigs flattened; crown large-leaved, long remaining monopodial.....**2. P. macrophylla**
 Leaf blade at most 20 cm long; lateral veins at most 20 pairs; twigs round; crown dense, dome-shaped.....2
2. Mature leaf blade without visible folds between the at most 9 curved pairs of lateral veins, not silvery lepidote below.....**4. P. parvifolia**
 Leaf blade with visible corrugations between the at least 9 pairs of straight lateral veins, more or less greyish silvery lepidote or tawny velutinous below.....3
3. Midrib glabrous below; petiole glabrescent.....**3. P. malaanonan**
 Midrib below and petiole tomentose or velutinous.....4
4. Leaf undersurface persistently pale tawny velutinous.....**6. P. tomentella**
 Leaf undersurface more or less sparsely caducous yellowish brown scabrid-pubescent on the veins.....5

5. Leaf lateral veins 9–12 pairs; petiole not geniculate.....**1. P. lucida**
 Leaf lateral veins 8–10 pairs; petiole geniculate.....**5. P. smythiesii**

1. *Parashorea lucida* (Miq.) Kurz

(Latin, *lucidus* = clear; the venation)

J. As. Soc. Beng. 39, 2 (1870) 66; Slooten *op. cit.* (1927) 372, *p.p.*; Symington *op. cit.* (1943) 102; Ashton *op. cit.* (1968) 38, *op. cit.* (1982) 387; PROSEA *op. cit.* 331; Newman *et al. op. cit.* 70. **Basionym:** *Shorea lucida* Miq., Fl. Ned. Ind., Suppl. (1862) 487. **Lectotype** (designated here): *Diepenhorst HB 2074*, Sumatra, Pariaman (holotype U). **Synonym:** *Shorea subpeltata* Miq., *op. cit.* 488.

Tree to 60 m tall, to 1.5 m diameter; *crown dense and dome-shaped. Young parts and leaf venation below more or less caducously greyish brown scabrid-pubescent; petiole, inflorescence, parts of flower exposed in bud, and ovary persistently so. Twigs* terete; stipule scars short, pale, horizontal. Leaf buds ovoid, to 4 × 2 mm. **Leaves** thinly coriaceous, *dull and more or less silvery stellate pubescent below, more or less persistently corrugated in between the lateral veins; blade* ovate-lanceolate to elliptic, 6–14 × 2.5–6.5 cm, base unequal, broadly cuneate to subcordate, apex acuminate, acumen to 1 cm long; *lateral veins 9–12 pairs*, slender but prominent below, straight; intercostal venation slender but distinct below; *petiole 1–2 cm long, tomentose, not geniculate. Inflorescences* to 12 cm long, with secund flowers. **Flowers:** buds to 7 × 4 mm; connectival appendage acicular, prominent and longer than anthers. **Fruits:** calyx lobes to 8 × 1.7 cm. **Nuts** to 2.5 cm diameter.

Distribution. Sumatra and Borneo. In Borneo, known only in C and E Sarawak from Belaga, Bintulu, Kapit, and Sarikei districts (e.g., *S 18059, S 22238, S 22316, S 27990, and S 48164*).

Ecology. In Sarawak, local and uncommon and scattered in mixed dipterocarp forest on clay and sandy clay soils, at altitudes below 700 m. Vulnerable owing to land conversion.

2. *Parashorea macrophylla* Wyatt Smith ex P.S.Ashton

(Greek, *makros* = big, *phullon* = leaf; with large leaves)

Gard. Bull. Sing. 19 (1962) 262, *op. cit.* (1964) 83, *op. cit.* (1968) 38, *op. cit.* (1982) 382; Anderson *op. cit.* (1980) 118; PROSEA *op. cit.* 331; Newman *et al. op. cit.* 71; Coode *et al.* (eds.), CLBD (1996) 73. **Type:** *Ladi BRUN 2002*, Brunei, Kuala Belalong (holotype K; isotypes KEP, L).

Large tree, to 50 m tall, to 1 m diameter, *remaining monopodial into maturity; crown diffuse and adorned with the giant silvery leaves. Young parts, buds and inflorescence densely ochreous puberulent. Twigs* c. 12 × 5 mm apically, *compressed at first*; stipule scars amplexicaul. Leaf buds linear-falcate, to 9 × 0.8 cm. **Stipules** to 15 × 2.5 cm. **Leaves** distichous, subchartaceous, silvery below, prominently corrugated between lateral veins; *blade oblong-elliptic, 30–50 × 16–24 cm*, base subcordate, apex obtuse to shortly acuminate; *lateral veins 28–36 pairs*, straight, prominent below; intercostal venation very slender, dense; *petiole 3–5 cm long. Inflorescences* to 16 cm long, 2–3-branched, terminal branches cymose; bracts ovate, to 40 × 25 mm, acute, amplexicaul. **Flowers:** buds to 20 × 8 mm; connectival appendage prominent, c. ½x the length of anther. **Fruits:** calyx lobes to 22 × 2 cm. **Nuts** ellipsoid, to 2.5 × 1.5 cm.

Vernacular names. Sarawak—*bilat* (Iban), *peran* (preferred name).

Distribution. Endemic in Borneo. In Sarawak known from Bintulu, Kapit, Limbang, Marudi, Miri, and Tatau districts (e.g., *S 13791*, *S 18176*, *S 23049*, *S 23471*, and *S 75391*). Also occurring in Brunei (e.g., *BRUN 901*, *BRUN 3136*, *FMS 30388*, and *SAN 17377*) and W Kalimantan.

Ecology. In mixed dipterocarp forest on moist lower slopes and periodically flooded alluvium, along the inland rivers, on clay soils, at altitudes to 300 m. The gigantic silvery fallen leaves on the forest floor look like crashed model zeppelins. Occurring in Mulu NP but vulnerable elsewhere.

3. *Parashorea malaanonan* (Blanco) Merr.

(Tagalog, *mala* = false, *anonang* = the custard apple; a putative vernacular name)

Sp. Blancoan. (1918) 271, PEB (1929) 400; Slooten *op. cit.* (1927) 375; Symington, Gard. Bull. S. S. 9 (1938) 334; Keith *op. cit.* 19; Masamune *op. cit.* 192; Browne *op. cit.* 128; Ashton *op. cit.* (1964) 84, *op. cit.* (1968) 38, *op. cit.* (1982) 383; Meijer & Wood *op. cit.* 192; Burgess *op. cit.* 143; Anderson *op. cit.* (1980) 118; PROSEA *op. cit.* 332; Newman *et al. op. cit.* 72; Coode *et al.* (eds.) *op. cit.* 73. **Basionym:** *Mocanera malaanonan* Blanco, Fl. Filip. ed. 1 (1837) 858. **Neotype** (designated here): Merrill Sp. Blancoan. 1053 (= US 874771), the Philippines, Luzon, Laguna Province, Mt. Maquiling (A, US). **Synonyms:** *Dipterocarpus malaanonan* (Blanco) Blanco, Fl. Filip. ed. 2 (1845) 312; *Shorea malaanonan* (Blanco) Blume Mus. Bot. Lugd. Bat. 2 (1852) 34; *Parashorea plicata* Brandis, J. Linn. Soc. Bot. 31 (1895) 104.

Large tree to 60 m tall, to 2 m diameter, *with dense dome-shaped crown*. **Bark** dark, eventually blackish purple, fissured, thinly flaky. *Young parts sparsely greyish brown pubescent, glabrescent except on bud, inflorescence and nut*. **Twigs** terete, with amplexicaul stipule scars. Leaf buds lanceolate-falcate, to 6 × 2 mm. **Stipules** hastate, to 15 × 6 mm. **Leaves** thinly coriaceous, *with visible corrugations between lateral veins, greyish silvery lepidote below; blade broadly elliptic-ovate, 9–15 × 3.5–7.5 cm, base unequal, obtuse to broadly cuneate, margin wavy distally, apex acuminate, acumen to 1 cm long; midrib prominent and glabrous below; lateral veins 9–14 pairs, prominent below; intercostal venation slender, sinuate; petiole 1.2–2 cm long, somewhat geniculate, glabrescent*. **Inflorescences** to 18 cm long, doubly branched. **Flowers:** buds to 14 × 8 mm; connectival appendage somewhat longer than anther. **Fruits:** calyx lobes to 16 × 1.7 cm. **Nut** to 1.7 cm diameter.

Vernacular names. Sabah—*urat mata daun licin* (preferred name). Sarawak—*urat mata* (preferred name).

Distribution. Borneo and the Philippines. In Sabah widespread and recorded from Beaufort, Kinabatangan, Kota Belud, Kota Merudu, Kudat, Lahad Datu, Papar, Ranau, Sandakan, Semporna, Sipitang, Tambunan, Tawau, and Tenom districts (e.g., *SAN 15225*, *SAN 17229*, *SAN 28928*, *SAN 30811*, and *SAN 76053*) and in Sarawak from Lawas and Miri districts (e.g., *S 3431*, *S 24976*, and *S 25329*). Also occurring in Brunei (e.g., *FMS 30531*, *KEP 80138*, *S 5728*, and *SAN 17065*) and E Kalimantan (e.g., *Endert 5165*).

Ecology. In mixed dipterocarp forest on deep friable clay soils overlying shale, basic and intermediate igneous rocks, at altitudes to 1300 m. Once abundant in the eastern parts of

Sabah lowlands and still locally so in surviving forests; rare in areas west of the Crocker Range (Sabah) and in Sarawak. Vulnerable.

Uses. In the past, the species supplied timber export from Sabah.

4. *Parashorea parvifolia* Wyatt Smith ex P.S.Ashton

(Latin, *parvus* = small, *folius* = leaf; small-leaved)

Gard. Bull. Sing. 19 (1962) 264, *op. cit.* (1964) 85, *op. cit.* (1968) 38, *op. cit.* (1982) 382; Meijer & Wood *op. cit.* 195; Burgess *op. cit.* 140; Anderson *op. cit.* 118; PROSEA *op. cit.* 332; Newman *et al. op. cit.* 73; Coode *et al.* (eds.) *op. cit.* 73. **Type:** *Haviland 2810/2331*, Sarawak, Belaga (holotype K).

Tree to 60 m tall, to 1.5 m diameter; *crown dense, dome-shaped*. **Bark** at first blackish purple. *Young parts pale yellowish brown puberulent, indumentum persistent only on bud, inflorescence, and ovary*. **Twigs** *terete*, slender; stipule scar short. Leaf buds to 3 × 1 mm. **Stipules** narrowly hastate, to 4 mm long, fugaceous. **Leaves** thinly coriaceous, *not corrugated, not silvery lepidote below; blade* elliptic to narrowly ovate, 6–9 × 3–4.5 cm, base broadly cuneate, equal, apex with slender acumen to 1.5 cm long; midrib slender but elevated below; *lateral veins 8–10 pairs*, slender and hardly raised below, arching, well-spaced; intercostal venation subreticulate, well-spaced; petiole 1–1.8 cm long, somewhat geniculate. **Inflorescence** to 14 cm long, singly branched. **Flowers:** buds to 4.5 × 3 mm; connectival appendage short, slightly extruded above anther. **Fruits:** calyx lobes to 8.5 × 1.7 cm. **Nuts** to 1.5 cm diameter.

Vernacular names. Sabah—*urat mata daun kecil* (preferred name). Sarawak—*urat mata bukit* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Kota Belud, Labuk Sugut, Pandawan, Penampang, Pensiangan, Ranau, and Tenom districts (e.g., *SAN 37782*, *SAN 76191*, *SAN 95283*, and *SAN 119902*) and in Sarawak from Belaga, Bintulu, Lawas, Limbang and Miri districts (e.g., *KEP 79350*, *S 18194* and *S 43169*). Also occurring in Brunei (e.g., *BRUN 2604*, *BRUN 3013*, *BRUN 3381*, and *FMS 34567*) and E Kalimantan (e.g., *bb. 11772* and *bb. 18165*).

Ecology. Scattered, usually uncommon or rare in mixed dipterocarp forest on clay soils. Especially on upper slopes and ridges, and at altitudes to 1350 m in upper dipterocarp forest. Occurring in Lambir NP but vulnerable elsewhere.

5. *Parashorea smythiesii* Wyatt Smith ex P.S.Ashton

(B.E. Smythies, Conservator of Forests, Sarawak 1959–1964; ornithologist and botanist)

Gard. Bull. Sing. 19 (1962) 266, *op. cit.* (1964) 86, *op. cit.* (1968) 38, *op. cit.* (1982) 387; Meijer & Wood *op. cit.* 197; Burgess *op. cit.* 140; Anderson *op. cit.* 118; PROSEA *op. cit.* 332; Newman *et al. op. cit.* 74; Coode *et al.* (eds.) *op. cit.* 74. **Type:** *Ladi BRUN 2000a*, Brunei, Kuala Belalong (holotype K; isotypes KEP, L).

Large tree, to 55 m tall, to 1.2 m diameter; *crown dense, dome-shaped*. *Young parts pale yellowish brown scabrid-puberulent, indumentum persistent on inflorescence, bud and ovary*. **Twigs** *terete*, c. 3 mm diameter apically; stipule scars to 1.5 mm at first, horizontal.

Leaf buds to 5×3 mm. **Leaves** coriaceous, *silvery lepidote below*, drying greyish mauve above, *evidently corrugated between lateral veins*; blade elliptic-oblong, $10\text{--}18 \times 4\text{--}7$ cm, base unequal, obtuse, apex with short slender acumen to 0.5 cm long; *midrib prominent and tomentose below*, narrowly furrowed above; *lateral veins 8–10 pairs*, prominent below, somewhat arched; intercostal venation distinct, dense; *petiole 1.5–2.2 cm long*, stout, *geniculate, tomentose*. **Inflorescences** to 10 cm long, doubly branched. **Flowers:** buds ovoid, to 7×4 mm; connectival appendage short, not exceeding anther. **Fruits:** calyx lobes to 10×1.7 cm. **Nuts** to 1.3×0.9 cm.

Vernacular names. Sabah—*urat mata batu* (preferred name). Sarawak—*meruyun* (Iban), *urat mata daun putih* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Beaufort, Sipitang and Tawau districts (e.g., *SAN 18720*, *SAN 25272*, *SAN 44595*, and *SAN 72180*) and in Sarawak from Belaga, Bintulu, Kapit, Limbang, Miri, and Tatau districts (e.g., *S 29151*, *S 32551*, *S 41302*, *S 41329*, and *S 56857*). Also occurring in Brunei (e.g., *BRUN 3016*, *BRUN 3169*, *FMS 35448*, and *KEP 80138*), and E Kalimantan (e.g., *bb. 17890* and *bb. 18320*).

Ecology. Locally frequent in mixed and occasionally upper dipterocarp forests on clay soils, at altitudes to 1000 m. Occurring in Lambir and Mulu NPs, probably not yet vulnerable.

6. *Parashorea tomentella* (Symington) Meijer

Fig. 18.

(Latin, *tomentellus* = with small stuffing (e.g., of a pillow); the indumentum)

Acta Bot. Neerl. 12 (1963) 320; Meijer & Wood *op. cit.* 199; Burgess *op. cit.* 140; Ashton *op. cit.* (1982) 385; PROSEA *op. cit.* 333; Newman *et al. op. cit.* 75. **Basionym:** *Parashorea malaanonan* (Blanco) Merr. var. *tomentella* Symington *op. cit.* (1938) 338. **Type:** *Otik FMS 38745*, Borneo, Sabah, Sandakan district, Kabili-Sepilok FR (holotype KEP).

Large emergent tree, to 65 m tall, to 2 m diameter; *crown dense, dome-shaped*. *Young twigs, buds, leaf undersurface, petiole, inflorescence, bracts outside, parts of calyx and corolla exposed in buds, and ovary densely evenly more or less persistently pale tawny velutinous*. **Twigs** *c.* 3 mm diameter apically, much-branched, ribbed, *becoming terete*, smooth, dark brown; stipule scars slender, horizontal, amplexicaul. Buds lanceolate, acute, to 10×4 mm. **Stipules** narrowly lanceolate, to 16×6 mm. **Leaves** subcoriaceous, *subpersistently corrugated between veins*; blade elliptic-oblong, $10\text{--}20 \times 5\text{--}10$ cm, base obtuse to subcordate, subequal (peltate in young trees and saplings), margin frequently narrowly subrevolute, apex subacute or broadly acuminate, acumen to 1 cm long; midrib stout and prominent below, elevated above; *lateral veins 11–13 pairs*, ascending, prominent below, somewhat arched; intercostal venation densely scalariform, evident and slightly elevated below; petiole 1.5–2.5 cm long, *c.* 3 mm diameter, stout, hardly geniculate. **Inflorescences** to 13 cm long, singly or doubly branched, branches bearing to 3 flowers; bracts lanceolate, to 10×4 mm. **Flowers:** buds broadly lanceolate, 15×10 mm; sepals narrowly deltoid; stamens somewhat shorter than style, filament compressed, tapering, anthers oblong-linear, connectival appendage shorter than anthers, stoutly acicular; ovary small, ovoid, style columnar, *c.* 5x the length of ovary, stout, pubescent but for the apical 1/5. **Fruits:** pedicels *c.* 3 mm long; calyx lobes aliform, 3 larger lobes spatulate, to 20×2.3 cm, obtuse, 2 shorter ones lorate, to 10×0.8 cm, acute. **Nuts** subglobose, to 2 cm diameter, verrucose, apiculate.

Vernacular name. Sabah—*urat mata beludu* (preferred name).

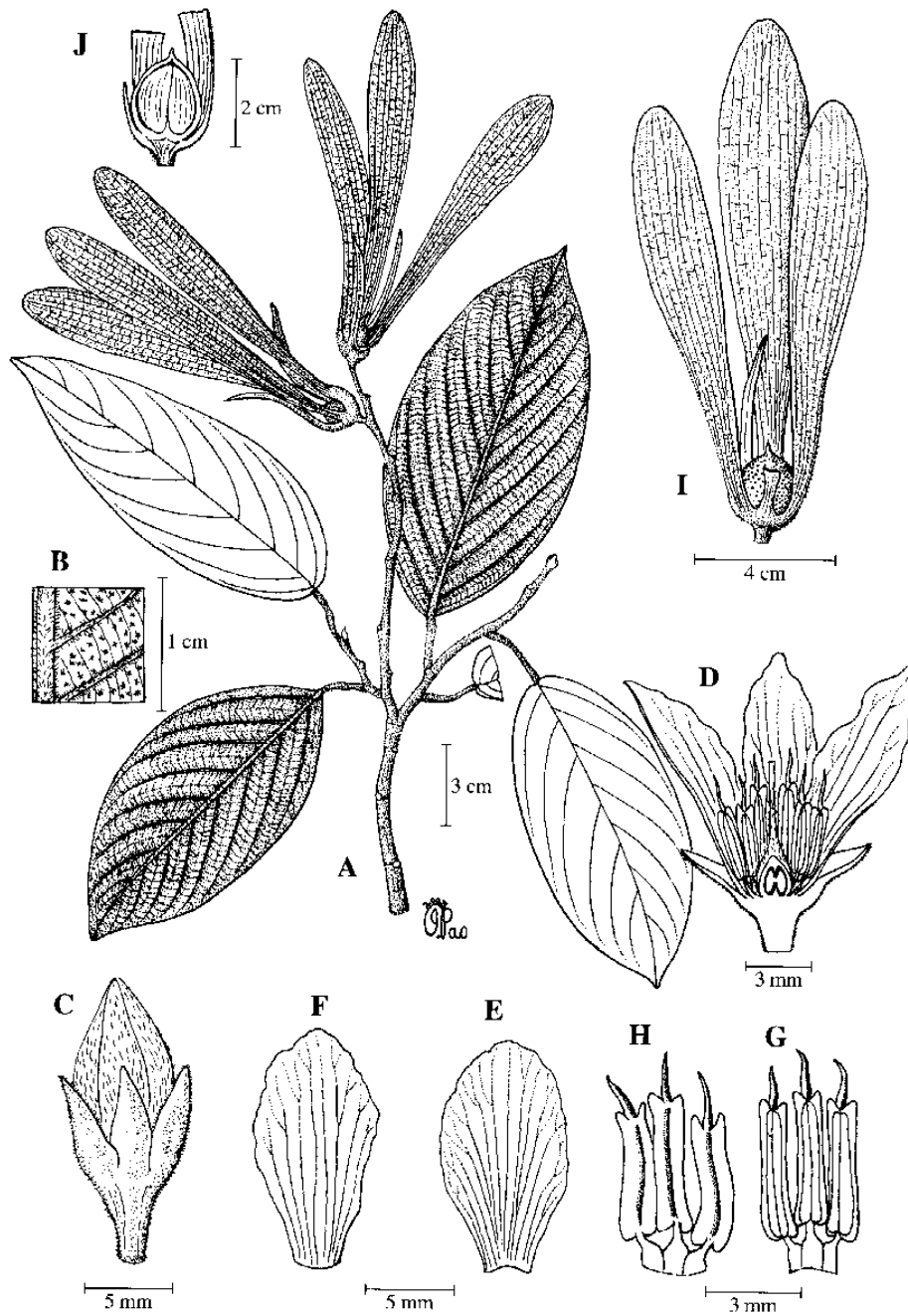


Fig. 18. *Parashorea tomentella*. A, fruiting leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, longitudinal section of open flower; E, adaxial view of petal; F, abaxial view of petal; G, adaxial view of stamens; H, abaxial view of stamens; I, fruit with one of the smaller calyx lobes cut-off; J, longitudinal section of fruit. (A–B from SAN 18703, C–H from FMS 55170, I–J from SAN A 1464.)

Distribution. Endemic in Borneo. In Sabah recorded from Kinabatangan, Labuk Sugut, Lahad Datu, Papar, Sandakan, and Tawau districts (e.g., *SAN 18785*, *SAN 31098*, *SAN 38163*, *SAN 96625*, and *SAN 134924*). Also occurring in E Kalimantan (e.g., *Ambriansyah & Arifin Berau 804*, *Ambriansyah & Arifin Berau 1050* and *Kessler et al. Berau 851*).

Ecology. Locally abundant in mixed dipterocarp forest on fertile clay soils, on undulating land and alluvium, at altitudes to 200 m. Vulnerable owing to forest conversion.

7. *SHOREA* Roxb. ex Gaertn.f.

(Sir John Shore, Governor-General for the British East India Company, 1793–1798)

lun, *meranti*, *selangan batu* (preferred names), *seraya*

Fruct. 3 (1805) 48; Brandis, J. Linn. Soc. Bot. 31 (1895) 73; Masamune, EPB (1942) 492; Symington, Malay. For. Rec. 16 (1943) 1; Ashton, MDB (1964) 115, MDBS (1968) 60, FM 1, 9 (1982) 436; Meijer & Wood, Sabah For. Rec. 5 (1964) 48; Burgess, TBS (1966) 134; Anderson, CLTS (1980) 118; PROSEA 5, 1 (1993) 384; Coode *et al.* (eds.), CLBD (1996) 74; Newman *et al.*, MDF-LHW (1996) 77, MDF-MHHW (1998) 159. **Synonyms:** *Doona* Thwaites in Hooker, Kew J. 3 (1851) t. 14; *Pentacme* A.DC., Prod. 16, 2 (1868) 626; *Isoptera* Scheff. ex Burck, Med. Lands Pl. Tuin 3 (1886) 27; *Ridleyinda* Kuntze, Rev. Gen. Pl. 1 (1891) 65; *Richetia* F.Heim, Bull. Mens. Soc. Linn. Paris (1891) 975; *Parahopea* F.Heim, Rech. Dipt. (1892) 66; *Pachychlamys* (Dyer ex King) Dyer ex Ridl., FMP 1 (1922) 233.

Emergent, sometimes main canopy trees; *buttresses stout or thin* (in most species of sect. *Shorea*), *somewhat concave, usually more or less as wide as tall*; stilt roots or flying buttresses rarely present; mature crown sympodial, hemispherical, spreading. **Bark** various. Stipule scars more or less short. **Leaves:** *blade pinnately veined, rarely with intermediates*; apex with tapering acumen, rarely caudate; *intercostal venation generally scalariform* (excepting, notably, many species of sect. *Richetioides*); petiole frequently but not generally geniculate. **Inflorescences** paniculate, terminal or generally 1-axillary, singly if axillary, doubly if terminal, branched, flowers secund. **Flowers:** buds lanceolate to spindle-shaped, occasionally subglobose (always so in sect. *Shorea* subsect. *Barbata*, sect. *Isoptera*, and sect. *Ovalis*); *sepals free down to receptacle, unequal or sometimes subequal, if unequal the 3 outer lobes longer than the 2 inner ones*; stamens 10–105, in 1, 2 or 3 whorls, or irregular; ovary usually pubescent, occasionally glabrous. **Fruits:** *calyx lobes unequal or subequal, expanded into a broad, saccate, spoon-shaped and distinctly imbricate base appressed to the nut; if unequal then all expanded into spatulate aliform lobes, with the 3 outermost lobes longer and broader than the 2 inner ones, if subequal then all 5 lobes are short but the outer 3 ones still somewhat thicker and longer than the inner 2* (all 5 equal, aliform, in *S. isoptera*). **Nuts** relatively large, *most usually pubescent, acute*, free from fruit calyx base, splitting irregularly at germination.

Distribution. About 196 species from S Asia through Indo-Burma and Malesia to the Philippines, Java and the Moluccas. One hundred thirty eight (138) species are known in Borneo, of which 91 are endemic, and 130 occur in Sabah and Sarawak. There are few local endemics, for instance between two major rivers, or confined to the Kinabalu Massif or the Bau limestone; but 65 species, not all of them endemic in Borneo Is. are restricted within Borneo to north of a line between Pontianak and Tidung in Kalimantan. Most of those are

soils specialists, especially of white or yellow sands. Of these, many do not extend into Sabah beyond Sipitang and Beaufort districts in the south-west.

Ecology. The most frequently dominant genus in the emergent stratum of the zonal mixed and upper dipterocarp forests on yellow/red soils, at altitudes below 1200 m in W Malesia and the Philippines. A few, especially among the yellow meranti field group (sect. *Richetioides*) reach maximum height in the main canopy. In Sarawak, and Brunei still, most of the vast coastal peat swamp was dominated by the single species *Shorea albida*, the *alan*. Most species have narrow edaphic ranges within the dipterocarp forests. A few in our region, such as *S. retusa*, *S. revoluta* and *S. stenoptera* are confined to *kerangas* forest, others such as *S. inaequilateralis*, *S. macrantha*, *S. platycarpa*, *S. teysmanniana* and *S. uliginosa* to the peat swamp forests, and yet others including *S. platyclados*, *S. flaviflora* and *S. monticola* to upper dipterocarp forests; while *S. seminis* and several others are exclusively found on river banks and alluvium. Few species of dipterocarps are confined to limestone habitat, though *S. calcicola* appears to be a good example in our area. Other species found on limestone habitat either grow on acid organic soils overlying it on plateaux and are *kerangas* species, e.g., *S. multiflora*, or are species of the seasonal tropics which penetrate our area on dry limestone karst hills, e.g., *S. guiso* and *H. plagata*, or are species of mesic lower limestone slopes that occur elsewhere on clay soils over basic rocks, e.g., *S. isoptera* and *S. virescens*.

Uses. The most important timber genus in Sabah and Sarawak, albeit largely exhausted. The four field groups produce distinctively different timbers (*cf.* PROSEA *op. cit.* 1993). *Selangan batu* species yield heavy hard yellow-brown close-grained timbers suitable for decking, garden furniture and construction. White meranti timbers are pale, of medium density, and siliceous, suitable for veneer; yellow merantis yield a light hardwood pale yellow-brown in colour, and red merantis a pink to crimson hardwood of light to moderately heavy density that was until recently the most favoured tropical general utility hardwood on international markets. Several large-fruited species, mostly in botanical sect. *Pachycarpae* of the red meranti field group, continue to be harvested, on account of the high content of cocoa butter with an unusually high melting point in their fleshy cotyledons. This is mixed with true cocoa butter in chocolates, and for lipsticks and polishes.

Notes. *Shorea* is a very large genus, but fairly clearly divided into subgroups/sections based on characters of the stamens, and in many or some cases also the ovary, wood anatomy, bark anatomy and morphology, bud and leaf morphology, and resin chemistry. Six rather distinct field groups are also recognised, four of which occur in Sabah and Sarawak. Four of these six field groups exactly correlate with four of the botanical groupings, one includes two of them, but the largest field group, the red merantis, includes five botanical groups each with its distinct floral and bark characters. Meijer (*Act. Bot. Neerl.* 12 (1963) 322) recognised the red merantis as a botanical subgenus, *Rubroshorea*, solely on the basis of the pink to crimson red colour of the wood and inner bark. There are, however, exceptions even to this tenuous definition: *Shorea guiso*, in the *selangan batu* field group and botanical sect. *Shorea*, has red inner bark and heartwood, while *S. scaberrima*, whose wood anatomy and botanical grouping places it as a red meranti, has yellow-brown inner bark and heartwood. There is no single qualitative character which binds the red merantis as a natural botanical group.

A more serious problem has been revealed by molecular phylogenetic studies (Kamiya *et al. op. cit.* 1998; Dayanandan *et al. op. cit.* 1999), which indicate that three botanical groups within *Shorea*, namely *Anthoshorea*, *Doona* (of Sri Lanka) and *Pentacme* (Indo-Burma and

the Philippines), are more closely related to *Hopea* and *Neobalanocarpus* than to other *Shorea*; and that *Parashorea* is closer to the ancestral line of those other *Shorea* than they are to that of *Shorea* sect. *Anthoshorea*, *Doona*, and *Pentacme*, and *Hopea* and *Neobalanocarpus*. Yet no character has been identified which characterises each of these two groups of *Shorea* sections separately. The two natural, phylogenetically separate major groupings within *Shorea*, cannot therefore be given generic status, recognizable in the herbarium or in the field. The alternative might be to give full generic status to the eleven currently recognised botanical sections. This would be difficult in some cases, such as sect. *Rubella* (red meranti), some of whose species share some characters with sect. *Brachyptera* (red meranti) or sect. *Anthoshorea* (white meranti). Perhaps more importantly, no-one who is interested in these trees who is not a botanist would welcome the division of the red merantis into 11 generic names. We, therefore, retain the commonly accepted definition and name of *Shorea*, perhaps the best known indigenous tree genus in Sabah and Sarawak, notwithstanding its paraphyletic origins.

Classification. In Borneo (Sabah and Sarawak), the genus *Shorea* as delimited in the present study can be subdivided into 9 sections base on the following combinations of vegetative and floral characters:

Key to Sections and Subsections of *Shorea*

1. Connectival appendage setose, stout; anthers 4-loculed, apices of anterior locules often also setose.....2
 sect. **Shorea** (*selangan batu* group)
 Flowers: petals cream, often pink at base; stamens 20–60, not distinctly whorled, filaments broad at base, gradually tapering, *anthers 4-loculed, each locule oblong, often setose distally*, ear-like with protruding base and apex, *connectival appendage hardly exceeding the length of anther, more or less setose*; ovary shortly conical, pubescent, with short columnar style. Leaf blade with conspicuous, flat or raised, or sometimes furrowed midrib above; intercostal venation densely scalariform, usually sinuate and hardly elevated.
 Connectival appendage generally sericeous or glabrous, if setose, then anthers glabrous and 2-loculed.....3
2. Flower buds ovoid to spindle-shaped; petals narrow, falling separately; connectival appendage sparsely setose.....sect. **Shorea**, subsect. **Shorea**
 Flower buds globose; petals short, broadly oblong, connate at base on falling; connectival appendage and anther locule apices densely setose.....
 sect. **Shorea**, subsect. **Barbata**
3. Fruit calyx lobes far exceeding ripe nut, spatulate, wing-like but equal, patent; stamens 15, anthers subglobose, connectival appendage shorter than anther apices, stout, not recurved.....
 sect. **Neohopea** (*selangan batu* group)
 Flowers small; buds globose; petals cream, broadly elliptic, falling separately; stamens to 15, in 3 whorls, filaments short, stout, hardly tapering compressed, anthers 4-loculed, locules subglobose, connectival appendage short, glabrous; ovary and stylopodium conical, style very short. Leaf blade with conspicuous, raised midrib on both surfaces; intercostal venation densely scalariform, slender, hardly raised below. Sapling leaves narrowly peltate.

- Fruit calyx lobes unequal and spatulate, or equal and shorter than nut; stamens at least 30, anthers of other shapes, connectival appendage longer than anther apices or, if shorter, then recurved..... 4
4. Anthers 2-loculed.....5
 sect. **Richetioides** (yellow meranti group)
 Flowers usually small; buds usually at most 5 × 3 mm, small; petals usually a shade of yellow, narrow, strongly twisted at anthesis forming a distinct albeit small cup at base enclosing the anthers, falling in rosette. Leaf blade with conspicuous, flat or somewhat furrowed midrib above; intercostal venation more or less reticulate or subscalariform with lesser cross-connecting veinlets. Opening leaves violet or magenta; sapling leaves often peltate.
 Anthers 4-loculed..... 6
5. Flower buds larger, broadly ovoid; stamens at least 100, not whorled, filaments gradually tapering, anthers lorate, connectival appendage shorter than anther apice, densely setose; ovary without stylopodium, style short broad, distinctly truncate, stigmatrifid.....sect. **Richetioides**, subsect. **Polyandrae**
 Flower buds usually smaller, ellipsoid or spindle-shaped; stamens (10–)15, in (2–)3 whorls, filaments tapering abruptly medially, anthers subglobose to broadly ellipsoid, connectival appendage aristate, much exceeding anther apice, sericeous or glabrous; ovary with prominent stylopodium, style long, slender, stigma not trifid.....
sect. **Richetioides**, subsect. **Richetioides**
6. Anther locules linear to oblong; filaments lorate or tapering gradually; ovary without stylopodium, style at least as long as ovary.....7
 Anther locules broadly oblong to subglobose; filaments tapering abruptly medially; ovary usually with distinct stylopodium, style usually short.....8
7. Connectival appendage at least 3x the length of anther, frequently sericeous; wood pale yellow, vessel arrangement reticulate in TS, with silica.....
 sect. **Anthoshoreae** (white meranti group)
 Flowers usually large; buds ovoid; petals usually white, sometimes with pink median suffusion, broadly elliptic to ovate-lanceolate, contorted and imbricate at anthesis forming a broad goblet enclosing the anthers, loosely connate on falling; stamens 15–30, in 3 or more whorls, filaments broad at base, tapering gradually, anthers 4-loculed, locules narrowly oblong to lorate, connectival appendage aristate, erect, at least 3x longer than anther; ovary ovoid, without distinct stylopodium, style longer than ovary, filiform, stigma more or less distinctly trifid. Leaf blade more or less bent backward along midrib; midrib generally obscure, sunken above. Wood-ray cells containing silica crystals; vessels reticulately arranged in TS of the wood.
 Connectival appendage less than ¾x the length of anther, usually stout and glabrous; wood pink, vessel arrangement loosely oblique in TS of wood, without silica..
 sect. **Rubella** (red meranti group)
 Flowers medium-sized; buds spindle-shaped; petals cream suffused with pink, lanceolate, contorted, imbricate at base forming a goblet enclosing the anthers, connate on falling; stamens 15–50, in 3 (if 15) or indistinct whorls, filaments lorate, gradually or abruptly tapering below anthers, anthers 4-loculed, connectival appendage short or exceeding the anther but of shorter length, tapering, glabrous, becoming recurved at anthesis; ovary with or without stylopodium, style columnar,

stigma obscure. Leaf blade (in mature tree) more or less cream lepidote below; midrib conspicuous (except in *S. albida*); intercostal venation densely scalariform, hardly conspicuous. Wood without silica; vessels loosely diagonal to rays in TS.

8. Stamens 50–70, not in distinct whorls whorls, filaments very long, filiform, connectival appendage vestigial.....
 - sect. **Ovalis** (red meranti group)

Stipules and bracts not early caducous. Flower buds broadly ovoid; petals as in sect. Rubella; anthers subglobose, 4-loculed; ovary and stylopodium narrowly conical, style short. Leaf blade with obscure, sunken midrib above; intercostal venation scalariform.

Stamens less than 30, in 3 whorls, filaments compressed and broad at base, connectival appendage aristate.....9

9. Connectival appendage at most as long as anthers, becoming more or less reflexed at anthesis; filaments applanate, tapering from the base to apex.....10
 - sect. **Mutica** (red meranti group)

Stipules and bracts early caducous (except in *S. quadrinervis*). Flower buds ovoid; petals as in sect. Rubella; stamens to 15, in 3 whorls, anthers 4-loculed, locules globose; ovary with distinct stylopodium, style shorter or only slightly longer than ovary. Leaf blade generally with obscure or very slender midrib above; intercostal venation scalariform.

Connectival appendage at least 1½x the length of anther, not becoming reflexed at anthesis, filaments broad and flat at base, tapering abruptly medially and filiform below anthers.....11

10. Bark surface mostly becoming deeply and persistently v-section fissured, rotting off only in large trees. Fruit calyx lobes not auriculate.....sect. **Mutica**, subsect. **Mutica**

Bark surface generally at first remaining smooth, then, after passing through a generally ephemeral shallowly v-section period, becoming chunkily flaky. Fruit calyx lobes auriculate at base.....sect. **Mutica**, subsect. **Auriculatae**

11. Base of filaments connate at base but otherwise free; ovary ovoid without, or pyriform with, a stylopodium, style filiform, prominent.....
 - sect. **Brachypterae** (red meranti group)

Inflorescences lax, with long branches; stipules and bracts at times somewhat persistent. Flower buds ovoid; petals as in sect. Rubella; stamens 15 or 24–28, in 3 whorls or indistinctly so, anthers 4-loculed, locules globose or broadly ellipsoid, connectival appendage 1½–3½x as long as anthers, slender, erect; ovary with distinct stylopodium, together pyriform, or ovoid without stylopodium but with puberulent style base. Leaf blade with conspicuous or obscure and shallowly sunken midrib above; intercostal venation scalariform. Bark cracking and becoming flaky in clean more or less flat thin pieces.

Margin of flattened bases of outer filaments united to form a tube around ovary; ovary ovoid, small, stylopodium tapering into style, style and stylopodium spindle-shaped, tapering at base and apex, or stylopodium indistinct and style filiform, more than 2½x the length of ovary.....

sect. **Pachycarpae** (red meranti group)

Stipules and bracts subpersistent, usually relatively large. Flower buds ovoid to fusiform; petals as in sect. Rubella; stamens to 15, in 3 whorls, filaments lorate, abruptly tapering and filiform below anthers; anthers subglobose to broadly ellipsoid, connectival appendage at least 2x as long as anther locules; ovary small, ovoid, with glabrous or glabrescent stylopodium. Bark remaining smooth, hoop-marked, pale greyish brown, eventually often becoming irregularly flaked and scroll-marked.

Key to *Shorea* species

(based on flowering and/or fruiting specimens)

1. Connectival appendage of stamen setose, stout; anthers 4-loculed, apices of anterior locules often also setose.....2
Connectival appendage generally sericeous or glabrous but, if setose, then anthers glabrous and 2-loculed.....27
2. Flower buds ovoid to spindle-shaped, petals narrow, falling separately, connective appendage sparsely setose.....3
Flower buds globose, petals short, broadly oblong, connate at base on falling, connective appendages and apices of anther sacs densely setose.....22
3. Connectival appendage typically with 1–4 (a few with to 8) bristles, stamens otherwise glabrous.....4
Connectival appendage with at least 5 bristles, shoulder of anther apices setose.....8
4. Lateral veins at least 15 pairs.....**49. S. guiso**
Lateral veins at most 14 pairs.....5
5. Fruit calyx lobes short, subequal.....**50. S. havilandii**
Fruit calyx lobes unequal, 3 larger ones wing-like.....6
6. Stamens at least 40.....**18. S. brunnescens**
Stamens 20–30.....7
7. Lateral veins 10–12 pairs, dense. In mixed dipterocarp forest.....**114. S. scrobiculata**
Lateral veins to 9 pairs, distant. In forest on limestone karst hills.....**20. S. calcicola**
8. Fruit calyx lobes subequal, shorter than nut.....9
Fruit calyx lobes unequal, wing-like, longer than the nut.....10
9. Stamens c. 55; ripe nut to 5 × 5 cm.....**46. S. geniculata**
Stamens 30–40; nut at most 2 cm diameter.....**115. S. seminis**

DIPTEROCARPACEAE (ASHTON)

10. Staminal filaments setose along their distal margins.....11
 Staminal filaments glabrous.....18
11. Leaf blade not eventually pale lepidote below.....**45. S. foxworthyi**
 Leaf blade of mature tree pale lepidote below.....12
12. Twigs at first compressed.....13
 Twigs entirely terete.....14
13. Tomentum on twig and petiole yellowish brown scabrid; petiole less than 1.5 cm long**35. S. exelliptica**
 Tomentum on twig and petiole buff, even; petiole at least 1.5 cm long.....
**56. S. inappendiculata**
14. Leaf blade falcate, base asymmetric; lateral veins slender below.....15
 Leaf blade more or less symmetric, base equal; lateral veins prominent below.....16
15. Stamens 33–44.....**38. S. falcifera**
 Stamens 25–32.....**74. S. materialis**
16. Stamens 25–33.....**12. S. atrinervosa**
 Stamens 35–46.....17
17. Petiole at least 3.5 cm long.....**27. S. crassa**
 Petiole at most 2 cm long.....**83. S. obscura**
18. Stamens at least 40.....19
 Stamens at most 37.....20
19. Leaf with more or less equal base, not cream lepidote below; lateral veins 11–15 pairs, stout below.....**69. S. lunduensis**
 Leaf falcate, cream lepidote below (mature trees); lateral veins 8–12 pairs, slender below.....**39. S. falciferoides** (subsp. **glaucescens**)
20. Lateral veins 16–24 pairs, puberulent below.....**121. S. superba**
 Lateral veins at most 16 pairs, not puberulent below.....21
21. Lateral veins 11–16 pairs; domatia minute.....**53. S. hypoleuca**
 Lateral veins at most 12 pairs; domatia prominent, pore-like.....**33. S. domatiosa**
22. Stamens at least 45.....**63. S. laevis**
 Stamens at most 35.....23
23. Leaf blade less than 8 cm long; lateral veins 6–7 pairs, not sunken above.....24
 Leaf blade at least 10 cm long; lateral veins at least 8 pairs, sunken above or not....25
24. Fruit calyx lobes subequal, shorter than nut.....**11. S. asahi**
 Fruit calyx lobes unequal, wing-like, longer than nut.....**77. S. micans**

25. Fruit calyx lobes unequal, wing-like, longer than nut.....**75. S. maxwelliana**
 Fruit calyx lobes subequal, shorter than nut.....26
26. Leaf blade coriaceous; lateral veins 5–6 pairs, not sunken above.....**62. S. ladiana**
 Leaf blade thin-textured; lateral veins at least 8 pairs, slightly sunken above.....
**16. S. biawak**
27. Fruit calyx lobes far exceeding the length of ripe nut, spatulate, wing-like but equal,
 patent; stamens 15, anthers subglobose, connectival appendage not exceeding the
 anther apice, stout.....**58. S. isoptera**
 Fruit calyx lobes either unequal and spatulate, or equal and shorter than nut;
 connectival appendage as long as or longer than the anther apice or, if shorter, either
 recurved or stamens at least 20.....28
28. Anthers 2-loculed.....29
 Anthers 4-loculed.....57
29. Flower buds large, broadly ovoid; stamens at least 100, filaments gradually tapering,
 anthers lorate, connectival appendage shorter than anther apice, densely setose; ovary
 ovoid, without stylopodium, style short, broad, distinctly trifurcate..**99. S. polyandra**
 Flower buds usually small, ellipsoid or spindle-shaped; stamens (10–)15, in (2–)3
 whorls; anther locules subglobose to broadly ellipsoid, tapering abruptly medially,
 connectival appendage aristate, much exceeding anther apice, sericeous or glabrous;
 ovary with prominent stylopodium, with long slender style, stigma not trifid.....30
30. Fruit calyx lobes shorter than nut, subequal.....31
 Fruit calyx lobes longer than nut, wing-like, unequal.....47
31. Nut glabrous, shiny, drying black.....32
 Nut pubescent, drying dull, pale.....33
32. Petiole at most 1.2 cm long; ovary glabrous; stamens *c.* 15.....**67. S. longiflora**
 Petiole at least 1.8 cm long; ovary puberulent; stamens *c.* 10.....**71. S. macrobalanos**
33. Leaf blade less than twice as long as wide.....34
 Leaf blade more than twice as long as wide.....39
34. Stamens 16–17.....**106. S. richetia**
 Stamens 10–15.....35
35. Leaf venation persistently cream puberulent below.....**65. S. laxa**
 Leaf entirely glabrous.....36
36. Mature tree leaf deeply peltate; understory tree with smooth bark.....**94. S. peltata**
 Juvenile leaf peltate only; canopy tree with flaky bark.....37
37. Leaf blade 7–12 cm long; lateral veins 5–7 pairs; nut to 3 × 1.3 cm, drying mauve
 puberulent.....**14. S. balanocarpoides**

DIPTEROCARPACEAE (ASHTON)

- Leaf blade at most 8 cm long; lateral veins at least 7 pairs; nut to 2 × 1.2 cm, cream buff tomentose (rarely glabrous).....38
38. Lateral veins 8–10 pairs, hardly raised below; blade base not decurrent; petiole drying rugulose; ovary without distinct stylopodium.....**80. S. multiflora**
Lateral veins 7–9 pairs, slender but distinctly raised below; blade base shortly decurrent; petiole drying smooth, black; ovary with distinct stylopodium.....**92. S. patoensis**
39. Leaf blade greyish brown scabrid-pubescent below.....**57. S. induplicata**
Leaf glabrous, or venation alone pubescent below.....40
40. Midrib and lateral veins shallowly furrowed above.....**120. S. subcylindrica**
Midrib and lateral veins not furrowed above.....41
41. Leaf venation puberulent below.....42
Leaf venation entirely glabrous.....43
42. Blade base equal; midrib prominently narrowly furrowed above.....**82. S. obovoidea**
Blade base unequal; midrib not narrowly furrowed above.....**22. S. chaiana**
43. Petiole persistently pale cream, puberulent or glabrous.....44
Petiole drying greyish brown or black, glabrous.....45
44. Petiole at least 1.9 cm long; blade greyish matte below; stamens *c.* 10; fruit calyx lobes subpatent.....**23. S. collaris**
Petiole less than 1.5 cm long; blade pale tawny below; stamens *c.* 15; fruit calyx lobes clasping the nut.....**9. S. angustifolia**
45. Twig slender, pale; leaf blade dull below; distal end of petiole drying cream.....**123. S. tenuiramulosa**
Twig stout, drying dark; leaf blade shiny below; petiole drying entirely black.....46
46. Leaf blade coriaceous; midrib flat above.....**13. S. bakoensis**
Leaf blade thin-textured; midrib raised above.....**130. S. xanthophylla**
47. Petiole at least 1.9 cm long; lateral veins at least 10 pairs.....48
Petiole at most 1.8 cm long or, if longer; lateral veins less than 9 pairs.....49
48. Petiole 3–4 mm diameter, stout; blade thickly coriaceous.....**54. S. iliasii**
Petiole less than 2 mm diameter; blade chartaceous.....**37. S. faguetioides**
49. Lateral veins at least 14 pairs.....**6. S. alutacea**
Lateral veins at most 12 pairs.....50
50. Leaf venation persistently tomentose below.....51
Leaf venation glabrescent or glabrous below.....53
51. Leaf blade more or less densely pale greyish green puberulent below.....**68. S. longisperma**

	Leaf blade glabrous; venation scabrid-puberulent below.....	52
52.	Leaf margin revolute; lateral veins 9–12 pairs; tomentum scabrid.....	1. S. acuminatissima
	Leaf margin not revolute; lateral veins 7–9 pairs; tomentum even.....	47. S. gibbosa
53.	Lateral veins very slender, hardly raised, with distinct shorter intermediates; midrib drying reddish or blackish, frequently with paired glabrous pore-like domatia at base.....	52. S. hopeifolia
	Lateral veins stout, without intermediates; midrib not drying darker than blade, distinctly raised, without domatia.....	54
54.	Petiole 1.7–2.2 cm long.....	60. S. kudatensis
	Petiole at most 1.6 cm long.....	55
55.	Lateral veins 5–7 pairs.....	29. S. cuspidata
	Lateral veins at least 8 pairs.....	56
56.	Lateral veins <i>c.</i> 8 pairs, prominently raised below; leaf margin narrowly revolute.....	79. S. mujongensis
	Lateral veins 9–12 pairs, raised but not prominent below; leaf margin not revolute....	36. S. faguetiana
57.	Anther locules linear to oblong; filaments lorate or tapering gradually; ovary without stylopodium, style at least as long as ovary.....	58
	Anther locules broadly oblong to subglobose; filaments tapering abruptly medially; ovary usually with distinct stylopodium.....	72
58.	Connectival appendage at least 3x the length of anther, frequently sericeous; wood pale yellow, vessel arrangement reticulate in TS, with silica.....	59
	Connectival appendage less than $\frac{3}{4}x$ the length of anther, usually stout, glabrous; wood pink, vessel arrangement loosely oblique in TS; silica absent.....	69
59.	Stamens at least 17.....	60
	Stamens to 15.....	61
60.	Stamens <i>c.</i> 17; blade undersurface pale pink lepidote (mature trees); lateral veins 20–24 pairs.....	31. S. dealbata
	Stamens <i>c.</i> 25; blade not pale lepidote below; lateral veins at most 14 pairs.....	48. S. gratissima
61.	Leaf venation persistently tomentose below.....	62
	Leaf venation early glabrescent below.....	64
62.	Tomentum red- to cream-brown; leaf blade oblong-ovate, bright yellow lepidote below.....	84. S. ochracea
	Tomentum dull greyish to tawny brown; blade obovate or ovate-oblong not pale lepidote below.....	63

63. Leaf blade obovate; lateral veins at most 17 pairs; twig at first compressed.....
**127. S. virescens**
 Leaf blade ovate-oblong; lateral veins 17–26 pairs; twig terete.....**64. S. lamellata**
64. Lateral veins at least 15 pairs; twigs at first compressed.....65
 Lateral veins at most 15 pairs or, if more, then twigs terete.....66
65. Fruit pedicel *c.* 1 cm long, *c.* 5 mm diameter; receptacle obconical; longer fruit calyx lobes to 18 cm long.....**122. S. symingtonii**
 Fruit pedicel at most 2 mm long and diameter; receptacle cup-shaped, abruptly constricted at base; longer fruit calyx lobes at most 13 cm long.....**25. S. cordata**
66. Twig apices more or less compressed; leaf blade subchartaceous, drying chocolate-brown.....**17. S. bracteolata**
 Twig terete; leaf blade coriaceous, drying tawny to pale yellowish brown.....67
67. Base of leaf blade cuneate.....**103. S. resinosa**
 Base of leaf blade obtuse to subcordate.....68
68. Base of fruit impressed; flower bud to 5 × 2.5 mm.....**3. S. agamii**
 Base of fruit tapering; flower bud to 9 × 5 mm.....**24. S. confusa**
69. Midrib obscure above; twigs compressed.....**4. S. albida**
 Midrib conspicuous above; twigs terete.....70
70. Stamens 25.....**32. S. dispar**
 Stamens 15–20.....71
71. Stamens 15.....**108. S. rubella**
 Stamens 19–20.....**34. S. elliptica**
72. Stamens 50–70, connectival appendage vestigial, filaments very long, filiform.....
**85. S. ovalis**
 Stamens less than 30, connectival appendage aristate, filaments compressed and broad at base.....73
73. Connectival appendage aristate, at least 1½x the length of anther, not reflexed, filaments broad and flat at base, tapering abruptly and filiform below anthers.....74
 Connectival appendage at most of the same length as anther, generally becoming reflexed at anthesis; filaments flat, tapering from base to apex.....106
74. Filaments broad at base, tapering abruptly medially and filiform below anthers, connate at base but otherwise free; ovary ovoid without, or pyriform with, a stylopodium, style filiform, prominent.....75
 Margins of flattened bases of outer filaments united to form a tube round the ovary; stylopodium tapering into style, style and stylopodium spindle-shaped, tapering at base and apex, or stylopodium indistinct and style more than 2½x the length of ovary, filiform.....96

75. Stamens 24–28.....**117. S. smithiana**
 Stamens 15.....76
76. Ovary without distinct stylopodium, ovoid, style at least as long as ovary, generally
 puberulent in the basal half.....77
 Ovary and stylopodium distinctly pyriform, style shorter than both, glabrous.....89
77. Leaf blade falcate, base distinctly unequal.....**55. S. inaequalateralis**
 Leaf and base more or less symmetrical.....78
78. Leaf blade below, petiole and young twig scabrid-tomentose.....79
 Leaf blade below, petiole and young twig shortly evenly tomentose or glabrous.....81
79. Leaf blade coriaceous, margin revolute, cream-lepidote below (mature trees); longer
 fruit calyx lobes to 6.5×2.5 cm.....**43. S. flemmichii**
 Leaf blade more or less chartaceous, margin not revolute, not lepidote below; longer
 fruit calyx lobes to 14×2.5 cm.....80
80. Leaf blade concave; tomentum drying paler than blade undersurface.....**5. S. almon**
 Leaf blade flat; tomentum drying same colour or darker than blade undersurface.....
**91. S. parvistipulata**
81. Lateral veins at least 13 pairs, very slender, hardly raised below; intercostal venation
 not raised, densely scalariform.....82
 Lateral veins, if more than 13 pairs, prominent below; intercostal venation not as
 above.....83
82. Leaf blade $10\text{--}15 \times 5\text{--}8$ cm, base subpeltate discernable as a rib over the base of the
 midrib (mature trees); stipule scars cuneate.....**26. S. coriacea**
 Leaf blade $6\text{--}10 \times 3\text{--}5$ cm, base not subpeltate; stipule scars long, often amplexicaul
**126. S. venulosa**
83. Lateral veins at least 16 pairs; blade pinkish cream lepidote below.....**128. S. waltoni**
 Lateral veins at most 16 pairs; blade not pale lepidote below.....84
84. Petiole 4–6 cm long.....**87. S. pachyphylla**
 Petiole at most 3.5 cm long.....85
85. Connectival appendage scarious.....**93. S. pauciflora**
 Connectival appendage glabrous.....86
86. Leaf blade with to 3 pairs of pale scale-like domatia at base.....**59. S. johorensis**
 Leaves without scale-like domatia.....87
87. Leaf thickly coriaceous; style glabrous. In karapa forest, at 800–1200 m altitudes.....
**21. S. carapae**
 Leaf thinly coriaceous; style densely pubescent at least in basal $\frac{1}{4}$. In flood plain and
 mixed dipterocarp forest, at altitudes to 600 m.....88

88. Fruit calyx lobes shorter than nut.....**88. S. palembanica**
 Fruit calyx lobes wing-like, much longer than nut.....**8. S. andulensis**
89. Twigs compressed; midrib sharply acute below; lateral veins hardly raised below.....
**98. S. platyclados**
 Twigs terete; midrib terete but prominent below; lateral veins distinctly raised.....90
90. Fruit calyx lobes less than 2x the length of nut.....91
 Fruit calyx lobes at least 3x the length of nut.....92
91. Ovary and stylopodium hardly distinguishable, filiform towards apex, stouter below,
 frequently further swollen in the basal half, style short; ripe nut to 5×2.5 cm.....
**112. S. scaberrima**
 Ovary and stylopodium ovoid, crowned by a filiform style equal in length; ripe nut to
 3.5×1.5 cm.....**40. S. fallax**
92. Ovary and stylopodium densely pubescent but for the short style apex.....
**101. S. pubistyla**
 Ovary and stylopodium puberulent, glabrescent to glabrous or if puberulent, then
 style equal in length.....93
93. Connectival appendage exceeding the style at anthesis, very slender, crisped; leaf
 blade bullate between intercostal veins; venation below, petiole and twig scabrid-
 tomentose.....**19. S. bullata**
 Connectival appendage not exceeding style at anthesis, awn-like; leaf blade flat,
 evenly tomentose or glabrous.....94
94. Ovary and stylopodium glabrescent, *c.* 2x the length of style; anther locules large,
 strongly tapering to and fused at apex.....**42. S. flaviflora**
 Ovary and stylopodium puberulent, equal to style length; anther locules not large,
 hardly tapering, free.....95
95. Lateral veins 13–19 pairs; blade golden lepidote (mature trees) below, without
 domatia.....**78. S. monticola**
 Lateral veins 6–8 pairs; blade glabrous, with pore-like domatia.....**61. S. kunstleri**
96. Stipule scars amplexicaul.....97
 Stipule scars prominent but not amplexicaul.....104
97. Leaf blade densely golden-brown tomentose below, with axillary domatia.....
**95. S. pilosa**
 Leaf blade sparsely short-tomentose or glabrous below.....98
98. Stipules with cordate subequal base.....**118. S. splendida**
 Stipules not cordate at base.....99
99. Leaf base peltate.....**129. S. woodii**
 Leaf base cordate, obtuse or cuneate.....100

100. Lateral veins 11–20 pairs; nut to 6 × 4 cm; longer fruit calyx lobes to 11 cm long101
 Lateral veins 9–12 pairs; nut to 3.7 × 2.5 cm; longer fruit calyx lobes exceeding 15 cm long.....102
101. Inflorescences to 35 cm long, axillary on modified sections of the twig with short internodes and rudimentary or aborted leaves; stipules to 2 cm long, subrevolute.....**119. S. stenoptera**
 Inflorescences to 20 cm long, in axils of normal leaves on normal twig; stipules to 5 cm long, flat.....**72. S. macrophylla**
102. Leaf blade at least 25 cm long.....**100. S. praestans**
 Leaf blade at most 21 cm long.....103
103. Leaf blade broadly ovate to suborbicular, 10–13 cm wide.....**107. S. rotundifolia**
 Leaf blade elliptic, 5–8 cm wide.....**7. S. amplexicaulis**
104. Leaf base cordate; undersurface densely persistently golden pubescent.....
**76. S. mecistopteryx**
 Leaf base not cordate; tomentum caducous or not golden, or leaf glabrous.....105
105. Stipule scars short, horizontal or somewhat ascending; lateral veins 11–14 pairs.....
**15. S. beccariana**
 Stipule scars falcate, descending; lateral veins mostly 14–19 pairs.....**96. S. pinanga**
106. Fruit calyx lobes auriculate at base.....107
 Fruit calyx lobes not auriculate at base.....112
107. Leaf blade narrowly oblong; lateral veins at least 19 pairs.....108
 Leaf blade elliptic, oblong to lanceolate; lateral veins at most 15 pairs.....110
108. Leaf blade concave boat-shaped; lateral veins sunken above.....**116. S. slootenii**
 Leaf blade flat; lateral veins prominent above.....109
109. Leaf blade sparsely tufted pubescent or glabrescent below; lateral veins 24–28 pairs**81. S. myrionerva**
 Leaf blade densely shortly persistently scabrid-puberulent below; lateral veins 19–25 pairs.....**111. S. sagittata**
110. Leaf blade 14–26 × 6.5–12 cm, thickly coriaceous.....**2. S. acuta**
 Leaf blade 7–16 × 2.2–6 cm, thinly coriaceous.....111
111. Leaf blade lustrous below; lateral veins prominent.....**73. S. macroptera**
 Leaf blade dull below; lateral veins hardly raised, very slender.....**41. S. ferruginea**
112. Stipules exceeding 20 mm long, broad, boat-shaped, prominently ribbed, coriaceous, not early caducous.....**102. S. quadrinervis**
 Stipules at most 19 mm long, chartaceous, flat, not prominently ribbed, early caducous.....113

113. Flower buds at least 14 mm long.....114
 Flower buds at most 10 mm long.....115
114. Petiole at most 0.6 cm long; leaf base cordate, unequal.....**70. S. macrantha**
 Petiole 0.6–1.2 cm long; leaf base obtuse, equal.....
**51. S. hemsleyana** (subsp. **grandiflora**)
115. Leaf blade glabrous below.....116
 Leaf blade sparsely or densely tomentose or pale lepidote below.....118
116. Apex of leaf blade retuse.....**104. S. retusa**
 Apex of leaf blade acuminate.....117
117. Lateral veins 8–9 pairs, with prominent axillary pore-like domatia.....
**44. S. foraminifera**
 Lateral veins 11–12 pairs, with at most a few pairs of small domatia at the midrib
 base.....**124. S. teysmanniana**
118. Leaf with at least 14 pairs of lateral veins or, if sometimes with as few as 11, greyish
 brown scabrid, cream pubescent or lepidote below, or with pale scale-like domatia up
 sides of midrib.....119
 Leaf with at most 13 pairs of lateral veins, or if tomentum as above, then with at
 most 10 pairs of lateral veins; domatia and indumentum not as above.....125
119. Leaf blade evenly pinkish brown velutinous below; lateral veins 20–25 pairs, with
 prominent intermediates.....**10. S. argentifolia**
 Leaf blade not pinkish brown velutinous below; lateral veins less than 21 pairs,
 without intermediates.....120
120. Leaf venation, petiole and twigs densely scabrid-tomentose.....121
 Leaf venation, petiole and twigs sparsely or evenly tomentose.....124
121. Leaf blade cream lepidote below.....**89. S. pallidifolia**
 Leaf blade not lepidote below.....122
122. Leaf blade ovate-elliptic, finely scabrid; lateral veins slender below.....
**30. S. dasyphylla**
 Leaf blade oblong-elliptic, oblong-obovate, or oblong-ovate; lateral veins stoutly
 prominent below.....123
123. Leaf blade concave, chartaceous; petiole 2.2–3.2 cm long.....**125. S. uliginosa**
 Leaf blade flat, thickly coriaceous; petiole 1.3–2.3 cm long.....**110. S. rugosa**
124. Leaf blade (mature tree) pinkish buff puberulent below; lateral veins 12–15 pairs.....
**66. S. leprosula**
 Leaf blade (mature tree) sparsely scabrid below; lateral veins 16–20 pairs.....
**97. S. platycarpa**
125. Leaf blade narrowly ovate to lanceolate, cream to pink lepidote below (mature tree);
 lateral veins slender, hardly raised below.....**28. S. curtisii** (subsp. **curtisii**)

	Leaf blade elliptic or broadly ovate, not cream or pink lepidote below; lateral veins prominent.....	126
126.	Leaf blade shiny below.....	127
	Leaf blade dull below.....	128
127.	Leaf blade elliptic, 5–9 × 3–5 cm, margin hardly or not revolute, apex shortly acuminate or frequently retuse.....	113. S. scabrída
	Leaf blade broadly ovate, 10–15 × 5.5–10 cm, margin prominently revolute, apex prominently acuminate.....	105. S. revoluta
128.	Leaf blade broadly ovate; lateral veins 8–10 pairs.....	86. S. ovata
	Leaf blade ovate to elliptic; lateral veins <i>c.</i> 11 pairs.....	129
129.	Leaf blade below, petiole and twigs densely deep rufous-brown scabrid-puberulent... ..	109. S. rubra
	Leaf blade below, petiole and twigs densely evenly pale brown puberulent.....	90. S. parvifolia

Key to *Shorea* species

(based on field characters)

(**Caution:** this key is only reliable for leaves from mature trees; juveniles have smooth bark; in saplings, leaves often lack pale lepidote blade undersurfaces, blades are larger, narrower, with more prominent acumens and frequently more veins, petioles are longer, more slender, frequently geniculate)

1. Wood hard, dense, ray ends glistening on tangential surface (observable with the aid of hand lens).....2
Wood relatively soft, ray ends not glistening on tangential surface.....5
2. Inner bark and heartwood orange red to meat-red; leaf base sometimes prominently unequal.....3
Inner bark and heartwood cream-brown or, if reddish, inner bark evenly textured; leaf base subequal to equal.....7
Selangan batu (preferred name); Sabah and Sarawak—*selangan* (lighter wood species, Malay), *tekam* (Iban) (sect. **Shorea** and sect. **Neohopea**)
Buttresses prominent, narrow, sharp (except in *S. geniculata*, *S. isoptera*, *S. superba*). Bark thin, hard, dull greyish brown to fawn, occasionally tawny or chocolate, indistinctly small-lenticellate, becoming longitudinally cracked and oblong flaky, the flakes thin, with flat clean surfaces (both sides); inner bark relatively thin, close-textured, hard, homogeneous yellowish brown paling towards cambium (rarely pink to red). Sapwood close-textured, glistening on tangential surface and readily exuding dammar; heartwood chocolate-brown to dark reddish brown; dammar frequent on bark as cream to cream yellow opaque incrustations or smears.

3. Inner bark dense, homogeneous. Lateral veins typically at least 15 pairs.....
**49. S. guiso** (in part)
 Inner bark fibrous. Lateral veins at most 13 pairs.....4
4. Leaf base equal.....**61. S. kunstleri** (in part)
 Leaf base prominently unequal.....**55. S. inaequilateralis** (in part)
5. Inner bark distinctly laminated.....35
 White meranti; Sabah—*melapi* (preferred name); Sarawak—*rarak* (Iban) (sect. **Anthoshorea**)
 Buttresses more or less prominent, stout. Bark pale or dark, thick irregular-section cracked, eventually rotting off in chunky flakes, the lower and subsequent surfaces rough, powdery, rarely thinly flaky; inner bark laminated cream to yellow to orange-brown, thick, fibrous. Sapwood pale yellow, coarse; heartwood indistinct; dammar incrustations pale to bright yellow. Leaf midrib obscure, more or less sunken above.
 Inner bark not distinctly laminated.....6
6. Dammar dark brown to black on fresh surfaces, often as coxcombs on bark, or as copious incrustations. Bark tawny (except in *S. acuminatissima*), becoming vertically cleanly cracked and thinly oblong flaky, the flakes with clean surfaces; inner bark fibrous, tawny brown with a greenish tinge at the cambium.....45
 Yellow meranti; Sabah—*seraya kuning*, yellow seraya (preferred names); Sarawak—*damar hitam* (preferred name), *lun* (light; Iban), *merakunyit* (heavy; Iban) (sect. **Richetioides**)
 Buttresses small or prominent, stout. Sapwood dull yellow to lemon yellow; heartwood pale tawny brown. Twigs commonly striated or rugulose. Leaf generally drying yellowish brown to greenish brown; intercostal venation reticulate or, if subscalariform, with distinct cross-connections, generally drying darker than blade. Sapling leaves often peltate.
 Dammar incrustations opaque, cream to yellow. Bark variously smooth, fissured or cleanly flaky, greyish to pinkish or chocolate-brown; inner bark meat-red or plum- to crimson-brown, rarely coffee-coloured.....76
 Red meranti; Sabah—*seraya*, red seraya (preferred name); Sarawak—*lop* (Iban), *perawan* (Iban) (sect. **Brachypterae**, sect. **Mutica**, sect. **Ovalis**, sect. **Pachycarpae** and sect. **Rubella**)
 Buttresses generally prominent, stout. Sapwood cream to pale yellow. Midrib usually evident, sometimes obscure sunken above; blade drying grey- to pink-brown.
7. Bark surface covered with a superficial but distinct pattern of small v-section fissures and sharp narrow ridges, pale grey, eventually patchily cracked and peeling.....
**16. S. biawak**
 Bark at first smooth, becoming flaky, yellow- to chocolate-brown.....8
8. Leaf blade white or cream lepidote below.....9
 Leaf not pale lepidote below.....24
9. Petiole more than 3.5 cm long.....10
 Petiole less than 3.5 cm long.....11

10. Leaf blade broadly ovate to orbicular; lateral veins drying black; petiole white lepidote.....**46. S. geniculata**
 Leaf blade narrowly ovate to elliptic; lateral veins not drying black; petiole cream pubescent.....**27. S. crassa**
11. Midrib persistently or caducous pubescent below.....12
 Midrib glabrous below.....15
12. Lateral veins less than 9 pairs.....**83. S. obscura**
 Lateral veins more than 9 pairs.....13
13. Venation scabrid-tomentose below.....**35. S. exelliptica**
 Venation evenly tomentose below.....14
14. Lateral veins at most 15 pairs.....**115. S. seminis** (in part)
 Lateral veins at least 16 pairs.....**121. S. superba**
15. Lateral veins at least 15 pairs.....16
 Lateral veins at most 14 pairs.....17
16. Leaf blade cream lepidote below; lateral veins drying cream or yellowish brown below; petiole 1–1.6 cm long.....**114. S. scrobiculata** (in part)
 Leaf blade white lepidote below or drying greyish brown; lateral veins drying black or greyish brown below; petiole 1.5–2.6 cm long.....**56. S. inappendiculata**
17. Petiole 0.7–1 cm long.....**75. S. maxwelliana**
 Petiole at least 1.1 cm long.....18
18. Leaf venation drying black below.....19
 Leaf venation drying cream to pale brown below.....21
19. Leaf blade coriaceous; lateral veins stout, prominent below; petiole stout.....
**12. S. atrinervosa**
 Leaf blade chartaceous to thinly coriaceous; lateral veins slender, hardly raised; petiole slender.....20
20. Petiole 1–1.5 cm long; leaf blade falcate; lateral veins without domatia...**63. S. laevis**
 Petiole 1.5–2.5 cm long; leaf blade broadly ovate, subequal; lateral veins with pore-like domatia.....**33. S. domatiosa**
21. Leaf lateral veins 11–16 pairs, stout, prominent below.....**53. S. hypoleuca**
 Leaf lateral veins at most 12 pairs, elevated but not prominent below.....22
22. Leaf base unequal; blade subfalcate; petiole and midrib cream lepidote; twig glabrescent. In *kerangas* forest.....**74. S. materialis**
 Leaf base subequal; blade not falcate; petiole and twig cream puberulent. In mixed dipterocarp forest.....23
23. Leaf blade 6.5–12 × 2.5–5 cm. In forest on sandy soils west of Batang Lupar (Sarawak).....**38. S. falcifera**

	Leaf blade 10–18 × 4.5–8 cm. In forest on clay soils east of Batang Lupar.....	
	39. S. falciferoides (subsp. glaucescens)
24.	Midrib puberulent above.....	25
	Midrib glabrous above.....	29
25.	Midrib glabrous below.....	26
	Midrib puberulent below.....	27
26.	Leaf thickly coriaceous; lateral veins <i>c.</i> 9 pairs, lax. In forest on limestone karst hills.....	20. S. calcicola
	Leaf thinly coriaceous; lateral veins 9–12 pairs, dense. In <i>kerangas</i> forest or in forest on organic soils over limestone.....	50. S. havilandii
27.	Twig compressed.....	45. S. foxworthyi
	Twig terete.....	28
28.	Petiole at least 1 cm long.....	115. S. seminis (in part)
	Petiole at most 0.8 cm long.....	114. S. scrobiculata (in part)
29.	Petiole at most 1.1 cm long; lateral veins at most 10 pairs.....	30
	Petiole at least 1.2 cm long or, if less, then leaf with more than 10 pairs of lateral veins.....	32
30.	Leaf blade larger, 10–14 × 4.5–7.5 cm; lateral veins at most 6 pairs.....	62. S. ladiana
	Leaf blade smaller, 5–10 × 1.8–5 cm; lateral veins at least 6 pairs.....	31
31.	Species of ultrabasic soils (Sabah).....	77. S. micans
	Species of shallow humic soils on high ridge crests.....	11. S. asahii
32.	Leaf blade base shortly decurrent into petiole; lateral veins somewhat sunken above; sapling leaf peltate.....	58. S. isoptera
	Leaf base not decurrent; lateral veins not sunken; sapling leaf not peltate.....	33
33.	Inner bark pink. Lateral veins and midrib drying distinctly black below.....	49. S. guiso (in part)
	Inner bark yellowish brown. Lateral veins and midrib not drying black below.....	34
34.	Leaf blade at most 6 cm wide; petiole 1–1.5 cm long; intercostal venation subreticulate.....	18. S. brunnescens
	Leaf blade at least 6 cm wide; petiole 2–3.5 cm long; intercostal venation densely scalariform.....	69. S. lunduensis
35.	Leaf venation persistently tomentose below.....	36
	Leaf venation glabrescent or glabrous below.....	37
36.	Leaf undersurface grey tomentose; lateral veins 20–25 pairs.....	64. S. lamellata
	Leaf undersurface bright yellow lepidote; lateral veins 25–30 pairs.....	84. S. ochracea

37. Leaf pale pinkish brown lepidote below; lateral veins 20–24 pairs **31. S. dealbata**
 Leaf undersurface not pale lepidote below; lateral veins at most 18 pairs 38
38. Leaf base cuneate 39
 Leaf base obtuse or subcordate 40
39. Midrib slender, acute; lateral veins hardly raised below **48. S. gratissima**
 Midrib stout, terete; lateral veins distinctly raised below **103. S. resinosa**
40. Leaf blade chartaceous, drying undulate, chocolate-brown 41
 Leaf blade coriaceous, drying not undulate, tawny to pale yellowish brown 42
41. Leaf base usually subcordate; lateral veins 15–18 pairs, prominent below
 **25. S. cordata**
 Leaf base obtuse; lateral veins 11–15 pairs, slender and not prominent below
 **17. S. bracteolata**
42. Twig compressed apically; lateral veins 22–26 pairs **127. S. virescens**
 Twig terete apically; lateral veins at most 22 pairs 43
43. Leaf base more or less cordate; lateral veins at least 18 pairs **122. S. symingtonii**
 Leaf base obtuse; lateral veins at most 18 pairs 44
44. Leaf blade thinly coriaceous; lateral veins (9–)13–18 pairs, slender, not prominent
 below, drying paler than the blade **24. S. confusa**
 Leaf blade thickly coriaceous; lateral veins 9–13 pairs, stout and prominent below,
 drying of the same colour as blade **3. S. agamii**
45. Bark deeply fissured, overall appearing more fissured than flaky 46
 Bark smooth or appearing flaky rather than fissured 48
46. Leaf blade persistently scabrid-tomentose or sometimes also cream-lepidote below,
 drying rich rust-brown. Bark dark chocolate-brown **1. S. acuminatissima**
 Leaf blade glabrous or glabrescent on the veins below, drying dull greyish brown to
 tawny. Bark tawny brown 47
47. Bark surface at first reticulate v-section fissured **29. S. cuspidata** (in part)
 Bark surface square-section fissured **36. S. faguetiana** (in part)
48. Mature tree leaf deeply peltate; smooth barked subcanopy tree **94. S. peltata**
 Juvenile leaf peltate only; main canopy or emergent tree at maturity 49
49. Leaf blade drying dark reddish brown, purplish rufous lepidote below
 **99. S. polyandra**
 Leaf blade drying tawny to greyish green, not lepidote below 50
50. Midrib and lateral veins more or less persistently tomentose below 51
 Leaf blade entirely glabrous 58
51. Leaf blade greyish brown scabrid-tomentose below 52
 Leaf blade evenly or yellowish brown tomentose below 53

DIPTEROCARPACEAE (ASHTON)

52. Leaf base cordate, margin revolute.....**57. S. induplicata**
 Leaf base obtuse, margin not revolute.....**68. S. longisperma**
53. Petiole 2.2–3 cm long; lateral veins 12–14 pairs.....**54. S. iliasii** (in part)
 Petiole less than 2 cm long or, if 2.2 cm, leaf with less than 11 pairs of lateral
 veins.....54
54. Lateral veins 14–19 pairs.....**6. S. alutacea**
 Lateral veins less than 13 pairs.....55
55. Midrib hidden and sunken above.....**82. S. obovoidea**
 Midrib clearly evident, at most shallowly furrowed above.....56
56. Leaf base unequal.....**22. S. chaiana**
 Leaf base more or less equal.....57
57. Twig smooth, persistently tomentose; leaf base obtuse.....**65. S. laxa**
 Twig glabrescent, rugulose; leaf base cuneate.....**47. S. gibbosa**
58. Leaf blade dull greyish lepidote below.....**23. S. collaris**
 Leaf tawny brown, glabrous below.....59
59. Leaf blade more than 3x as long as broad.....60
 Leaf blade less than 3x as long as broad.....62
60. Leaf margin prominently revolute; lateral veins 12–15 pairs. In forest on acid humic
 soils.....**67. S. longiflora**
 Leaf margin hardly or not revolute; lateral veins at most 13 pairs. In forest on non-
 humic clay soils.....61
61. Leaf blade 12–15 × 4–7 cm; petiole 0.8–1.5 cm long, glabrous, drying black.....
**130. S. xanthophylla**
 Leaf blade 8–14 × 2.5–4 cm; petiole 0.6–0.8 cm long, puberulent, drying brownish
 cream.....**9. S. angustifolia**
62. Petiole at least 3 mm diameter.....63
 Petiole at most 2 mm diameter.....64
63. Leaf blade with revolute margin and cordate base.....**71. S. macrobalanos**
 Leaf blade with flat margin and cuneate to obtuse base.....**54. S. iliasii** (in part)
64. Petiole 2–3 cm long; leaf blade frequently subcordate at base, chartaceous; lateral
 veins 10–15 pairs.....**37. S. faguetioides**
 Petiole at most 1.8 cm long or, if longer, leaf blade coriaceous and with at most 7
 pairs of lateral veins.....65
65. Leaf margin revolute.....66
 Leaf margin flat.....68

66. Leaf base cuneate; lateral veins 5–7 pairs.....**106. S. richetia**
 Leaf base obtuse; lateral veins at least 7 pairs.....67
67. Leaf blade ovate; midrib furrowed above.....**79. S. mujongensis**
 Leaf blade oblong-lanceolate; midrib flat above.....**13. S. bakoensis**
68. Leaf blade narrow, at least twice as long as wide.....69
 Leaf blade broad, less than twice as long as wide.....70
69. Midrib and lateral veins evident but shallowly grooved above; canopy tree with flaky bark.....**120. S. subcylindrica**
 Midrib and lateral veins not furrowed above; subcanopy tree with smooth bark.....
**123. S. tenuiramulosa**
70. Bole eventually scroll-marked, smooth overall with patchy flakes.....
**29. S. cuspidata** (in part)
 Bole becoming evenly flaky.....71
71. Petiole at least 1 cm long; leaf blade 7–15 cm long.....72
 Petiole at most 1 cm long; leaf blade 2.5–8 cm long.....74
72. Leaf blade thinly coriaceous; lateral veins at most 7 pairs, prominent below.....
**14. S. balanocarpoides**
 Leaf blade thickly coriaceous; lateral veins at least 7 pairs, hardly raised below.....73
73. Lateral veins 7–9 pairs; petiole at least 1.7 cm long.....**60. S. kudatensis**
 Lateral veins 9–12 pairs; petiole at most 1.5 cm long.....**36. S. faguetiana** (in part)
74. Leaf blade narrowly ovate; lateral veins 7–9 pairs, slender but prominent below.....
**92. S. patoensis**
 Leaf blade broadly ovate; lateral veins 8–11 pairs, hardly raised below.....75
75. Midrib drying dark purplish brown to red below; vast emergent tree.....
**52. S. hopeifolia**
 Midrib drying of the same colour as blade; low emergent or main canopy tree.....
**80. S. multiflora**
76. Bark remaining smooth, hoop-marked, or eventually becoming cracked or shallowly v-section fissured, and sometimes patchily flaky.....77
 Bark early becoming flaky or deeply fissured.....90
77. Stipule scars amplexicaul.....78
 Stipule scars not amplexicaul.....85
78. Stipules ovate, cordate, subsistent; leaf blade glabrous.....79
 Stipules oblong to hastate; leaf blade glabrous or pubescent.....80
79. Twigs with sections with short internodes and no leaves.....**119. S. stenoptera**
 Twigs without leafless sections with short internodes.....**118. S. splendida**

80. Leaf base peltate.....**129. S. woodii**
 Leaf base cordate, obtuse or cuneate.....81
81. Leaf blade densely golden brown tomentose below; lateral veins with prominent
 tomentose domatia.....**95. S. pilosa**
 Leaf blade sparsely puberulent or glabrous below; lateral veins without domatia....82
82. Stipules falcate, subacute; twigs less than 3 mm diameter apically, slender.....83
 Stipules oblong to hastate, obtuse; twigs at least 3 mm diameter apically, stout.....84
83. Leaf blade broadly ovate to suborbicular, 10–13 cm wide.....**107. S. rotundifolia**
 Leaf blade elliptic, 5–8 cm wide.....**7. S. amplexicaulis**
84. Petiole 1.5–3 cm long. In forest on clay rich soils.....**72. S. macrophylla** (in part)
 Petiole 3.5–4.5 cm long. In forest on sandy soils.....**100. S. praestans**
85. Twigs distinctly compressed apically. Bark remaining smooth or becoming shallowly
 flaky.....86
 Twigs more or less terete apically. Bark becoming v-section fissured, eventually
 powdery chunkily flaky.....88
86. Leaf base cordate, blade densely golden tomentose below.....
**76. S. mecistopteryx** (in part)
 Leaf base cuneate or obtuse, blade not densely golden tomentose below.....87
87. Stipule scars short, horizontal or ascending. Leaf blade dull below; lateral veins 11–
 14 pairs.....**15. S. beccariana** (in part)
 Stipule scars falcate, descending. Leaf blade shiny below; lateral veins 14–19 pairs...
**96. S. pinanga**
88. Tomentum on veins and twigs even, short; lateral veins slender, hardly raised below..
**41. S. ferruginea** (in part)
 Tomentum on veins and twig scabrous; lateral veins stout, prominent below.....89
89. Leaf blade 14–26 × 6.5–12 cm. Inner bark plum-red.....**2. S. acuta** (in part)
 Leaf blade 8–16 × 4–6 cm. Inner bark pale pinkish brown.....
**73. S. macroptera** (in part)
90. Leaf base distinctly unequal, subcordate.....91
 Leaf base equal or subequal.....92
91. Leaf blade evenly tomentose below; lateral veins 11–13 pairs.....
**55. S. inaequilateralis** (in part)
 Leaf blade scabrid-tomentose below; lateral veins 13–17 pairs.....**70. S. macrantha**
92. Leaf blade cream, pink or golden lepidote below.....93
 Leaf blade not distinctly lepidote below.....102
93. Twig compressed apically.....94
 Twig terete or ribbed apically.....95

94. Lateral veins 11–14 pairs..... **15. S. beccariana** (in part)
 Lateral veins 16–20 pairs..... **4. S. albida**
95. Lateral veins 9–11 pairs.....96
 Lateral veins 5–7 or at least 10 pairs.....97
96. Leaf blade pink lepidote below; lateral veins hardly raised below.....**28. S. curtisii** (subsp. **curtisii**)
 Leaf blade more or less cream lepidote below; lateral veins prominent below.....
 **32. S. dispar** (in part)
97. Leaf blade golden lepidote below. In montane forest at altitude above 900 m.....
 **78. S. monticola**
 Leaf blade cream lepidote below. In lowland forest at altitude to 800 m.....98
98. Lateral veins 5–7 pairs..... **108. S. rubella**
 Lateral veins at least 10 pairs.....99
99. Bark appearing flaky rather than fissured. Leaf blade thinly coriaceous, sparsely lepidote below, base narrowly cuneate..... **8. S. andulensis**
 Bark prominently v-section fissured. Leaf blade chartaceous or thickly coriaceous, evenly or scabrid-tomentose, base obtuse to cordate (occasionally broadly cuneate)100
100. Leaf blade chartaceous; lateral veins at least 18 pairs; tomentum if present even.....
 **128. S. waltoni**
 Leaf blade thickly coriaceous; lateral veins at most 19 pairs; tomentum scabrid....101
101. Leaf blade 13–22 × 7–13 cm, ochreous scabrid below..... **89. S. pallidifolia**
 Leaf blade 7–16 × 4–9 cm, evenly cream lepidote below except on veins.....
 **34. S. elliptica**
102. Lateral veins at most 13 pairs.....103
 Lateral veins at least 14 pairs.....130
103. Bark appearing fissured rather than flaky.....104
 Bark appearing flaky rather than fissured.....122
104. Leaf venation below entirely tomentose.....105
 Leaf blade below glabrous or puberulent on midrib and lateral veins only.....114
105. Leaf tomentum scabrid or tufted.....106
 Leaf tomentum even, short.....109
106. Bark shallowly cracked. Leaf blade somewhat bullate between intercostal veins.....
 **19. S. bullata** (in part)
 Bark becoming more or less deeply v-section fissured. Leaf blade flat.....107
107. Leaf blade sparsely tometose below..... **113. S. scabrida** (in part)
 Leaf blade densely tomentose below.....108

108. Tomentum tawny, prominently tufted.....**110. S. rugosa** (in part)
Tomentum yellowish brown, scabrous.....**30. S. dasyphylla**
109. Leaf margin more or less revolute.....110
Leaf margin flat.....113
110. Leaf margin prominently revolute; blade coriaceous, glabrescent, shiny below. In *kerangas* forest.....**105. S. revoluta**
Leaf margin narrowly slightly revolute; blade thinly coriaceous, not shiny below. In other forest types.....111
111. Tomentum rich vinous reddish brown.....**109. S. rubra**
Tomentum cream to brown.....112
112. Leaf blade 6–11 × 3.5–6 cm; lateral veins 10–13 pairs, the basal pair often with large pale glabrous domatia.....**90. S. parvifolia**
Leaf blade 4–8 × 2.5–4.5 cm; lateral veins 8–10 pairs, with small hairy domatia in their axils.....**86. S. ovata**
113. Leaf blade 5–9 × 3–5 cm, glabrescent below; lateral veins 8–11 pairs, without prominent domatia.....**113. S. scabrida** (in part)
Leaf blade 8–14 × 3.5–5.5 cm, sparsely pale brown puberulent below; lateral veins 12–15 pairs, sparsely puberulent with pale scale-like domatia in rows up the midrib (immature), or with densely cream-buff puberulent undersurface without domatia.....**66. S. leprosula** (in part)
114. Lateral veins only 4 pairs; blade concave.....**102. S. quadrinervis**
Lateral veins at least 5 pairs; blade flat.....115
115. Petiole 4–6 cm long; blade broadly ovate to orbicular, 10–20 × 9–16 cm, thickly coriaceous. In peat swamp forest and poorly drained *kerangas*.....**87. S. pachyphylla**
Petiole less than 3.5 cm long; blade otherwise. In other types of habitat.....116
116. Petiole at most 1.7 cm long.....117
Petiole at least 2 cm long.....120
117. Leaf apex retuse.....**104. S. retusa**
Leaf apex acuminate.....118
118. Leaf base cuneate; lateral veins without domatia. On inland hills.....**32. S. dispar** (in part)
Leaf base obtuse; lateral veins with domatia. In lowland swamps and valleys.....119
119. Lateral veins 8–9 pairs with prominent axillary domatia up the midrib.....**44. S. foraminifera**
Lateral veins 11–12 pairs with a few pairs of small domatia towards the midrib base only.....**124. S. teysmanniana**
120. Lateral veins 11–13 pairs; leaf margin revolute.....**21. S. carapae**
Lateral veins 6–8 pairs; leaf margin flat.....121

121. Leaf blade narrowly ovate, drying rust-brown below; lateral veins slender but prominent below, ascending. Bark dark chocolate-brown.....**42. S. flaviflora**
 Leaf blade broadly ovate, drying dull greyish; lateral veins slender and hardly raised below, spreading. Bark pale greyish brown.....**61. S. kunstleri** (in part)
122. Stipule scars amplexicaul.....**72. S. macrophylla** (in part)
 Stipule scars not amplexicaul.....123
123. Leaf blade scabrid-tomentose below.....124
 Leaf blade evenly tomentose, glabrous or glabrescent below.....125
124. Leaf blade concave, with revolute margin, more or less bullate between intercostal veins.....**19. S. bullata** (in part)
 Leaf blade flat, margin not revolute.....**91. S. parvistipulata** (in part)
125. Lateral veins 8–9 pairs. Inner bark plum-red.....**93. S. pauciflora**
 Lateral veins at least 10 pairs. Inner bark rust-, plum- or yellow-brown.....126
126. Leaf base with to 3 pairs of pale scale-like domatia in the axils of the basal lateral veins below.....**59. S. johorensis**
 Leaf base without pale scale-like domatia.....127
127. Leaf blade drying deep reddish brown below, purplish brown above.....
**88. S. palembanica** (in part)
 Leaf blade drying pale orange-rust below, pale pinkish brown above.....128
128. Lateral veins hardly raised below; blade dull lepidote below.....
**41. S. ferruginea** (in part)
 Lateral veins prominent below; blade glabrescent, somewhat shiny below.....129
129. Leaf blade 14–26 × 6.5–12 cm.....**2. S. acuta** (in part)
 Leaf blade 8–16 × 4–6 cm.....**73. S. macroptera** (in part)
130. Leaf blade evenly pubescent or glabrous below.....131
 Leaf blade scabrid-tomentose below.....140
131. Lateral veins very slender, hardly raised below.....132
 Lateral veins prominent below.....135
132. Bark cracked, scaly, rather than fissured.....**41. S. ferruginea** (in part)
 Bark appearing fissured rather than flaky.....133
133. Midrib sharply acute, prominent below; blade lanceolate, margin undulate, base inrolled; petiole 1–1.5 cm long.....**98. S. platyclados**
 Midrib terete below; blade broadly ovate, margin not undulate, base not inrolled; petiole at least 1.5 cm long.....134
134. Leaf blade 10–15 × 5–8 cm, base subpeltate, margin revolute. Stipule scars cuneate**26. S. coriacea**

- Leaf blade 6–10 × 3–5 cm, base not subpeltate, margin hardly revolute. Stipule scars amplexicaul.....**126. S. venulosa**
135. Bark flaky.....136
Bark fissured rather than flaky.....138
136. Leaf blade oblong, base cordate, undersurface golden tomentose.....
.....**76. S. mecistopteryx** (in part)
Leaf blade if oblong and with cordate base, then not golden tomentose below.....137
137. Leaf blade densely pale cream-buff puberulent below, or sparsely pale brown puberulent and with pale scale-like domatia running alongside the midrib.....
.....**66. S. leprosula** (in part)
Leaf blade glabrous below but for sparsely buff-puberulent midrib and lateral veins, without domatia.....**88. S. palembanica** (in part)
138. Leaf blade 6–11 × 2.5–4.5 cm, densely pinkish buff-velutinous below.....
.....**10. S. argentifolia**
Leaf blade at least 8 × 4.5 cm, not densely velutinous below.....139
139. Bark deeply fissured. Leaf blade elliptic-oblong to broadly ovate; lateral veins 16–20 pairs. In mixed peat swamp forest.....**97. S. platycarpa** (in part)
Bark shallowly fissured. Leaf blade narrowly oblong; lateral veins 24–28 pairs. On river banks.....**81. S. myrionerva** (in part)
140. Bark cracked and flaky, not deeply fissured.....141
Bark appearing fissured rather than flaky.....145
141. Leaf venation densely scabrid-tomentose below.....142
Leaf venation sparsely tomentose below.....144
142. Leaf blade concave.....**5. S. almon** (in part)
Leaf blade flat.....143
143. Leaf blade narrowly oblong to lanceolate, coriaceous; tomentum pink-brown.....
.....**111. S. sagittata**
Leaf blade broadly oblong to elliptic, thinly coriaceous; tomentum pale yellow- to grey-brown.....**91. S. parvistipulata** (in part)
144. Leaf blade 14–26 × 6.5–12 cm. Inner bark plum-red.....**2. S. acuta** (in part)
Leaf blade 8–16 × 4–6 cm. Inner bark pale pinkish brown.....
.....**73. S. macroptera** (in part)
145. Bark dark warm brown to blackish, deeply fissured.....146
Bark pinkish to greyish brown, shallowly or deeply fissured.....151
146. Inner bark yellowish or pinkish brown.....147
Inner bark rich meat red.....150

147. Leaf blade concave.....148
 Leaf blade flat.....149
148. Petiole 2.2–3.2 cm long. In mixed peat swamp forest.....**125. S. uliginosa**
 Petiole 1–1.8 cm long. In forest on clay soils.....**5. S. almon** (in part)
149. Petiole 1.3–2.3 cm long.....**110. S. rugosa** (in part)
 Petiole 2.5–4 cm long.....**101. S. pubistyla**
150. Leaf blade ovate, 5–9 × 3–4.5 cm; lateral veins 14–17 pairs. Bark blackish.....
**43. S. flemmichii**
 Leaf blade broadly oblong, 11–22 × 4–7 cm; lateral veins 25–34 pairs. Bark rich
 reddish brown.....**116. S. slootenii**
151. Leaf blade at least 3x as long as broad.....152
 Leaf blade at most 2½x as long as broad.....153
152. Leaf blade 12–17 × 2–4.5 cm, bending back along the midrib, densely tomentose
 below; lateral veins 20–25 pairs.....**85. S. ovalis**
 Leaf blade 12–25 × 4.5–9 cm, remaining flat, sparsely tomentose below; lateral veins
 24–28 pairs.....**81. S. myrionerva** (in part)
153. Bark shallowly patchily flaky.....154
 Bark deeply fissured.....156
154. Lateral veins 18–22 pairs. Inner bark pink.....**91. S. parvistipulata** (in part)
 Lateral veins 14–17 pairs. Inner bark yellowish brown.....155
155. Lateral veins with short intermediate veins.....**112. S. scaberrima**
 Lateral veins without short intermediate veins.....
**51. S. hemsleyana** (subsp. **grandiflora**)
156. Lateral veins without distinct intermediate veins. In mixed peatswamp forest.....
**97. S. platycarpa** (in part)
 Lateral veins with distinct intermediate veins. In mixed dipterocarp forest.....157
157. Petiole 0.8–1.5 cm long; leaf not lepidote below; lateral veins 15–20 pairs.....
**40. S. fallax**
 Petiole 2.2–2.7 cm long; leaf frequently dull greyish lepidote below (mature trees);
 lateral veins 14–17 pairs.....**117. S. smithiana**

1. *Shorea acuminatissima* Symington

(Latin, *acuminatissimus* = prominently acuminate; the leaf apex)

(sect. **Richetioides**; yellow meranti)

Gard. Bull. S. S. 9 (1938) 340; Browne, FTSB (1955) 162; Ashton *op. cit.* (1964) 149, *op. cit.* (1968) 81, *op. cit.* (1982) 482; Meijer & Wood *op. cit.* 65; Burgess *op. cit.* 217; Anderson *op. cit.* (1980) 121; PROSEA *op. cit.* 417; Coode *et al.* (eds.) *op. cit.* 74; Newman *et al.* *op. cit.* (1996) 109. **Type:** *Ayan FMS 38723*, Borneo, Sabah, Sandakan (holotype KEP).

Vast emergent tree, to 70 m tall, to 2 m diameter; buttresses tall, stout. **Bark** dark chocolate-brown, deeply square-section fissured, the ridges only later becoming flaky; inner bark tawny-brown, fibrous, not distinctly laminated. **Twig**, inflorescence, petiole, leaf bud, parts of flower exposed in bud, stipules and venation below more or less persistently rusty-brown scabrid-pubescent. **Twigs** c. 1.5 mm diameter apically, terete, much-branched. Leaf buds ovoid, to 1.2 mm long. **Stipules** oblong-falcate, c. 6×3.5 mm, base obtuse to subcordate, somewhat persistent in young trees. **Leaves** glabrous or sometimes cream-lepidote below, coriaceous, drying rich rusty-brown or cream below with the veins usually darker; blade ovate, $7-10 \times 3-4$ cm, base obtuse, margin revolute, apex with acumen to 0.7 cm long; midrib evident but sunken above, prominent below; lateral veins 9–12 pairs, prominent below; intercostal venation densely scalariform, distinctly raised below; petiole 1–1.5 cm long, slender. **Inflorescences** terminal or axillary; rachis to 8 cm long, singly branched, branchlets bearing to 6 flowers; bracteoles oblong, to 2×2 mm, obtuse. **Flowers:** buds ellipsoid, to 5×3 mm; sepals broadly ovate; petals yellow; stamens 15, anthers 2-loculed, locules subglobose to broadly elliptic, connectival appendage aristate, sericeous, exceeding anther apice; ovary and stylopodium glabrous but for band of minute hairs towards apex, style equal to ovary and stylopodium, stigma not trifid. **Fruits** subsessile; calyx lobes unequal, 3 longer lobes spatulate, to 6×1.3 cm, tapering to 3 mm above the tuberculate concave base, 2 shorter ones to 4.5×0.8 cm, otherwise similar. **Nuts** narrowly ovoid, to 4.5×0.8 cm, densely pale rufous pubescent.

Vernacular names. Sabah—*seraya kuning runcing* (preferred name). Sarawak—*lun runcing* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Kinabatangan, Sandakan, and Sipitang districts (e.g., *SAN 16942*, *SAN 17767*, *SAN 17953*, *SAN 37516*, and *SAN 70201*) and in Sarawak from Lawas district (e.g., *S 26560*). Also occurring in Brunei (e.g., *BRUN 3350* and *FMS 30404*).

Ecology. Locally frequent in mixed dipterocarp forest on friable sandy clay soils, on low hills at altitudes to 1600 m (near G. Murut). Vulnerable.

2. *Shorea acuta* P.S.Ashton

(Latin, *acutus* = sharp; the leaf tip)

(sect. *Mutica*, subsect. *Auriculatae*; red meranti)

Gard. Bull. Sing. 19 (1962) 268, *op. cit.* (1964) 174, *op. cit.* (1968) 104, *op. cit.* (1982) 533; Anderson *op. cit.* (1980) 124; Coode *et al.* (eds.) *op. cit.* 74; Newman *et al.* *op. cit.* (1996) 110. **Type:** *Mohsin S 1924*, Borneo, Brunei, Belait, Sg. Liang (holotype K; isotype KEP).

Small emergent tree, to 45 m tall, to 1 m diameter; buttresses stout. **Bark** cracked and flaky becoming shallowly v-section fissured, pale reddish brown; inner bark plum-brown, densely fibrous. **Young twig**, inflorescence, leaf bud, parts of flower exposed in bud, petiole, venation below and midrib above shortly pale brown puberulent; glabrescent on leaf and fruit calyx. **Twigs** terete, to 4 mm diameter apically, compressed at first, with non-amplexicaul stipule scars to 3 mm long. **Leaf buds** ovoid, $6-10 \times 4-6$ mm, acute. **Stipules** oblong, to 12×5 mm, obtuse. **Leaves** thickly coriaceous, shiny and scabrid-tomentose or glabrescent below, drying pale pinkish brown above; blade elliptic, $14-26 \times 6.5-12$ cm, base equal or subequal, without domatia, obtuse or occasionally broadly cuneate, apex with

tapering acumen to 2 cm long; midrib prominent below, narrowly slightly sunken above; lateral veins 10–13 pairs, prominent below, arched; intercostal venation densely scalariform, slender, sinuate; petiole 1.5–2 cm long, stout. Inflorescences terminal or axillary; rachis compressed, to 8 cm long, singly or doubly branched, branchlets bearing to 9 flowers; bracteoles elliptic, to 3.5 × 2.5 mm, caducous. **Flowers:** buds narrowly ellipsoid, obtuse, to 9 × 4 mm; sepals subequal, ovate; *petals linear, dark crimson; stamens 15, filament flat, tapering from base to apex, connectival appendage aristate, not setose, at most of the same length as anther, becoming reflexed at anthesis, anther 4-loculed, locules broadly oblong to subglobose; ovary and distinct stylopodium pubescent. Fruits:* calyx lobes unequal, 3 longer lobes spatulate, obtuse, to 15 × 2.8 cm, tapering to 1.5 cm towards the narrowly auriculate base, 2 shorter ones unequal, linear-lobed, to 8 × 0.7 cm, similar at base. **Nuts** ovoid, to 3 × 2 cm, acute, buff puberulent.

Vernacular names. Sarawak—*engkabang tikus* (Iban), *kawang tikus* (Iban), *meranti kawang tikus* (Malay).

Distribution. Endemic in Borneo. Recorded in Sarawak from Limbang, Marudi and Miri districts (e.g., *S 1492, S 46478, S 46479, S 46482, and S 46591*). Also occurring in Brunei (e.g. *BRUN 3076, BRUN 3291, S 1906, and SAN 17474*). Conserved in the Lambir Hills NP and Mulu NP, Sarawak.

Ecology. Locally common in mixed dipterocarp forest on deep yellow sands, on hills at altitudes to 400 m. Endangered outside parks system.

3. *Shorea agamii* P.S.Ashton

(J. Agama, one-time forest officer in the Sabah Forest Department)

(sect. *Anthoshorea*, white meranti)

Gard. Bull. Sing. 19 (1962) 270, *op. cit.* (1964) 161, Gard. Bull. Sing. 22 (1967) 285, *op. cit.* (1968) 93, *op. cit.* (1982) 497; Meijer & Wood *op. cit.* 51; Burgess *op. cit.* 159; Anderson *op. cit.* (1980) 123; PROSEA *op. cit.* 409; Coode *et al.* (eds.) *op. cit.* 74; Newman *et al.* *op. cit.* (1996) 111. **Type:** *Smith FMS 30525*, Brunei, Labi Hills (holotype KEP).

Emergent tree, to 50 m tall, to 2 m diameter, with prominent stout buttresses. **Bark** becoming chocolate, ochreous and grey mottled, irregularly cracked and thickly flaky through surface rotting; inner bark distinctly laminated, orange-brown and cream-mottled. *Young twig, inflorescence, leaf bud, parts of perianth exposed in bud, ovary, stipule outside, petiole and midrib below pale brown puberulent, caducous. Twigs terete, 2–3 mm diameter apically. Leaf buds* ovoid to falcate, c. 4 × 2.5 mm. **Stipules** oblong, obtuse, c. 10 × 3 mm, caducous. **Leaves** thickly coriaceous, drying tawny yellow with the venation the same shade; blade broadly ovate to oblong, 10–15 × 6–10 cm (subsp. *agamii*) or narrowly ovate, 4.5–10 × 2.5–4 cm (subsp. *diminuta*), base obtuse or subcordate, apex with broad acumen of 0.5–1 cm long; midrib prominent below, obscure, furrowed above as also the veins; lateral veins 9–13 pairs, well-spaced, arched; intercostal venation densely scalariform; petiole 1–1.5 cm long. **Inflorescences** terminal or axillary; rachis to 10 cm long, branches short, bearing to 5 flowers; bracteoles elliptic, to 3 mm long, caducous. **Flowers:** buds narrowly ellipsoid, to 5 × 2.5 mm; sepals narrowly ovate, unequal; petals ovate-elliptic, acute, densely pubescent on exposed parts in bud; stamens 15, in 3 unequal whorls, filaments more or less as long as anthers, tapering gradually, anthers oblong, 4-loculed,

connectival appendage *c.* 3x the length of anther; ovary ovoid, *without stylopodium*, densely pubescent, style slightly longer than ovary, sparsely pubescent in the basal half, stoutly filiform, obscurely trifurcate. **Fruits** *impressed at the c. 1 mm stout pedicel; calyx lobes unequal, 3 longer lobes to 12 × 2.2 cm, tapering to c. 5 mm above the saccate base, 2 shorter ones linear-lobed, unequal, to 6 × 0.4 cm.* **Nuts** *ovoid, to 2 × 1.5 cm, glabrescent, with acicular style remnant to 4 mm long.*

Vernacular names. Sabah—*melapi agama* (preferred name). Sarawak—*meranti putih timbul* (preferred name).

Distribution. Endemic in Borneo.

Ecology. Scattered in mixed dipterocarp forest on well-drained sandy clay soils, and clay-rich soils on ridges, at altitudes to 700 m.

Notes. Two subspecies, subsp. *agamii* and subsp. *diminuta*, are recognised.

Key to subspecies

Leaf blade broadly ovate to oblong, 10–15 × 6–10 cm.....
subsp. **agamii**

In Sabah known from Beaufort, Kudat, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 18476* and *SAN 36222*) and in Sarawak from Lawas, Marudi and Miri districts (e.g., *S 1537* and *S 1936*). Also occurring in Brunei (e.g., *BRUN 3092* and *FMS 35449*) and E Kalimantan (e.g., *Ambriansyah Berau 1140* and *Meijer 2464*). Occurring in Lambir and Mulu NPs; elsewhere vulnerable following logging.

Leaf blade narrowly ovate, 4.5–10 × 2.5–4 cm.....
subsp. **diminuta** P.S.Ashton

(Latin, *diminutus* = made small; the leaf)

Gard. Bull. Sing. 22 (1967) 285, *op. cit.* (1968) 93, *op. cit.* (1982) 497; PROSEA *op. cit.* 409; Newman *et al. op. cit.* (1996) 112. Type: *Sibat S 25027*, Borneo, Sarawak, Bt. Mersing, Anap (holotype K; isotype KEP).

Known in Sarawak from Kapit, Miri, Serian, Simunjan, and Tatau districts (e.g., *S 15227*, *S 23860*, *S 27005*, *S 36655*, and *S 46520*). Also occurring in W Kalimantan (e.g., *bb. 27005*, *bb. 29076* and *Wilkie 94313*). Ecology as the species. Vulnerable following logging. For differences from *S. confusa*, see there.

4. *Shorea albida* Symington

Fig. 19.

(Latin, *albidus* = whitish; the leaf undersurface)

(sect. **Rubella**, red meranti)

Gard. Bull. S. S. 8 (1935) 283; Masamune *op. cit.* 492; Browne *op. cit.* 137; Anderson, Gard. Bull. Sing. 20 (1963) 158, *op. cit.* (1980) 74; Ashton *op. cit.* (1964) 175, *op. cit.* (1968) 104, *op. cit.* (1982) 499; PROSEA *op. cit.* 391. **Lectotype** (designated here): *Zainal FMS 30353*, Borneo, Brunei, Kuala Belait (hololectotype KEP; isolectotype L).

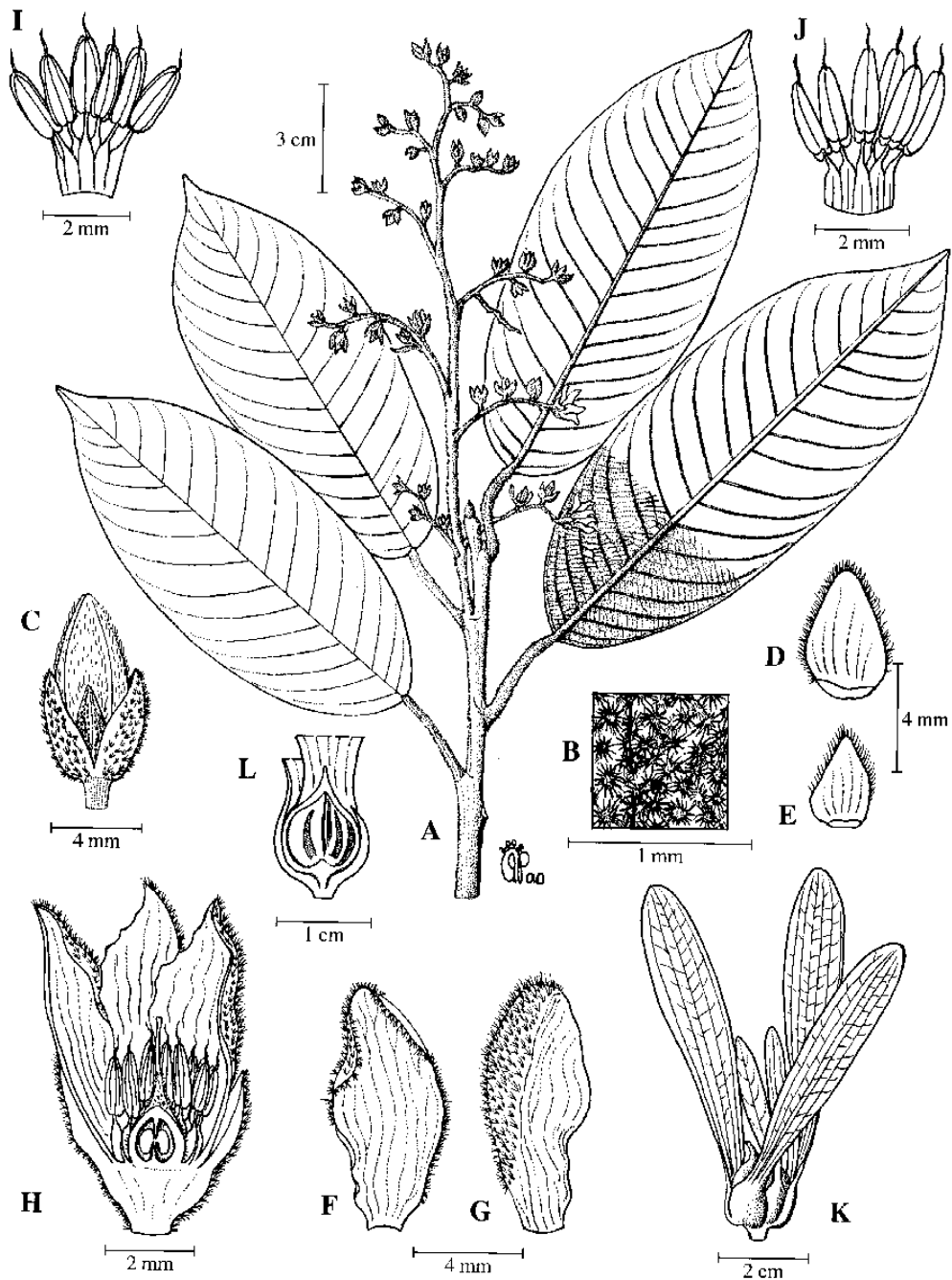


Fig. 19. *Shorea albida*. A, flowering leafy twig; B, detail of indumentum on the lower leaf surface; C, flower bud; D, outer sepal; E, inner sepal; F, adaxial view of petal; G, abaxial view of petal; H, longitudinal section of open flower; I, adaxial view of stamens; J, abaxial view of stamens; K, fruit; L, longitudinal section of fruit. (A–J from *S* 651, K–L from *S* 2852.)

Main canopy tree *c.* 30 m tall to giant emergent to 75 m tall, to 2.5 m diameter; crown vast, diffuse, sea-green; buttresses to 4 m tall and wide, stout. **Bark** becoming deeply v-section fissured, the surface eventually rotting off in irregular flakes; inner bark meat-red, fibrous, thick. **Heartwood** crimson red. *Twig, inflorescence, leaf bud, stipule and bracteole outside, parts of perianth exposed in bud, petiole and leaf venation below shortly densely persistently pinkish brown puberulent; leaf cream-lepidote below.* **Twigs** compressed, to 5 × 2 mm apically. *Leaf buds ovoid to hastate, compressed, acute, to 10 × 6 mm.* **Stipules** oblong, obtuse, to 20 × 8 mm, caducous. **Leaves** coriaceous, drying greyish brown above, cream below with darker venation; *blade oblong-elliptic, 7.5–15 × 4.5–6.5 cm, base obtuse, apex with tapering acumens to 6 m long; midrib obscure, sunken above, slender but prominent below; lateral veins 16–20 pairs, with shorter intermediates, slender, hardly elevated below; intercostal venation slender, densely scalariform; petiole 2–3.5 cm long, slender.* **Inflorescences** terminal or axillary; rachis compressed, lax, to 18 cm long, doubly branched, branchlets bearing to 3 flowers; bracteoles lanceolate, acute, to 8 × 3 mm. **Flowers:** buds broadly ellipsoid, to 9 × 5 mm, acute; sepals deltoid, unequal; petals ovate, cream; *stamens 20–25, filament broad at base, tapering gradually and filiform distally, anthers 4-loculed, locules narrowly oblong, longer than filament, connectival appendage glabrous, short, slender, erect, shorter than anther; ovary without stylopodium, together with basal half of style pubescent, style 2x the length of ovary.* **Fruits:** calyx lobes unequal, 3 longer lobes narrowly spatulate, to 8 × 1.4 cm, tapering to 4 mm above the saccate base, 2 shorter ones linear-lobed, to 3.5 × 0.4 cm. **Nuts** ovoid, to 1.2 × 0.9 cm, grey-buff puberulent, with to 2 mm filiform style remnant.

Vernacular name. Sarawak—*alan* (preferred name).

Distribution. Endemic in Borneo; known in Sarawak from Bintulu, Limbang Marudi, Miri, Serian, Sibuan, and Sri Aman districts (e.g., *S 1253, S 2805, S 12250, S 13504, and S 13506*), Brunei (e.g., *BRUN 5009 and FMS 37149*), and Lower Kapuas in W Kalimantan (e.g., *bb. 35243*).

Ecology. Formerly gregarious and dominant in three of the ‘phasic communities’ (PC) of the peat swamp forests (Anderson *op. cit.* 1963); from within the outermost mixed peat swamp forest, where this species reaches its greatest size in PC 2, the ‘*alan* forest’, through PC 3, the ‘*alan bunga* forest’, to PC 4, where it is shortest, the ‘*padang alan* forest’. The species seldom flowers and juveniles are rare, few surviving, except in the ‘*alan bunga* forest’ where there is patchy regeneration; in ‘*padang alan*’ forest the trees frequently topple, then shoot from epicormic branches forming new orthotrophic leaders. *Alan* forest individuals are generally hollow. Also occasional in poorly drained lower montane *kerangas* on Merurong Plateau, Bintulu district, at 800 m altitude. Occurring in Loagan Bunut and Mulu NPs. Critically endangered owing to failure to regenerate and conversion of the peat swamp forests.

5. *Shorea almon* Foxw.

(from a Philippine name—*almon*)

(sect. **Brachypterae**, red meranti)

Philip. J. Sci. 67 (1938) 313; Browne *op. cit.* 150; Meijer & Wood *op. cit.* 93; Burgess *op. cit.* 181; Ashton *op. cit.* (1968) 104, *op. cit.* (1982) 507; Anderson *op. cit.* (1980) 124; PROSEA *op. cit.* 291;

Newman *et al. op. cit.* (1996) 114. **Lectotype** (designated here): *Whitford FB 11647*, the Philippines, Cadiz, Negros Occidental (hololectotype K; isolectotype L).

Large emergent tree, to 70 m tall, to 1.2 m diameter; crown dense; bole tall, straight; buttresses to 2.5 m tall, 2 m wide, stout. **Bark** dark greyish brown, becoming vertically cracked and thinly flaked; inner bark pinkish brown, fibrous, hard. *Twig, inflorescence, bud, stipule and bracteole outside, parts of perianth exposed in bud, and leaf venation below more or less densely persistently pinkish brown scabrid-tomentose; stipule inside and venation above sparsely so; midrib above, nut and ovary evenly so.* **Twigs** c. 2 mm diameter apically. *Leaf buds ovate, compressed, acute, to 4 × 3 mm.* **Stipules lanceolate, acute, to 10 × 5 mm, caducous.** **Leaves chartaceous, somewhat concave, drying pinkish brown with the midrib and lateral veins typically distinctly paler; blade obovate-oblong, 9–16 × 3.5–7 cm, base equal, broadly cuneate to obtuse, apex with short, broad acumens, to 0.8 cm long; midrib evident, flat or slightly furrowed above, slender but prominent below as also the veins; lateral veins 17–20 pairs; intercostal venation densely scalariform, elevated below; petiole slender, 1–1.8 cm long.** **Inflorescences** terminal or axillary; rachis ascending, lax, to 20 cm long, singly branched, branchlets bearing to 10 flowers; bracteoles elliptic, to 5 × 3 mm, obtuse, not at first caducous. **Flowers:** buds lanceolate, to 7 × 3 mm; sepals unequal, deltoid to ovate; petals lanceolate, hirsute on exposed part in bud; stamens 15, in 3 unequal whorls, filaments compressed at base, abruptly tapering medially and filiform below the subglobose, 4-loculed anthers, connectival appendage slender, glabrous, c. 3x the length of anther; ovary without distinct stylopodium, ovoid, style c. 1½x the length of ovary, filiform. **Fruits:** pedicels to 3 mm long, prominent; calyx lobes unequal, 3 longer lobes to 14 × 2.5 cm, tapering to c. 8 mm above the saccate base, 2 shorter ones lorate-lobed, to 8 × 1 cm. **Nuts** ovoid, to 2 × 1.5 cm, shortly mucronate.

Vernacular name. Sabah—*seraya kerukup* (preferred name).

Distribution. Borneo and the Philippines. In Borneo, known in Sabah from Keningau, Kinabatangan, Lahad Datu, and Sandakan districts (e.g., *SAN 4472*, *SAN 23966*, *SAN 35632*, and *SAN 83424*) and in Sarawak from Bintulu, Lawas and Miri districts (e.g., *S 22576* and *S 24960*). Also occurring in Brunei (e.g., *FMS 35679* and *S 5792*) and NE Kalimantan (e.g., *Arifin et al. Berau 906*).

Ecology. Usually rare in mixed dipterocarp forest, on yellow clay soil over shale, on undulating land, at altitudes to 400 m. Rare in Lambir NP; endangered.

6. *Shorea alutacea* P.S.Ashton

(Latin, *alutaceus* = leather colour; the tomentum)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 288, *op. cit.* (1968) 81, *op. cit.* (1982) 481; Anderson *op. cit.* (1980) 121; Newman *et al. op. cit.* (1996) 115. **Type:** *Bojeng S 10170*, Borneo, Sarawak, Lundu district, G. Gading NP (holotype K).

Medium-sized tree, to 1 m diameter; buttresses stout. **Bark** smooth; inner bark fibrous. *Twig, inflorescence, bracteole, parts of flower exposed in bud, ovary and nut, stipules, leaf bud, petiole and midrib shortly densely persistently tawny buff pubescent; leaf blade below sparsely so; fruit calyx sparsely caducously so.* **Twigs** c. 2 mm diameter apically, terete,

sparsely branched, with prominent stipule scars. Leaf buds ovoid, acute, c. 2×1.5 mm, small. **Stipules** narrowly deltoid, acute, to 8×3 mm, relatively large. **Leaves** chartaceous, drying pale greenish grey, wrinkling; blade ovate to lanceolate, $15\text{--}22 \times 6\text{--}8$ cm, base cordate, apex with slender acumen to 1 cm long; midrib and veins furrowed above, slender but prominent below; lateral veins 14–19 pairs; intercostal venation slender, subscalariform, indistinct; petiole 0.6–1 cm long, 0.2 cm diameter, rugose on drying. **Inflorescences** terminal or axillary; rachis to 15 cm long, singly or doubly branched; bracteoles to 4×3 mm, ovate, acute, fugaceous. **Flowers:** buds to 6×3 mm; stamens 15, anthers 2-loculed, locules subglobose, tapering abruptly medially, connectival appendage setose, 3–4x the length of anther; ovary and stylopodium pyriform. **Fruits:** pedicel c. 1 mm long; calyx lobes unequal, 3 longer lobes to 8×1.8 cm, tapering to 4 mm above the tuberculate narrowly saccate base, 2 shorter ones to 6×1.2 cm. **Nuts** narrowly ovoid, to 2.2×1 cm, apiculate.

Distribution. Locally endemic in the granodiorite mountains of W Sarawak; so far only known from G. Gading NP, Lundu district (e.g., S 7975, S 7976 and the type), and the Bau limestone hills at Tiang Bekap, Kuching district (e.g., S 32684).

Ecology. In mixed dipterocarp forest on deep yellow clay loams, at altitudes below 300 m, apparently not common. Vulnerable.

7. *Shorea amplexicaulis* P.S.Ashton

Fig. 20.

(Latin, *amplexicaulis* = stem-clasping; the petiole)

(sect. *Pachycarpae*, red meranti)

Gard. Bull. Sing. 19 (1962) 273, *op. cit.* (1964) 177, *op. cit.* (1968) 104, *op. cit.* (1982) 524; Meijer & Wood *op. cit.* 95; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 124; PROSEA *op. cit.* 392; Coode *et al.* (eds.) *op. cit.* 74; Newman *et al.* *op. cit.* (1996) 116. **Type:** Ashton BRUN 3261, Borneo, Brunei, Andulau FR (holotype K; isotype KEP).

Medium-sized emergent tree, to 50 m tall, to 1.2 m diameter, with stout low buttresses. **Bark** pale greyish brown, remaining smooth, hoop-marked; inner bark pale pinkish brown. **Heartwood** pink. *All exposed fleshy parts typically glabrous, but frequently sparsely caducous or persistently pale buff to golden pubescent.* **Twigs** slightly compressed at first, to 3×2 mm apically, with prominent pale horizontal amplexicaul stipule scars. *Leaf buds hastate, obtuse, $10\text{--}15 \times 3\text{--}5$ mm.* **Stipules** hastate, subacute, to 25×8 mm, not early caducous. **Leaves** coriaceous, drying dark crimson red often shiny below, paler pinkish brown above; blade elliptic, $11\text{--}21 \times 5\text{--}8$ cm, base cuneate, apex with tapering acumen to 1 cm long; midrib evident, flat above, terete and prominent below; lateral veins 9–12 pairs, arched, prominent below; intercostal venation remotely scalariform, distinct and slightly elevated below; petiole distinctly geniculate, 1.5–2.5 cm long. **Inflorescences** terminal or axillary; rachis lax, slender, compressed, to 24 cm long, singly branched, branchlets bearing to 11 distichous flowers; bracteoles lanceolate, to 13×8 mm, fugaceous. **Flowers:** buds to 10×3.5 mm; petals pale yellow; anthers narrowly oblong, connectival appendage more than 2x the length of anther; ovary ovoid, glabrous, without distinct stylopodium, style columnar. **Fruits** impressed at base; calyx generally glabrescent, lobes unequal, 3 longer lobes to 18×3 cm, tapering to 2 cm above the saccate base, 2 shorter ones to 13×0.8 cm, similar at base. **Nuts** broadly ovoid, acute, to 3.7×2.5 cm, persistently golden buff pubescent.

Vernacular names. Sabah—*kawang bukit* (preferred name). Sarawak—*engkabang pinang licin* (preferred name), *langgai* (Iban).

Distribution. Endemic in Borneo, occurring throughout the island except for the southwestern parts. In Sabah known from Beaufort, Sandakan and Tawau districts (e.g., *SAN 15106*, *SAN 22690*, *SAN 27397*, and *SAN 62919*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Miri, and Simunjan districts (e.g., *S 164*, *S 10708*, *S 15840*, *S 23611*, *S 32240*, and *S 68171*). Also occurring in Brunei (e.g., *BRUN 3006* and *S 1633*) and Kalimantan (e.g., *bb. 29663*, *Church & Mahyar 1753* and *Jarvie and Ruskandi 5756*).

Ecology. In mixed dipterocarp forest, especially on clay-rich soils but also on sandy clay, at altitudes to 700 m. Not vulnerable.

Notes. Closely related to *S. beccariana* which differs in its golden tomentum, generally dull leaf undersurface and short ascending stipule scars. The two often occur together though *S. beccariana* ranges onto more sandy soils.

8. *Shorea andulensis* P.S.Ashton

(of Andulau FR in Brunei)

(sect. **Brachypterae**, red meranti)

Gard. Bull. Sing. 19 (1962) 275, *op. cit.* (1964) 178, *op. cit.* (1968) 105, *op. cit.* (1982) 514; Meijer & Wood *op. cit.* 97; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 124; Coode *et al.* (eds.) *op. cit.* 74; Newman *et al.* *op. cit.* (1996) 117. **Type:** Ashton *BRUN 3263*, Borneo, Brunei, Andulau FR (holotype K; isotypes KEP, L).

Medium-sized emergent tree, to 45 m tall, to 1.2 m diameter; crown pale from below, diffuse, hemispherical; buttresses stout, to 1 m tall. **Bark** becoming cracked and patchily flaky, pale pinkish brown mottled. **Twig**, **inflorescence**, **bracteole**, **leaf bud**, **parts of flower exposed in bud**, **stipule and petiole densely persistently yellowish buff-puberulent**, **more sparsely so on venation below and midrib above**. **Twigs** slender, at first compressed, 1.5–2 mm diameter apically. Leaf buds ovoid, compressed, 3–6 × 1.5–3 mm, subacute. **Stipules** hastate, subacute, to 14 × 5 mm. **Leaves** thinly coriaceous, cream lepidote in mature tree, otherwise drying rich reddish brown below, pinkish brown above; blade elliptic-ovate, 6–9 × 3–5 cm, base obtuse or broadly cuneate, margin undulate, apex with acumen to 0.8 cm long; midrib narrowly furrowed above, slender but prominent below as also the veins; lateral veins 10–13 pairs, straight and abruptly arched within margin; intercostal venation slender, scalariform, sinuate; petiole 1–1.2 cm long. **Inflorescences** terminal or axillary; rachis terete or slightly compressed, to 12 cm long, singly or doubly branched, branchlets bearing to 10 flowers; bracteoles ovate, to 3 × 1.2 mm, subacute. **Flowers:** buds to 8 × 2.5 mm; calyx spreading; petals lilac; stamens 15, connectival appendage c. 3x the length of anther; ovary small, ovoid, glabrous, stylopodium obscure, style c. 2x the length of ovary, columnar, pubescent in basal half. **Fruits:** pedicels to 2 mm long; calyx tube glabrescent, lobes unequal, 3 longer lobes lorate, to 5 × 0.7 cm, base saccate, 2 shorter ones to 3 cm long, otherwise similar. **Nuts** ovoid, to 3.5 × 2.5 cm, apiculate.

Vernacular names. Sabah—*seraya daun merah* (preferred name). Sarawak—*meranti daun putih* (preferred name).

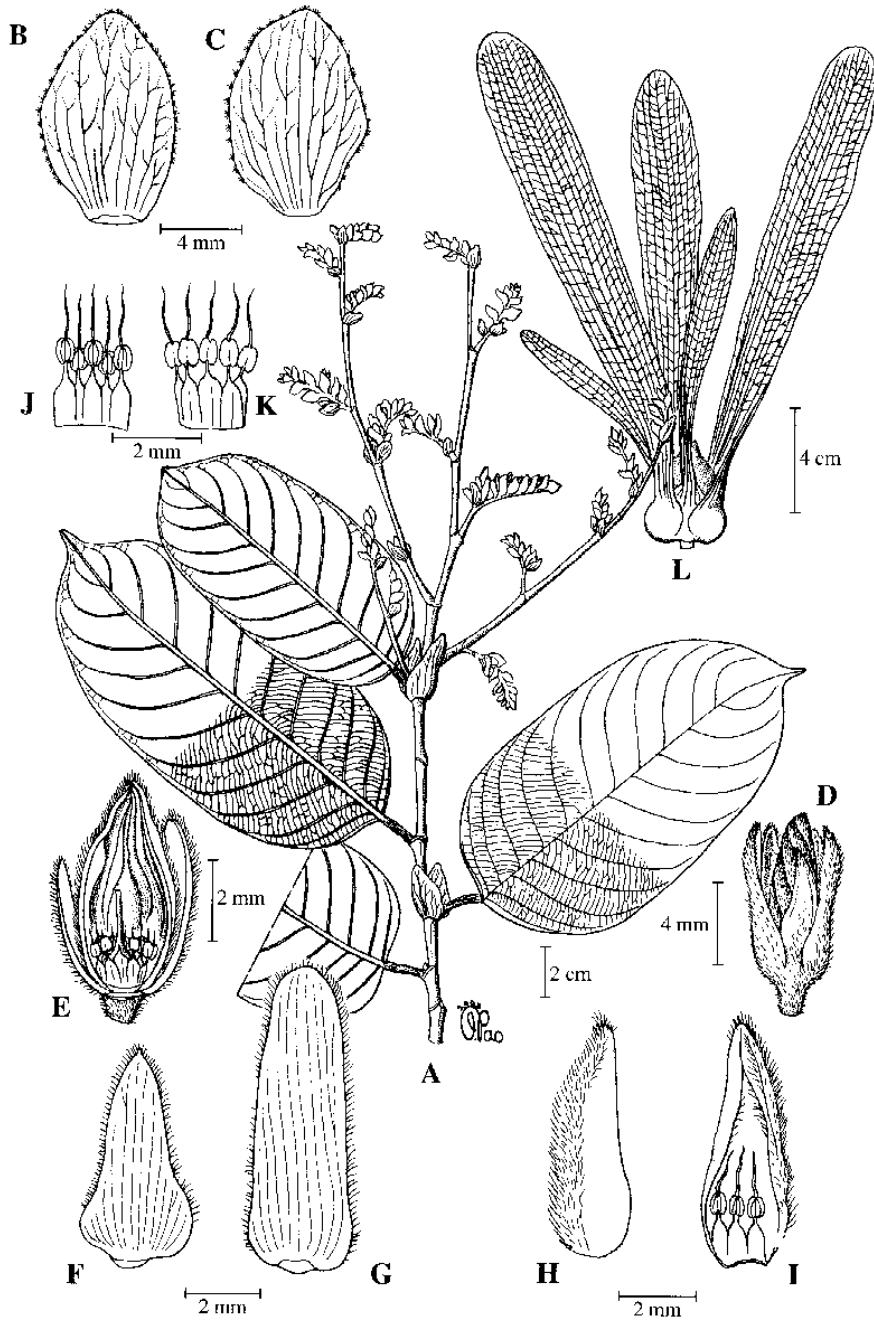


Fig. 20. *Shorea amplexicaulis*. A, flowering leafy twig; B, adaxial view of bract; C, abaxial view of bract; D, flower bud; E, flower bud with a few sepals and petals removed; F, adaxial view of inner sepal; G, adaxial view of outer sepal; H, abaxial view of petal; I, adaxial view of petal with 3 stamens; J, adaxial view of stamens; K, abaxial view of stamens; L, fruit. (A from *S* 65194, B–K from *S* 29202, L from *S* 23611.)

Distribution. Endemic in Borneo. In Sabah known from Kinabatangan and Labuk Sugut districts (e.g., *SAN 23264*, *SAN 99663* and *SAN 131981*) and in Sarawak from Bintulu, Kapit, Kuching, Lawas, and Limbang districts (e.g., *S 18408*, *S 22338*, *S 29580*, *S 32368*, and *S 44085*). Also occurring in Brunei (e.g., *BRUN 3030* and *BRUN 5435*) and W and E Kalimantan.

Ecology. Local and rare in mixed dipterocarp forest on yellow sandy clay soils, at altitudes to 600 m. In Sabah the species occurs in forest on ultrabasic substrates. Vulnerable.

9. *Shorea angustifolia* P.S.Ashton

(Latin, *angustus* = narrow, *folius* = leaf; with narrow leaves)

(sect. **Richetioides** subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 19 (1962) 277, *op. cit.* (1964) 150, *op. cit.* (1968) 81, *op. cit.* (1982) 478; Meijer & Wood *op. cit.* 67; Burgess *op. cit.* 217; Anderson *op. cit.* (1980) 121; Coode *et al.* (eds.) *op. cit.* 74; Newman *et al.* *op. cit.* (1996) 118. **Type:** Ashton *BRUN 778*, Borneo, Brunei, Kuala Temburong Macang (holotype K; isotypes KEP, L).

Main canopy tree, to 40 m tall, to 90 cm diameter, with frequently misshapen bole and low rounded buttresses. **Bark** becoming greyish tawny, thinly irregular flaky. *Twig endings and stipules sparsely caducous pale buff-brown puberulent; leaf bud, parts of flower exposed in bud, ovary and nut, inflorescence, bracteoles and petiole persistently so.* **Twigs** to 2 mm diameter apically, straight, terete, superficially cracked, rugose. Leaf buds small, ovoid, obtuse, to 0.5 × 1 mm. **Stipules** linear, to 3 mm long, fugaceous. **Leaves** thinly coriaceous, drying pale greenish brown; blade deep violet when opening, ovate to oblong-lanceolate, 8–14 × 2.5–4 cm, base cuneate, apex with tapering acumen to 1.5 cm long; midrib flat above, hardly elevated below as also the veins; lateral veins 8–10 pairs, well-spaced, arched; intercostal venation subscalariform; petiole 0.6–0.8 cm long, finely cracked and drying distinct pale brown to cream-grey. **Inflorescences** terminal or axillary; rachis slender, lax, terete, to 10 cm long, singly or doubly branched, branchlets bearing to 8 flowers; bracteoles small, fugaceous. **Flowers:** buds to 2.5 × 1.5 mm, small; petals cream; stamens 15, connectival appendage 1–2x the length of anther; ovary and stylopodium conical, style short, glabrous. **Fruits:** calyx lobes subequal, broadly ovate, obtuse, to 0.5 × 0.5 cm, incrassate and clasping the nut. **Nuts** obovoid, to 0.8 × 0.9 cm, acute.

Vernacular names. Sabah—*seraya kuning bukit* (preferred name). Sarawak—*lun bukit* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Kota Kinabalu (Gaya Is.), Lahad Datu and Ranau (G. Kinabalu) districts (e.g., *KEP 80302*, *SAN 20704*, *SAN 24259*, *SAN 99630*, and *SAN 116969*) and in Sarawak from Belaga, Kapit and Lawas districts (e.g., *S 23309*, *S 25306*, *S 29484*, and *S 57667*). Also occurring in Brunei (e.g., *BRUN 3393*, *BRUN 5682* and *BRUN 5736*) and W and E Kalimantan (e.g., *bb. 29071*, *Kessler et al. Berau 888*, *Kostermans 5412*, and *Newman et al. 588*).

Ecology. Locally frequent on skeletal soils along shale ridges towards the upper limits of mixed dipterocarp forest, at 500–1200 m altitude. Occurring in Kinabalu and Mulu NPs; elsewhere becoming vulnerable.

10. *Shorea argentifolia* Symington

Fig. 21.

(Latin, *argenteus* = silvery, *folius* = leaf; the silvery leaf undersurface)(sect. **Mutica** subsect. **Mutica**, red meranti)

Gard. Bull. Sing. 17 (1960) 489; Ashton *op. cit.* (1964) 179, *op. cit.* (1968) 105, *op. cit.* (1982) 539; Meijer & Wood *op. cit.* 98; Burgess *op. cit.* 166; Anderson *op. cit.* (1980) 124; PROSEA *op. cit.* 392; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al.* *op. cit.* (1996) 119. **Type:** *Maidin FMS 38838*, Borneo, Sabah, Tawau (holotype KEP).

Emergent tree, to 45 m tall, to 1.5 m diameter, with pale golden-suffused crown with pendent twig endings; buttresses to 1.5 m tall, stout. **Bark** becoming v-section fissured, pinkish brown; inner bark and heartwood pinkish brown. *Twig endings, inflorescence, leaf bud, parts of flower exposed in bud, nut, stipule, bracteole, petiole, leaf blade below, and midrib above persistently densely pinkish golden velutinous; fruit calyx shortly sparsely pubescent.* **Twigs** at first compressed, *c.* 2 × 1 mm apically, sparingly branched; stipule scars obscure. *Leaf buds ovoid, slightly compressed, subacute, c.* 4 × 2.5 mm. **Stipules** oblong-hastate, to 20 × 7 mm, acute, cordate, not early caducous. **Leaves** thinly coriaceous, drying pinkish brown below, pale mauve-brown above; blade oblong-lanceolate, 6–11 × 2.5–4.5 cm, base obtuse, apex with acumen *c.* 0.5 cm long; midrib narrowly sunken above, terete, slender but prominent below as also the veins; lateral veins 20–25 pairs, dense with short intermediates; intercostal venation slender, densely scalariform; petiole 0.8–1 cm long, relatively short, rugose. **Inflorescences** terminal or axillary; rachis compressed, to 12 cm long, singly branched, branchlets bearing to 6 flowers; bracteoles oblong-elliptic, obtuse, to 8 × 3.5 mm, caducous. **Flowers:** buds to 6 × 3 mm; petals pink; stamen 15, connectival appendage short, hardly or not reflexed; ovary and stylopodium pyriform, short-pubescent, style as long as ovary, glabrous. **Fruits:** calyx lobes unequal, 3 longer lobes to 8 × 1.2 cm, tapering to 4 mm above the saccate base, 2 shorter ones unequal, linear-lobed, to 3 × 0.15 cm, similar at base. **Nuts** ovoid, to 1.4 × 0.9 cm, with to 2.5 mm long acicular style remnant.

Vernacular names. Sabah—*seraya daun perak* (preferred name). Sarawak—*meranti binatoh* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort, Keningau, Kinabatangan, Lahad Datu, Labuk Sugut, Ranau, Sandakan, and Tawau districts (e.g. *SAN 16976*, *SAN 23972*, *SAN 55561*, *SAN 77288*, and *SAN 99224*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Limbang and Miri districts (e.g., *S 15564*, *S 29660*, *S 32224*, and *S 69132*). Also occurring in Brunei (e.g., *BRUN 126*, *FMS 28661* and *FMS 30534*) and NE Kalimantan (pers. obs.).

Ecology. Locally frequent in mixed dipterocarp forest on clay rich alluvium soils, on hill slopes and sometimes ridges, at altitudes to 900 m. Occurring in Lambir and Mulu NPs; elsewhere vulnerable owing to forest conversion.

11. *Shorea asahii* P.S. Ashton

(Asah Unyong, c. 1938–, Sarawakian tree climber and dendrologist extraordinaire)

(sect. *Shorea* subsect. *Barbata*, *selangan batu*)

Gard. Bull. Sing. 19 (1962) 279, *op. cit.* (1964) 128, *op. cit.* (1968) 68, *op. cit.* (1982) 463; Meijer & Wood *op. cit.* 163; Burgess *op. cit.* 202; Anderson *op. cit.* (1980) 118; Coode *et al.* (eds.) 75; Newman *et al. op. cit.* (1998) 169. **Type:** *Flemmich FMS 37183*, Borneo, Brunei, Tutong district, Bt. Bedawan (holotype KEP).

Low emergent tree, to 40 m tall, to 90 cm diameter, with frequently misshapen bole and low thin buttresses to 80 cm tall. **Bark** surface becoming dark greyish brown mottled, cracked and thinly flaky. *Young parts at first shortly puberulent, otherwise glabrous but for densely persistently cream-buff puberulent inflorescence; parts of flower exposed in bud, ovary, nut, and fruit calyx sparsely so.* **Twigs** c. 0.7 mm diameter apically, slender, much-branched, terete. Leaf buds falcate, to 1.5 × 1 mm, small. **Stipules** narrowly deltoid, to 5 mm long, fugaceous. **Leaves** coriaceous, lustrous; blade ovate, 6–10 × 3–5 cm, base subequal, broadly cuneate, apex with slender acumen c. 1 cm long; midrib hardly raised; lateral veins 6–7 pairs, arched, slender, unraised on either surface; intercostal venation densely scalariform, unraised, obscure; petiole c. 1 cm long, slender. **Inflorescences** terminal or axillary; rachis slender, terete, to 2 cm long, singly branched, branchlets zig-zag, bearing to 4 close flowers; bracteoles elliptic, to 2 mm, fugaceous. **Flowers:** buds globose, to 2 mm diameter; *stamens* c. 30, filaments, anthers and connectival appendage sparsely barbate distally, appendage to 2x the length of anther; ovary and stylopodium ovoid, densely pubescent, style short, slender, glabrous. **Fruits:** calyx lobes subequal, ovate, to 0.4 × 0.4 cm, subacute, appressed to nut. **Nuts** oblong-ovoid, to 1.1 × 0.6 cm, acute.

Vernacular names. Sabah—*selangan batu asah* (preferred name). Sarawak—*kumus bukit* (Iban).

Distribution. Endemic in Borneo. In Sabah known from the Crocker Range (e.g., *SAN 24279*) and in Sarawak from Kapit, Limbang, Lubok Antu, and Miri districts (e.g., *SA 690*, *S 29561*, *S 41410*, and *S 57238*). Also occurring in Brunei (e.g., *BRUN 772*, *BRUN 5632* and *S 1183*) and W Kalimantan (e.g., *bb. 35219* and *bb. 35220*).

Ecology. Very rare, in the lower limits of upper dipterocarp forest, on thinly organic skeletal soils over shale and sandstone on minor peaks and spurs, usually at 650–850 m altitude. Recorded from Lambir NP, elsewhere endangered.

12. *Shorea atrinervosa* Symington

Fig. 22.

(Latin, *ater* = dull black, *nervosus* = nerved; the leaf venation drying black)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Gard. Bull. S. S. 10 (1939) 363, *op. cit.* (1943) 9; Masamune *op. cit.* 492; Browne *op. cit.* 167; Meijer & Wood *op. cit.* 163; Burgess *op. cit.* 202, 210; Ashton *op. cit.* (1968) 68, *op. cit.* (1982) 457; Anderson *op. cit.* (1980) 118; PROSEA *op. cit.* 427; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al. op. cit.* (1998) 170. **Type:** *Alwi FMS 31832*, Peninsular Malaysia, Pahang, Bt. Goh FR (holotype KEP).

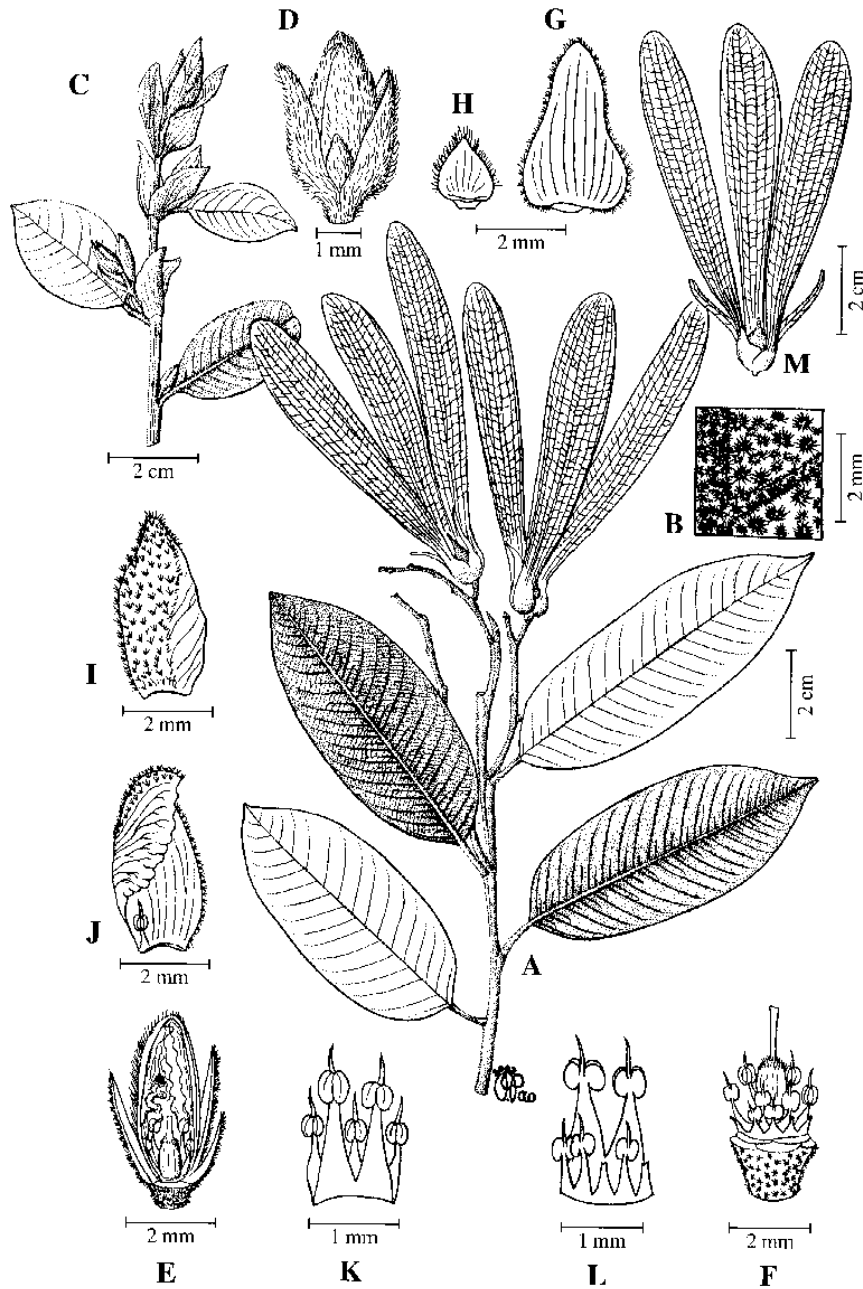


Fig. 21. *Shorea argentifolia*. A, fruiting leafy twig; B, detail of indumentum on the lower leaf surface; C, young shoot with stipules, bracts and young inflorescence; D, flower bud; E, flower bud with exposed gynoecium; F, gynoecium and stamens; G, adaxial view of outer sepal; H, adaxial view of inner sepal; I, abaxial side of petal; J, adaxial side of petal; K, adaxial view of stamens; L, abaxial view of stamens; M, fruit. (A–B from *S* 15564, C–I. from *SAN* 55561, M from *SAN* 99224.)

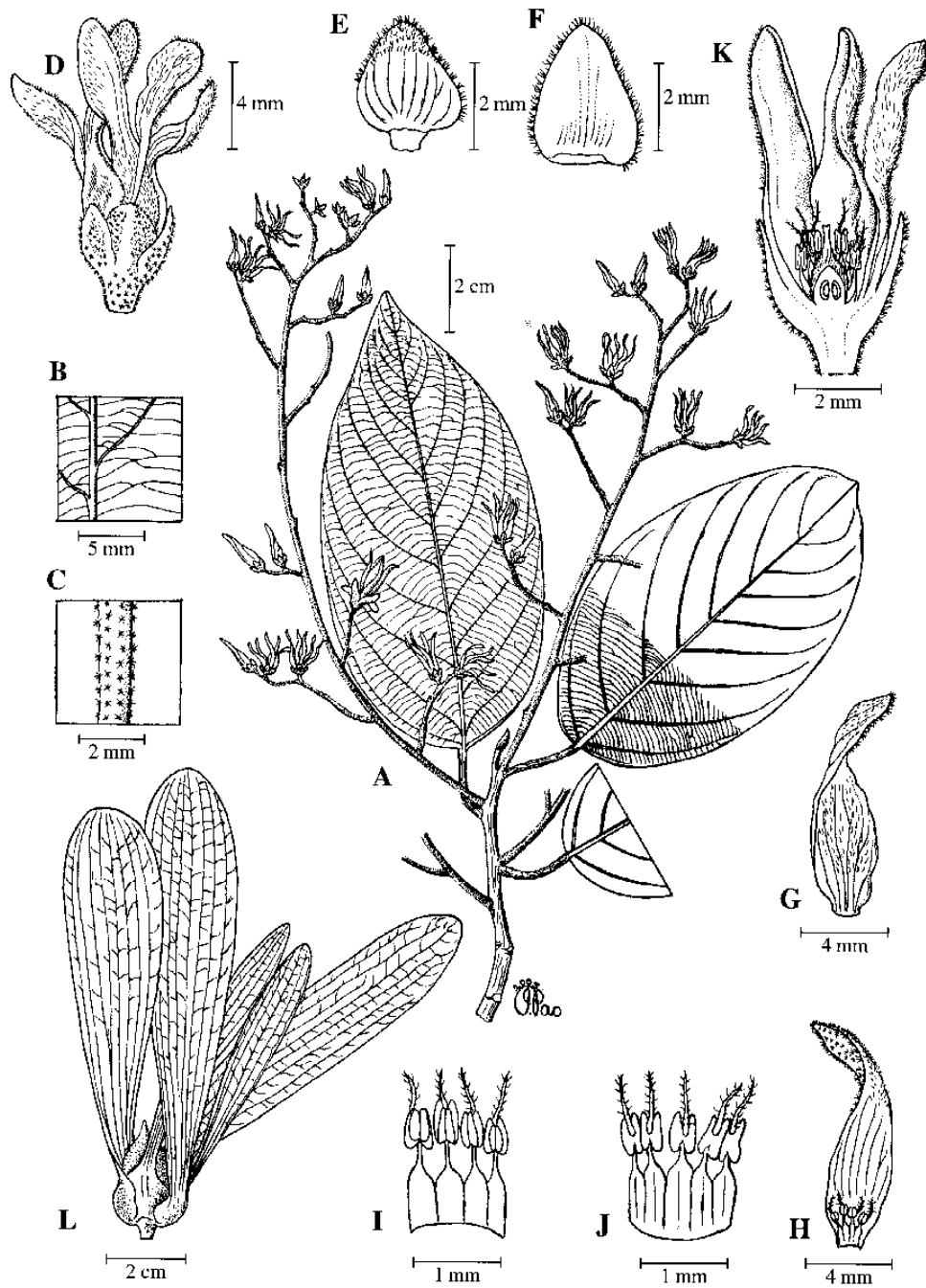


Fig. 22. *Shorea atrinervosa*. A, flowering leafy twig; B, detail of venation on lower leaf surface; C, detail of indumentum on midrib; D, open flower; E, adaxial view of outer sepal; F, adaxial view of inner sepal; G, abaxial side of petal; H, adaxial side of petal with stamens; I, adaxial view of stamens; J, abaxial view of stamens; K, longitudinal section of open flower; L, fruit. (A–C from SAN 15091, D–K from SAN 27274, L from SAN 16957.)

Large emergent tree, to 50 m tall, to 1.2 m diameter, with pale diffuse somewhat irregular crown; bole tall and straight; buttresses to 3 m tall, thin, spreading. **Bark** tawny-brown, irregularly oblong-flaky. *Bud, twig and petiole fugaceous puberulent; stipules, inflorescences, parts of perianth exposed in bud, ovary, and nut, persistently so; parts otherwise glabrous.* **Twigs** c. 2 mm diameter apically, terete, drying black, becoming ribbed. Leaf buds narrowly ovoid, acute, to 4 × 2 mm. **Stipules** lanceolate, to 8 × 3 mm acute, caducous. **Leaves** thinly coriaceous, undulate, more or less white lepidote below (in mature trees) with the veins drying distinct black; blade elliptic to ovate, frequently of irregular shape, 8–16 × 3.5–9 cm, base broadly cuneate to subcordate, apex with tapering acumen to 1 cm long; midrib elevated above, prominently so below; lateral veins 10–12 pairs, stout and elevated below, often somewhat sinuous, sometimes with small glabrous domatia; intercostal venation scalariform, slender, sinuous; petiole at first whitish lepidote, drying black, 1.2–2.2 cm long, geniculate. **Inflorescences** terminal or axillary; rachis straight, terete, to 11 cm long, singly branched, branchlets bearing to 6 secund flowers; bracteoles elliptic, to 3 × 2 mm, acute. **Flowers:** buds to 8 × 3 mm; petals cream with crimson median stripe towards base; stamens 25–33, filaments sparsely setose, outer anther locules glabrous, connectival appendage as long as anther, setose; ovary and stylopodium ovoid, pubescent, surmounted by a short, glabrous style. **Fruits:** pedicels to 4 mm long, broadening into fruit base; calyx lobes unequal, longer lobes to 11 × 2.5 cm, tapering to 1 cm above the saccate base, 2 shorter ones lorate-lobed, to 8.5 × 0.9 cm. **Nuts** ellipsoid, to 2.5 × 2 cm, tapering into to 8 mm stout style remnant.

Vernacular name. Sabah and Sarawak—*selangan batu hitam* (preferred name).

Distribution. Peninsular Malaysia, Sumatra and Borneo. In Sabah known from Beaufort, Kinabatangan, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15041*, *SAN 15262*, *SAN 16595*, *SAN 24258*, and *SAN 72287*) and in Sarawak from Bintulu, Kapit, Kuching, Lawas, Lundu, Marudi, Mukah, Simunjan, and Tatau districts (e.g., *S 15215*, *S 19570*, *S 22830*, *S 24698*, and *S 57601*). Also occurring in Brunei (e.g., *BRUN 3337* and *BRUN 3342*) and W and E Kalimantan (e.g., *bb. 23517*, *Kessler et al. Berau 793* and *Kostermans 13890*).

Ecology. Scattered, locally frequent in mixed dipterocarp forest on clay-rich soils on low hills and moist valleys, at altitudes to 600 m. Occurring in Lambir and Mulu NPs; elsewhere vulnerable.

13. *Shorea bakoensis* P.S.Ashton

(of Bako NP, Sarawak)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 289, *op. cit.* (1968) 81, *op. cit.* (1982) 479; Anderson *op. cit.* (1980) 121; Newman *et al. op. cit.* (1996) 121. **Type:** *Brunig S 17502*, Borneo, Sarawak, Bako NP (holotype K).

Subcanopy or low canopy tree, recorded to 7 m tall, to 5 cm diameter. **Bark** smooth. *All observed parts glabrous but for the sericeous fruit calyx outside, and densely buff-pubescent nut.* **Twigs** c. 2 mm diameter apically, terete, drying black. Buds and stipules unknown. **Leaves** thickly coriaceous, drying dark tawny brown, shiny below; blade narrowly oblong to lanceolate, 13–18 × 5–6 cm, base obtuse, apex with slender acumen to 1 cm long; midrib evident but flat above, prominent below; lateral veins 9–10 pairs, prominent below;

intercostal venation subscalariform, hardly raised below; petiole 1–1.2 cm long, stout, drying black. Inflorescences and flowers unknown. Fruits: pedicels short; *calyx lobes subequal, oblong, obtuse, incrassate, clasping the nut. Nuts ellipsoid-cylindric, to 2.5 × 1.4 cm, apiculate.*

Distribution. Endemic in Borneo; rare and localised, known only by a single collection (the type) from Bako NP but also observed at G. Santubong, Kuching district, Sarawak, at altitudes below 200 m.

Ecology. In *kerangas* forest on shallow podsols on sandstone ridges and plateaux. Rare and possibly endangered.

14. *Shorea balanocarpoides* Symington

(Greek, resembling *Balanocarpus*; the fruit resembles that of *Neobalanocarpus*, a genus endemic in Peninsular Malaysia)

(sect. **Richetioides** subsect. **Richetioides**, yellow meranti)

Gard. Bull. S. S. 9 (1938) 330, *op. cit.* (1943) 47; Slooten, Reinwardtia 3 (1956) 340; Ashton *op. cit.* (1982) 475; PROSEA *op. cit.* 418; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al.* *op. cit.* (1996) 123. **Type:** Lambak FMS 15768, Peninsular Malaysia, Pahang, Rompin (holotype KEP). **Synonyms:** *Balanocarpus pahangensis* Foxw., Malay. For. Rec. 10 (1932) 145; *Shorea dolichocarpa* Slooten *op. cit.* (1956) 342, Ashton *op. cit.* (1964) 151, *op. cit.* (1968) 83, Anderson *op. cit.* (1980) 121.

Main canopy tree, to 40 m tall, to 80 cm diameter; bole frequently misshapen; buttresses to 1 m tall, stout. **Bark** tawny brown, cracked and irregularly flaky. *Young twig, leaf bud, stipule outside, inflorescence, and flower calyx outside sparsely greyish puberulent; parts of petals exposed in bud, ovary and stylopodium persistently so; nut densely mauve-grey pubescent. Twigs* c. 1.5 mm diameter apically, terete, much-branched. Leaf buds small, globose to ovoid, obtuse, to 2 × 1.5 mm. **Stipules** linear, fugaceous, to 4 mm long. **Leaves** coriaceous, drying tawny-brown; *blade ovate, 6–12 × 2–7 cm, base obtuse to cuneate (narrowly peltate in juveniles), decurrent to 1.5 mm down petiole, usually unequal, apex with slender acumen, to 1 cm long; midrib stout on both surfaces, somewhat elevated above, raised below; lateral veins 5–7 pairs, arched, widely spaced, raised below; intercostal venation more or less reticulate to scalariform towards margin, distant, elevated below; petiole 1.2–2 cm long. Inflorescences* terminal or axillary; rachis slender, to 8 cm long, somewhat irregularly doubly branched, branchlets often zig-zag, bearing to 8 distichous flowers; bracteoles minute, fugaceous. **Flowers:** buds to 4.5 × 1.2 mm; petals yellowish brown with bright yellow margin; *stamens 15, connectival appendage ciliate towards apex; ovary and stylopodium subglabrous. Fruits* subsessile; *calyx lobes subequal, deltoid, c. 0.5 × 0.5 cm, subrevolute at margins, appressed to the nut. Nuts* ellipsoid to obovoid, to 3 × 1.3 cm, acute, mauve-grey pubescent.

Vernacular names. Sarawak—*barek* (Iban), *lun gondol* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. Not yet reported from Sabah. In Sarawak known from Belaga, Bintulu, Kapit, Limbang, and Miri districts (e.g., *S 15139*, *S 29244*, *S 32358*, *S 42977*, and *S 57655*). Also occurring in Brunei (e.g., *BRUN 3003* and *BRUN 3365*).

Ecology. Local, but there often common, in mixed dipterocarp forest, on clay and sandy clay soils, particularly on slopes, at altitudes to 700 m. Vulnerable.

15. *Shorea beccariana* Burck

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

(sect. **Pachycarpae**, red meranti)

Ann. Jard. Bot. Buitenz. 6 (1887) 213; Merrill, EB (1921) 404; Browne *op. cit.* 138; Ashton, Gard. Bull. Sing. 20 (1963) 280, *op. cit.* (1964) 180, *op. cit.* (1968) 105, *op. cit.* (1982) 525; Meijer & Wood *op. cit.* 100; Burgess *op. cit.* 154, 182; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 393; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al.* *op. cit.* (1996) 124. **Lectotype** (designated here): *Beccari PB 1127*, Borneo, ‘Sarawak’ (hololectotype BO). **Synonym:** *Shorea franchetiana* F.Heim, *op. cit.* (1891) 956.

Emergent tree, to 60 m tall, to 1.1 m diameter; crown often golden-suffused from below; bole tall, often somewhat sinuate; buttresses to 1.5 m tall, stout. **Bark** smooth, hoop-marked, occasionally somewhat flaky in large trees; inner bark pinkish brown; heartwood pink. *Young twig, inflorescence, parts of perianth exposed in bud, leaf bud, stipule, and petiole evenly densely rufous-brown puberulent, turning mauve-grey, sparsely so on venation below; nut buff pubescent.* **Twigs** compressed, 3–6 × 1–2.5 mm apically, dull greyish brown; *stipule scars shortly cuneate to falcate, more or less ascending.* Leaf buds hastate, compressed, acute, 7–11 × 3.5–4.5 mm. **Stipules** oblong, obtuse, small, to 14 × 5 mm, caducous. **Leaves** coriaceous, golden lepidote turning to dull mauve-grey below (in mature trees); *blade elliptic to ovate, 11–20 × 5.5–7 cm, base obtuse or broadly cuneate, apex with broad acumen to 0.8 cm long; midrib prominent below, evident albeit shallowly sunken above; lateral veins 11–14 pairs, arched, slender but elevated below* (more prominent in immature trees); *intercostal venation remotely scalariform; petiole 2–4 cm long.* **Inflorescences** terminal or axillary; rachis lax, more or less compressed, to 20 cm long, singly branched, branchlets bearing to 8 distichous flowers; bracteoles oblong, obtuse, to 15 × 9 mm, caducous. **Flowers:** buds to 9 × 3 mm; petals pink; stamens 15, connectival appendage 2–3x the length of anther; stylopodium and style cylindrical. **Fruits:** base frequently impressed; calyx glabrescent, *lobes unequal, 3 longer lobes to 19 × 2.7 cm, tapering to 1.2 cm above the saccate base, 2 shorter ones linear-lobed, to 10.5 × 0.9 cm, similar at base.* **Nuts** broadly ovoid, to 4 × 2.8 cm; style remnant conical, to 4 mm long.

Vernacular names. Sabah—*seraya langgai* (preferred name). Sarawak—*langgai* (Iban), *meranti langgai* (preferred name).

Distribution. Endemic in Borneo. Common and known in Sabah from Labuk Sugut, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 16023*, *SAN 16468*, *SAN 27397*, *SAN 35898*, and *SAN 97628*) and in Sarawak from Bintulu, Kapit, Kuching, Limbang, Lundu, and Miri districts (e.g., *S 10125*, *S 12612*, *S 27129*, *S 32308*, and *S 46476*). Also occurring in Brunei (e.g., *BRUN 418*, *BRUN 3187*, *Niga NN 225*, *S 1933*, and *S 2172*) and W and NE Kalimantan (e.g., *bb. 27726*, *bb. 30208*, *Newman et al. 585*, and *Suzuki K 9494*).

Ecology. One of the commonest trees in mixed dipterocarp forest on well-drained sites, on yellow sandy and sandy clay soils, and on well-drained shale ridges, at altitudes to 700 m. Occurring in Bako, Lambir and Mulu NPs; not vulnerable.

Notes. For comparison with *S. amplexicaulis*, see there.

16. *Shorea biawak* P.S.Ashton

(*biawak* = the monitor lizard, whose skin the bark resembles)

(sect. *Shorea* subsect. *Barbata*, *selangan batu*)

Gard. Bull. Sing. 19 (1962) 281, *op. cit.* (1964), *op. cit.* (1968) 68, *op. cit.* (1982) 464; Meijer & Wood *op. cit.* 165; Burgess *op. cit.* 202; Anderson *op. cit.* (1980) 118; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al.* *op. cit.* (1998) 171. **Type:** Ashton BRUN 3369, Borneo, Brunei, Bangar (holotype K; isotype KEP).

Main canopy tree, to 35 m tall, to 70 cm diameter, with straight bole and low thin buttresses. **Bark** overall remaining smooth, but patterned by dense minute zig-zag v-section surface fissures. **Twigs** c. 1 mm diameter apically, slender, terete, much-branched, smooth and striated. *Young twig, leaf bud, parts of perianth exposed in bud, ovary, nut, inflorescence, and petiole more or less densely pale buff-puberulent, persistent only on inflorescence, bud and ovary.* Leaf buds to 1 mm long, small. **Stipules** unknown. **Leaves** thinly coriaceous, drying pale greyish brown; blade ovate, 6–10 × 2.5–4.5 cm, base obtuse or broadly cuneate, apex subcaudate, acumen to 1.5 cm long; midrib slender, somewhat elevated below, flat or slightly elevated above; lateral veins slender, 5–6 pairs, arched and ascending, elevated below, slightly furrowed above, with small puberulent domatia; intercostal venation densely scalariform, not raised; petiole 0.7–1 cm long, slender. **Inflorescences** terminal or axillary; rachis terete, to 14 cm long, singly branched, branchlets densely bearing to 6 flowers; bracteoles ovate, acute, to 2 mm long, fugaceous. **Flowers:** buds globose, to 1.5 mm diameter; petals cream-white; *stamens* c. 35, filaments glabrous, anthers sparsely barbate apically, connectival appendage slightly shorter than anther, densely barbate; ovary and stylopodium ovoid to pyriform, densely pubescent, style short, glabrous. **Fruits:** calyx lobes subequal, suborbicular, obtuse, appressed to nut, to 0.7 × 0.9 cm. **Nuts** subglobose, to 1.3 × 1 cm, obtuse with apiculate style remnant to 1.5 mm long.

Vernacular names. Sabah—*selangan batu biawak* (preferred name). Sarawak—*resak biawak* (Iban), *selangan batu biawak* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort district (e.g., SAN 15068, SAN 24825 and SAN 26567) and in Sarawak from Bintulu, Kapit and Miri districts (e.g., S 14453, S 28778 and S 31711). Also occurring in Brunei (e.g., BRUN 3005 and BRUN 3351).

Ecology. Widespread but apparently rare, easily overlooked, in mixed dipterocarp forest on clay soils, at altitudes to 600 m. Present in Lambir NP; elsewhere vulnerable.

17. *Shorea bracteolata* Dyer

(Latin, *bracteolatus* = with bracteoles; the persistent bracteoles of the inflorescence)

(sect. *Anthoshorea*, white meranti)

Fl. Brit. Ind. 1 (1874) 305; Masamune *op. cit.* 493; Slooten, Bull. Jard. Bot. Buitenz. 3, 18 (1949) 259; Browne *op. cit.* 158; Ashton *op. cit.* (1964) 163, *op. cit.* (1968) 93 & 496, *op. cit.* (1982) 496; Meijer & Wood *op. cit.* 53; Burgess *op. cit.* 159; Anderson *op. cit.* (1980) 123; PROSEA *op. cit.* 410; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al.* *op. cit.* (1996) 125. **Type:** *Maingay 204*, Peninsular Malaysia, Malacca (holotype K; isotype L).

Emergent tree, to 50 m tall, to 1.2 m diameter; bole straight; crown large, hemispherical, dense; buttresses to 1.2 m tall, stout. **Bark** surface pale chocolate-brown, becoming cracked and rather thinly irregularly flaky; inner bark laminated pale and dark brown. *All parts at first sparsely pale brown puberulent, surfaces waxy scurfy; glabrescent except on inflorescence, buds and ovary.* **Twigs** c. 2 mm diameter apically, somewhat compressed. Leaf buds shortly falcate, compressed, subacute, 3–5 × 2 mm. **Stipules** linear, c. 10 mm long, fugaceous. **Leaves** chartaceous or thinly coriaceous, drying dull greyish brown; blade oblong-ovate to elliptic, 9–14 × 4–6 cm, base obtuse, apex with tapering acumen to 1.5 cm long; midrib obscurely sunken above, slender but prominent below; lateral veins slender, 12–15 pairs, arched; intercostal venation distantly scalariform to subreticulate; petiole 1–2 cm long, slender. **Inflorescence** terminal or axillary; rachis slender, straight, terete, to 10 cm long, singly branched, branchlets bearing to 5 flowers; bracteoles lanceolate, to 12 × 5 mm, not early caducous. **Flowers:** buds to 10 × 5 mm; *petals pale yellow tinged pink at base within; stamens 15, anthers narrowly oblong, connectival appendage 3–4x the length of anther, scabrous; ovary ovoid, scabrous apically without stylopodium, style c. 2x the length ovary.* **Fruits:** calyx glabrescent; lobes unequal, 3 longer lobes to 10 × 1.7 cm, tapering to 4 mm above the saccate base, 2 shorter ones unequal, to 8 × 0.7 cm. **Nuts** narrowly ovoid, to 2 × 1 cm, with filiform style remnant to 4 mm long.

Vernacular names. Sabah—*melapi pa'ang* (preferred name). Sarawak—*meranti pa'ang* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and throughout Borneo. In Sabah known from Lahad Datu and Tawau districts (e.g., *SAN 17832*, *SAN 22651*, *SAN 31227*, *SAN 39093*, and *SAN 54885*) and in Sarawak from Kuching, Lawas and Lundu districts (e.g., *S 10705*, *S 15199*, *S 32443*, and *S 40580*). Also occurring in Brunei (e.g., *BRUN 907* and *Dransfield JD 6662*) and Kalimantan (e.g., *bb. 14612*, *bb. 27691*, *Kostermans 6354*, and *Kostermans 13329*).

Ecology. In mixed dipterocarp forest on well-drained clay and sandy soils. Mostly scattered and often uncommon, but locally frequent on coastal hills, at altitudes to 700 m. Vulnerable.

18. *Shorea brunnescens* P.S.Ashton

(Latin, *brunnescens* = brownish; the dry leaf)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Gard. Bull. Sing. 22 (1967) 283, *op. cit.* (1968) 68, *op. cit.* (1982) 449; Anderson *op. cit.* (1980) 119; Newman *et al.* *op. cit.* (1998) 172. **Type:** *Smythies S 15218*, Borneo, Sarawak, Simunjan districts, Bt. Gaharu (holotype K; isotypes KEP, L).

Emergent tree, to 45 m tall, to 1.2 m diameter; bole straight, buttresses to 1.2 m tall, thin. **Bark** becoming vertically cracked and thinly oblong-flaky, pale tawny-brown. *Leaf bud, parts of perianth exposed in bud, ovary, and nut densely more or less persistently buff-pubescent; inflorescence, young twig and petiole sparsely caducously so.* **Twigs** c. 1 mm

diameter apically, terete. Leaf buds small, ovoid, acute, to 2.5×2 mm. **Stipules** not seen. **Leaves** coriaceous, drying pale ochreous-brown; blade broadly ovate to lanceolate, $6-12 \times 2.5-6$ cm, base broadly cuneate, apex with narrow acumens to 1 cm long; midrib obscure, furrowed above, slender but prominent below; lateral veins 9-11 pairs, slender, arched, barely elevated below; intercostal venation dense, subreticulate, hardly raised but evident below; petiole 1-1.5 cm long, subgeniculate. **Inflorescences** terminal or axillary; rachis angular, to 9 cm long, singly branched; bracteoles not seen. **Flowers:** buds to 4×2 mm; stamens 46-62, filaments and anthers glabrous, connective appendage shorter than anther, glabrous but for 1-2 apical setae; ovary and stylopodium pyriform. **Fruits:** calyx lobes glabrescent, unequal, 3 longer lobes to 6.5×1 cm, tapering to 3 mm above the saccate base, 2 shorter ones to 3×0.3 cm, similar at base. **Nuts** ovoid-ellipsoid, to 1.2×0.7 cm, with to 3 mm tapering filiform style remnant.

Vernacular name. Sarawak—*selangan batu tinteng* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Kota Belud, Kuala Penyu, Ranau and Sipitang districts (e.g., *SAN 16360*, *SAN 22088*, *SAN 22406*, *SAN 50947*, and *SAN 72276*) and in Sarawak from Julau, Kapit, Kuching, Lubok Antu, Lundu, Miri, Samarahan, Sri Aman, and Tatau districts (e.g., *S 15220*, *S 29623*, *S 36924*, *S 37708*, and *S 41374*). Also occurring in Brunei (e.g., *S 1183*) and W and SE Kalimantan (e.g., *Suzuki K 3565*).

Ecology. Locally frequent in mixed dipterocarp forest on leached yellow sandy clay soils and in upper dipterocarp forest, at altitudes to 1400 m. Occurring in Kinabalu and Mulu NPs; probably not yet vulnerable.

19. *Shorea bullata* P.S.Ashton

(Latin, *bullatus* = blistered; the leaf blade)

(sect. **Brachypterae**, red meranti)

Gard. Bull. Sing. 19 (1962) 283, *op. cit.* (1964) 181, *op. cit.* (1968) 105; *op. cit.* (1982) 517; Anderson *op. cit.* (1980) 125; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al.* *op. cit.* (1996) 126. **Type:** *Ladi & Angga BRUN 2003*, Borneo, Brunei, Bangar (holotype K; isotypes KEP, L).

Low emergent tree, to 45 m tall, to 1.2 m diameter; bole straight; crown hemispherical with golden tinge from below; buttresses stout, to 1 m tall. **Bark** smooth, hoop-marked at first, mauve-grey and chocolate-brown mottled, becoming vertically cracked and patchily oblong flaky; inner bark and heartwood crimson. *Twig, outside of stipules, inflorescence, petiole and venation below persistently scabrid fulvous-pubescent; leaf bud, parts of perianth exposed in bud and leaf midrib above densely evenly so; blade above sparsely caducous hispid; ovary and nuts densely cream-brown pubescent.* **Twigs** c. 2 mm diameter apically, terete, much-branched, becoming papery flaky. Leaf buds broadly ovoid, $3-4 \times 2-3$ mm. **Stipules** narrowly hastate, acute, to 7×2 mm. **Leaves** chartaceous, becoming concave and prominently bullate between the intercostal veins, drying dark reddish brown; blade elliptic to oblong-ovate, $6.5-10 \times 3-4.5$ cm, base narrowly obtuse or broadly acuminate, margin usually revolute, apex obtuse or shortly broadly acuminate; midrib narrowly furrowed above, prominent below as also lateral veins; lateral veins 10-12 pairs; intercostal venation distantly scalariform; petiole 0.8-1 cm long. **Inflorescences** terminal or axillary; rachis terete, lax, to 11 cm long, singly branched, branchlets bearing to 8 flowers; bracteoles broadly elliptic, obtuse, to 6×3.5 mm. **Flowers:** buds to 15×3 mm; petals cream with pink

at base; stamens 15, *connectival appendage c. 4x the length of anther, slender, twisted towards apex*; ovary and stylopodium ovoid, densely short-pubescent, *style almost 2x the length of ovary, columnar, pubescent in basal half*. **Fruits:** *calyx lobes unequal, 3 longer lobes to 9 × 1.3 cm, tapering to 5 mm above the saccate base, 2 shorter ones linear-lobed, to 3 × 0.3 cm, with a similar base*. **Nuts** ovoid, to 1 × 0.7 cm, acute.

Vernacular name. Sarawak—*meranti melecur* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Bintulu, Kapit, Kuching (sterile collection), Miri, and Tatau districts (e.g., *S 18378*, *S 27138* and *S 63844*). Also recorded from Brunei (e.g., *BRUN 924*, *BRUN 5773* and *BRUN 5798*).

Ecology. Rare, in scattered populations in mixed dipterocarp forest on yellow sandy clay soils, on low hills, at altitudes to 400 m. Occurring in Lambir and Mulu NPs; elsewhere endangered.

20. *Shorea calcicola* P.S.Ashton

(Latin, *calx* = limestone, *colere* = to grow; the natural habitat)

(sect. *Shorea*, subsect. *Shorea*)

TFSS 5 (2004) 479. **Type:** *Murthy & Chai S 24690*, Borneo, Sarawak, Kuching district, Kuching-Serian Road (holotype KEP; isotype SAR).

Medium-sized tree, occasionally to 50 m tall, to 1.2 m diameter, with low thin buttresses. **Bark** chocolate-brown, becoming flaky. *Inflorescence, flower calyx, twig and petiole at first buff puberulent, glabrescent; midrib above, parts of petal exposed in bud, ovary and nut densely persistently buff pubescent*. **Twig** *c. 2 mm diameter apically, terete, smooth, dark brown*. **Stipules** unknown. **Leaves** *thickly coriaceous, somewhat lustrous and drying orange brown below, dark red-brown above; blade broadly ovate 10–14 × 5–7 cm; lateral veins c. 9 pairs, slender but raised below, evident but hardly raised above as also the midrib; intercostal venation densely scalariform, evident but hardly raised; petiole 2–3 cm long, distinctly geniculate*. Complete **inflorescences** unknown. **Flowers:** buds to 7 × 3 mm, fusiform; stamens 25–28, filaments and anther locules glabrous, connectival appendages surmounted by a single apical seta; ovary and stylopodium broadly pyriform. **Fruits:** pedicels *c. 2 mm long, slender*; 3 longer calyx lobes to 6 × 1.5 cm, broadly spatulate, obtuse, tapering to *c. 4 mm broad above the saccate base, 2 shorter lobes to 2 cm long, linear, similar at base*. **Nuts** ovoid, to 1.8 × 1.3 cm, tapering to a distinct apiculus.

Distribution. Endemic in Borneo. Not yet known in Sabah. In Sarawak recorded from Kuching and Serian districts (e.g., *S 12582*, *S 22777* and *S 28041*). One tentative collection from G. Subis, Miri district (*i.e.*, *S 27282*) and unconfirmed records (sterile) from the Mulu limestone hills.

Ecology. Locally quite common on organic soils over limestone, at altitudes below 400 m. Not vulnerable.

21. *Shorea carapae* P.S.Ashton

(from Iban word—*karapa* = swampy pole forest; the habitat)

(sect. **Brachypterae**, subsect. **Brachypterae**, red meranti)

Gard. Bull. Sing. 22 (1967) 294, *op. cit.* (1968) 105, *op. cit.* (1982) 551; Anderson *op. cit.* (1980) 125; Newman *et al. op. cit.* (1996) 127. **Type:** *Kostermans 13095*, Borneo, Kalimantan, W Kutei, Mt. Palimasan near Tabang, Ulu Belayan (holotype K; isotypes KEP, L).

Medium-sized canopy tree, to 35 m tall, to 65 cm diameter; bole frequently crooked; buttresses to 1 m tall but usually lower, stout. **Bark** becoming cracked and patchily flaky, chocolate and greyish brown mottled; inner bark orange-brown; heartwood yellow-brown. *Twig, leaf bud, stipule, petiole, and parts of corolla exposed in bud persistently densely evenly buff-sericeous; venation below and midrib above sparsely so; fruit calyx and pedicel sparsely puberulent; nuts glabrous.* **Twigs** compressed, *c. 3 × 2 mm apically, stipule scars prominent, almost amplexicaul.* Leaf buds lanceolate, compressed, acute, to 7 × 2 mm. **Stipules** oblong-lanceolate, subacute, to 25 × 20 mm, caducous. **Leaves** thickly coriaceous, drying warm yellowish brown; blade broadly ovate to elliptic, 14–18 × 7–10 cm, base obtuse to cordate, apex with short, broad acumen; midrib evident, flat to somewhat sunken above, prominent below; lateral veins 11–13 pairs, stoutly prominent below; intercostal venation slender, densely scalariform, unraised; petiole 2.3–3.5 cm long. **Inflorescences** terminal or axillary; rachis terete, to 15 cm long, singly branched; bracteoles lanceolate, acute, to 16 × 5 mm, puberulent. **Flowers:** buds spindle-shaped, to 8 × 3 mm; stamens 15, irregularly whorled, filaments flat at base, shouldered medially, anthers ellipsoid, connectival appendage *c. 3x* the length of anther, acicular, erect; ovary small, ovoid, without stylopodium, finely sericeous, style 3x ovary, slender, stigma obscure. **Fruits:** pedicel short, stout; calyx lobes unequal, 3 longer lobes to 7 × 1.5 cm, tapering to *c. 5 mm* broad above the saccate base, 2 shorter ones linear-lobed, to 2.5 × 0.3 cm, similar at base. **Nuts** ovoid, to 1 × 0.7 cm, acute.

Distribution. Endemic in Borneo. Known in Sarawak from Belaga, Dalat, Kapit, Lubok Antu, and Marudi districts (e.g., *S 25895*, *S 40709*, *S 60087*, *S 62412*, and *S 69724*). Also occurring in E Kalimantan (e.g., the type); not yet recorded from Sabah.

Ecology. Locally frequent in swampy pole forest on organic soils on poorly drained plateaux over acid and also basic volcanic rocks and sandstone, at 800–1200 m altitude. Becoming vulnerable owing to logging.

22. *Shorea chaiana* P.S.Ashton

(P.P.K. Chai, former Senior Forest Botanist in the Sarawak Forest Department)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 31 (1978) 42, *op. cit.* (1982) 477; Newman *et al. op. cit.* (1996) 128. **Type:** *Suib S 29722*, Borneo, Sarawak, Kapit district, Sg. Sepangil (holotype K; isotype SAR).

Emergent tree, to 45 m tall, to 80 cm diameter; buttresses to 1 m tall. *Petiole, inflorescence, parts of perianth exposed in bud, ovary and nut persistently more or less densely cream-buff puberulent; fruit calyx lobes, twig and leaf venation below sparsely more or less caducously so; other parts glabrous. Twigs* c. 1 mm diameter apically, terete, much-branched. Leaf buds minute. **Stipules** not seen. **Leaves** *thinly coriaceous, drying greenish grey; blade elliptic-lanceolate, more or less distinctly falcate, 6–11 × 2–4 cm, base cuneate or obtuse, margin narrowly subrevolute, apex with caudate acumen to 1.5 cm long; midrib prominent below, evident but flat to shallowly sunken above; lateral veins 8–11 pairs, slender but distinctly raised below, evident above, arched; intercostal venation reticulate, distinctly elevated below; petiole 0.5–0.8 cm long, slender. Inflorescences* terminal or axillary; rachis slender, to 6.5 cm long, singly branched. **Flowers:** buds to 5 × 2 mm; stamens 15, connectival appendage c. 2½x the length of anther; ovary ovoid-conical, stylopodium columnar, puberulent, style columnar, glabrous, as long as ovary. **Fruits** (young): *calyx lobes subequal, short, ovate.*

Distribution. Endemic in Borneo. Known in C and NE Sarawak from the Rajang and Kemena hinterlands in Kapit district (e.g., *S* 29626, *S* 29632 and *S* 57838). Also occurring in Brunei (e.g., *FMS* 35478 and *FMS* 35479).

Ecology. Apparently not common, in mixed dipterocarp forest, at altitudes below 1000 m. Endangered owing to forest conversion.

23. *Shorea collaris* Slooten

(Latin, *collum* = neck; the rimmed fruit calyx)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Reinwardtia 3 (1956) 329; Ashton *op. cit.* (1968) 82, *op. cit.* (1982) 477; Anderson *op. cit.* (1980) 121; Newman *et al. op. cit.* (1996) 129. **Type:** *bb. 20650*, Borneo, Kalimantan, Long Pahangai, Mahakam (holotype BO; isotype L).

Emergent tree to 50 m tall, to 1.5 m diameter; bole tall, straight; buttresses to 2 m tall, stout almost straight. **Bark** pale yellowish brown, evenly vertically cracked and flaked leaving a scroll-marked surface below; coxcombs of black dammar frequent. *Petiole and leaf bud persistently greyish buff-sericeous; young twig caducously so; inflorescence, parts of perianth exposed in bud, ovary, stylopodium, and nut greyish buff-puberulent or glabrous. Twigs* c. 2 mm diameter apically, terete. Leaf buds ovoid, subacute, to 2 × 2 mm. **Stipules** unknown. **Leaves** *somewhat chartaceous, drying dull greyish green below, greyish brown above; blade oblong-lanceolate, 13–23 × 4.3–8.5 cm, base obtuse, margin usually narrowly revolute, apex with broad acumen to 1 cm long; midrib slender but prominent below, evident and flat above; lateral veins* c. 13 pairs, slender but elevated below; intercostal venation slender, hardly raised, scalariform; *petiole 1.9–3 cm long, slender. Inflorescences* terminal or axillary; rachis terete, to 9 cm long, singly branched, branchlets bearing to 8 flowers; bracteoles fugaceous. **Flowers:** buds to 5 × 3 mm; stamens 10, connectival appendage c. 2½x the length of anther, sparsely sericeous towards apex; ovary and stylopodium pyriform, style short. **Fruits:** pedicels to 3 mm long; calyx glabrescent, lobes equal, ovate, acute, clasping the nut at base, more or less reflexed distally giving a collared appearance, to 1 × 0.9 cm. **Nuts** broadly obovoid-ellipsoid, to 3 × 2 cm, apiculate.

Vernacular names. Sarawak—*lun kunyit* (preferred name), *merakunyit* (Iban).

Distribution. Endemic in Borneo. Known in Sabah from G. Ampuria, Beaufort district (e.g., *SAN 43580*) and in Sarawak from Kapit, Samarahan, Simunjan, and Tatau districts (e.g., *S 19307*, *S 23246*, *S 29612*, *S 60142*, and *S 67579*). Also occurring in SE Kalimantan (e.g., *bb. 20479*, *bb. 20658* and the type).

Ecology. Frequent in mixed dipterocarp forest on clay rich soils at low altitudes, often near streams, including on the Iju rhyolite and Mersing basalt, at altitudes to 500 m. Endangered owing to forest conversion.

24. *Shorea confusa* P.S.Ashton

(Latin, *confusus* = confused; long confused with *S. virescens*)

(sect. *Anthoshorea*, white meranti)

Gard. Bull. Sing. 31 (1978) 44, *op. cit.* (1982) 497; Coode *et al.* (eds.) *op. cit.* 76; Newman *et al. op. cit.* (1996) 129. **Synonym:** *Shorea virescens auct. non Parijs*: Ashton *op. cit.* (1964) 167, *op. cit.* (1968) 95, Meijer & Wood *op. cit.* 60, Burgess *op. cit.* 159. **Type:** Meijer *SAN 19395*, Borneo, Sabah, Tawau, Mile 24, Cocoa Estate (holotype K; isotypes KEP, SAN).

Large emergent tree, to 50 m tall, to 1.7 m diameter, with large hemispherical crown; bole straight; buttresses to 3 m tall, stout. **Bark** pale fawn-brown, closely shallowly cracking and thinly flaking; inner bark laminated pale orange-brown and cream. *Leaf bud, parts of perianth exposed in bud, ovary, inflorescence, stipule outside, petiole, and very young twig caducous puberulent.* **Twigs** 2–3.5 mm diameter apically, frequently rugulose. Leaf buds conical, acute, 3–4 × 2 mm. **Stipules** linear to deltoid, subacute, c. 8 × 3 mm. **Leaves** thinly coriaceous, drying yellowish brown with the venation paler than the blade below; blade elliptic to slightly obovate, 6–12 × 3.5–5 cm, base obtuse, apex with broad acumens to 1 cm long; midrib prominent below, obscurely furrowed above; lateral veins (10–)13–18 pairs, arched, slender but raised below; intercostal venation evident, scalariform; petiole 1–1.5 cm long, c. 1 mm diameter, slender. **Inflorescences** terminal or axillary; rachis terete, lax, to 22 cm long, singly or doubly branched, branches bearing to 6 flowers; bracteoles not observed. **Flowers:** buds to 9 × 5 mm; *stamens 15, anther oblong, connective appendage c. 3x the length of anther*; ovary ovoid, without stylopodium small, puberulent, *style c. 3x the length of ovary, sericeous in basal two-thirds.* **Fruits:** *pedicels stout, base of fruit tapering; 3 longer calyx lobes to 12 × 1.5 cm, hardly tapering above the saccate base, 2 shorter ones unequal, linear-lobed, to 6 × 0.5 cm, with similar base.* **Nuts** ovoid, to 2 × 1.5 cm, with c. 6 mm slender style remnant.

Vernacular name. Sabah—*melapi sulang saling* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Kinabatangan, Kota Belud, Kota Kinabalu, Kota Marudi, Lahad Datu, Sandakan, Tawau, and Tenom districts (e.g., *SAN 15027*, *SAN 16349*, *SAN 16592*, *SAN 40334*, and *SAN 97247*) and in Sarawak from Kapit, Lawas, Marudi, and Miri districts (e.g., *S 1533*, *S 17771*, *S 23023*, and *S 41224*). Also occurring in Brunei (e.g., *BRUN 2004* and *BRUN 5281*) and E Kalimantan.

Ecology. Frequent in mixed dipterocarp forest on clay-rich soils, on undulating land and hills, at altitudes to 600 m. Recorded in Lambir NP; elsewhere vulnerable.

Notes. *Shorea virescens*, with which this species was formerly confused, differs in its velutinate young parts, compressed twigs and larger number of lateral veins. *Shorea confusa* differs from *S. agami* notably in its more slender and paler lateral veins below, and the tapered base of its fruit. One collection with young fruit (*SAN 33016* from Kelumpang, Tawau district) may represent *S. assamica* Dyer which occurs in E Kalimantan. Flowering material is required for confirmation.

25. *Shorea cordata* P.S.Ashton

(Latin, *cordatus* = heart-shaped; the leaf base)

(sect. **Anthoshorea**, white meranti)

Gard. Bull. Sing. 22 (1967) 285, *op. cit.* (1968) 93, *op. cit.* (1982) 495; Anderson *op. cit.* (1980) 123; Newman *et al. op. cit.* (1996) 130. **Type:** *Smythies SA 678*, Borneo, Sarawak, Kuching district, near Semengoh FR (holotype K).

Large emergent tree, to 50 m tall, to 1 m diameter, with tall straight bole; buttresses to 3 m tall, stout. **Bark** pale chocolate-brown, irregularly cracked; inner bark pale brown, obscurely laminated. *Young twig and petiole densely caducous greyish brown puberulent; stipule and leaf venation sparsely so; leaf bud and parts of perianth exposed in bud persistently so.* **Twigs** at first somewhat compressed c. 3 × 2 mm apically; stipule scars horizontal, pale, prominent. Leaf buds ellipsoid, compressed, acute, to 7 × 4 mm. **Stipules** elliptic, obtuse, to 12 × 6 mm. **Leaves** coriaceous, drying chocolate-brown below; blade oblong to obovate, 8–15 × 5.5–10.5 cm, base cordate to obtuse, apex obtuse, retuse or abruptly shortly acuminate; midrib prominent below, furrowed above; lateral veins 15–18 pairs, prominent below; intercostal venation slender, densely scalariform; petiole 1.2–2.5 cm long, frequently becoming rugulose. **Inflorescences** terminal or axillary; rachis lax, compressed or ribbed, to 12 cm long, singly branched, branchlets bearing to 5 flowers; bracteoles elliptic, obtuse, to 10 × 5 mm, not at first caducous. **Flowers:** buds to 10 × 5 mm; petals pale yellow tinged pink at base within; *stamens 15, connectival appendage 3–4x the length of anther, scabrous; ovary puberulent distally, style c. 2x as long as ovary.* **Fruits:** calyx glabrous; 3 longer lobes to 13 × 2.5 cm, tapering to 8 mm above the saccate base, 2 shorter ones unequal, to 6.5 × 0.8 cm, similar at base. **Nuts** narrowly ovoid, to 1.4 × 1 cm, with to 4 mm slender style remnant.

Distribution. Endemic in Borneo. Known in Sarawak from Kuching, Lundu and Tatau districts (e.g., *S 10177*, *S 13183*, *S 19306*, and *S 68788*). Also occurring in NW Kalimantan.

Ecology. Rare and probably endangered, in mixed dipterocarp forest, apparently on clay-rich soils especially on igneous rocks, at altitudes below 500 m.

26. *Shorea coriacea* Burck

Plate 3F.

(Latin, *coriaceus* = leathery; the leaf blade)

(sect. **Brachypterae**, red meranti)

Ann. Jard. Bot. Buitenz. 6 (1887) 214; Merrill *op. cit.* (1921) 404; Masamune *op. cit.* 493; Browne *op. cit.* 146; Ashton *op. cit.* (1964) 182, *op. cit.* (1968) 106, *op. cit.* (1982) 509; Meijer & Wood *op. cit.* 102; Burgess *op. cit.* 154; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 393; Kessler & Sidiyasa,

TBSA-EK (1994) 102; Coode *et al.* (eds.) *op. cit.* 76; Newman *et al.* *op. cit.* (1996) 131. **Type:** *Beccari PB 2948*, Borneo, Sarawak (holotype BO; isotypes A, K).

Large emergent tree, to 50 m tall, to 1.4 m diameter, with straight bole; buttresses to 1.5 m tall, stout. **Bark** dark chocolate-brown, narrowly fissured and flaky; inner bark pinkish brown; heartwood deep crimson. *Young parts densely pale grey sericeous, caducous except on stipule outside, leaf bud, parts of perianth exposed in bud and inflorescence; ovary and nut puberulent except at base.* **Twigs** terete or slightly compressed, 2–3 mm diameter apically; *stipule scars cuneate, pale brown, horizontal or slightly descending.* Leaf buds ovoid, to 6 × 3 mm. **Stipules** narrowly oblong, acute, to 20 × 5 mm. **Leaves** coriaceous, lustrous, *drying dark reddish brown below; blade ovate, 10–15 × 5–8 cm, base obtuse, obscurely subpelvate, margin narrowly revolute, apex with acumen to 1 cm long; midrib prominent below, obscurely sunken above; lateral veins 16–20 pairs, slender, hardly raised below, curved within margin; intercostal venation densely scalariform, unraised; petiole geniculate, drying black, 2.5–4 cm long.* **Inflorescences** terminal or axillary; rachis terete, to 14 cm long, singly or doubly (if terminal) branched, branchlets bearing to 10 flowers; bracteoles ovate, subacute, to 4 × 2.5 mm. **Flowers:** buds to 6 × 1.2 mm; petals pink; *stamens 15, connectival appendage 2–3x the length of anther;* ovary ovoid, densely short-pubescent except at the base, stylopodium indistinct, *style as long as ovary.* **Fruits:** *calyx lobes unequal, 2 longer lobes to 9 × 1.5 cm, tapering to 4–5 mm at the saccate base, 2 shorter ones subequal, linear-lobed, to 3.5 cm long, similar at base.* **Nuts** ovoid, to 1.8 × 0.9 cm, with *c.* 3 mm slender style remnant.

Vernacular names. Sabah—*seraya tangkai panjang* (preferred name). Sarawak—*meranti tangkai panjang* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Sipitang district (e.g., *SAN 16682* and *SAN 69878*) and in Sarawak from Bau, Belaga, Kuching, Lawas, Lundu, and Tatau districts (e.g., *S 363*, *S 9484*, *S 11095*, *S 32776*, and *S 64942*). Also occurring in Brunei (e.g., *BRUN 3335*) and W, C and E Kalimantan (e.g., *Ambriansyah and Arifin AA 41*, *bb. 29692* and *Laman et al. TL 1348*).

Ecology. Locally abundant in *kerangas* forest especially on deep podsols, in the lowlands and on sandstone and acid volcanic plateaux in the lower montane zone, at 100–1200 m altitude; on ultrabasic substrate in eastern Sabah; occasional in mixed dipterocarp forest in the *kerangas* ecotone. Occurring in Mulu NP; elsewhere becoming endangered.

27. *Shorea crassa* P.S.Ashton

(Latin, *crassus* = thick; the leaf blade)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Gard. Bull. Sing. 20 (1963) 271, *op. cit.* (1964) 130, *op. cit.* (1968) 69, *op. cit.* (1982) 457; Anderson *op. cit.* (1980) 119; Coode *et al.* (eds.) *op. cit.* 76; Newman *et al.* *op. cit.* (1998) 172. **Type:** *Ismail S 11701*, Borneo, Sarawak, Semengoh FR (holotype K; isotype KEP).

Emergent tree, to 45 m tall, to 1.1 m diameter, with straight bole; buttresses to 1.5 m tall, thin, sharp. **Bark** tawny to purplish brown, vertically cracked and irregular flaky. *Twig, inflorescence, leaf bud, parts of perianth exposed in bud, ovary, nut, stipule outside, and petiole densely greyish-puberulent; venation below and fruit calyx sparsely so.* **Twigs** at

first somewhat compressed, *c.* 5 × 2.5 mm apically; stipule scars *c.* 2 mm long, pale, ascending. Leaf buds ovoid, compressed, subacute, to 6 × 6 mm. **Stipules** ovate, acute, concave, to 8 × 4 mm, fugaceous. **Leaves** *thickly coriaceous, pale cream to golden lepidote below; blade elliptic to ovate, 10–18 × 5–10 cm, base equal or subequal, cuneate or narrowly obtuse, occasionally subcordate, apex with tapering acumen to 1 cm long; midrib prominent below, applanate above to sunken towards apex, evident; lateral veins 7–11 pairs, prominent below, well-spaced, ascending; intercostal venation densely scalariform, sinuate, unraised; petiole 3.5–5 cm long, stout, somewhat geniculate.* **Inflorescences** terminal or axillary; rachis terete or somewhat compressed, ribbed on drying, stout, to 13 cm long, singly branched, branchlets bearing to 12 flowers; bracteoles suborbicular, to 3 mm across, caducous. **Flowers:** buds to 15 × 3.5 mm; petals cream, pink at base; *stamens 38–46, filaments hispid, connectival appendage prominent but shorter than the anther, setose; ovary ovoid, stylopodium cylindrical longer than ovary, style glabrous, short.* **Fruits:** *calyx lobes unequal, 3 longer lobes to 9 × 2.5 cm, tapering to 8 mm above the saccate base, 2 shorter ones narrowly oblong, to 7 × 0.7 cm, similar at base.* **Nuts** ellipsoid, to 2.5 × 2 cm, tapering into stout to 8 mm long style remnant.

Vernacular name. Sarawak—*selangan batu daun tebal* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Bintulu, Kapit, Kuching, Lundu, and Miri districts (e.g., *S 6210, S 9468, S 32051, S 46484, and S 59866*). Also occurring in Brunei (e.g., *BRUN 570 and BRUN 642*) and C and W Kalimantan (e.g., *bb. 17036 and bb. 26409*).

Ecology. Locally common in mixed dipterocarp forest on deep yellow sandy soils in the lowlands, and occasionally at altitudes to 1000 m on sandstone. Occurring in Mulu NP; elsewhere vulnerable.

28. *Shorea curtisii* Dyer ex Brandis

(C. Curtis, 1853–1928, first Curator of Waterfall gardens, Penang, Peninsular Malaysia)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

J. Linn. Soc. Bot. 31 (1895) 101; Symington *op. cit.* (1943) 67; Browne *op. cit.* 147; Ashton *op. cit.* (1964) 185, *op. cit.* (1968) 106, *op. cit.* (1982) 541; Meijer & Wood *op. cit.* 103; Burgess *op. cit.* 166; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 393; Coode *et al.* (eds.) *op. cit.* 76; Newman *op. cit.* (1996) 541. **Lectotype** (designated here): *Curtis 1394*, Peninsular Malaysia, Penang Hill (hololectotype K).

Notes. Two subspecies, subsp. *curtisii* and subsp. *grandis* P.S.Ashton, are recognised. Of the two, only subsp. *curtisii* occurs in Sabah and Sarawak.

subsp. **curtisii**

Vast emergent tree, to 70 m tall, to 2 m diameter, *with huge hemispherical cauliflower-shaped crown, sea-green from a distance; buttresses to 1.8 m tall, stout.* **Bark** becoming pinkish brown, deeply v-section fissured and eventually crumbly flaky; inner bark thick, pinkish brown; heartwood pale crimson. *Young twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipule outside, ovary, nut, petiole, and midrib and veins below*

densely evenly more or less persistently pinkish brown to grey puberulent. Twigs c. 1.5 mm diameter apically, slender, terete, much branched. *Leaf buds* ovate to slightly falcate, subacute, 4–9 × 2.5–3.5 mm. **Stipules** oblong, obtuse, to 10 × 4 mm. **Leaves** coriaceous, pale pink to grey lepidote and dull below; blade ovate-lanceolate, 6–9 × 2.5–3.5 cm, base broadly cuneate, apex with narrow acumen to 0.8 cm long; midrib slender, terete, prominent below, obscure, slightly sunken above; lateral veins 9–11 pairs, slender, hardly raised below, arched; intercostal venation obscure, slender, densely scalariform; petiole 1–1.3 cm long, slender. **Inflorescences** terminal or axillary; rachis terete, to 6 cm long, singly or doubly branched, branchlets bearing to 12 flowers; bracteoles elliptic, subacute, to 2.5 × 2 mm, fugaceous. **Flowers:** buds to 5 × 3 mm; petals deep crimson; stamens 15, connectival appendage short or rudimentary; ovary and stylopodium ovoid, style short. **Fruits:** pedicels c. 1 mm long; calyx lobes unequal, 3 longer lobes to 7 × 1 cm, tapering to c. 2.5 mm above the saccate base, 2 shorter ones unequal, linear-lobed, to 4 × 0.3 cm, similar at base. **Nuts** ovoid, to 1.2 × 0.9 cm, tapering to 1 mm apiculus.

Vernacular name. Sabah and Sarawak—*seraya* (preferred name).

Distribution. SE Peninsular Thailand, Sumatra (Singkep and Lingga), Peninsular Malaysia, and Borneo. In Borneo, known in Sabah from Sipitang district (e.g., *SAN 15185*) and in Sarawak from Bintulu, Miri and Mukah districts (e.g., *S 15146*, *S 23606*, *S 23653*, and *S 46414*). Also occurring in Brunei (e.g., *BRUN 246*, *BRUN 2538* and *BRUN 3279*).

Ecology. Locally common in mixed dipterocarp forest on deep yellow sands along the Neogene coastal hills. Recorded in Brunei and Ulu Limbang from shallow organic soils along shale ridges to c. 1200 m altitude in upper dipterocarp forest. Locally frequent in Lambir and Mulu NPs. Vulnerable in Sarawak outside the parks; critically endangered in Sabah.

29. *Shorea cuspidata* P.S.Ashton

(Latin, *cuspis* = a cusp; the slightly swollen acumen apex)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 290, *op. cit.* (1968) 82, *op. cit.* (1982) 483; Anderson *op. cit.* (1980) 121; Newman *et al. op. cit.* (1996) 134. **Type:** *Galau S 15258*, Borneo, Sarawak, Kuching, Semengoh FR (holotype K; isotype KEP).

Low emergent tree, to 45 m tall, to 1 m diameter, with straight bole; buttresses to 3 m tall, rather thin. **Bark** surface at first v-section zig-zag fissured, later flaking in small oblong pieces leaving a scroll-marked surface. *Leaf bud, parts of perianth exposed in bud, ovary, nut, stipule, bracteole, and inflorescence* shortly densely buff-puberulent; *young twig and fruit calyx* caducously so; *parts otherwise* glabrous. **Twigs** c. 1 mm diameter apically, slender, becoming minutely striated. Leaf buds ovoid, c. 1 mm long, small. **Stipules** not seen. **Leaves** thinly coriaceous, drying greenish to yellowish brown; blade broadly ovate, 5–9 × 2–6 cm, base broadly cuneate, apex caudate-cuspidate, acumen to 1.5 cm long; midrib slender, evident and flat or elevated above, prominent below; lateral veins 5–7 pairs, slender, hardly raised below, arched; intercostal venation obscure, reticulate; petiole 0.7–1.1 cm long, slender. **Inflorescences** terminal or axillary; rachis slender, terete, to 9 cm long, singly branched. **Flowers:** buds to 3 × 2 mm; petals pale lime-yellow; stamens 15, connectival appendage c. 1/2x the length of anther, sericeous distally; ovary and

stylopodium pyriform, style glabrous, short. **Fruits:** pedicels c. 1 mm long; *calyx lobes unequal*, 3 longer lobes to 5×1.5 cm, tapering to 5 mm above the narrowly saccate tuberculate base, 2 shorter ones to 4×1 cm, otherwise similar. **Nuts** obovoid, mucronate, to 2.5×1.5 cm.

Vernacular name. Sarawak—*lun runching padi* (preferred name).

Distribution. Endemic in Borneo; known in Sarawak from Bau, Kuching, Lundu, Miri, and Simunjan districts (e.g., *S 6513*, *S 9607*, *S 9843*, *S 15211*, and *S 49991*). Also occurring in W Kalimantan (e.g., *Suzuki K 9542*).

Ecology. Frequent to locally abundant in mixed dipterocarp forest on yellow sandy soils over the Plateau Sandstone, also on leached clay-rich soils on other substrates, on undulating ground and low hills, at altitudes to 500 m. Common in Bako NP and recorded from Lambir NP; elsewhere endangered by land conversion.

30. *Shorea dasyphylla* Foxw.

(Greek, *dasy-* = markedly hairy, *phullon* = leaf; the pubescent leaf)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Malay. For. Rec. 10 (1932) 224; Browne *op. cit.* 138; Ashton *op. cit.* (1968) 106, *op. cit.* (1982) 546; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 394; Newman *et al. op. cit.* (1996) 135. **Type:** *Symington KEP 24462*, Peninsular Malaysia, Selangor, Sg. Buloh FR (holotype KEP).

Medium-sized emergent tree, to 45 m tall, to 1.1 m diameter, with dense hemispherical crown; bole straight; buttresses to 1.5 m tall, stout. **Bark** dark greyish brown, deeply v-section fissured; inner bark and heartwood rich crimson. *Twig, leaf bud, inflorescence, parts of perianth exposed in bud, ovary, nut, stipule, bracteole, petiole, leaf below, and midrib above densely persistently golden brown scabrid-pubescent; blade above puberulent.* **Twigs** c. 2 mm diameter apically, terete. Leaf buds ovoid, obtuse, to 3×2 mm. **Stipules** broadly ovate, obtuse, to 6×4 mm, caducous. **Leaves** coriaceous, drying pale yellowish brown below, pale mauve-brown above; blade ovate to elliptic, $7-14 \times 3-6$ cm, obtuse or broadly cuneate, margin somewhat revolute, base obtuse or broadly cuneate, apex with slender acumen to 0.6 cm long; midrib prominent below, terete, striated, furrowed above; lateral veins 11–15 pairs, prominent below; intercostal venation scalariform, elevated below; petiole 1.2–1.5 cm long. **Inflorescences** terminal or axillary; rachis terete or ribbed, to 8 cm long, singly branched, branchlets bearing to 4 flowers; bracteoles elliptic, obtuse, to 3×2 mm, caducous. **Flowers:** buds to 4×3 mm; petals cream-yellow; stamens 15, connectival appendage short, slender, becoming reflexed; ovary and stylopodium ovoid to conical, style shorter than ovary, glabrous. **Fruits:** pedicel to 2 mm long; *calyx lobes unequal*, 3 longer lobes to 9×1.3 cm, tapering to c. 4 mm above the saccate base, 2 shorter ones linear-lobed, to 4×0.4 cm, similar at base. **Nuts** ovoid, shortly apiculate, to 1.8×0.9 cm.

Vernacular name. Sarawak—*meranti batu* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo known in Sabah from Tambunan district (e.g., *KEP 80416*) and in Sarawak from Bau, Kuching, Limbang, and Lundu districts (e.g., *S 6515*, *S 10305*, *S 15432*, *S 25230*, and *S 37803*). Also occurring in SE Kalimantan (e.g., *bb. 34435*).

Ecology. Frequent, sometimes common, in mixed dipterocarp forest on yellow sandy clay soils, at altitudes below 400 m. Common in Bako NP; elsewhere vulnerable owing to land conversion.

31. *Shorea dealbata* Foxw.

(Latin, *dealbatus* = whitewashed; the leaf undersurface)

(sect. **Anthoshorea**, white meranti)

Malay. For. Rec. 10 (1932) 192; Symington *op. cit.* (1943) 35; Ashton *op. cit.* (1968) 93, *op. cit.* (1982) 485; Anderson *op. cit.* (1980) 123; PROSEA *op. cit.* 410; Newman *et al. op. cit.* (1996) 136. **Type:** *Mat Sohor KEP 4188*, Peninsular Malaysia, Pahang, Kuantan district, Jambu, Lepar (holotype KEP).

Low emergent or main canopy tree, to 30 m tall, to 60 m diameter, with straight bole and low stout buttresses. **Bark** at first mottled brown and grey, hoop-marked, becoming deeply irregularly cracked, rotting off in flakes in between; inner bark finely pale rust and cream laminated. *Young twigs, leaf buds, parts of perianth exposed in bud, stipule and bracteole outside, petiole, and nut densely dark-fulvous pubescent; inflorescence similarly hirsute, venation below fugaceously so; blade below pale pink-brown lepidote. Twigs compressed, c. 4 × 2 mm apically.* Leaf buds ovoid, conical, subacute, to 6 × 4 mm. **Stipules** elliptic-oblong, subacute, to 20 × 5 mm. **Leaves** thickly coriaceous, turned up along the midrib, drying dull olive-brown above, pale pinkish grey below with petiole; blade ovate to elliptic, 8–16 × 4–7.5 cm, base obtuse or occasionally cuneate, apex with narrow acumens to 1 cm long; midrib prominent, subacute, below, obscurely sunken above; lateral veins (11–)20–24 pairs, obscure and slightly depressed above, slender and hardly elevated below, ascending; petiole stout, becoming rugose, 1.5–2.5 cm long. **Inflorescences** axillary or terminal, rachis terete or angular, unbranched or singly branched; bracteole unknown. **Flowers:** buds to 12 × 5 mm; petals white tinged with pink at base; *stamens 17, anthers narrowly oblong, connectival appendage stout at base, tapering and slender apically, c. 3x the length of anther; ovary ovoid, sparsely sericeous, without stylopodium, style filiform, trifurcate apically, sericeous in the basal half.* **Fruits:** pedicels to 5 mm long, slender; calyx lobes unequal, 3 longer lobes to 9 × 1.3 cm, tapering to 4 mm above the saccate base, 2 shorter ones lorate-lobed, to 6.5 × 0.5 cm, similar but narrower at base. **Nuts** narrowly ovoid, to 1.8 × 0.8 cm, with to 3 mm slender style remnant.

Vernacular name. Sarawak—*meranti bumbung* (preferred name).

Distribution. Sumatra (Lingga), Peninsular Malaysia and Borneo. In Borneo known only in Sarawak from Kuching district (e.g., *S 9409*, *S 10139*, *S 12476*, and *S 32730*).

Ecology. Very local, but there often common, in *kerangas* forest on white sand terraces and on sandstone plateau, at altitudes to 600 m. Occurring in Bako NP; elsewhere vulnerable.

32. Shorea dispar P.S.Ashton

(Latin, *dispar* = unlike; the flowers, compared with those of *S. parvifolia* with similar leaves)

(sect. **Rubella**, red meranti)

Gard. Bull. Sing. 31 (1978) 45, *op. cit.* (1982) 502; Newman *et al. op. cit.* (1996) 157. **Type:** *Othman S 29208*, Borneo, Sarawak, Kapit, Ulu Baleh above Nanga Mengiong (holotype K; isotypes KEP, L).

Large buttressed emergent tree. *Twig, petiole, bud, inflorescence, and parts of perianth exposed in bud densely persistently pale-tawny puberulent; leaf venation below sparsely so; parts otherwise glabrous.* **Twigs** c. 2 mm diameter apically, terete, much branched. Leaf buds ellipsoid, obtuse, to 3 × 2 mm. **Stipules** unknown. **Leaves** coriaceous, somewhat cream lepidote below; blade elliptic, 4–7 × 2–3.5 cm; midrib prominent below, obscurely sunken above as also the veins; lateral veins 9–11 pairs, ascending; intercostal venation scalariform, obscure, unraised; petiole 1.2–1.6 cm long. **Inflorescences** terminal or axillary; rachis rigid, ascending, singly branched, to 8 cm long. **Flowers:** buds ovoid, plump, to 6 × 4 mm; sepals subequal, broadly ovate, acute; petals lanceolate, contorted; stamens c. 25, filaments lorate, somewhat tapering, anthers oblong, connectival appendage c. 3/4x the length of anther, stout, becoming somewhat reflexed; ovary ovoid, without stylopodium, small, glabrous, style filiform, c. 2x the length of ovary. **Fruits:** pedicels to 1 mm; calyx lobes unequal, 3 longer lobes to 9 × 2 cm, more or less tapering to a more or less subauriculate base, 2 shorter ones lorate-lobed, to 2.5 × 0.5 cm, not auriculate. **Nuts** ovoid, to 3 × 1.5 cm, apiculate, glabrous.

Distribution. Endemic in Sarawak; known only from the Ulu Baleh, Kapit district (e.g., *S 29489* and *S 29639*).

Ecology. In mixed dipterocarp forest on shale ridges, at 500–600 m altitudes. Rare and critically endangered.

33. Shorea domatiosa P.S.Ashton

(Latin, *domus* = a dwelling; the leaf domatia, dwellings for acarines)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Gard. Bull. Sing. 19 (1962) 285, *op. cit.* (1964) 131, *op. cit.* (1968) 69, *op. cit.* (1982) 460; Meijer & Wood *op. cit.* 166; Burgess *op. cit.* 202; Anderson *op. cit.* (1980) 119; Coode *et al. (eds.) op. cit.* 76; Newman *et al. op. cit.* (1998) 173. **Type:** *G.H.S. Wood SAN 16601*, Borneo, Sabah, Sipitang (holotype KEP).

Large emergent tree, to 50 m tall, to 1.2 m diameter, with diffuse pale hemispherical crown; bole straight; buttresses to 2 m tall, thin, prominent. **Bark** becoming vertically cracked and thinly oblong flaky, pale fawn-brown. *Inflorescence, parts of perianth exposed in bud, ovary except at base and apex, nut, and stipules cream puberulent; domatia fimbriate; parts otherwise glabrous.* **Twigs** c. 1.5 mm diameter apically, slender, much-branched. Leaf buds ovoid, acute, c. 4 × 2 mm. **Stipules** ovate, narrowly acute, to 6 × 2.5 mm, caducous. **Leaves** chartaceous, cream lepidote below (mature tree), drying dark greyish brown; blade broadly ovate to obovate, 6.5–10 × 3–7 cm, base obtuse to subcordate, subequal, apex with acumen to 0.8 cm long; midrib raised but not prominent below, more or less flat, evident, above;

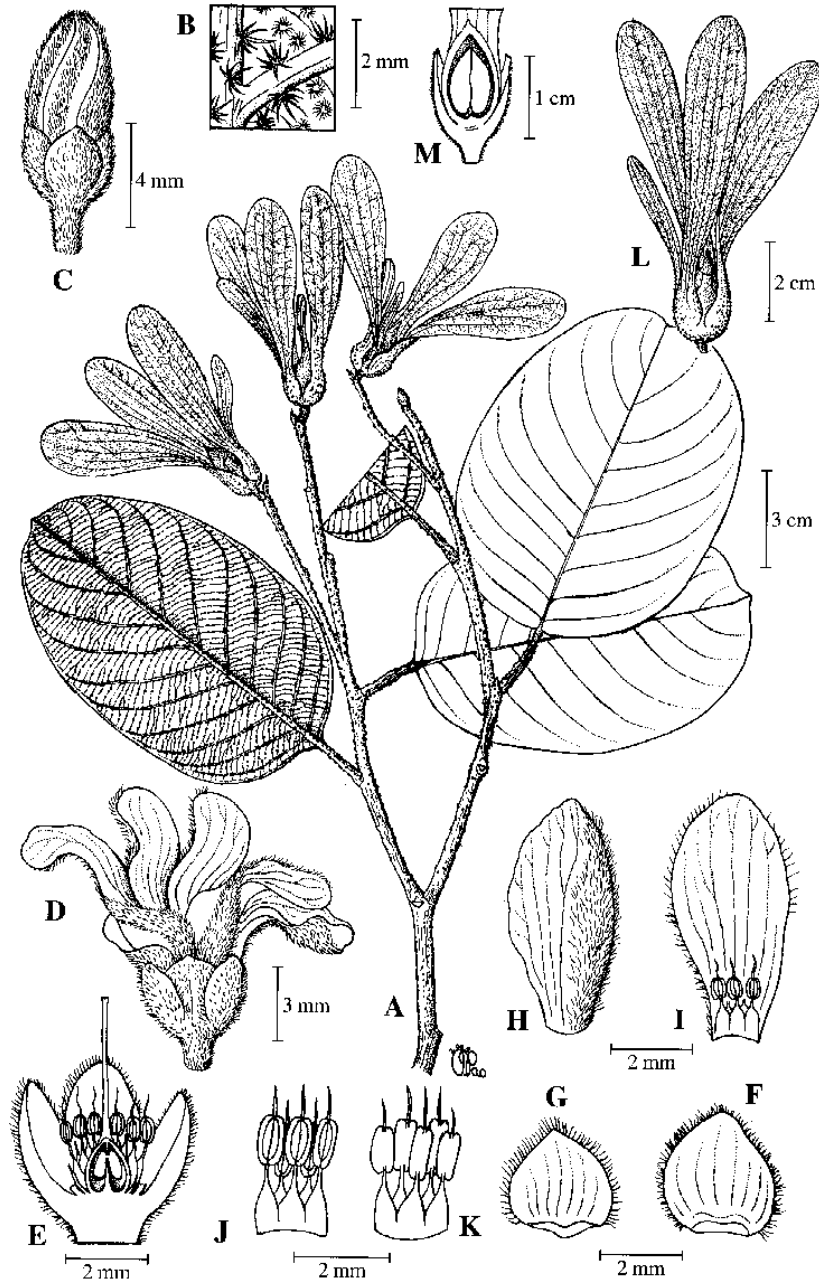


Fig. 23. *Shorea elliptica*. A, fruiting leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, open flower; E, longitudinal section of open flower with petals removed; F, adaxial view of outer sepal; G, adaxial view of inner sepal; H, abaxial view of petal; I, adaxial view of petal with stamens; J, adaxial view of stamens; K, abaxial view of stamens; L, fruit; M, longitudinal section of fruit. (A–B and L from *S* 15794, C–K from *S* 37698, M from *S* 29468.)

lateral veins 8–12 pairs, slender, arched, elevated below, with small pore-like domatia; intercostal venation slender, densely scalariform, sinuate; petiole 1.5–2.5 cm long, slender, geniculate and swollen in the distal half. **Inflorescences** terminal or axillary; rachis terete, to 7 cm long, singly branched, branches bearing to 5 flowers. **Flowers:** buds to 13 × 4 mm; stamens 25–30, anthers sparsely setose towards apices, connectival appendage c. 1/4x the length of anther, stout, setose; ovary small, ovoid, stylopodium 1 1/2x the length of ovary, slender, style glabrous, short. **Fruits:** calyx glabrous, lobes unequal, 3 longer lobes to 13 × 3 cm, tapering to 8 mm above the saccate base, 2 shorter ones to 7 × 1.2 cm, otherwise similar. **Nuts** ovoid, to 3.5 × 2.5 cm, with to 1 cm prominent style remnant.

Vernacular names. Sabah—*selangan batu mata-mata* (preferred name). Sarawak—*selangan batu lubang hidung* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort, Sipitang and Tawau districts (e.g., *SAN 15164*, *SAN 21492* and *SAN 37110*) and in Sarawak from Bintulu, Lawas and Miri districts (e.g., *S 1785*, *S 22069* and *S 24984*). Also occurring in Brunei (e.g., *BRUN 3395* and *BRUN 5666*), and NE Kalimantan.

Ecology. Scattered, usually as single mature trees, but widespread, in mixed dipterocarp forest on shale ridges, at altitudes to 700 m. Vulnerable.

34. *Shorea elliptica* Burck (Latin, *ellipticus*; the elliptic leaf blade)

Fig. 23.

(sect. **Rubella**, red meranti)

Ann. Jard. Bot. Buitenz. 6 (1887) 215; Merrill *op. cit.* (1921) 404; Masamune *op. cit.* 493; Browne *op. cit.* 138; Ashton *op. cit.* (1968) 151, *op. cit.* (1982) 500; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 428; Newman *et al. op. cit.* (1996) 137. **Type:** *Beccari PB 2574*, Borneo, Sarawak, Matang (holotype BO).

Medium-sized emergent tree, to 40 m tall, to 1.2 m diameter, with hemispherical dense crown pale from below; bole straight; buttresses to 1.5 m tall, stout. **Bark** becoming dark mauve-brown dappled, pale grey, deeply v-section fissured; inner bark orange-brown; heartwood pink. *Twig, leaf bud, parts of perianth exposed in bud, stipule and bracteole outside, inflorescence, nut, and veins and midrib below densely ochreous to cream scabrid-puberulent; lateral veins above and stipule within sparsely evenly so; blade densely cream-lepidote below.* **Twigs** c. 2 mm diameter apically, terete to somewhat compressed, much-branched; stipule scars short. Leaf buds ovoid, obtuse, compressed, to 8 × 6 mm. **Stipules** narrowly ovate, acute, to 10 × 6 mm, caducous. **Leaves** thickly coriaceous, drying dull greyish brown above, cream below; blade elliptic-oblong, 7–10 × 4–9 cm, base broadly cuneate to subcordate, apex obtuse to shortly broadly acuminate; midrib evident but shallowly furrowed above, prominent, terete below; lateral veins 11–16 pairs, prominent below; intercostal venation slender, densely scalariform, more or less obscure; petiole 1.5–3.3 cm long. **Inflorescences** terminal or axillary; rachis more or less compressed, to 12 cm long, singly or doubly branched, branchlets bearing to 3 flowers; bracteoles elliptic, obtuse, to 2 × 1 mm, caducous. **Flowers:** buds to 4 × 3 mm; petals pale yellow; stamens 19–20, anthers oblong, almost as long as filaments, connectival appendage stout, somewhat shorter than anther; ovary without stylopodium, glabrous, style c. 2x as long as ovary. **Fruits:** pedicels to 3 mm, expanding into receptacle; calyx lobes unequal, 3 longer lobes narrowly

spatulate to suborbate, to 8 × 1.5 cm, tapering to 4 mm above the saccate base, 2 shorter ones to 6 × 0.8 cm, otherwise similar. Nuts ovoid, acute, to 1.5 × 1.2 cm.

Vernacular name. Sarawak—*meranti lang* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Kuching and Lundu districts (e.g., *S 10059*, *S 27769*, *S 29468*, *S 37765*, and *S 49960*) and in Kalimantan from Lower Kapuas valley.

Ecology. Locally common, in mixed dipterocarp forest on leached sandy clay soils, at altitudes to 500 m. Occurring in Bako NP; elsewhere endangered.

35. *Shorea exelliptica* Meijer

Plate 4A.

(Latin, *ex-* = excluded from, *elliptica* = *S. elliptica*; species formerly confused with *S. elliptica*)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Act. Bot. Neerl. 12 (1963) 323; Meijer & Wood *op. cit.* 167; Ashton *op. cit.* (1964) 132, *op. cit.* (1968) 69, *op. cit.* (1982) 455; Burgess *op. cit.* 202; Anderson *op. cit.* (1980) 119; PROSEA *op. cit.* 428; Coode *et al.* (eds.) *op. cit.* 76; Newman *et al.* *op. cit.* (1998) 174. **Lectotype** (designated here): *Rahman S 1641*, Borneo, Brunei, Belait (holotype K; isolectotypes KEP, L). **Synonyms:** *Shorea ?elliptica auct. non Burck*: Symington *op. cit.* (1943) 13; *S. sp.* Browne *op. cit.* 170.

Emergent tree, to 60 m tall, to 1 m diameter, with dense hemispherical crown pale from below; bole straight; buttresses to 1.5 m tall, spreading, rather thin. **Bark** becoming closely cracked, then thinly oblong flaky, the flakes becoming persistent in big trees. **Twig**, **inflorescence**, **leaf bud**, **parts of perianth exposed in bud**, **stipule**, **bracteole**, **petiole**, **midrib on both surfaces**, and **veins below densely persistently purplish brown to golden brown scabrid-pubescent, sometimes glabrescent on midrib above; ovary and nut evenly buff-pubescent. Twigs** ridged, at first somewhat compressed or terete, c. 2 mm diameter apically. Leaf buds ovoid, more or less compressed, to 3.5 × 3 mm. **Stipules** broadly ovate, acute, to 8 × 4 mm, *not at first caducous*. **Leaves** coriaceous, *golden to silver lepidote below* (mature trees), *drying purplish brown with cream undersurface, the veins and midrib dark purplish; blade oblong to broadly ovate, 9–15 × 3.5–7 cm, base broadly cuneate, apex with tapering acumen to 1 cm long; midrib prominent below, evident but furrowed above; lateral veins 12–18 pairs, prominent below; intercostal venation scalariform, slender, sinuate; petiole 1.2–1.7 cm long, rugose. Inflorescences* terminal or axillary; rachis ribbed and slightly compressed, to 12 cm long, singly branched, branchlets bearing to 8 flowers; bracteoles elliptic, acute, to 4 mm long, caducous. **Flowers:** buds to 10 × 3 mm; petals cream, pink at base; *stamens 30–40, filaments slightly hispid, connectival appendage as long as anther, setose; ovary and stylopodium shortly ovoid, densely tomentose except at the base, style as long as both, slender, glabrous. Fruits:* calyx glabrous, *lobes unequal, 3 longer lobes to 8 × 2.4 cm, tapering to 4 mm above the saccate base, 2 shorter ones to 4.5 × 1.7 cm, otherwise similar. Nuts* ovoid, to 1.5 × 1 cm, with to 3 mm tapering style remnant.

Vernacular name. Sabah and Sarawak—*selangan batu tembaga* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Borneo known in Sabah from Kinabatangan, Lahad Datu, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 15165*, *SAN 16986*, *SAN 19559*, and *SAN A 4242*) and in Sarawak from Belaga, Kapit, Kuching, Lawas, Limbang, Marudi, and Miri districts (e.g., *S 1432*, *S 32326*, *S 38750*, *S 41230*, and *S 68994*). Also occurring in Brunei (e.g., *BRUN 880* and *BRUN 5661*) and Kalimantan (e.g., *Ambriansyah & Arifin Berau 1075* and *bb. 29311*).

Ecology. Frequent in mixed dipterocarp forest on yellow clay and sandy clay soils on the sedimentary rocks of the inland ridges, at altitudes to 600 m; and less so on undulating land in the lowlands. Occurring in Lambir and Mulu NPs; elsewhere vulnerable owing to logging.

36. *Shorea faguettiana* F.Heim

(Faguet, 19th century French botanical assistant at Paris)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Bull. Mens. Soc. Linn. Paris 2 (1891) 975; Merrill *op. cit.* (1921) 414; Symington, Gard. Bull. S. S. 7 (1933) 148, *op. cit.* (1939) 381, *op. cit.* (1943) 50; Masamune *op. cit.* 493; Browne *op. cit.* 162; Ashton *op. cit.* (1964) 152, *op. cit.* (1968) 83, *op. cit.* (1982) 484; Meijer & Wood *op. cit.* 69; Burgess *op. cit.* 217; Anderson *op. cit.* (1980) 121; PROSEA *op. cit.* 418; Coode *et al.* (eds.) *op. cit.* 76; Newman *et al.* *op. cit.* (1996) 138. **Lectotype** (designated here): *Beccari PB 2491*, Borneo, Sarawak, Matang (hololectotype P).

Large emergent tree, to 50 m tall, to 1.5 m diameter, with straight bole and dense hemispherical crown; buttresses to 1.5 m tall, stout. **Bark** fawn-brown, vertically cracked and thinly oblong flaky; dammar coxcombs present, dark greyish brown. *Leaf bud, parts of perianth exposed in bud, young twig, inflorescence, stipule, and bracteole pale greyish brown puberulent; young leaves fugaceous puberulent below; ovary, stylopodium, and nut densely cream buff pubescent.* **Twigs** c. 1 mm diameter apically, slender, rugulose, lenticellate. Leaf buds ovoid to conical, c. 2 × 1.5 mm, small. **Stipules** hastate, to 4 × 1.5 mm. **Leaves** coriaceous, drying greyish green; blade elliptic to oblong-lanceolate or ovate, 7–12 × 3–5 cm, base cuneate to obtuse, equal or subequal, apex with tapering acumen to 1 cm long; midrib raised and terete below, evident and shallowly furrowed to flat above; lateral veins 9–12 pairs; intercostal venation rather dense, subscalariform, slightly elevated; petiole 1–1.5 cm long, fairly stout. **Inflorescences** terminal or axillary, rachis lax, terete, to 20 cm long, doubly or trebly branched, branchlets bearing to 8 flowers; bracteoles small, fugaceous. **Flowers:** buds small, to 3 mm long; petals cream; *stamens 15, connectival appendage as long as anther, sericeous towards apex; ovary subglobose, stylopodium as long as ovary, style short, glabrous.* **Fruits:** calyx sparsely puberulent, lobes unequal, 3 longer lobes to 6 × 1.2 cm, tapering to 2.5 mm above the tuberculate saccate base, 2 shorter ones to 4.5 cm long, narrower, otherwise similar. **Nuts** narrowly ellipsoid to obovoid, acute, to 1.5 × 0.5 cm.

Vernacular names. Sabah—*seraya kuning siput* (preferred name). Sarawak—*lun siput* (preferred name).

Distribution. SE Peninsular Thailand, Peninsular Malaysia and Borneo. In Borneo, occur throughout Sabah and recorded from Beaufort, Keningau, Kinabatangan, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15143*, *SAN 22789*, *SAN 36401*, *SAN 61239*, *SAN 63063*, and *SAN 68597*) and in Sarawak from Bau, Belaga, Bintulu, Kapit,

Kuching, Lawas, Limbang, Lundu, Simunjan, and Tatau districts (e.g., *S* 15221, *S* 22485, *S* 27122, *S* 29635, and *S* 49931). Also occurring in Brunei (e.g., *BRUN* 3019 and *BRUN* 3178) and E Kalimantan (e.g., *Arifin et al. Berau* 710 and *Arifin and Ambriansyah Berau* 1040).

Ecology. Widespread and frequent, in mixed dipterocarp forest on well-drained clay and sandy clay soils, at altitudes to 1000 m. Well represented in Kubah, Lambir and Mulu NPs; probably not vulnerable.

37. *Shorea faguetioides* P.S.Ashton

(Greek, *-oides* = resembling; similar to *S. faguetiana*)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 19 (1962) 287, *op. cit.* (1964) 154, *op. cit.* (1968) 83, *op. cit.* (1982) 480; Meijer & Wood *op. cit.* 80; Anderson *op. cit.* (1980) 122; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al. op. cit.* (1996) 139. **Type:** *Drahman S* 1771, Borneo, Sarawak, Lawas, Bt. Pengalih (holotype K; isotype KEP).

Large emergent tree, to 50 m tall, to 1.4 m diameter, with straight cylindrical bole and dense hemispherical crown. **Bark** pale greyish tawny, shallowly cracked and evenly flaky, appearing smooth overall; dammar in greyish coxcombs, black within. *Inflorescence and parts of perianth exposed in bud persistently greyish brown puberulent; ovary, stylopodium and nut densely buff puberulent; young twig sometimes caducously so; parts otherwise glabrous.* **Twigs** c. 3 mm diameter apically, somewhat compressed at first, drying blackish, rugulose. Leaf buds ovoid, obtuse, compressed, 3–4 × 2.5 mm. **Stipule** narrowly deltoid, saccate, obtuse, to 18 × 6 mm, not at first caducous. **Leaves** brilliant magenta when opening, chartaceous, drying tawny-brown lustrous below with darker midrib; blade narrowly ovate, 12–18 × 5–7 cm, base subequal, broadly cuneate to subcordate, apex with prominent acumen to 2 cm long; midrib evident, flat or shallowly furrowed above, prominent below; lateral veins 10–15 pairs, slender but distinctly raised below, arched; intercostal venation scalariform, slender, evident; petiole 2.2–3 cm long, c. 2 mm diameter, slender, drying black, weakly geniculate. **Inflorescences** terminal or axillary; rachis terete, lax, to 15 cm long, doubly or sometimes trebly branched, branchlets bearing to 7 flowers; bracteoles small, fugaceous. **Flowers:** buds to 2.5 × 1.5 mm; *petals cream; stamens 15, connectival appendage c. 3x the length of anther, sericeous towards apex; ovary ovoid, stylopodium shorter than ovary, cylindrical, style short, glabrous.* **Fruits:** calyx puberulent towards base, otherwise glabrous, lobes unequal, chartaceous, 3 longer lobes to 7 × 1.5 cm, tapering to 4 mm above narrow saccate tuberculate base, 2 shorter ones to 5 × 0.7 cm, otherwise similar. **Nuts** ellipsoid to obovoid, to 2 × 0.6 cm, with 3 mm slender style remnant.

Vernacular names. Sabah—*seraya kuning* (preferred name). Sarawak—*barek* (Iban).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Keningau and Kota Kinabalu districts (e.g., *SAN* 16242, *SAN* 38713 and *SAN* 66242) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Limbang, Lundu, Miri, Simunjan, and Tatau districts (e.g., *S* 23743, *S* 25025 and *S* 27004). Also occurring in Brunei (e.g., *BRUN* 3340 and *BRUN* 5645) and W Kalimantan (e.g., *bb.* 29609 and *bb.* 29610).

Ecology. Locally frequent in mixed dipterocarp forest on clay-rich soils, on shale and volcanic rocks, at altitudes to 700 m. Occurring in Lambir NP; elsewhere vulnerable owing to land conversion.

38. *Shorea falcifera* Dyer ex Brandis

(Latin, *falx* = a sickle, *ferre* = to bear; carrying a sickle, the sickle-shaped leaf)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

J. Linn. Soc. Bot. 31 (1895) 64; Merrill *op. cit.* (1921) 571; Ashton *op. cit.* (1978) 36, *op. cit.* (1982) 456; PROSEA *op. cit.* 428; Newman *et al. op. cit.* (1998) 177. **Type:** *Beccari PB 3046*, Borneo, Sarawak, Santubong (holotype K). **Synonyms:** *Hopea linggensis* Boerl., Cat. Hort. Bog. 2 (1901) 105; *Shorea flava* Meijer *op. cit.* 325, Ashton *op. cit.* (1968) 69, Anderson *op. cit.* (1980) 119.

Emergent tree, to 45 m tall, to 1.4 m diameter, with sea-green diffuse hemispherical crown; bole straight; buttresses to 1.5 m tall, fairly thin. **Bark** yellowish brown, patchily becoming rich reddish brown, cracked and patchily oblong flaky. *Twig, bud, stipules (sparsely so within) venation, and blade below densely persistently pale yellow lepidote; inflorescence, parts of perianth exposed in bud and nut densely persistently buff-puberulent; fruit calyx sparsely caducously so; ovary and stylopodium sericeous.* **Twigs** c. 1 mm diameter apically, slender, terete. Leaf buds small, elliptic, subacute, to 2 × 1 mm. **Stipules** elliptic, obtuse, to 6 × 4 mm, fugaceous. **Leaves** coriaceous, drying mauve-grey above, cream below; blade narrowly ovate- to lanceolate-falcate, 6.5–12 × 2.5–5 cm; midrib shallowly sunken, slender but evident above, prominent below; lateral veins c. 10 pairs, slender but slightly raised below; intercostal venation obscure, scalariform; petiole slender, somewhat geniculate, 1.1–1.8 cm long. **Inflorescences** terminal or axillary; rachis terete or ribbed, to 11 cm long, singly branched, branchlets bearing to 5 flowers. **Flowers:** buds to 8 × 2 mm; petals cream; stamens 33–34, filaments setose, anthers sparsely so on distal margin, connectival appendage shorter than anther, shortly setose; ovary and stylopodium pyriform, style short, glabrous. **Fruits:** calyx lobes unequal, 3 longer lobes to 9.5 × 1.8 cm, tapering to 7 mm above the saccate base, 2 shorter ones to 7 × 0.8 cm, otherwise similar. **Nuts** ovoid, to 2.5 × 1.5 cm, with to 7 mm prominent filiform style remnant.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo known in Sarawak from Kuching, Lundu, Simunjan, and Sri Aman districts (e.g., *S 10288*, *S 15433*, *S 25291*, *S 58976*, and *S 68888*).

Ecology. Common in mixed dipterocarp forest on sandy soils on hills, often rocky, near the sea, at altitudes to 200 m. Occurring in Bako NP; vulnerable outside parks system.

39. *Shorea falciferoides* Foxw.

(Greek, *-oides* = resembling; similar to *S. falcifera*)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Philip. J. Sci. 13 (1918) Bot. 189. **Lectotype** (designated here): *Mayor FB 25664*, the Philippines, Luzon, Zambales Province, Masinloc (hololectotype K). **Synonym:** *Shorea gisok* Foxw., *op. cit.* (1938) 294.

Notes. Two subspecies, subsp. *falciferoides* and subsp. *glaucescens* are recognised, of which the former is endemic in the Philippines.

subsp. **glaucescens** (Meijer) P.S.Ashton

Gard. Bull. Sing. 31 (1978) 37, *op. cit.* (1982) 458; PROSEA *op. cit.* 428; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al.* *op. cit.* (1998) 178. **Basionym:** *Shorea glaucescens* Meijer *op. cit.* 327, Meijer & Wood *op. cit.* (1964) 170, Ashton *op. cit.* (1964) 134, *op. cit.* (1968) 71, Burgess *op. cit.* 202, Anderson *op. cit.* (1980) 119. **Type:** *G.H.S. Wood & Agama SAN 15484*, Borneo, Sabah, Sepilok FR (holotype K; isotype KEP).

Emergent tree, to 50 m tall, to 1.1 m diameter; crown sparse, irregularly hemispherical; bole straight or misshapen; buttresses to 3 m tall, spreading, thin. **Bark** reddish brown, becoming cracked and irregularly oblong flaky. *Young twig, inflorescence, petiole, leaf bud, stipules, bracteole, parts of perianth exposed in bud, ovary, stylopodium, and nut* densely evenly persistently cream puberulent; *fruit calyx* sparsely so towards base. **Twigs** 2–3.5 mm diameter apically, terete or somewhat compressed and ribbed; stipule scars *c.* 1.5 mm long, pale, horizontal. Leaf buds globose to ovoid, subacute, slightly compressed, to 5 × 3.5 mm. **Stipules** obtuse, to 10 × 4 mm, fugaceous. **Leaves** chartaceous, drying pale tawny above, cream below; blade broadly ovate-falcate, 10–18 × 4.5–8 cm, base subequal, obtuse to cuneate, apex with tapering acumen *c.* 0.8 cm long; midrib evident, flat to shallowly furrowed above, prominent below; lateral veins 8–12 pairs, slender, well-spaced, ascending, raised but not prominent below; intercostal venation slender, densely scalariform, not raised; petiole 1.5–2 cm long, stout. **Inflorescences** terminal or axillary; rachis ribbed and somewhat compressed, to 4 cm long, singly branched, branchlets bearing to 6 close flowers; bracteoles elliptic, to 3 mm long, fugacious. **Flowers:** buds to 5 × 2.5 mm; petals cream; *stamens c.* 45, filaments and anthers glabrous, connectival appendage very short, stout, shortly setose with one long apical bristle; ovary and stylopodium ovoid, style short, glabrous. **Fruits:** calyx lobes unequal, 3 longer lobes to 9.5 × 2.5 cm, tapering to 5 mm broad above the saccate base, 2 shorter ones to 7 × 1 cm, otherwise similar. **Nuts** broadly ovoid, to 1.5 × 1.5 cm, with to 4 mm tapering style remnant.

Vernacular names. Sabah—*selangan batu laut* (preferred name). Sarawak—*selangan batu daun nipis* (preferred name).

Distribution. Endemic in Borneo; widespread but absent from the W and SW parts. In Sabah known from Beaufort, Beluran, Kudat, and Sandakan districts (e.g., *SAN 16423*, *SAN 16523*, *SAN 16962*, *SAN 25439*, and *SAN 61155*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Limbang, and Miri districts (e.g., *S 14741*, *S 27130*, *S 29677*, *S 32312*, and *S 43355*). Also occurring in Brunei (e.g., *BRUN 795*, *BRUN 5718*, *KEP 80140*, and *S 2116*) and in E Kalimantan (e.g., *Ambriansyah Berau 981* and *bb. 29684*).

Ecology. Locally frequent in mixed dipterocarp forest on clay-rich soils, at altitudes to 600 m, especially on moist slopes. Occurring in Lambir NP and Sepilok FR; elsewhere vulnerable owing to conversion of its habitat.

40. *Shorea fallax* Meijer

(Latin, *fallax* = deceptive; not at first clearly distinguished from *S. scaberrima*)

(sect. **Brachypterae**, red meranti)

Act. Bot. Neerl. 12 (1963) 335; Meijer & Wood *op. cit.* 105; Ashton *op. cit.* (1964) 186, *op. cit.* (1968) 107, *op. cit.* (1982) 516; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 394; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al.* *op. cit.* (1996) 140. **Lectotype** (designated here): *G.H.S. Wood SAN A 1734*, Borneo, Sabah, Beaufort Hill (hololectotype K; isolectotypes KEP, L). **Synonyms**: *Shorea squamata auct. non* Benth. & Hook.f.: Browne *op. cit.* 144; *S. oleosa* Meijer *op. cit.* 338, Meijer & Wood *op. cit.* 124, Burgess *op. cit.* 183.

Emergent tree, to 50 m tall, to 1.3 m diameter but usually smaller; crown dense, hemispherical; bole straight, cylindrical; buttresses to 2 m tall, stout. **Bark** warm brown, deeply cracked and becoming oblong flaky; inner bark dull reddish brown; heartwood pink. *Young twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipule and bracteole outside, petiole, leaf below, and midrib above sparsely persistently pale brown scabrid-pubescent; ovary, stylopodium and nut densely evenly buff-pubescent. Twigs 2–2.5 mm diameter apically, terete, ribbed below the c. 2 mm long pale subfalcate stipule scars. Leaf buds ovoid, subacute, 5–8 × 4–6 mm, large. Stipules hastate, to 15 × 5 mm, caducous. Leaves coriaceous, drying chocolate-brown below, mauve-grey above; blade broadly oblong to ovate, 12–24 × 5.5–11 cm, base obtuse, apex with tapering acumen to 1.2 cm long; midrib evident, flat above, prominently terete below; lateral veins 15–19 pairs, prominent below, arched, generally with many short intermediate veins; intercostal venation scalariform, distant, prominent below; petiole 1–1.5 cm long. Inflorescences terminal or axillary; rachis terete or ribbed, lax, to 22 cm long, singly or doubly branched, branchlets bearing to 7 flowers; bracteoles ovate, acute, to 7 × 3 mm, not at first caducous. Flowers: buds to 8 × 4 mm; petals cream-yellow; stamens 15, connectival appendage c. 2x the length of anther; ovary and stylopodium pyriform, style equally long, columnar, glabrous. Fruits subsessile; calyx glabrescent, lobes unequal, 3 longer lobes to 5 × 0.8 cm, tapering to 3.5 mm broad above the saccate base, 2 shorter ones linear-lobed, to 2.5 × 0.15 cm, similar at base. Nuts ovoid, to 2.7 × 1 cm, apiculate.*

Vernacular names. Sabah—*seraya daun kasar* (preferred name). Sarawak—*engkabang pinang* (Iban), *engkabang layar* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Keningau, Kinabatangan, Labuk Sugut, Sandakan, and Tawau districts (e.g., *SAN 16466*, *SAN 28687*, *SAN 36910*, *SAN 61257*, and *SAN 123774*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 15113*, *S 22386*, *S 31702*, *S 46429*, and *S 53496*). Also occurring in Brunei (e.g., *BRUN 769* and *BRUN 3065*) and Kalimantan (e.g., *Endert 4783*).

Ecology. Frequent in mixed dipterocarp forest, on clay soils mostly over shale, on moist hillsides, low hills and alluvium, at altitudes to 600 m. Occurring in Danum Valley Conservation Area and Sepilok FR in Sabah and Lambir and Mulu NPs in Sarawak; elsewhere vulnerable owing to forest conversion.

41. *Shorea ferruginea* Dyer ex Brandis
(Latin, *ferrugineus* = rust-coloured; the dry leaf)

(sect. **Mutica**, subsect. **Auriculatae**, red meranti)

J. Linn. Soc. Bot. 31 (1895) 91; Merrill *op. cit.* (1921) 405; Masamune *op. cit.* 493; Browne *op. cit.* 139; Ashton *op. cit.* (1964) 187, *op. cit.* (1968) 108, *op. cit.* (1982) 533; Meijer & Wood *op. cit.* 106; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 394; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al.* *op. cit.* (1996) 142. **Type:** *Beccari PB 2604*, Borneo, Sarawak, Matang (holotype K).

Emergent tree, to 45 m tall, to 1.6 m diameter, with diffuse hemispherical, cauliflower-shaped crown; bole straight, cylindrical; buttresses to 3.5 m tall, stout. **Bark** smooth at first, becoming yellowish fawn, shallowly v-section fissured and powdery thinly oblong flaky, occasionally becoming somewhat shaggy; inner bark and heartwood yellowish brown. *Young twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipule and bracteole outside (sparsely so within), petiole, and blade below persistently pale brown scabrid-puberulent; ovary, stylopodium and nut sparsely cream buff pubescent.* **Twigs** 2–2.5 mm diameter apically, terete, ribbed below the short pale falcate stipule scars. Leaf buds ovoid, subacute, 5–8 × 4–6 mm. **Stipules** hastate, acute, to 15 × 5 mm. **Leaves** *thinly coriaceous, drying dull orange-brown below, paler above; blade broadly oblong to ovate-lanceolate, 6–15 × 3.3–5.3 cm, base obtuse, apex with slender acumen to 1.2 cm long; midrib obscure, sunken above, prominent below; lateral veins 11–14 pairs, slender and hardly raised below; intercostal venation slender, scalariform, obscure; petiole 1–1.5 cm long.* **Inflorescences** terminal or axillary; rachis terete or ribbed, lax, to 22 cm long, singly or doubly branched, branchlets bearing to 7 flowers; bracteoles ovate, acute, to 7 × 3 mm, fugaceous. **Flowers:** stamens 15, *connectival appendage curved but not becoming fully reflexed; ovary and stylopodium pyriform, style equally long, columnar, glabrous.* **Fruits** subsessile; calyx glabrescent; lobes unequal, 3 longer lobes to 12 × 3.5 cm, tapering to 1.3 cm at the auriculate base, saccate at the incrassate centre, 2 shorter ones linear-lobed, to 4 × 0.8 cm, *hardly auriculate at base.* **Nuts** ovoid, to 2.7 × 1 cm, *prominently apiculate.*

Vernacular names. Sabah—*seraya melantai kecil* (preferred name). Sarawak—*engkabang kali* (Iban), *meranti menalit* (preferred name).

Distribution. Endemic in Borneo; widespread. In Sabah recorded from Beaufort, Kota Merudu, Labuk Sugut, Nabawan, Ranau, and Tenom districts (e.g., *SAN 15089*, *SAN 16363*, *SAN 94903*, *SAN 99272*, and *SAN 99547*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Lubok Antu, Miri, and Samarahan districts (e.g., *S 10703*, *S 15833*, *S 29640*, *S 36929*, and *S 68123*). Also occurring in Brunei (e.g., *BRUN 422* and *BRUN 3396*).

Ecology. Locally common in mixed and upper dipterocarp forests on dry sandy clay and skeletal clay soils, especially on ridges, at altitudes to 1100 m. Occurring in Kinabalu, Lambir and Mulu NPs; not vulnerable.

42. *Shorea flaviflora* Wood *ex P.S. Ashton*

(Latin, *flavus* = yellow, *flos* = flower; yellow-flowered)

(sect. **Brachypterae**, subsect. **Brachypterae**, red meranti)

Gard. Bull. Sing. 19 (1962) 289, *op. cit.* (1964) 188, *op. cit.* (1968) 108, *op. cit.* (1982) 518; Meijer & Wood *op. cit.* 107; Anderson *op. cit.* (1980) 126; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al.* *op. cit.* (1996) 518. **Type:** *G.H.S. Wood SAN 15109*, Borneo, Sabah, Beaufort, Pangi (holotype KEP; isotype L).

Emergent tree, to 45 m tall, to 1.4 m diameter, with irregular crown; bole cylindrical or frequently misshapen; buttresses to 4 m tall, stout. **Bark** dark brown to blackish, becoming deeply v-section fissured and eventually thinly flaky, with occasional cream dammar smears; inner bark rich crimson; heartwood dark yellowish brown. *Young parts shortly pale grey puberulent with minute adpressed hair-tufts, caducous except on inflorescence, leaf bud, stipule, and parts of perianth exposed in bud; ovary, stylopodium and nut densely buff pubescent.* **Twigs** 2–3 mm diameter apically, terete, glabrous, smooth; *stipule scars narrow, pale, ascending, half encircling twig.* *Leaf buds falcate, acute, 6–12 × 1.5–3 mm.* **Stipules** narrowly hastate, to 24 × 7 mm, caducous. **Leaves** thinly coriaceous, undulate, drying rich fawn-brown below with paler veins, pale tawny above; blade narrowly ovate, 12–18 × 5.5–7 cm, base broadly cuneate to obtuse, apex tapering to c. 1.5 cm slender acumen; midrib flat, evident above, prominent below; lateral veins 6–7 pairs, ascending, arched, slender but prominent below, with small pore-like axillary domatia; intercostal venation very slender, hardly raised, densely scalariform; petiole 2–3 cm long, geniculate. **Inflorescences** terminal or axillary, pendent; rachis terete, to 15 cm long, doubly branched, branchlets bearing to 12 flowers; bracteoles elliptic, obtuse, to 5 × 2.5 mm, fugaceous. **Flowers:** buds large, to 14 × 4.5 mm; petals rich yellow; stamens 15, anthers large, reniform, locules indistinct, connectival appendage c. 3x the length of anther; ovary and stylopodium pyriform, style filiform, as long as ovary and stylopodium, glabrous. **Fruits:** calyx glabrous, lobes unequal, 3 longer lobes to 13 × 3 cm, tapering to 11 mm above the saccate base, 2 shorter ones to 8 × 1.3 cm, otherwise similar. **Nuts** ovoid, to 2.5 × 1.3 cm, with tapering style remnant to 1 cm long.

Vernacular names. Sabah—*seraya daun besar* (preferred name). Sarawak—*selangan merah bukit* (preferred name).

Distribution. Endemic in Borneo; known in Sabah from Beaufort, Ranau, Sipitang, Tambunan, and Tenom districts (e.g., *SAN 15098*, *SAN 16389*, *S 23484*, *SAN 24817*, and *SAN 69870*) and in Sarawak from Bintulu, Kapit, Limbang, and Tatau districts (e.g., *S 17764*, *S 29181*, *S 48960*, *S 53677*, and *S 64905*). Also occurring in Brunei (e.g., *BRUN 5276* and *BRUN 5664*).

Ecology. Locally frequent in mixed dipterocarp but especially upper dipterocarp forest on high shale ridges, at (150–)400–1300 m altitude. Occurring in Kinabalu and Mulu NPs; elsewhere vulnerable owing to logging.

43. *Shorea flemmichii* Symington

(C.O. Flemmich, Forestry Officer in Peninsular Malaysia, who served in Brunei 1938–1941 and collected important dipterocarp types)

(sect. **Brachypterae**, subsect. **Brachypterae**, red meranti)

Gard. Bull. S. S. 10 (1939) 378; Masamune *op. cit.* 493; Browne *op. cit. l.c.* 147; Ashton *op. cit.* (1964) 190, *op. cit.* (1968) 108, *op. cit.* (1982) 507; Anderson *op. cit.* (1980) 126; PROSEA *op. cit.* 395; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al.* *op. cit.* (1996) 144. **Type:** *Flemmich FMS 32585*, Borneo, Brunei, Belait district, Tenajor, Bt. Rotan (holotype KEP; isotype KEP).

Magnificent emergent tree, to 60 m tall, to 2.5 m diameter, with vast cauliflower-shaped crown suffused golden brown from below; bole tall, cylindrical; buttresses to 1.5 m tall, stout. **Bark** purplish grey, black and ochre-mottled, becoming densely deeply v-section

fissured, the intervening ridges oblong-flaky; dammar in prominent ochre-yellow smears; inner bark deep crimson; heartwood reddish rust. *Young twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipule and bracteole outside, petiole, midrib below and at base above, and venation below densely persistently golden tawny scabrid-tomentose; leaf above scabrid-puberulent; ovary and nut buff-pubescent.* **Twigs** stout though tapering to 2 mm diameter apically, much branched, terete, verruculose. Leaf buds ovoid, subacute, slightly compressed, 3–6 × 2–4 mm. **Stipules** narrowly hastate, acute, to 8 × 2.5 mm, fugaceous. **Leaves** coriaceous, cream lepidote below, otherwise drying chocolate-brown; blade broadly elliptic or ovate (young trees), 5–9 × 3–4.5 cm, base obtuse, margin revolute, apex with narrow acumen to 0.5 cm long; lateral veins 14–17 pairs, dense, prominent below; intercostal venation scalariform, sinuate; petiole 0.7–0.9 cm long, stout. **Inflorescences** terminal or axillary; rachis terete or slightly compressed, to 8 cm long, singly or doubly irregularly branched, branchlets somewhat zig-zag, bearing to 8 flowers; bracteoles suborbicular, obtuse, to 6 × 5 mm, caducous. **Flowers:** buds subglobose, to 4.5 × 3.5 mm; corolla dark crimson; stamens 15, connectival appendage c. 3x the length of anther; ovary and stylopodium ovoid-conical, style filiform, glabrous, as long as ovary. **Fruits** subsessile; calyx puberulent, calyx lobes unequal, 3 longer lobes to 6.5 × 1.5 cm, tapering to 2.5 mm above the saccate base, 2 shorter ones linear-lobed, to 2 × 0.15 cm, similar at base. **Nuts** ovoid, to 1.5 × 1 cm, subacute,

Vernacular name. Sarawak—*meranti raya* (preferred name).

Distribution. Endemic in Borneo. In Sarawak known from Kuching, Lawas, Miri, Samarahan, and Simunjan districts (e.g., S 6525, S 16753 and SFN 10246).

Ecology. Very local and rare or scattered in mixed dipterocarp forest on deep yellow sands, at altitudes below 400 m. Well represented in Lambir NP; elsewhere critically endangered.

44. *Shorea foraminifera* P.S.Ashton

(Latin, *foramen* = opening, *ferre* = to bear; the prominent pore-like leaf domatia)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Gard. Bull. Sing. 22 (1967) 295, *op. cit.* (1968) 108, *op. cit.* (1982) 538; Anderson *op. cit.* (1980) 126; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al.* *op. cit.* (1996) 143. **Type:** Sabli S 1916, Borneo, Brunei, Andulau FR (holotype K; isotype KEP).

Emergent tree, to 50 m tall, to 1.2 m diameter; bole straight, cylindrical; buttresses to 1 m tall, stout. **Bark** pinkish brown, prominently v-section fissured; inner bark pinkish brown; heartwood deep pink. *Young parts, leaf and stipules excepted, fugaceous puberulent; calyx sparsely puberulent towards base; nut persistently sericeous, known parts otherwise glabrous.* **Twigs** at first slightly compressed, 1–2 mm diameter apically. Leaf buds ovoid, compressed, subacute, to 8 × 5 mm. **Stipules** oblong to elliptic, obtuse, to 10 × 5 mm, caducous. **Leaves** coriaceous, drying warm brown below, greyish brown above; blade broadly ovate, 6–9 × 4–7 cm, base cordate to obtuse, apex with somewhat falcate acumen to 0.5 cm long; midrib obscure and slightly sunken above, prominent, terete, below; lateral veins 8–9 pairs, prominent below, arched, with prominent pustular porous domatia; intercostal venation very slender, scalariform, hardly raised; petiole 1–1.5 cm long. **Inflorescences** and **flowers** unknown. **Fruits:** pedicels c. 1 mm long; calyx lobes puberulent towards base, unequal, 3 longer lobes to 7 × 1.2 cm, tapering to c. 4 mm above

the saccate base, 2 shorter ones lorate-lobed, to 4.5×0.4 cm, similar at base. **Nuts** ovoid, to 1.5×1 cm, shortly apiculate.

Vernacular name. Sarawak—*meranti lubang hidung* (preferred name).

Distribution. Endemic in Borneo. Rare, known definitely from Brunei (e.g., *BRUN 243*, *FMS 28659*, *FMS 28675*, *S 1916*, and *SAN 17531*). Fallen leaves observed at Similajau FR, Bintulu district and Ulu Arip, Mukah district in Sarawak.

Ecology. Occasional, in small groups on periodically flooded sandy alluvium, including shallow peat, at low altitude. Critically endangered.

45. *Shorea foxworthyi* Symington

(F.W. Foxworthy, 1877–1950, first research officer at the Forest Research Institute, Kepong, Malaysia)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Gard. Bull. S. S. 8 (1935) 272, *op. cit.* (1943) 14; Keith *op. cit.* 44; Meijer & Wood *op. cit.* 169; Burgess *op. cit.* 202; Ashton *op. cit.* (1968) 70, *op. cit.* (1982) 453; Anderson *op. cit.* (1980) 119; PROSEA *op. cit.* 428; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al.* *op. cit.* (1998) 179. **Type:** *Foxworthy KEP 9507*, Peninsular Malaysia, Pahang, Baloh FR (holotype KEP).

Large emergent tree, to 60 m tall, to 1.2 m diameter, with dense irregularly hemispherical crown; bole straight, cylindrical; buttresses to 3 m tall, slender, spreading. **Bark** greyish fawn, becoming irregularly cracked then shallowly flaked, and eventually shaggy leaving scroll-marked surfaces below. *Twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipule outside, and petiole densely shortly evenly golden-tawny velutinous; leaf venation below, and inside of stipules and bracteoles sparsely so, caducous on venation.* **Twigs** somewhat compressed, c. 2×3 mm apically. Leaf buds ellipsoid, obtuse, to 3×2 mm. **Stipules** narrowly elliptic to falcate, subacute, to 15×4 mm, caducous. **Leaves** coriaceous, drying tawny-brown below; blade somewhat bullate in between lateral veins, elliptic, $8\text{--}13 \times 3\text{--}6.5$ cm, base broadly cuneate, subequal, apex with broad acumen to 1 cm long; midrib evident but somewhat sunken above, prominent below; lateral veins 10–14 pairs, ascending, arched, prominent below; intercostal venation slender, densely scalariform; petiole 1.1–2 cm, drying rugose, velutinous. **Inflorescences** terminal or axillary; rachis to 5 cm long, singly branched, branchlets bearing to 3 secund flowers; bracteoles not seen. **Flowers:** buds to 10×3 mm; petals cream with a pink base; *stamens 32–41, filaments densely setose, anther with sparsely setose distal margin, connectival appendage densely setose, hardly exceeding anther; ovary ovoid, stylopodium conical, glabrous, filiform, as long as ovary.* **Fruits:** calyx lobes unequal, 3 longer lobes to 10×2.5 cm, tapering to 7 mm above the saccate base, 2 shorter ones linear-lobed, to 8×1 cm, similar at base. **Nuts** ovoid, to 2.5×1.4 cm, with prominent tapering style remnant to 6 mm long.

Vernacular names. Sabah—*selangan batu bersisik* (preferred name). Sarawak—*selangan batu bukit* (Malay).

Distribution. Sumatra, extreme SE Peninsular Thailand, Peninsular Malaysia, and Borneo. In Sabah known from Lahad Datu, Sandakan, Sipitang, and Tawau districts (e.g., *SAN*

15183, SAN 19686 and SAN 36224); and in Sarawak from Bintulu, Kapit, Lawas, Marudi, Miri, and Simunjan districts (e.g., S 4640, S 15149, S 18380, S 19577, and S 29622). Also occurring in Brunei (e.g., BRUN 676) and Kalimantan (e.g., Wilkie 94306).

Ecology. Uncommon in mixed dipterocarp forest on yellow clay and sandy clays soils, at altitudes to 700 m. Occurring in Lambir NP; elsewhere endangered owing to the loss of its natural habitat.

46. *Shorea geniculata* Symington ex P.S.Ashton

(Latin, *geniculatus* = kneed; the petiole)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Gard. Bull. Sing. 19 (1962) 291, *op. cit.* (1964) 133, *op. cit.* (1968) 71, *op. cit.* (1982) 451; Anderson *op. cit.* (1980) 119; PROSEA *op. cit.* 429; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al.* *op. cit.* (1998) 180. **Type:** Ashton BRUN 3264, Borneo, Brunei, Andulau FR (holotype K; isotypes KEP, L).

Large emergent tree, to 50 m tall, to 1.8 m diameter; crown irregularly hemispherical, pale from below; bole straight, cylindrical; *buttresses stout*. **Bark** dark yellowish brown, vertically cracked and irregularly flaked, sometimes becoming shaggy. **Inflorescence**, *bracteoles, parts of perianth exposed in bud, ovary, stylopodium, and fruit densely persistently greyish-buff puberulent, vegetative parts glabrous*. **Twigs** stout, terete, much-branched, c. 3 mm diameter apically, with swollen nodes. *Leaf buds linear-falcate, 4–7 × 1–1.5 mm*. **Stipules** narrowly oblong, acute, to 10 × 3 mm, caducous. **Leaves** coriaceous, drying cream lepidote below with black venation; blade broadly ovate to suborbicular, 11–17 × 7–13 cm, base obtuse to subcordate, apex with short acumen to 0.8 cm long; midrib stout, terete, slightly elevated above, more so below as also lateral veins; lateral veins 9–11 pairs, slender, distant, arched; intercostal venation densely scalariform, sinuate, slender; petiole 4–6 cm long, geniculate. **Inflorescences** terminal or axillary; rachis terete, to 12 cm long, singly branched, branchlets bearing to 4 flowers; bracteoles oblong, to 4 mm long, fugaceous. **Flowers:** buds to 20 × 4 mm; petals cream; *stamens c. 55, filament and anther glabrous, connective appendage somewhat shorter than anther, stout, setose; ovary and stylopodium broadly ovoid, tapering abruptly, style short, glabrous*. **Fruits:** calyx lobes subequal, short, incrassate, deltoid, c. 1.5 × 1.5 cm, appressed to nut. **Nuts** globose, very large, to 5 cm diameter, shortly mucronate.

Vernacular name. Sarawak—*upun penyau* (Malay, preferred name).

Distribution. Endemic in Borneo. Recorded in W Sarawak from Bau, Kuching, Miri, and Samarahan districts (e.g., S 21420). Also occurring in Brunei (e.g., BRUN 3060, BRUN 3264, S 1929, and SAN 17470).

Ecology. Extremely local, but there frequent, in mixed dipterocarp forest on deep yellow sands on low hills, at altitudes to 300 m. Occurring in Lambir NP; elsewhere critically endangered owing to land conversion and logging.

47. *Shorea gibbosa* Brandis

(Latin, *gibbosus* = pouched; the staminal filament)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

J. Linn. Soc. Bot. 31 (1895) 99; Symington *op. cit.* (1933) 143, *op. cit.* (1943) 51; Masamune *op. cit.* 493; Keith *op. cit.* 17, 23; Browne *op. cit.* 162; Meijer & Wood *op. cit.* 71; Burgess *op. cit.* 217; Ashton *op. cit.* (1968) 83, *op. cit.* (1982) 482; Anderson *op. cit.* (1980) 122; PROSEA *op. cit.* 418; Kessler & Sidiyasa *op. cit.* 103; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al.* *op. cit.* (1996) 146. **Type:** Ridley 6079, Singapore (holotype K). **Synonym:** *Hopea grisea* Brandis *op. cit.* 63.

Vast emergent tree, to 70 m tall, to 2 m diameter; bole tall, cylindrical; crown vast, cauliflower-shaped, somewhat diffuse; buttresses to 5 m tall, spreading, stout. **Bark** pale tawny, becoming cracked and peeling in thin small oblong flakes, leaving a scroll-marked surface. *Twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipules, bracteole, ovary, nut, and petiole persistently shortly evenly pale buff to rufous puberulent; leaf venation and fruit calyx sparsely so, glabrescent.* **Twigs** c. 1 mm diameter apically, slender, terete, much-branched, pale greyish brown, striated. Leaf buds minute. **Stipules** narrowly elliptic, to 3 × 1 mm, acute, fugaceous. **Leaves** chartaceous, undulate, pink when opening, drying dark tawny-brown and wrinkling; blade ovate, 5–13 × 2–5 cm, base broadly cuneate to obtuse, apex with tapering acumen to 1.5 cm long; midrib evident but somewhat furrowed above, prominent below; lateral veins 7–9 pairs, slender but distinctly raised below, arched; intercostal venation subreticulate, slightly elevated below; petiole 0.8–1.2(–1.6) cm long, slender. **Inflorescences** terminal or axillary; rachis terete, to 10 cm long, singly branched, branchlets bearing to 6 flowers; bracteoles oblong, obtuse, to 2 × 1 mm, fugaceous. **Flowers:** buds to 5 × 3 mm; petals cream with pink base; stamens 15, connectival appendage somewhat longer than anther, glabrous; ovary ovoid, style columnar, pubescent in basal half. **Fruits:** pedicels to 2 mm long, slender; sepals unequal, 3 longer lobes to 9 × 2 cm, tapering to 4 mm above the narrow tuberculate saccate base, 2 shorter ones to 6 × 0.5 cm, otherwise similar. **Nuts** narrowly ellipsoid, acute, to 1.8 × 1.2 cm.

Vernacular names. Sabah—*seraya kuning gajah* (preferred name). Sarawak—*lun gajah* (preferred name).

Distribution. SE Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Sabah widespread and recorded from Beaufort, Keningau, Kinabatangan, Kota Belud, Kota Kinabalu, Labuk Sugut, Lahad Datu, Pensiangan, Ranau, Sandakan, Tambunan, Tawau, and Tenom districts (e.g., SAN 9273, SAN 15452, SAN 16906, SAN 17004, and SAN 100174) and in Sarawak from Bau, Belaga, Kapit, Kuching, Lundu, Marudi, Miri, and Tatau districts (e.g., S 7971, S 15357, S 22090, S 43602, and S 43368). Also occurring in Brunei (BRUN 3128 and FMS 35461) and C, E and SE Kalimantan (e.g., bb. 13877, bb. 31384, Endert 5256, Kostermans 5261, and Kostermans 13247).

Ecology. Local dense populations occur in mixed dipterocarp forest on deep well-structured clay loams, particularly on low hills and undulating land over intermediate and igneous rocks but rare, scattered, on the prevailing sedimentaries, at altitudes to 1000 m. Recorded from Kubah and Mulu NPs; elsewhere endangered.

Notes. This variable species which can be confused with *S. mujongensis* which differs in its glabrous leaf and twigs, and *S. polyandra* in which the leaf dries purplish brown with darker venation below, and in which the inner bark is distinctly albeit faintly laminated.

48. *Shorea gratissima* (Wall. ex Kurz) Dyer

(Latin, *gratus* = pleasing; very pleasing)

(sect. **Anthoshorea**, white meranti)

Fl. Brit. Ind. 1 1874) 307; Symington *op. cit.* (1943) 36; Meijer & Wood *op. cit.* 54; Burgess *op. cit.* 159; Ashton *op. cit.* (1982) 487; PROSEA *op. cit.* 411; Newman *et al. op. cit.* (1996) 147. **Basionym:** *Hopea gratissima* Wall., Cat. (1828) 960, *nom. nud.*; *H. gratissima* Wall. ex Kurz, J. As. Soc. Beng. 42, 2 (1873) 61. **Type:** *Wallich s.n.*, Singapore (holotype K).

Magnificent tree, to 60 m tall, to 2 m diameter; bole straight or frequently twisted; crown large, hemispherical with a few large twisted branches; buttresses to 2 m tall, stout. **Bark** surface pale greyish fawn, shallowly vertically cracked and thinly oblong flaked; inner bark laminated orange-brown and yellow. *Exposed young parts evenly pale fulvous puberulent, glabrescent except on stipules.* **Twigs** c. 1.5 × 1 mm apically, at first somewhat compressed. Leaf buds ovoid, subacute, to 2 × 1 mm. **Stipules** lanceolate, acute, to 10 × 3 mm, caducous. **Leaves** *thinly coriaceous, drying pale tawny with paler venation; blade ovate to elliptic, 4–10 × 1.5–4.5 cm, base cuneate, margin undulate, apex acute or acuminate with slender acumen to 1 cm long; midrib obscure and sunken above, slender and acute below; lateral veins 12–14 pairs, slender, arched, hardly raised below; intercostal venation subscalariform, obscure; petiole 0.8–1.5 cm long, slender.* **Inflorescences** terminal or axillary; rachis to 10 cm long, singly (if axillary) or doubly branched, branchlets bearing to 8 flowers; bracteoles to 2 mm long, linear, fugaceous. **Flowers:** buds to 5 × 3 mm; *stamens 25, anthers oblong, tapering, connectival appendage c. 3x the length of anther, villous in the distal half; ovary narrowly ovoid, without stylopodium, style c. 1½x as long as ovary.* **Fruits:** pedicels c. 1.5 mm long; *calyx lobes unequal, 3 longer lobes lorate-spatulate, to 7 × 1.3 cm, tapering to c. 6 mm above the saccate base, 2 shorter ones to 5.5 × 0.6 cm, otherwise similar.* **Nuts** ovoid, apiculate, to 1.5 × 0.8 cm.

Vernacular name. Sabah—*melapi laut* (preferred name).

Distribution. Myanmar, Peninsular Thailand, Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Borneo known in Sabah from Kudat, Lahad Datu and Tawau districts (e.g., *SAN 15453*, *SAN 16408*, *SAN 20162*, *SAN 31644*, and *SAN A 4345*). Also occurring in Kalimantan (*pers. obs.*).

Ecology. Locally abundant in mixed dipterocarp forest on dry hills near the coast, at altitudes to 500 m. Endangered.

49. **Shorea guiso** (Blanco) Blume

(from a Philippino name)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Mus. Bot. Lugd.-Bat. 2 (1852) 343; Merrill, Sp. Blancoan. (1918) 270, PEB (1929) 203; Symington *op. cit.* (1935) 266; Masamune *op. cit.* 494; Keith *op. cit.* 34; Browne *op. cit.* 153; Meijer & Wood *op. cit.* 171; Burgess *op. cit.* 173; Ashton *op. cit.* (1968) 71, *op. cit.* (1982) 447; Anderson *op. cit.* (1980) 119; PROSEA *op. cit.* 429; Newman *et al. op. cit.* (1998) 181. **Basionym:** *Mocanera guiso* Blanco, Fl. Filip. ed. 1 (1837) 449. **Neotype** (designated here): *Merrill Sp. Blancoan. 407 (= US 904091)*, the Philippines, Luzon, Bataan province, Limay (K, US). **Synonyms:** *Euphoria malaanonan* Blanco *op. cit.* (1837) 286; *Dipterocarpus guiso* (Blanco) Blanco, Fl. Filip. ed. 2 (1845) 313; *Anisoptera guiso* (Blanco) A.DC., *op. cit.* 616; *Shorea pierrei* Hance, J. Bot. 16 (1878) 302; *S. vulgaris* Pierre ex

Lanessan, Pl. Util. Colon. Fr. (1886) 301; *S. vidaliana* Brandis *op. cit.* 83; *Isoptera burckii* Boerl. *op. cit.* 111; *S. obtusa* Wall. var. *kohchangensis* F.Heim, Bot. Tidskr. (1902) 263; *S. robusta* Gaertn.f. var. *schmidtii* F.Heim *op. cit.* (1902) 263; *S. longipetala* Foxw. *op. cit.* (1932) 174.

Large emergent tree, to 60 m tall, to 1.6 m diameter, with dense cauliflower-shaped crown; bole straight, cylindrical; buttresses to 3 m tall, long, thin, prominently concave. **Bark** greyish tawny, becoming vertically shallowly cracked and narrowly oblong flaky; *inner bark rich pink, finely textured*. **Sapwood** straw-yellow merging to dark reddish brown heartwood, moderately hard. *Young parts at first greyish buff puberulent, early caducous except on inflorescence, parts of perianth exposed in bud, ovary and nut; becoming sparsely so as parts expand except on inflorescence and nut*. **Twigs** slender, c. 1 mm diameter apically. Leaf buds compressed, ovate-falcate, to 5 × 3 mm. **Stipules** oblong, subacute, to 7 × 5 mm, caducous. **Leaves** *thinly coriaceous, drying undulate, purplish above, pale chocolate-brown below with blackish veins and midrib; blade oblong-lanceolate, 5–14 × 2.5–6 cm, base obtuse to broadly cuneate, apex with broad, prominent acuminate to 1 cm long; midrib slender but prominent below, evident but somewhat furrowed above; lateral veins (11–)15–19 pairs, slender but prominent below, dense; intercostal venation densely scalariform, more or less obscure; petiole slender, somewhat geniculate, 1–1.8 cm long*. **Inflorescences** slender, lax, pendent; rachis to 10 cm long, branchlets bearing to 5 flowers; bracteoles minute, linear, fugaceous. **Flowers:** buds slender, to 1 cm long; *petals bright yellow, red towards base within; stamens 20–28, anthers glabrous, connectival appendage c. ½x the length of anther, with 1–4(–8) long terminal bristles; ovary ovoid-conical, without stylopodium, style columnar, c. ½x as long as ovary*. **Fruits:** *calyx lobes unequal, 3 longer lobes to 5.5 × 1 cm, tapering to 3 mm broad above the saccate base, 3 shorter ones linear-lobed, to 3 cm long, similar at base*. **Nuts** ovoid, apiculate, small, to 0.8 × 0.5 cm, hidden within calyx lobes.

Vernacular name. Sabah and Sarawak—*selangan batu merah* (preferred name).

Distribution. Cochin-China, Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Sabah locally abundant on the coastal hills in Kinabatangan, Kudat, Lahad Datu, Sandakan, Semporna, and Tawau districts (e.g., *SAN 5230*, *SAN 16409*, *SAN 29721*, *SAN 38959*, *SAN 39221*, and *SAN 62396*) and in Sarawak rare on limestone slopes in Bau, Kapit and Miri districts (e.g., *S 27265*, *S 24692*, *S 24694*, and *S 41542*). Also occurring in E Kalimantan (e.g., *Kostermans 5889*, *Kostermans 13324* and *Kostermans 13470*).

Ecology. In mixed dipterocarp forest on dry sites, at altitudes to 300 m; locally common along the east coast of Sabah, as also in the weakly seasonal tropics throughout its range. Vulnerable.

50. *Shorea havilandii* Brandis

(G.D. Haviland, 1857–1901, first Sarawak Medical Officer, plant and insect collector)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

J. Linn. Soc. Bot. 31 (1895) 82; Merrill *op. cit.* (1921) 405; Masamune *op. cit.* 494; Browne *op. cit.* 168; Ashton *op. cit.* (1964) 136, *op. cit.* (1968) 72, *op. cit.* (1982) 448; Meijer & Wood *op. cit.* 173; Burgess *op. cit.* 202; Anderson *op. cit.* (1980) 119; PROSEA *op. cit.* 430; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al.* *op. cit.* (1998) 182. **Type:** *Haviland 2395/1899*, Borneo, Sarawak, near Kuching (holotype K; isotype L). **Synonym:** *Hopea ovalifolia* Boerl. *op. cit.* 102.

Main canopy tree, to 40 m tall, to 50 cm diameter, with narrow dense crown; bole more or less fluted and twisted; buttresses to 0.7 m tall, small, slender. Bark yellowish brown, becoming thinly flaky eventually cracked and oblong flaky. Twig, petiole, midrib above, leaf bud, stipule, inflorescence, bracteoles, parts of perianth exposed in bud, ovary, and nut more or less persistently greyish tawny puberulent. Twigs terete, slender, c. 1 mm diameter apically. Leaf buds ovoid, obtuse, c. 2 × 1.5 mm. Stipules oblong, subacute, c. 6 × 2.5 mm, fugaceous. Leaves thinly coriaceous, drying pale chocolate-brown below, mauve-brown above, curling; blade ovate-elliptic, 8–16 × 2.5–6 cm, base obtuse to broadly cuneate, apex with narrow acumen to 0.7 cm long; midrib slender but prominent below, evident but grooved above; lateral veins 9–12 pairs, dense, slender but prominent below, with small axillary pubescent domatia; intercostal venation slender, densely scalariform; petiole 0.8–1.2 cm long. Inflorescences terminal or axillary; rachis straight, terete or slightly compressed, to 12 cm long, singly branched, branchlets bearing to 7 flowers; bracteoles elliptic, subacute, to 4 mm long, fugaceous. Flowers: buds to 8 × 2.5 mm; petals cream, pink at base; stamens 30–50, filaments and anthers glabrous, connectival appendage short, with single terminal bristle; ovary broadly ovoid, without stylopodium, style c. ½x the length of ovary. Fruits: calyx lobes subequal, ovate, thin, narrowly acuminate, saccate, to 1 × 0.8 cm. Nuts globose, to 1.5 × 1 cm, obtuse but for 2 mm style remnant.

Vernacular name. Sabah and Sarawak—*selangan batu pinang* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Kinabatangan and Tawau districts (e.g., *SAN 16451*, *SAN 19490*, *SAN 23135*, and *SAN 26589*) and in Sarawak from Bintulu, Kuching, Lawas, Lundu, Marudi, and Miri districts (e.g., *S 1517*, *S 4428*, *S 9620*, *S 27555*, and *S 46595*). Also occurring in Brunei (e.g., *BRUN 3007* and *BRUN 5562*) wherever its habitat exists.

Ecology. Locally frequent, in *kerangas* on white sand podsols, on poorly drained white and yellow sandy alluvium, also on organic soil over limestone, at altitudes to 400 m. Occurring in Bako, Lambir and Mulu NPs; elsewhere vulnerable owing to land conversion.

51. *Shorea hemsleyana* (King) King ex Foxw.

(W.P. Hemsley, 1843–1924, botanist at Kew)

(sect. **Mutica**, subsect. **Mutica**, *selangan batu*)

Malay. For. Rec. 10 (1932) 167, *p.p.*; Symington *op. cit.* (1933) 129; Ashton *op. cit.* (1967) 293, *op. cit.* (1982) 536. **Basionym:** *Balanocarpus hemsleyanus* King, J. As. Soc. Beng. 62, 2 (1893) 134. **Lectotype** (designated here): *King's Collector (Kunstler) 6670*, Peninsular Malaysia, Perak, Larut (hololectotype K). **Synonym:** *Pachychlamys hemsleyanus* (King) Ridl., *op. cit.* (1922) 234.

Notes. Two subspecies, *viz.* subsp. *hemsleyana* and subsp. *grandiflora*, are recognised. The former occurs in Peninsular Thailand, Sumatra and Peninsular Malaysia and the latter is confined to Sarawak and W Kalimantan in Borneo.

subsp. **grandiflora** (Brandis) P.S.Ashton
(Latin, *grandis* = large, *flora* = flower; large-flowered)

Gard. Bull. Sing. 22 (1967) 293, *op. cit.* (1968) 109, *op. cit.* (1982) 536; Browne *op. cit.* 147; Anderson *op. cit.* (1980) 126; PROSEA *op. cit.* 395; Newman *et al. op. cit.* (1996) 147. **Basionym:**

Shorea grandiflora Brandis *op. cit.* 93. **Type:** *Haviland 2121*, Borneo, Sarawak, near Kuching (holotype K).

Main canopy or subcanopy tree, to 20 m tall, to 40 cm diameter, with dense hemispherical crown; bole cylindrical; buttresses low, rounded. Bark pink and grey-mottled, becoming shallowly densely v-section fissured; inner bark yellowish brown, faintly laminated; heartwood pink. Twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipule and bracteole outside, petiole, and leaf venation below densely persistently more or less yellowish brown to fulvous scabrid-tomentose; fruit calyx lobes, ovary and nut, stipule and bracteole inside, and midrib above evenly so. Twigs terete, stout, 2–4 mm diameter apically. Leaf buds lanceolate, subacute, to 6 × 3 mm. Stipules lanceolate, subacute, to 16 × 5 mm, not at first caducous. Leaves coriaceous, drying pale mauve-brown above, rufous scabrid below; blade oblong, 10–23 × 4–11 cm; midrib and venation prominent below, somewhat furrowed above; lateral veins 14–17 pairs; intercostal venation remotely scalariform; petiole short, stout, 0.6–1.2 cm long. Inflorescences axillary; rachis terete, to 4 cm long, singly branched, flowers crowded on short branchlets; bracteole elliptic, obtuse, to 3 mm. Flowers: buds large, to 18 × 6 mm; petals dark red within, pink outside; stamens 15, connectival appendage becoming reflexed; ovary ovoid, stylopodium short, pubescent, style as long as ovary, glabrous. Fruits subsessile; calyx lobes subequal, 3 longer lobes as short as ripe nut, lanceolate, acute, chartaceous, to 2.5 × 1.8 cm, with thickened and saccate base, 2 shorter ones ovate, to 2 × 1.8 cm, otherwise similar. Nuts ovoid, to 7 × 3 cm, shortly apiculate.

Distribution. Endemic in Borneo; recorded from Kapit, Kuching and Lundu districts in Sarawak (e.g., *S 584*, *S 18860*, *S 35964*, and *S 35966*) and Lower Kapuas, in W Kalimantan.

Ecology. Rare, in mixed dipterocarp forest on yellow leached sandy clay soils, and on shallow peat, at altitudes to 600 m. Recorded from Kubah NP; elsewhere endangered.

52. *Shorea hopeifolia* (F.Heim) Symington

(Latin, *Hopea*-like, *folia* = leaf)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. S. S. 7 (1933) 150, Gard. Bull. S. S. 8 (1934) 36, *op. cit.* (1943) 52; Masamune *op. cit.* 494; Browne *op. cit.* 163; Meijer & Wood *op. cit.* 73; Burgess *op. cit.* 217; Ashton *op. cit.* (1968) 84, *op. cit.* (1978) 43, *op. cit.* (1982) 482; Anderson *op. cit.* (1980) 122; PROSEA *op. cit.* 419; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al.* *op. cit.* (1996) 148. **Basionym:** *Cotylelobium hopeifolium* F.Heim *op. cit.* (1891) 971. **Type:** *Beccari PB 2491*, Borneo, Sarawak, Matang (holotype P). **Synonyms:** *Shorea ridleyana* King *op. cit.* 115, *p.p.*; *Hopea heimiana* Brandis *op. cit.* 63, Merrill *op. cit.* (1921) 402; *H. albescens* Ridl., J. Str. Br. Roy. As. Soc. 73 (1916) 142; *S. kaluntii* Merr., Philip J. Sci. 26 (1925) 475; *H. hopeifolia* (F.Heim) Slooten, Bull. Jard. Bot. Buitenz. 3, 10 (1929) 396.

Vast and elegant emergent tree, to 65 m tall, to 2 m diameter, with large diffuse cauliflower-shaped crown; bole majestic, columnar; buttresses massive to 4 m tall, spreading, stout. **Bark** tawny brown, shallowly vertically cracked and thinly oblong flaky; dammar coxcombs few, small, blackish. *Vegetative parts glabrous; inflorescence, bracteole outside, parts of perianth exposed in bud, ovary, base of style and nut persistently pale buff woolly-puberulent; fruit calyx glabrescent except at base. Twigs slender, much-branched, terete, minutely rugulose, c. 1 mm diameter apically. Leaf buds ovoid, acute, minute, c. 1 × 1 mm. Stipules lanceolate, acute, to 5 × 2 mm, fugaceous. Leaves somewhat chartaceous and*

undulate, drying dark tawny-brown with the midrib distinctly dark red below; blade ovate, 3.5–8 × 2–4 cm, base broadly cuneate, apex with prominent acumen to 1 cm long; midrib flat above, prominent below, usually with prominent pore-like domatia either side at base; lateral veins 9–11 pairs, with distinct shorter intermediates, slender, hardly raised below, arched; intercostal venation reticulate, evident; petiole slender, geniculate, 0.8–1 cm long. **Inflorescences** terminal or axillary; rachis terete, to 5 cm long, singly branched, branchlets bearing to 9 flowers; bracteoles elliptic, obtuse, to 2 × 2 mm. **Flowers:** buds to 5 × 2 mm; petals pale yellow; stamens 15, connectival appendage slightly shorter than anther; ovary ovoid, without stylopodium, style columnar. **Fruits:** pedicels to 3 mm long; calyx lobes unequal, 3 longer lobes to 7 × 1.5 cm, tapering to 4 mm above the saccate tuberculate base, 2 shorter ones to 4 × 0.7 cm, otherwise similar. **Nuts** ellipsoid, to 2.7 × 1.2 cm, shortly apiculate.

Vernacular names. Sabah—*seraya kuning jantan* (preferred name). Sarawak—*lun siput jantan* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and the Philippines (Mindanao). In Sabah, recorded from Beaufort, Tambunan, Tawau, and Tenom districts (e.g., *SAN 15104*, *SAN 17161*, *SAN 19492*, *SAN 32051*, and *SAN A 4313*) and in Sarawak from Bintulu, Kuching, Lundu, Miri and Tatau districts (e.g., *S 9603*, *S 20285*, *S 25041*, *S 32446*, and *S 53414*). Also occurring in Brunei (*BRUN 2529* and *FMS 30383*) and C Kalimantan (e.g., *Argent et al. 9461*, *bb. 24181* and *Jarvie & Ruskandi 5771*).

Ecology. As *S. gibbosa* and often occurring with it, but less common; occasionally to 1200 m altitude. Recorded from Lambir NP; elsewhere endangered.

Notes. Easily confused with *S. multiflora* but the midrib here dries dark red below, while the tree becomes vastly taller.

53. *Shorea hypoleuca* Meijer

(Greek, *hypo-* = underneath, *leucos* = white; the leaf undersurface)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Act. Bot. Neerl. 12 (1963) 329; Meijer & Wood *op. cit.* 174; Burgess *op. cit.* 202; Ashton *op. cit.* (1968) 72, *op. cit.* (1982) 459; Anderson *op. cit.* (1980) 119; Newman *et al. op. cit.* (1998) 183. **Lectotype** (designated here): *G.H.S. Wood SAN 16048*, Borneo, Sabah, Sandakan district, Sepilok FR (hololectotype K).

Large emergent tree, to 60 m tall, to 1.8 m diameter; bole tall, cylindrical; crown hemispherical, pale from below; buttresses low, thin. **Bark** fawn-brown, irregularly flaky. *Midrib above, leaf bud, inflorescence, parts of perianth exposed in bud, ovary, nut, stipule, and bracteole shortly evenly persistently ochreous puberulent; fruit calyx glabrescent except towards base; mature tree twig, midrib above, petiole, and leaf blade below yellowish cream lepidote.* **Twigs** ribbed at first, becoming terete, 1.5–2 mm diameter apically. Leaf buds ovoid, obtuse, to 3 × 2 mm. **Stipules** oblong-ovate, to 7 × 4 mm, subacute, fugaceous. **Leaves** coriaceous, drying tawny-brown above, pale yellow lepidote below; blade ovate to narrowly elliptic, 8.5–17 × 3.5–8 cm, base cuneate to obtuse, margin more or less undulate distally, apex with slender acumen to 1.5 cm long; midrib and lateral veins evident but furrowed above, prominent below; lateral veins 11–16 pairs, ascending, with small

glabrous axillary domatia; intercostal venation scalariform, unraised; petiole 1–1.6 cm long. Inflorescences terminal or axillary; rachis ribbed, to 14 cm long, singly branched, branchlets bearing to 5 flowers; bracteoles small, fugaceous. **Flowers:** buds to 10×2 mm; *petals pale yellow; stamens c. 33, filaments and anthers glabrous, connectival appendage as long as anther, setose with the apical bristles longer; ovary and stylopodium pyriform, style short, glabrous. Fruits: calyx lobes unequal, 3 longer lobes to 8.5×1.7 cm, tapering to c. 3 mm above the saccate base, 2 shorter ones to 6×0.4 cm, similar at base. Nuts* ovoid, to 1.5×1 cm, with to 3 mm long tapering stylopodium.

Vernacular name. Sabah and Sarawak—*selangan batu kelabu* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Beaufort, Beluran, Kudat, Lahad Datu, Sandakan, and Tawau districts (e.g., *FMS 35636, KEP 80505, SAN 36654, SAN 37368, and SAN A 214*) and in Sarawak from Lawas and Lundu districts (e.g., *S 1751, S 7967, S 10158, and S 10175*).

Ecology. In mixed dipterocarp forest on well-structured clay soils over sedimentary and basic to intermediate igneous rocks, and around the base of limestone hills, at altitudes to 400 m; local but frequent where it occurs. Occurring in Sepilok FR; elsewhere vulnerable, possibly endangered, by forest conversion.

54. *Shorea iliasii* P.S. Ashton

(Ilias Paie, research assistant and sometime curator of the Kuching herbarium, avid and discriminating plant hunter)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 291, *op. cit.* (1968) 85, *op. cit.* (1982) 480; Anderson *op. cit.* (1980) 122; Newman *et al. op. cit.* (1996) 149. **Type:** *Ilias S 15102*, Borneo, Sarawak, Bintulu district, Ulu Segan FR (holotype K).

Emergent tree, to 50 m tall, to 1 m diameter; crown dense, hemispherical; bole cylindrical, tall; buttresses to 2 m tall, stout. **Bark** fawn-brown, becoming irregularly flaky. *Young parts greyish sericeous caducous except on inflorescence, parts of perianth exposed in bud, base of fruit calyx, ovary, and nut. Twigs* slightly compressed at first, minutely striated, c. 2 mm diameter apically. Leaf buds conical, subacute, c. 2×2 mm. **Stipules** not seen. **Leaves** coriaceous, drying tawny-brown, darker above than below; blade oblong-ovate, $19\text{--}25 \times 9\text{--}12$ cm, base subequal, obtuse but shortly decurrent with petiole, margin narrowly revolute, apex with broad, short acumen to 0.8 cm long; midrib flat or slightly raised above, prominent below; lateral veins 12–14 pairs, prominent below, obscurely furrowed above, arched; intercostal venation remotely subscalariform; petiole 2.2–3 cm long, stout, 0.3–0.4 cm diameter. **Inflorescences** terminal or axillary; rachis terete or compressed; bracteoles not seen. **Flowers:** buds to 4×2 mm; *petals cream; stamens 15, connectival appendage c. 1½x the length of anther; ovary narrowly ovoid, without stylopodium, style short, glabrous. Fruits: calyx lobes unequal, 3 longer lobes to 8×2.2 cm, tapering to c. 4 mm above the tuberculate saccate base, 2 shorter ones to 5.5×1.2 cm, otherwise similar. Nuts* ovoid, to 1×0.8 cm, acute.

Vernacular name. Sarawak—*lun siput daun besar* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Belaga, Bintulu, Kapit, and Lubok Antu districts (e.g., *S 14455*, *S 22041*, *S 29604*, *S 33551*, and *S 43608*) and from Ulu Barito in C Kalimantan.

Ecology. Locally frequent in mixed dipterocarp forest on yellow sandy clay soils on sedimentary rocks, on undulating land and hillsides, at altitudes to 400 m. Vulnerable owing to land conversion.

55. *Shorea inaequilateralis* Symington

(Latin, *inaequalateralis* = unequal-sided; the leaf base)

(sect. **Brachypterae**, red selangan, red meranti)

Gard. Bull. S. S. 8 (1935) 281; Masamune *op. cit.* 494; Browne *op. cit.* 153; Anderson *op. cit.* (1963) 158, *op. cit.* (1980) 126; Ashton *op. cit.* (1964) 191, *op. cit.* (1968) 109, *op. cit.* (1982) 505; PROSEA *op. cit.* 395; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al.* *op. cit.* (1996) 505. **Lectotype** (designated here): *Zainal FMS 30351*, Borneo, Brunei, Kuala Belait (hololectotype KEP).

Noble emergent tree, to 45 m tall, to 1.2 m diameter, with large crown and pendent branches; bole often somewhat sinuate; buttresses to 2 m tall, stout, spreading. **Bark** becoming deeply densely v-section fissured and narrowly oblong flaky, reddish brown and grey-mottled; inner bark deep reddish brown, fibrous; *heartwood hard, deep reddish brown. Young parts densely tawny pubescent, persistent on young twigs; leaf bud, outside of stipule, inflorescence, bracteole, parts of perianth exposed in bud, ovary, nut, petiole, and midrib above sparsely shortly so; appearing glabrescent on inside of stipule, leaf blade on both surfaces, and venation below. Twigs c. 2.5 × 1.5 mm apically, compressed at first, becoming terete, ribbed below the petiole insertion; stipule scars falcate, to 1.5 mm long. Leaf buds ovoid, acute, somewhat compressed, 3–6 × 1.5–1.5 mm. Stipules not at first caducous, narrowly hastate, acute, to 20 × 5 mm. Leaves chartaceous, drying tawny-brown; blade ovate, 9–14 × 4.5–7.5 cm, base strongly unequal, subcordate, apex with prominent caudate acumen to 2 cm long; midrib evident, flat above, slender, terete but prominent below; lateral veins 11–13 pairs, slender, raised below, arched; intercostal venation scalariform, well-spaced; petiole stout, 0.5–0.8 cm long. Inflorescences terminal or axillary; rachis terete, pendent, to 7 cm long, branchlets bearing to 4 flowers; bracteoles narrowly deltoid, to 10 × 3 mm. Flowers: buds to 12 × 3 mm; petals red; stamens 15, connectival appendage c. 3x as long as anther; ovary ovoid, without distinct stylopodium, style c. 2x as long as ovary. Fruits: calyx lobes unequal, 3 longer lobes narrow, to 14 × 1.2 cm, tapering to c. 5 mm above the saccate base, 2 shorter ones to 12 × 0.9 cm, similar at base. Nuts ovoid, to 1.8 × 1.4 cm, with to 6 mm slender filiform style remnant.*

Vernacular name. Sarawak—*semayur* (preferred name).

Distribution. Endemic in NW Borneo. Known in Sarawak from Marudi and Sibuh districts (e.g., *KEP 79319*, *S 1263* and *S 11244*) and in Brunei from Belait district (e.g., *BRUN 990*, *FMS 30499*, *FMS 35705*, and *S 2229*).

Ecology. Very local, but there semi-gregarious, on the banks of peat swamp streams into the mixed peat swamp forest. Critically endangered.

56. *Shorea inappendiculata* Burck

(Latin, *inappendiculatus* = lacking an appendix; the short connectival appendage of the stamen)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Ann. Jard. Bot. Buitenz. 6 (1887) 206; Merrill *op. cit.* (1921) 405; Masamune *op. cit.* 494; Browne *op. cit.* 171; Meijer & Wood *op. cit.* 175; Burgess *op. cit.* 211; Ashton *op. cit.* (1968) 73, *op. cit.* (1982) 455; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 430; Coode *et al.* (eds.) *op. cit.* 455; Newman *et al.* *op. cit.* (1996) 455. **Type:** *Beccari PB 3009*, Borneo, Sarawak, Matang (holotype BO).

Large emergent tree, to 60 m tall, to 1.5 m diameter; crown large, hemispherical; bole tall, cylindrical; buttresses to 3 m tall, thin, spreading. **Bark** greyish fawn, thinly irregularly flaky. **Twigs**, **leaf buds**, **stipules**, **inflorescence**, **parts of perianth exposed in bud**, and **bracteole densely persistently rufous scabrid-pubescent**; **leaf venation below sparsely so (more dense on young trees)**, **ovary and nut evenly so**; **blade below more or less densely silvery lepidote**. **Twigs** 2–4 mm diameter apically, prominently ribbed and somewhat compressed at first, blackish with pale horizontal stipule scars. Leaf buds ovoid, conical, to 6 × 4 mm. **Stipules** broadly lanceolate, to 10 × 4 mm. **Leaves coriaceous, often billowed between lateral veins, drying purplish brown above, more or less grey to silvery lepidote below with black venation**; **blade oblong-elliptic, (7–)10–16 × (2–)3–8 cm, base more or less unequal, obtuse to cordate, apex shortly acuminate to obtuse**; **midrib and lateral veins prominent below, evident but furrowed above**; **lateral veins 13–24 pairs**; **intercostal venation densely scalariform, slightly elevated below**; **petiole stout, 1.5–3 cm long**. **Inflorescences** axillary; rachis ribbed when dry, to 10 cm long, singly branched, branchlet bearing to 7 flowers; bracteoles elliptic, obtuse, to 3 × 2 mm, fugaceous. **Flowers:** buds to 7 × 3 mm; **stamens 28–34, filaments and anthers setose distally, connectival appendage as long as or longer than outer anther, with a few terminal bristles**; **ovary and stylopodium ovoid, style short**. **Fruits:** pedicels to 4 mm long, broadening into receptacle; **calyx lobes unequal, 3 longer lobes to 13 × 3 cm, tapering to c. 8 mm above the saccate base, 2 shorter ones lorate-lobed, to 10 × 0.9 cm, similar at base**. **Nuts** ovoid, to 3.3 × 1.6 cm, prominently apiculate.

Distribution. N Sumatra, Peninsular Malaysia (NW Johor) and Borneo. In Sabah known from Kinabatangan and Tawau districts (e.g., *SAN 16454*, *SAN 17833* and *SAN 23270*) and in Sarawak from Bintulu, Kapit, Lundu, Miri, Samarahan, and Tatau districts (e.g., *S 294*, *S 10060*, *S 15527*, *S 15885*, and *S 41128*). Also occurring in Brunei (e.g., *BRUN 3080*) and E Kalimantan.

Ecology. Scattered in mixed dipterocarp forest on well-structured clay soils, mostly in the coastal hills, at altitudes to 400 m; apparently generally rare, as single individuals with little regeneration. Recorded from Kubah and Lambir NPs; elsewhere endangered.

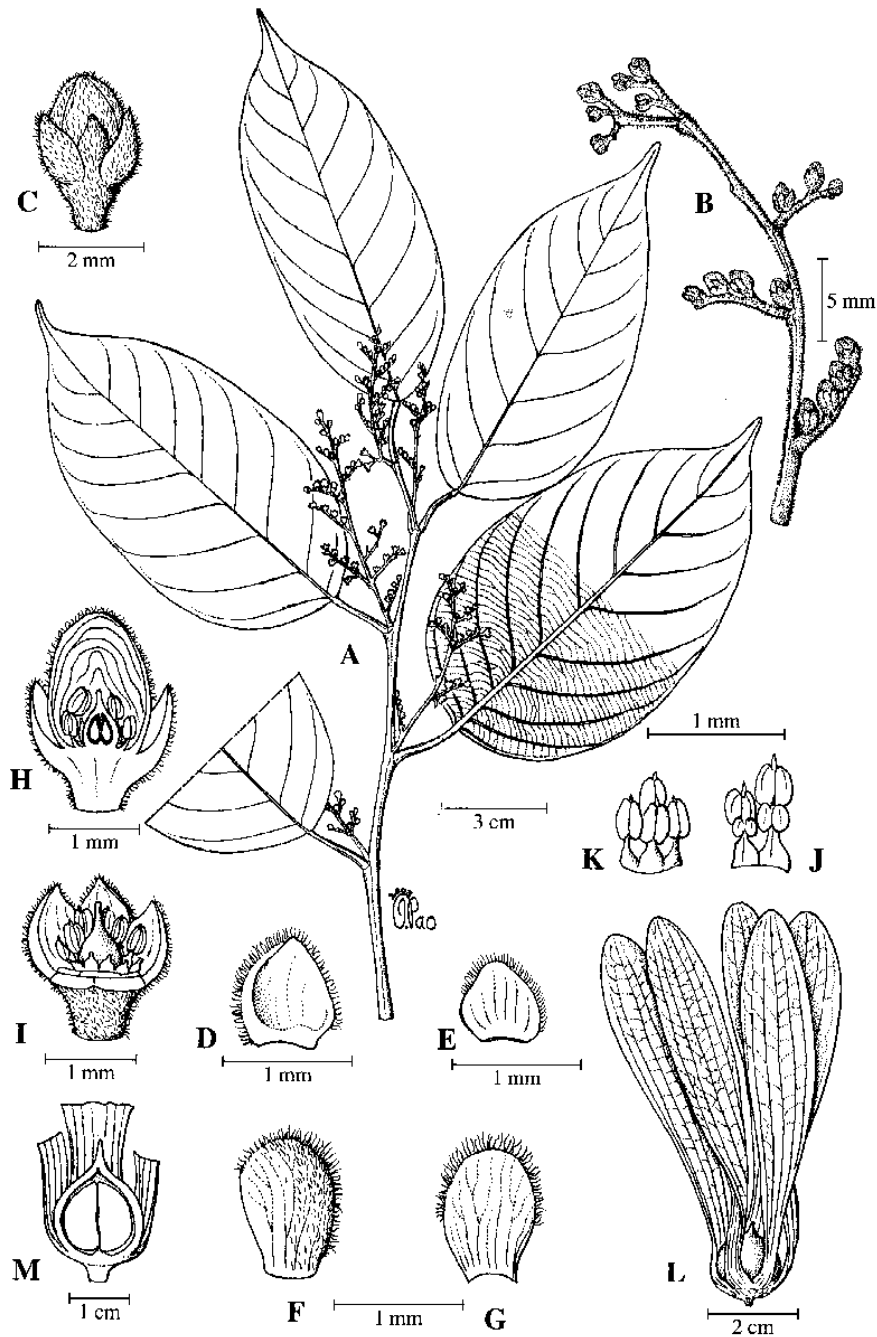


Fig. 24. *Shorea isoptera*. A, flowering leafy twig; B, part of inflorescence; C, flower bud; D, adaxial view of outer sepal; E, adaxial view of inner sepal; F, abaxial view of petal; G, adaxial view of petal; H, longitudinal section of flower bud; I, flower bud with two sepals, petals and stamens removed; J, adaxial view of stamens; K, abaxial view of stamens; L, fruit; M, longitudinal section of fruit. (A–K from S 7978, L–M from SAN 39018.)

57. *Shorea induplicata* Slooten(Latin, *induplicatus* = sharply turned in; the leaf margins)(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Reinwardtia 3 (1956) 327; Ashton *op. cit.* (1968) 85, *op. cit.* (1982) 476; Anderson *op. cit.* (1980) 122; Newman *et al. op. cit.* (1996) 151. **Type:** *Knight SA 582*, Borneo, Sarawak, Kuching district, Sampadi FR (holotype KEP).

Canopy or low emergent tree, to 40 m tall, to 60 cm diameter; bole frequently misshapen; crown dense, small, hemispherical, conspicuously cream-coloured in new leaf; buttresses low but continuing up bole as ribs to 3 m tall. **Bark** grey and rust-mottled, becoming thinly irregularly flaky. *Young parts pale rufous scabrid-pubescent, turning dark greyish brown and persisting on twig, leaf bud, stipules, petiole, and venation below; leaf below at first cream-puberulent, turning pale grey.* **Twigs** terete, becoming verruculose, *c.* 2 mm diameter apically. Leaf buds ellipsoid, obtuse, to 3 × 2 mm. **Stipules** linear, *not at first caducous, to 5 × 2 mm.* **Leaves** coriaceous, *drying pale greyish green above, pale grey below; blade lanceolate, 8–17 × 2–5 cm, base subequal, cordate, margin prominently narrowly revolute, apex with slender acumen to 2 cm long; midrib evident but shallowly furrowed above, prominent below; lateral veins 12–16 pairs, prominent below; intercostal venation laxly subscalariform; petiole rather short, 0.6–1.3 cm long.* **Inflorescences** and **flowers** unknown. **Fruits:** pedicels to 2 mm long; *calyx glabrescent, lobes subequal, ovate, acute, incrassate, the apices becoming patent, to 0.8 × 0.6 cm.* **Nuts** broadly ellipsoid to obovoid, *to 2.5 × 2 cm, subacute.*

Vernacular name. Sarawak—*lun putih* (preferred name).

Distribution. Endemic in the extreme NW Borneo. Known in Sarawak from Sampadi FR, Kuching district (e.g., *S 12611*, *S 18858* and *SFN 10399*) and in W Kalimantan from Sanggau district (e.g., *bb. 17608*).

Ecology. Rare, in the mixed dipterocarp forest-*kerangas* ecotone, on leached pale yellow and grey sandy soils, at altitude below 200 m. Critically endangered, perhaps extinct.

58. *Shorea isoptera* P.S.Ashton

Fig. 24.

(Greek, *iso-* = same, *pteron* = wing; the subequal fruit calyx lobes)(sect. **Neohopea**, *selangan batu*)

Gard. Bull. Sing. 19 (1962) 293, *op. cit.* (1964) 137, *op. cit.* (1968) 73, *op. cit.* (1982) 468; Meijer & Wood *op. cit.* 189; Burgess *op. cit.* 203; Anderson *op. cit.* (1980) 120; Coode *et al. (eds.) op. cit.* 78; Newman *et al. op. cit.* (1998) 185. **Type:** *Ashton BRUN 3018*, Borneo, Brunei, Temburong, Bt. Patoi (holotype K; isotype L).

Emergent tree, to 60 m tall, to 1.5 m diameter, with stout cylindrical bole; crown dense, hemispherical; buttresses stout, low. **Bark** greyish tawny, becoming irregularly rather thinly flaky; inner bark thin, pale pinkish brown, even-textured. **Sapwood** straw yellow, hard; heartwood dark brown; dammar exudations greyish white. *All vegetative parts glabrous; inflorescence, bracteole, parts of perianth exposed in bud, apex of ovary, and nut persistently greyish puberulent.* **Twigs** smooth, sparsely branched, slender, *c.* 1.5 mm

diameter apically. Leaf buds globose, small, c. 1.5 mm diameter. **Stipules** caducous, not seen. **Leaves** *thinly coriaceous, satiny, drying tawny-grey; blade ovate, 9–16 × 6–8 cm, base broadly cuneate to obtuse, decurrent to 2 mm down petiole (peltate in juveniles), margin undulate, apex with slender acumens to 1.5 cm long; midrib terete, elevated below, flat above; lateral veins 9–11 pairs, sunken above, raised below, slender, arched, sometimes with a few minute pore-like axillary domatia; intercostal venation sinuate, scalariform, very slender, unraised; petiole slender, 1.3–2 cm long.* **Inflorescences** terminal or to 3-axillary; rachis slender, terete or somewhat compressed, lax, regularly doubly branched, branchlets bearing to 6 close flowers; bracteoles linear, to 1 mm long, fugaceous. **Flowers:** *buds globose, to 1.5 mm long; sepals subequal, imbricate, acute, 3 outer lobes ovate, 2 inner ones deltoid; petals oblong, obtuse, contorted, falling separately; stamens 15, filaments broad, short, glabrous, anthers broadly oblong, outer anther locules slightly larger than that of the inner ones, connective appendage short, stout, glabrous; ovary and stylopodium ovoid-conical, style short glabrous.* **Fruits:** *calyx lobes subequal, lobes to 5.5 × 1.5 cm, tapering to 5 mm broad above the short saccate base, becoming rotate when ripe, barely twisted.* **Nuts** ovoid, to 0.9 × 1 cm, with to 4 mm tapering style remnant, on a broad shallow receptacle.

Vernacular names. Sabah—*selangan batu gelombang* (preferred name). Sarawak—*selangan batu bulu ayam* (preferred name).

Distribution. Endemic in Borneo, widespread but local. In Sabah, known from Beaufort, Kota Belud, Sandakan, Sipitang, and Tenom districts (e.g., *SAN 15111*, *SAN 16603*, *SAN 36909*, *SAN 39018*, and *SAN A 4319*) and in Sarawak from Bau, Kuching, Lundu, and Marudi districts (e.g., *S 7978*, *S 10169*, *S 22828*, *S 22829*, and *S 32659*). Also occurring in Brunei (*BRUN 3343*, *BRUN 5676* and *KEP 80132*) and E Kalimantan.

Ecology. Very local in mixed dipterocarp forest on clay-rich soils over shale and intermediate igneous rocks, at altitudes to 500 m; rather rare. Occurring in G. Gading NP; elsewhere endangered as its habitat is choice for oil palm plantation.

59. *Shorea johorensis* Foxw.

(of Johor, Peninsular Malaysia)

(sect. **Brachypterae**, red meranti)

Malay. For. Rec. 10 (1932) 236; Symington *op. cit.* (1943) 72; Ashton *op. cit.* (1967) 294, *op. cit.* (1982) 513; PROSEA *op. cit.* 395; Kessler & Sidiyasa *op. cit.* 103; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al.* *op. cit.* (1996) 152. **Type:** *Bain KEP 5992*, Peninsular Malaysia, Johor, G. Panti (holotype KEP). **Synonym:** *Shorea leptocladus* Symington *op. cit.* (1939) 376, *op. cit.* (1943) 77, Keith *op. cit.* 12, Browne *op. cit.* 140, Ashton *op. cit.* (1964) 195, *op. cit.* (1968) 110, Meijer & Wood *op. cit.* 112, Burgess *op. cit.* 154, 184, Anderson *op. cit.* (1980) 126.

Large emergent tree, to 50 m tall, to 1.6 m diameter; crown large, hemispherical; bole tall, straight, symmetrical; buttresses to 3 m tall, stout, prominent. **Bark** tawny-grey to fawn, overall appearing smooth, shallowly densely cracked and thinly oblong flaky. *Twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipules, bracteole, ovary, nut, petiole, venation below, and midrib above shortly evenly persistently greyish buff pubescent;*

young leaf caducously so. **Twigs** 2–3 mm diameter apically, somewhat ribbed and compressed at first, much branched; stipule scars to 2 mm long, pale, falcate, descending. Leaf buds ovoid, compressed, 6–8 × 2–3 mm. **Stipules** lanceolate, to 35 × 7 mm, caducous. **Leaves** chartaceous, drying tawny-grey below; blade ovate, 9–14 × 4.5–7.5 cm, base obtuse to subcordate, apex with slender and tapering acumen to 0.7 cm long; midrib evident, more or less flat, above, slender but prominent below; lateral veins 10–12 pairs, slender but prominent below, arched towards their ends, the basal 3–6 pairs usually with paired scale-like domatia; intercostal venation densely scalariform, very slender; petiole 1.5–2 cm long. **Inflorescences** terminal or axillary; rachis terete or somewhat compressed, slender, to 15 cm long, branchlets long, bearing to 18 flowers; bracteoles narrowly ovate, obtuse, to 7 mm long, caducous. **Flowers:** buds to 8 × 3 mm; petals pale yellow; stamens 15, connectival appendage c. 3x as long as anther; ovary globose, stylopodium indistinct, style 2x as long as ovary, filiform. **Fruits:** calyx lobes unequal, 3 longer lobes to 12 × 2.3 cm, tapering to c. 6 mm above the saccate base, 2 shorter ones linear-lobed, to 6.5 × 0.6 cm, similar at base. **Nuts** broadly ovoid, to 2 × 1.4 cm, shortly apiculate.

Vernacular names. Sabah—*seraya majau* (Malay, preferred name). Sarawak—*meranti majau* (Malay, preferred name).

Distribution. E Sumatra, SE Peninsular Malaysia and Borneo. In Sabah recorded from Beaufort, Beluran, Kinabatangan, Lahad Datu, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 16620*, *SAN 17233*, *SAN 17952*, *SAN 93829*, and *SAN A 512*) and in Sarawak from Kapit, Lawas, Limbang, Marudi, and Miri districts (e.g., *S 1527*, *S 1802* and *S 29616*). Also occurring in Brunei (e.g., *BRUN 355*, *FMS 30533* and *S 1951*) and E and C Kalimantan (e.g., *Sidiyasa 1121*).

Ecology. Formerly one of the commonest light red meranti species in the eastern part of its Borneo range, uncommon to the west; in mixed dipterocarp forest on moist clay and silty soils, especially on low hills and floodplains; occasionally at altitude to 800 m. Occurring in Lambir and Mulu NPs; elsewhere its natural habitat is greatly reduced by forest conversion; vulnerable.

Notes. The dull leaden dry leaf with several pairs of small pale scale-like domatia in the axils of the first few pairs of lateral veins distinguishes this species from *S. palembanica* and *S. pauciflora*.

60. *Shorea kudatensis* Wood ex Meijer (of Kudat, Sabah)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Act. Bot. Neerl. 12 (1963) 346; Meijer & Wood *op. cit.* 74; Burgess *op. cit.* 217; Ashton *op. cit.* (1982) 483; Newman *et al. op. cit.* (1996) 155. **Lectotype** (designated here): *G.H.S Wood SAN 15363*, Borneo, Sabah, Kudat district, Tamalang FR (hololectotype K).

Low emergent tree, to 45 m tall, to 1.9 m diameter; buttresses low, rounded. **Bark** deeply cracked, flaky. **Inflorescence**, parts of petals exposed in bud, ovary, and nut persistently cream puberulent; sepals becoming sparsely so in fruit; twig caducously so. **Twigs** c. 3 mm diameter apically, terete, more or less rugulose, stout. Leaf buds small, ovoid, obtuse. **Stipules** fugaceous. **Leaves** coriaceous, lustrous above, drying greyish green; blade ovate,

8–15 × 5–9 cm, base broadly cuneate to obtuse, subequal, shortly decurrent, apex shortly broadly acuminate; midrib stout, distinctly elevated on both surfaces; lateral veins 7–9 pairs, slender, arched; intercostal venation subreticulate, elevated below, evident above; petiole rather stout, 1.7–2.2 cm long. **Inflorescences** terminal or axillary; rachis to 14 cm long, doubly or more branched, many-flowered; bracteoles not seen. **Flowers:** buds c. 3 × 2 mm; petals cream; stamens 15, connectival appendage short, equal in length with anther, scarious apically; ovary ovoid, without stylopodium, style short. **Fruits** sessile; calyx lobes unequal, 3 longer lobes to 6 × 1 cm, tapering to 3 mm above the saccate base, 2 shorter ones to 4.3 × 0.5 cm, otherwise similar. **Nuts** narrowly ovoid, to 2 × 0.8 cm.

Vernacular name. Sabah—*seraya kuning* (preferred name).

Distribution. Endemic in NE Sabah; known from Kota Kinabalu, Kuala Penyu, Kudat, Labuan, Papar, and Pitas districts (e.g., *SAN 5905*, *SAN 15494*, *SAN 15552*, *SAN 30903*, and *SAN 37701*).

Ecology. Locally common in mixed dipterocarp forests on dry hills near the sea. Endangered.

61. *Shorea kunstleri* King

(H.H. Kunstler, 1837–1887, King's plant collector in Perak, Peninsular Malaysia)

(sect. **Brachypterae**, red meranti)

J. As. Soc. Beng. 62, 2 (1893) 116; Browne *op. cit.* 154; Ashton *op. cit.* (1964) 192, *op. cit.* (1968) 109, *op. cit.* (1982) 519; Meijer & Wood *op. cit.* 109; Burgess *op. cit.* 173; Anderson *op. cit.* (1980) 126; PROSEA *op. cit.* 430; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al.* *op. cit.* (1996) 155. **Lectotype** (designated here): *King's Collector (Kunstler) 3674*, Peninsular Malaysia, Perak, Larut (hololectotype K).

Large emergent tree, to 55 m tall, to 1.9 m diameter; crown large, cauliflower-shaped, somewhat diffuse, with a few large ascending branches; bole tall, cylindrical; buttresses to 1.5 m tall, spreading, stout. **Bark** becoming pale mauve- to grey-brown, deeply narrowly v-section fissured and flaky, with yellow dammar smears; inner bark orange brown. **Sapwood** hard; heartwood dark reddish brown. *Young parts shortly pale buff puberulent; more or less caducous on twig, petiole and leaf blade; more dense and persistent on inflorescence, leaf bud, ovary, nut, stipules and bracteole outside (sparse within).* **Twigs** c. 2 mm diameter apically, terete, much-branched. Leaf buds falcate, 5–7 × 2–2.5 mm. **Stipules** narrowly lanceolate, to 12 × 4 mm, fugaceous. **Leaves** coriaceous, drying pale greyish tawny; blade broadly ovate and frequently twisted to one side, 8–12 × 4.5–7 cm, base broadly cuneate to obtuse, apex with tapering acumen to 1 cm long; midrib evident but shallowly furrowed above, broadly elevated below; lateral veins 6–8 pairs, slender, more or less raised but not prominent below, arched, with or without minute axillary pore-like domatia; intercostal venation slender, scalariform; petiole 2–3.5 cm long, geniculate. **Inflorescences** terminal or rarely axillary; rachis slender, slightly compressed on drying, to 15 cm long, branchlets lax, bearing to 9 flowers; bracteoles elliptic, obtuse, to 5 × 3.5 mm, fugaceous. **Flowers:** buds to 9 × 3 mm; corolla pale yellow, pink at base; stamens 15, connectival appendage more than

2x the length of anther; ovary and stylopodium pyriform, style somewhat shorter than ovary, glabrous. **Fruits:** calyx glabrescent, lobes unequal, 3 longer lobes to 8.5×1.8 cm, tapering to c. 5 mm above the saccate base, 2 shorter ones linear-lobed, to 4×0.4 cm, similar at base. **Nuts** ovoid, to 2×1.5 cm, with c. 3 mm long conical style remnant.

Vernacular names. Sabah—*seraya sirap* (preferred name). Sarawak—*selangan merah* (preferred name).

Distribution. N Sumatra, Peninsular Malaysia and Borneo. In Sabah recorded from Lahad Datu, Sipitang, and Tawau districts (e.g., *SAN 16822*, *SAN 21503*, *SAN 24282*, *SAN 25468*, and *SAN A 294*) and in Sarawak from Bintulu, Kuching, Lawas, Miri, and Samarahan districts (e.g., *S 11079*, *S 15775*, *S 32451*, *S 40777*, and *S 46593*). Also occurring in Brunei (e.g., *BRUN 346*, *FMS 48490* and *S 1905*) and in scattered localities throughout Kalimantan (e.g., *bb. 11080*, *bb. 19164* and *bb. 26855*).

Ecology. Locally frequent in mixed dipterocarp forest on yellow sandy and sandy clay, usually deep, soils over sandstone; on ultrabasic substrates in E Sabah; occasionally on high ridges at altitudes to 800 m. Occurring in Kubah NP and common in Lambir NP; endangered outside parks system.

62. *Shorea ladiana* P.S.Ashton

Fig. 25.

(Ladi Bikas, plant collector in Brunei, 1957–1962)

(sect. *Shorea*, subsect. *Barbata*, *selangan batu*)

Gard. Bull. Sing. 19 (1962) 295, *op. cit.* (1964) 138, *op. cit.* (1968) 73, *op. cit.* (1982) 463; Anderson *op. cit.* (1980) 120; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al.* *op. cit.* (1998) 186. **Type:** *Ghazalli S 11076*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype K; isotype KEP).

Main canopy tree, to 40 m tall, to 1.5 m diameter; bole cylindrical; crown dense, hemispherical; buttresses to 1 m tall, thin. **Bark** yellowish brown, becoming irregularly oblong flaky, sometimes shaggy. *Young twig and petiole cinereous; leaf bud, parts of perianth exposed in bud, ovary, nut, inflorescence, and bracteole grey-buff pubescent; parts otherwise glabrous.* **Twigs** terete, much-branched, 1.5–2 mm diameter apically. Leaf buds small, conical, c. 1×0.5 mm. **Stipules** unknown. **Leaves** coriaceous, shiny; *blade ovate, 10–14 × 4.5–7.5 cm, base obtuse or broadly cuneate, margin narrowly revolute, apex with tapering acumen to 1.5 cm long; midrib evident and raised within a shallow furrow above, stout, raised but not prominent below as also the lateral veins; lateral veins 5–6 pairs, well-spaced, arched; intercostal venation indistinct, densely scalariform; petiole 1–2.2 cm long.* **Inflorescences** terminal or axillary, rachis somewhat compressed, straight, lax, with short branchlets bearing to 9 flowers; bracteoles ovoid-deltoid, acute, to 4.5 mm long, fugaceous. **Flowers:** buds globose, to 1.5 mm diameter; petals cream; *stamens 30–35, anther locules shortly barbate apically, connectival appendage longer than anther, densely barbate; ovary and stylopodium ovoid, style short, glabrous.* **Fruits:** pedicels to 3 mm long; *calyx lobes subequal, shorter than ripe nut, broadly ovate, acute, thickened, saccate, to 0.8×0.8 cm.* **Nuts** ovoid-globose, to 1.7×1.4 cm, sharply acute at the c. 1 mm long style remnant.

Vernacular name. Sarawak—*selangan batu kilat* (preferred name).

Distribution. Endemic in NW Borneo; known in W Sarawak from Bintulu, Kuching and Miri districts (e.g., *S 15255*, *S 27171*, *S 29309*, and *S 32416*) and in Brunei from Belait district (e.g., *BRUN 2622* and *BRUN 5543*).

Ecology. Locally frequent in mixed dipterocarp forest on deep yellow sands, at altitudes to 300 m. Recorded from Kubah NP; elsewhere endangered.

63. *Shorea laevis* Ridl.

(Latin, *laevis* = smooth, hairless; the leafy shoots)

(sect. *Shorea*, subsect. *Barbata*, *selangan batu*)

FMP 1 (1922) 232; Browne *op. cit.* 169; Ashton *op. cit.* (1964) 139, *op. cit.* (1968) 73, *op. cit.* (1978) 38, *op. cit.* (1982) 461; Meijer & Wood *op. cit.* 178; Burgess *op. cit.* 203; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 431; Kessler & Sidiyasa *op. cit.* 104; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al.* *op. cit.* (1998) 187. **Lectotype** (designated here): *Sahak FMS 1905*, Peninsular Malaysia, Negeri Sembilan, Kuala Pilah, Seriting FR (hololectotype K). **Synonyms:** *Hopea laevifolia* Parijs in Fedde, Rep. 33 (1933) 244; *Shorea laevifolia* (Parijs) Endert, Tectona 28 (1935) 292; *S. rogersiana* Raizada & Smitinand, Thai For. Bull. Bot. 1 (1954) 7.

Huge emergent tree, to 70 m tall, to 2.4 m diameter; bole stout, often twisted; crown vast irregular diffuse cauliflower-shaped, pale from below; buttresses to 6 × 4 m, stout. **Bark** pale orange- to grey-brown, becoming vertically cracked and irregularly thinly flaky, with pale yellow dammar smears. **Inflorescence**, **bracteole**, **parts of perianth exposed in bud**, **ovary**, and **nut persistently pale cream puberulent**; **fruit calyx sparsely so**; **vegetative parts epilose**; **leaf undersurface**, **petiole**, and **young twig cream lepidote** (mature trees). **Twigs** slender, terete, much-branched, c. 1 mm diameter apically. Leaf buds narrowly ovoid, 3.5 × 1.5 mm. **Stipules** narrowly lanceolate, to 8 × 2 mm, fugaceous. **Leaves** *thinly coriaceous*, *drying greyish brown with cream undersurface and black venation* (mature trees); *blade narrowly ovate-lanceolate, falcate, 6.5–10 × 2.5–4 cm, base subequal, broadly cuneate, apex with slender acumens to 2 cm long; midrib and venation hardly raised on either surface, midrib evident above; lateral veins slender, dense, 11–14 pairs; intercostal venation densely scalariform, slender; petiole 1–1.5 cm long, slender, geniculate.* **Inflorescences** terminal or axillary; rachis slender, terete, to 12 cm long, branchlets bearing to 9 flowers; bracteoles linear, to 2 mm long, fugaceous. **Flowers:** buds globose, c. 2 mm diameter; petals cream; *stamens c. 50, filaments sparsely barbate distally, anther locules barbate at base and apex, connectival appendage small, barbate; ovary and stylopodium small, conical, style short, glabrous.* **Fruits:** *calyx lobes unequal, 3 longer lobes chartaceous, to 6.5 × 1 cm, tapering to c. 4 mm above the saccate base, 2 shorter ones to 4 × 0.5 cm, otherwise similar.* **Nuts** ovoid, to 1.5 × 0.9 cm, with to 4 mm long tapering style remnant.

Vernacular names. Sabah—*selangan batu kumus* (preferred name). Sarawak—*kumus* (preferred name), *mikai* (Iban).

Distribution. Peninsular Myanmar, Peninsular Thailand (Pattani), N Sumatra, Peninsular Malaysia, and Borneo. In Borneo widespread. In Sabah known from Beaufort, Keningau, Kinabatangan, Kota Merudu, Kudat, Labuk Sugut, Lahad Datu, Ranau, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15207*, *SAN 17037*, *SAN 26086*, *SAN 97661*, and *SAN 99560*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Limbang, Miri, and Sri Aman districts (e.g., *S 1433*, *S 11908*, *S 23868*, *S 32268*, and *S 69765*). Also occurring in Brunei

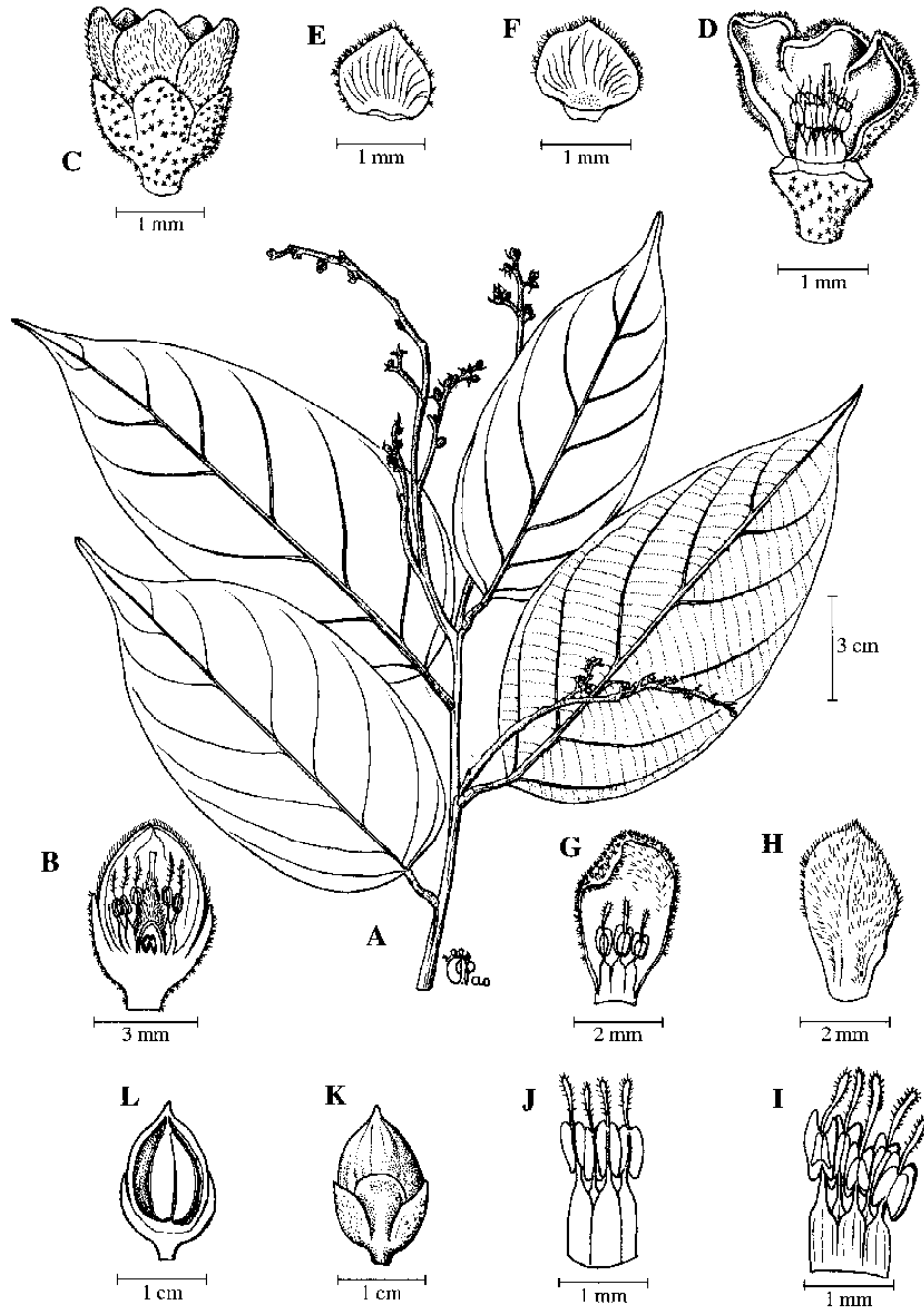


Fig. 25. *Shorea ladiana*. A, flowering leafy twig; B, longitudinal section of flower bud; C, open flower; D, open flower with sepals and two petals removed; E, adaxial view of outer sepal; F, adaxial view of inner sepal; G, adaxial view of petal with stamens; H, abaxial view of petal; I, adaxial view of stamens; J, abaxial view of stamens; K, fruit; L, longitudinal section of fruit. (A from *S* 583, B–J from *S* 26229, K–L from *S* 15255.)

(e.g., *BRUN 409* and *BRUN 3190*) and E Kalimantan (e.g., *bb. 23427*, *bb. 34270* and *bb. 34453*).

Ecology. One of the commonest emergent trees in mixed and upper dipterocarp forests along shale ridges, at 200–1000 m altitude, usually on leached skeletal clay and sandy clay soils. Occurring in Mulu NP; elsewhere vulnerable owing to logging.

64. *Shorea lamellata* Foxw.

(Latin, *lamellatus* = arranged in layers; the inner bark)

(sect. **Anthoshorea**, white meranti)

Malay. For. Rec. 10 (1932) 278; Symington *op. cit.* (1943) 39; Slooten *op. cit.* (1949) 236; Ashton *op. cit.* (1968) 94, *p.p.*, *op. cit.* (1982) 493; Anderson *op. cit.* (1980) 123, *p.p.*; PROSEA *op. cit.* 412; Kessler & Sidiyasa *op. cit.* 104; Newman *et al. op. cit.* (1996) 156. **Type:** *Arnot FMS 28082*, Peninsular Malaysia, Perak, Keledang Saiong FR (holotype KEP).

Large emergent tree, to 50 m tall, to 1.75 m diameter; bole tall, cylindrical; crown dense, hemispherical; buttresses to 3 m tall, stout. **Bark** greyish to purplish brown, becoming irregular-section fissured and coarsely flaky; inner bark laminated pale and dark yellow. *Twig, leaf bud, stipule and bracteole outside, inflorescence, and parts of calyx exposed in bud persistently tawny brown scabrid-pubescent; fruit calyx, stipule and bracteole within, petiole, and leaf venation below sparsely so; petals outside, ovary, and nut evenly pale brown pubescent.* **Twigs** terete, 2–3 mm diameter apically. Leaf buds ovoid-falcate, acute, to 7 × 4 mm. **Stipules** oblong-obtuse, to 20 × 6 mm. **Leaves** thinly coriaceous, drying greyish, frequently bullate in between lateral veins; blade elliptic-oblong to ovate or occasionally obovate, (6.5–)10–15 × (3.5–)4–8 cm, base obtuse to shallowly cordate, apex with short, abrupt acumen to 0.7 cm long; midrib slender but prominent below, obscure, sunken above; lateral veins 19–25 pairs, slender but prominent below; intercostal venation densely scalariform, evident and somewhat elevated below; petiole slender, 1.6–2.2 cm long. **Inflorescences** terminal or axillary; rachis slender, lax, to 14 cm long, singly branched, branchlets bearing to 3 flowers; bracteoles elliptic, acute, to 5 × 3 mm, tardily caducous. **Flowers:** buds ellipsoid, to 10 × 5 mm; petals white; *stamens 15, anthers oblong, twice as long as broad, connective appendage 2½–3x the length of anther, scarious towards apex; ovary small, ovoid, tapering into a slender pubescent stylopodium twice its length and glabrous columnar style 3x its length.* **Fruits:** pedicels c. 2 mm long, fruit base obtuse; *calyx lobes unequal, 3 longer lobes to 18 × 1.5 cm, tapering to c. 7 mm above the saccate base, 2 shorter ones lorate-lobed, to 7 × 0.5 cm, similar at base.* **Nuts** ovoid, to 1.4 × 1 cm, prominently apiculate.

Vernacular name. Sarawak—*meranti lapis* (preferred name).

Distribution. Sumatra (Lingga and Singkep), Peninsular Malaysia and Borneo. Absent from Sabah. In Sarawak known from Bintulu, Kuching, Mukah, and Tatau districts (e.g., *S 902*, *S 15126*, *S 15828*, and *S 18082*). Also occurring in E and SE Kalimantan (e.g., *bb. 34264*, *Kostermans 5813*, *Kostermans 7695*, and *Kostermans 8723*).

Ecology. Rare, scattered in mixed dipterocarp forest on low hills on sandy clay soils, on sedimentary substrates and also the Arip rhyolite, at altitudes to 500 m. Recorded from Kubah NP; elsewhere endangered owing to land conversion.

Notes. Confused by Ashton (*op. cit.* (1964) 164, *op. cit.* (1968) 94), Meijer and Wood (*op. cit.* 56), Burgess (*op. cit.* 159) and Anderson (*op. cit.* (1980) 123) with *S. confusa* and *S. virescens*. The typically oblong-ovate leaf blade, terete twig and scabrid indumentum serve to distinguish this species.

65. *Shorea laxa* Slooten

(Latin, *laxus* = loose; possibly referring to the inflorescence)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Reinwardtia 3 (1956) 345; Ashton *op. cit.* (1964) 155, *op. cit.* (1968) 86, *op. cit.* (1982) 474; Meijer & Wood *op. cit.* 75; Burgess *op. cit.* 218; Anderson *op. cit.* (1980) 122; PROSEA *op. cit.* 419; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al.* *op. cit.* (1996) 157. **Type:** *Flemmich FMS 48191*, Borneo, Brunei, Bt. Puan (holotype KEP).

Low emergent tree, to 50 m tall, to 1.6 m diameter; bole tall, cylindrical; crown dense, hemispherical; buttresses to 2.5 m tall, stout. **Bark** pale yellowish brown, becoming shallowly densely vertically cracked and thinly oblong flaky. **Inflorescence**, *bracteole outside, parts of perianth exposed in bud, ovary, nut, leaf bud, stipule outside, twig, petiole, and the basal half of the midrib below persistently sparsely cream-buff puberulent; calyx eventually glabrescent in fruit.* **Twigs** terete, 2 mm diameter apically. Leaf buds globose or ovoid, subacute, *c.* 3 × 2 mm. **Stipules** lanceolate, to 5 × 2 mm, fugaceous. **Leaves** *thinly coriaceous, drying warm brown, slightly shiny; blade ovate to elliptic, 7–14 × 4–9 cm, base obtuse to broadly cuneate (peltate in juveniles), margin narrowly revolute, apex with slender acumen to 1.5 cm long; midrib evident, flat above, prominent below as also the veins; lateral veins 8–10 pairs, arched and somewhat following the margin; intercostal venation scalariform, well-spaced; petiole 1.5–2.2 cm long.* **Inflorescences** terminal or axillary; rachis terete, slender, lax, to 18 cm long, branchlets bearing to 7 distichous flowers; bracteoles minute, to 1.5 mm long, fugaceous. **Flowers:** buds to 8 × 2 mm; *petals cream; stamens 15, connectival appendage 2x as long as anther, ciliate towards apex; ovary and stylopodium ovoid-conical, style short, pubescent at base.* **Fruits:** *calyx lobes subequal, broadly ovate, incrassate, saccate, tuberculate, c. 1 × 1 cm, the obtuse thin apices recurved.* **Nuts** *obovoid, acute, to 3.5 × 2.5 cm, on germination splitting to reveal brilliant red cotyledons.*

Vernacular names. Sabah—*seraya kuning keladi* (preferred name). Sarawak—*lun timbul* (preferred name).

Distribution. Endemic in the northern parts of Borneo. Known in Sabah from Labuk Sugut and Sandakan districts (e.g., *SAN 24299* and *SAN 39305*) and in Sarawak from Bintulu, Miri and Tatau districts (e.g., *S 15141*, *S 46410* and *S 46598*). Also occurring in Brunei (e.g., *BRUN 3010* and *BRUN 3061*).

Ecology. Very local on account of its local habitat, but there often common in mixed dipterocarp forest on deep yellow sandy soils of coastal hills comprised of soft neogene

sandstone in Sarawak, ultrabasic substrates in Sabah, at altitudes below 400 m. Common in Lambir NP; elsewhere vulnerable.

Notes. Closely related to *S. peltata*, see there.

66. *Shorea leprosula* Miq.

(Latin, *leprosulus* = leprous; the appearance of the domatia)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Fl. Ned. Ind., Suppl. (1861) 487; Beccari, Nelle For. Born. (1902) 570; Merrill *op. cit.* (1921) 405, *op. cit.* (1929) 203; Keith *op. cit.* 12; Masamune *op. cit.* 494; Slooten *op. cit.* (1949) 262; Browne *op. cit.* 110; Ashton *op. cit.* (1964) 193, *op. cit.* (1968) 110, *op. cit.* (1982) 540; Meijer & Wood *op. cit.* 110; Burgess *op. cit.* 154, 182; Anderson *op. cit.* (1980) 126; PROSEA *op. cit.* 396; Kessler & Sidiyasa *op. cit.* 105; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al.* *op. cit.* (1996) 158. **Lectotype** (designated here): *Teijsmann HB 1122*, Sumatra (hololectotype L). **Synonyms:** *Hopea ?maranti* Miq., *op. cit.* 489; *Shorea maranti* (Miq.) Burck *op. cit.* 217.

Large late successional tree, to 60 m tall, to 1.5 m diameter; crown pale pinkish from below, diffuse, cauliflower-shaped; bole tall, cylindrical; buttresses to 2 m tall, stout. **Bark** pale fawn-brown, deeply widely v-section fissured, the intervening ridges only becoming crumbly flaky in old trees; inner bark reddish brown. **Sapwood** light; heartwood pale reddish brown. *Twig, inflorescence, leaf bud, parts of flower exposed in bud, stipule, bracteole, petiole, and leaf venation below persistently densely pinkish buff-puberulent; blade undersurface densely pinkish brown sericeous* (mature trees only). **Twigs** terete, ridged at first, much-branched, c. 1.5 mm diameter apically. Leaf buds broadly ovoid, subacute, compressed, 3–5 × 2–3 mm. **Stipules** oblong to broadly hastate, obtuse, to 10 × 3.5 mm, fugaceous. **Leaves** *thinly coriaceous, drying pale pinkish brown above, pink-buff below* (mature trees); *blade ovate-oblong, 8–14 × 3.5–5.5 cm, base obtuse or broadly acuminate, apex with short acumen to 0.8 cm long; midrib obscure, sunken above, prominent below, beset with lines of scale-like domatia in young trees; lateral veins 12–15 pairs, slender but prominent below, arched near margin; intercostal venation slender, densely scalariform; petiole 1–1.5 cm long.* **Inflorescences** terminal or axillary; rachis terete, lax, slender, to 14 cm long, generally singly branched, branchlets bearing to 12 flowers; bracteoles elliptic, obtuse, to 3 × 2 mm, fugaceous. **Flowers:** buds to 6 × 3 mm; petals pale yellow; stamens 15, connectival appendage short, becoming reflexed; ovary and stylopodium ovoid, glabrous, style twice their length. **Fruits:** calyx more or less glabrescent; *calyx lobes unequal, aliform, 3 longer lobes to 10 × 2 cm, tapering to c. 5 mm above the saccate base, 2 shorter ones to 5.5 × 0.3 cm, otherwise similar.* **Nuts** ovoid, to 1 × 1.3 cm, with c. 2 mm long tapering style remnant.

Vernacular names. Sabah—*seraya tembaga* (preferred name). Sarawak—*meranti tembaga* (preferred name; Malay).

Distribution. Extreme SE Peninsular Thailand (Pattani), Sumatra, Peninsular Malaysia, and Borneo (throughout the island in suitable habitats). In Sabah known from most districts (e.g., *SAN 15509*, *SAN 18002*, *SAN 29715*, *SAN 69199*, and *SAN 94912*) and in Sarawak from Bintulu, Kapit, Kuching, Limbang, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 32115*, *S 32562*, *S 37832*, *S 43905*, and *S 75325*). Also occurring in Brunei (e.g., *BRUN 802*, *FMS 30484* and *FMS 37463*) and Kalimantan (e.g., *bb. 34268*, *Kostermans 12650* and *Meijer 2273*).

Ecology. Absent from the widespread sandy soils of Sabah and Sarawak, but frequent, locally quite common in mixed dipterocarp forest on clay soils on shales and clays, also acid and intermediate igneous rocks and periodically flooded alluvium, at altitudes to 600 m. A light demander, competitive in early to late succession and flowering more frequently than other species of sect. *Mutica*. Occurring in G. Gading, Lambir and Mulu NPs in Sarawak, and Danum Valley Conservation Area and Sepilok FR in Sabah; not vulnerable.

67. *Shorea longiflora* (Brandis) Symington

(Latin, *longus* = long, *flos* = flower)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. S. S. 9 (1938) 330; Slooten *op. cit.* (1956) 318; Browne *op. cit.* 163; Anderson *op. cit.* (1963) 158, *op. cit.* (1980) 122; Ashton *op. cit.* (1964) 156, *op. cit.* (1968) 86, *op. cit.* (1982) 473; PROSEA *op. cit.* 419; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al.* *op. cit.* (1996) 160. **Basionym:** *Hopea longiflora* Brandis *op. cit.* 63. **Type:** *Haviland 2120*, Borneo, Sarawak, probably near Kuching (holotype K). **Synonym:** *Balanaocarpus longiflorus* (Brandis) Foxw. *ex* Symington *op. cit.* (1934) 29.

Understory or low main canopy tree, to 35 m tall, to 50 cm diameter; bole frequently misshapen; crown loose, oblong, with pendent branches and leaves; buttresses low, stout, occasionally with a few stilt roots. **Bark** fawn and dark grey, becoming patchily cracked and thinly irregularly flaky. *Young twig, leaf bud, inflorescence, parts of perianth exposed in bud, and stipule fulvous powdery puberulent, more or less caducous.* **Twigs** terete, stout, rugulose, becoming papery scaly, c. 2.5 mm diameter apically. Leaf buds globose or ellipsoid, slightly compressed, c. 3 × 2 mm. **Stipules** oblong-elliptic, to 10 × 6 mm, obtuse, concave, caducous. **Leaves** thickly coriaceous; blade narrowly ovate-lanceolate, 10–24 × 4–6 cm, base obtuse, margin prominently revolute, apex with slender acumen to 2 cm long; midrib evident but furrowed above, prominent below; lateral veins 12–15 pairs, prominent below, distant, arched and ascending; intercostal venation distantly subscalariform; petiole 1–1.2 cm long. **Inflorescences** terminal or axillary; rachis terete, to 11 cm long, unbranched or singly branched, branchlets bearing few flowers; bracteoles minute, fugaceous. **Flowers:** buds to 8 × 3.5 mm; petals brownish purple to dark yellow; stamens 15, anthers becoming reflexed at anthesis, connectival appendage of same length as anther, ciliate towards apex; ovary and stylopodium attenuate-ovoid, glabrous, tapering into glabrous style. **Fruits** subsessile; calyx lobes subequal, broadly deltoid to ovate, rather thin, spreading not clasping the nut, c. 0.7 × 0.7 cm. **Nuts** ellipsoid to ovoid or obovoid, to 4.5 × 1.7 cm, glabrous, shiny, with short apical style remnant.

Vernacular name. Sarawak—*lun paya* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Kapit, Kuching, Marudi, Miri, Samarahan, Simunjan, and Tatau districts (e.g., *Richards 2441, S 6518, S 14400, S 19425, and S 34356*). Also occurring in Brunei (e.g., *BRUN 109, FMS 35658 and SAN 17535*) and C and E Kalimantan (e.g., *Suzuki K 11847*).

Ecology. Scattered, often in local patches in mixed dipterocarp forest on humic soils, often poorly drained but sometimes well-drained, on deep yellow sands; also in mixed peat swamp and *karapa* forest at 400–1000 m altitude. Occurring in Lambir NP; elsewhere vulnerable owing to its accessible habitat.

68. *Shorea longisperma* Roxb.

(Latin, *longus* = long, *spermus* = seed; the elongated nut)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Fl. Ind., ed. Carey 2 (1832) 618; Ashton *op. cit.* (1978) 43, *op. cit.* (1982) 481; PROSEA *op. cit.* 420; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al.* *op. cit.* (1996) 161. **Type:** *Roxburgh s.n.*, Peninsular Malaysia, Penang ('Prince of Wales Is.') (holotype CAL). **Synonyms:** *Parashorea longisperma* (Roxb.) Kurz *op. cit.* 66; *Shorea resina-nigra* Foxw., *op. cit.* (1932) 205, Ashton *op. cit.* (1968) 89, Anderson *op. cit.* (1980) 123.

Huge tree, to 70 m tall, to 2.9 m diameter; bole tall, cylindrical; buttresses to 4 m tall and out, stout; crown immense, diffuse, cauliflower-shaped, pale from below. **Bark** tawny-brown, deeply cracked and thinly oblong flaky; dammar blackish oxidizing to cream, as occasional small coxcombs. *Leaf bud, stipule, inflorescence, bracteole, and parts of perianth exposed in bud persistently fulvous scabrid-puberulent; twig and fruit calyx caducously so; ovary and nut evenly buff-puberulent; leaf undersurface buff lepidote.* **Twigs** slender, terete, 1–2 mm diameter apically. Leaf buds ovoid, acute, to 3 × 2 mm. **Stipules** ovate to lorate, acute, to 5 × 2 mm, caducous. **Leaves** somewhat chartaceous, pale mauve when opening, drying tawny-brown above, pale brownish grey below with the veins distinctly darker; blade elliptic to ovate, 7–12 × 2.3–6 cm, base cuneate to obtuse, apex with slender acumen to 1.5 cm long; midrib evident, flat to shallowly furrowed above, prominent below; lateral veins 10–13 pairs, slender but distinctly raised below; intercostal venation subscalariform; petiole 1–1.5 cm long. **Inflorescences** terminal or axillary; rachis terete, slender, to 7 cm long, singly branched, branchlets bearing to 4 flowers; bracteoles elliptic, to 3 × 2 mm. **Flowers:** buds to 9 × 3 mm; petals pale yellow; stamens 15, connective appendage c. 2x as long as anther; ovary and stylopodium pyriform, style as long as both, columnar, glabrous. **Fruits** sessile; calyx lobes unequal, 3 longer lobes to 6 × 4 cm, tapering to c. 3 mm above the narrowly saccate tuberculate base, 2 shorter ones linear-lobed, to 7 × 0.4 cm, similar at base. **Nuts** ellipsoid, to 2.3 × 1.2 cm, acute.

Vernacular name. Sarawak—*lun meranti* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sarawak known from Belaga, Kapit, Lawas, Marudi, Miri, and Tatau districts (e.g., *S 16738*, *S 18279*, *S 19276*, and *S 69118*). Also occurring in Brunei (*BRUN 2539*) and C and E Kalimantan (e.g., *Arifin et al. Berau 727*).

Ecology. Rare, as scattered individuals in mixed dipterocarp forest on well-structured deep clay soils over shale, dacite and basalt, on low coastal hills and uplands, at altitudes to 1100 m. Vulnerable, becoming endangered owing to logging at higher altitudes.

69. *Shorea lunduensis* P.S.Ashton

(of Lundu, Sarawak)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Gard. Bull. Sing. 22 (1967) 284, *op. cit.* (1968) 73, *op. cit.* (1982) 458; Anderson *op. cit.* (1980) 120; Newman *op. cit.* (1998) 190. **Type:** *Anderson et al. S 15396*, Borneo, Sarawak, Lundu district, G. Lundu (holotype K; isotypes KEP, L).

Large emergent tree, to 60 m tall, to 1.3 m diameter; bole straight, cylindrical; crown irregularly hemispherical, with a few large ascending branches; buttresses to 4 m tall, relatively stout. **Bark** greyish brown, irregularly flaky. *Inflorescence, parts of perianth exposed in bud, ovary, and nut densely buff-puberulent, persistent except on calyx; twigs and leaf bud shortly evenly fugaceous buff-pubescent; parts otherwise glabrous.* **Twigs** at first compressed, somewhat shiny, *c.* 3 × 2 mm apically; stipule scars pale, conspicuous, ascending, *c.* 3 mm long. Leaf buds ovoid, acute, to 5 × 3 mm. **Stipules** unknown. **Leaves** coriaceous, large, drying yellowish brown, satiny above; blade broadly ovate to elliptic, 14–24 × 6–15 cm, base broadly cuneate to subcordate, apex with tapering acumen to 1 cm long; midrib broad but hardly raised above, prominently so below; lateral veins 11–15 pairs, prominent below, ascending; intercostal venation densely scalariform, sinuate, evident but hardly raised; petiole 2–3.5 cm long, geniculate. **Inflorescences** terminal or axillary; rachis subterete, to 12 cm long, branchlets bearing to 5 flowers. **Flowers:** buds to 10 × 3 mm; corolla cream; *stamens 47–52, filaments and anthers glabrous, connectival appendage exceeding the length of anther, densely setose; ovary and stylopodium pyriform, style glabrous, columnar.* **Fruits** (mature fruit unknown): *calyx lobes unequal. Nuts* ovoid, shortly apiculate.

Distribution. Endemic in W Borneo. In Sarawak, recorded from Bau, Kuching and Lundu districts (e.g., *S 59, S 7984, S 10172, S 15502, and S 25296*) and in Kalimantan from Sambas district (e.g., *Suzuki K 9760*).

Ecology. Very local, there frequent in mixed dipterocarp forest on clay soils, on granodiorite, andesite plugs and a porphyry dike in limestone, at altitudes to 600 m. Endangered by forest conversion.

70. *Shorea macrantha* Brandis

(Greek, *makro-* = large, *anthos* = flower)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

J. Linn. Soc. Bot. 31 (1895); Merrill *op. cit.* (1921) 405; Symington *op. cit.* (1933) 131, *op. cit.* (1943) 77; Masamune *op. cit.* 495; Browne *op. cit.* 148; Anderson *op. cit.* (1963) 110, *op. cit.* (1980) 126; Ashton *op. cit.* (1968) 110, *op. cit.* (1982) 536; PROSEA *op. cit.* 397; Newman *et al. op. cit.* (1996) 162. **Type:** *Haviland 2119*, Borneo, Sarawak, Kuching (holotype K; isotype L).

Small canopy tree, to 40 m tall, to 60 cm diameter; bole moderately straight; crown with pendent branches, twigs and leaves; buttresses short, stout. **Bark** dull purplish grey, irregularly fissured; inner bark yellowish brown, pale at cambium; heartwood pale brown, hard. *Twig, leaf bud, stipule outside, inflorescence, parts of perianth exposed in bud, petiole, and venation below densely persistently yellowish brown scabrid-pubescent; stipule inside, midrib above, ovary, and nut evenly so; lateral veins above and fruit calyx sparsely evenly so.* **Twigs** terete, stout, 2–4 mm diameter apically; stipule scars short. Leaf buds ovoid, subacute, 6 × 3 mm. **Stipules** lanceolate, ribbed, subacute, to 16 × 5 mm, subpersistent. **Leaves** coriaceous, drying mauve-brown above, rufous below with yellowish brown tomentum; blade bullate between veins, narrowly ovate, 6–17 × 2.5–8 cm, base unequal, cordate, apex with slender acumen to 1.5 cm long; midrib, lateral and intercostal venation more or less obscure, sunken above, prominent below; lateral veins 13–17 pairs, arched; intercostal venation laxly scalariform; petiole very short, 0.5–0.6 cm long. **Inflorescences** terminal or axillary; rachis terete, to 10 cm long, singly branched, branchlets

short, the flowers congested. **Flowers:** buds to 14×4 mm; *petals dark red within, paler outside*; stamens 15, connectival appendage as long as anther; ovary ovoid, *without stylopodium*, style glabrous, about twice as long as ovary. **Fruits** subsessile; *calyx lobes subequal, ovate, acute, saccate towards base, to 2.5×2 cm*. **Nuts** ellipsoid, to 5.5×2.5 cm, acute.

Vernacular name. Sarawak—*engkabang bungkus* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and NW Borneo. In Borneo known only from Sarawak and recorded from Kuching, Serian, Sibuluan, and Sri Aman districts (e.g., *S 9781*, *S 13353* and *S 35965*).

Ecology. In small populations in the inland margins of the mixed peat swamp forest, and on poorly drained podsols on terraces in *kerangas*. Endangered.

Uses. Collected as a lesser valued illipe nut, for the cocoa butter content.

71. *Shorea macrobalanos* P.S.Ashton

(Greek, *makro-* = large, *balanos* = acorn; the huge nut)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 202, *op. cit.* (1968) 86, *op. cit.* (1982) 473; Anderson *op. cit.* (1980) 122; Kessler & Sidiyasa *op. cit.* 105; Newman *et al. op. cit.* (1996) 163. **Type:** *Smythies S 13192*, Borneo, Sarawak, Lundu district, G. Berumpit (holotype K; isotypes KEP, L).

Emergent tree, to 45 m tall, to 1 m diameter; crown dense, dark, hemispherical; bole tall, cylindrical; buttresses to 3 m tall, stout. **Bark** tawny-brown, irregularly flaky. *Leaf bud and stipule persistently buff-pubescent; flower calyx sparsely so; parts otherwise glabrous*. **Twigs** terete, becoming prominently verrucose, stout, c. 4 mm diameter apically; stipule scars obscure, ascending, c. 3 mm long. Leaf buds ovoid, acute, to 2×2 mm. **Stipules** unknown. **Leaves** *thinly coriaceous, drying greyish green above, tawny below with the veins, midrib and petiole darker to blackish; blade oblong, $19-37 \times 9-15$ cm, base cordate, margin revolute, apex obtuse or shortly broadly acuminate; midrib flat above, prominent below; lateral veins 12-16 pairs, prominent below; intercostal venation slender, remotely subreticulate; petiole stout, 1.8-3.8 cm long*. **Inflorescences** terminal or axillary; rachis terete or somewhat compressed, to 32 cm long. **Flowers:** buds large, to 9×3.5 mm; *stamens 10, connectival appendage as long as anther; ovary narrowly ovoid, tapering, without stylopodium, style glabrous, short*. **Fruits** sessile; *calyx lobes subequal, ovate, acute, subrotate, not appressed to the nut, to 0.8×0.8 cm, mounted on a to 8 mm deep receptacle*. **Nuts** oblong, to 5×2.5 cm, shortly apiculate.

Vernacular name. Sarawak—*engkabang melapi* (Iban).

Distribution. Endemic in Borneo; known in Sarawak from Kapit and Lundu districts (e.g., *S 13712*, *S 19611*, *S 34481*, and *S 37292*). Also occurring in NW and E Kalimantan (e.g., *Suzuki K 9762*).

Ecology. Locally frequent in forest on clay soils derived from shale and intermediate, and basic igneous rocks; especially on low hills and moist valleys but also occurs at altitudes to 900 m. Conservation status uncertain; likely endangered by logging.

Notes. For differences from *S. longiflora*, see there.

72. *Shorea macrophylla* (de Vriese) P.S.Ashton
(Greek, *makro-* = large, *phullon* = leaf)

Plates 4B–C.

(sect. **Pachycarpae**, red meranti)

Gard. Bull. Sing. 20 (1963) 278, *op. cit.* (1964) 196, *op. cit.* (1968) 110, *op. cit.* (1982) 523; Meijer & Wood *op. cit.* 156; Anderson *op. cit.* (1980) 127; PROSEA *op. cit.* 397; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al.* *op. cit.* (1996) 163. **Basionym:** *Hopea macrophylla* de Vriese, Minyak Tenkawang (1861) 28. **Lectotype** (designated here): *de Vriese s.n.* (= RHL Sheet No. 902146589), 'Borneo' (holotype L). **Synonyms:** *Shorea gysbertsiana* Burck *op. cit.* (1886) 15, Merrill *op. cit.* (1921) 405, Browne *op. cit.* 139, Meijer & Wood *op. cit.* 108, Burgess *op. cit.* 182; *S. bakeriana* F.Heim *op. cit.* (1891) 974, Merrill *op. cit.* (1921) 404; *Pachyklamys gysbertsiana* (Burck) Ridl., *op. cit.* (1922) 233 (*sphalm. gysbertsiana*).

Stocky low emergent or main canopy tree, to 45 m tall, to 1.5 m diameter; crown dense, oblong to hemispherical, branch endings pendent; bole usually not tall, often misshapen; buttresses to 2 m tall, stout. **Bark** greenish grey to pale brown, at first smooth, hoop-marked, becoming thinly irregularly flaky, leaving scroll-marked new surfaces; inner bark pale yellowish brown; heartwood rather light, pale brown. *Young twig, leaf bud, inflorescence, parts of perianth exposed in bud, ovary, nut, stipule, bracteole, petiole, leaf blade below, and midrib above persistently densely evenly pale brown pubescent.* **Twigs** compressed, becoming smooth, 2.5–4 × 2–3 mm apically; stipule scar amplexicaul, horizontal, c. 1 mm thick. *Leaf buds hastate, narrowly obtuse, compressed, 12–18 × 4–6 mm.* **Stipules** broadly hastate, obtuse, large, to 50 × 13 mm, not at first caducous. **Leaves** thickly chartaceous, drying pale greyish tawny; blade elliptic-oblong, 17–35 × 10–14 cm, base obtuse or subcordate, apex with slender acumen to 1.5 cm long; midrib broad, flat above, prominent below; lateral veins 11–20 pairs, prominent below, well-spaced; intercostal venation scalariform, well-spaced, distinctly elevated below; petiole 1.5–3 cm long. **Inflorescences** terminal or axillary; rachis compressed, pendent, to 17 cm long, singly branched; bracteoles oblong, subacute, to 12 × 5 mm, not at first caducous. **Flowers:** buds to 8 × 5 mm; petals pale pink; stamens 15, connectival appendage c. 2x as long as anther, glabrous; ovary ovoid, densely pubescent in the distal half, stylopodium and style spindle-shaped, glabrous, as long as ovary. **Fruits:** calyx glabrescent; *calyx lobes unequal, 3 longer lobes oblong, coriaceous, to 11 × 3 cm, tapering to 15 mm above the saccate base, 2 shorter ones to 8 × 1.5 cm, similar at base.* **Nuts** obovoid, to 6 × 4 cm, acute, large.

Vernacular names. Sabah—*kawang jantung* (preferred name). Sarawak—*engkabang jantung* (Iban).

Distribution. Endemic in Borneo; widespread. In Sabah known from Beaufort, Keningau, Kinabatangan, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 15073*, *SAN 15195*, *SAN 22864*, *SAN 23151*, and *SAN 38236*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Lundu, Miri, Mukah, Sarikei, and Song districts (e.g., *S 554*, *S 1461*, *S 29218*, *S 42150*, and *S 77061*). Also occurring in Brunei (e.g., *BRUN 5280*, *FMS 35515* and *Wong*

WKM 1570) and Kalimantan (e.g., *bb. 29058, Meijer 2218 and Wilkie 94275*), north of the equator. Widely planted.

Ecology. Locally abundant, in mixed dipterocarp forest on river banks and flood plains, also less commonly on moist hillsides, at altitudes to 600 m. Most abundant from the Rajang hinterland westwards. Occurring in Lambir and Mulu NPs; not vulnerable.

Uses. Besides a serviceable light hardwood, the tree produces the best and most plentiful of the illipe nuts.

Notes. The indigenous form in E Sabah and NE Kalimantan differs in the fruit, with smaller nut and longer narrower calyx lobes, and the leaf which is somewhat narrower, with cuneate base. There may be hybridization with *S. pinanga*.

73. *Shorea macroptera* Dyer

(Greek, *makro-* = large, *pteron* = a wing; the long auriculate fruit calyx lobes)

(sect. **Mutica**, subsect. **Auriculatae**, red meranti)

Fl. Brit. Ind. 1 (1874) 267; King *op. cit.* 113; Ridley *op. cit.* (1922) 225; Foxworthy *op. cit.* (1932) 195; Symington *op. cit.* (1943) 78; Ashton *op. cit.* (1963) 276, *op. cit.* (1964) 197, *op. cit.* (1968) 111, *op. cit.* (1982) 532; Meijer & Wood *op. cit.* 116; Anderson *op. cit.* (1980) 127; PROSEA *op. cit.* 397; Newman *et al. op. cit.* (1996) 165. **Type:** *Maingay 1198* (= *Kew Distr. No. 208*), Peninsular Malaysia, Malacca (holotype K). **Synonyms:** *Shorea baillonii* F.Heim *op. cit.* (1891) 973; *S. sandakanensis* Symington *op. cit.* (1938) 343.

Main canopy to emergent tree, 40–50 m tall, 70–140 cm diameter; bole straight, cylindrical; crown dense, hemispherical; buttresses to 2.5 m tall. **Bark** remaining smooth at first, becoming shallowly v-section fissured, or patchily crumbly flaky; inner bark dark red to pale brown at cambium; heartwood light, pinkish brown. *Young twig, inflorescence, leaf bud, parts of perianth exposed in bud, fruit calyx outside, stipule and bracteole outside (sericeous within), and petiole sparsely tufted puberulent, glabrescent, or densely, evenly persistent pubescent.* **Twig** frequently somewhat compressed, becoming terete, *c.* 2 mm diameter apically. Leaf buds ovoid, subacute, 4–6 × 2.5–4 mm. **Stipules** oblong, subacute, to 8 × 3 mm, fugaceous. **Leaves** coriaceous, somewhat shiny, drying distinct pale orange-brown; blade narrowly elliptic, or narrowly ovate, or narrowly oblong, (8–)12–19(–23) × 3.7–9.5 cm, base narrowly cuneate or obtuse, apex tapering or abruptly attenuate; midrib obscure, shallowly sunken above, prominent below; lateral veins 10–15(–18) pairs, prominent below, arched; intercostal venation densely scalariform, sinuate; petiole 1.5–2 cm long. **Inflorescences** terminal or axillary; rachis slightly compressed or terete, lax, 13–16 cm long, singly or doubly branched, branchlets bearing to 7 distichous flowers; bracteoles elliptic, obtuse, to 3.5 × 2.5 mm. **Flowers:** buds to 5 × 3 mm; petals cream with pink base; stamens 15, connectival appendage short, becoming reflexed; ovary and stylopodium conical, style half their length, glabrous. **Fruits:** calyx lobes unequal, 3 longer lobes 12–14 × 2–3 cm, somewhat tapering to 1.2 cm wide at the incrassate concave hardly auriculate base, 2 shorter ones lorate-lobed, to 6 × 0.6 cm, at base hardly auriculate to prominently auriculate. **Nuts** ovoid, to 1.8 × 0.2 cm, with to 2 mm acute tapering style remnant.

Vernacular names. Sabah—*seraya melantai* (preferred name). Sarawak—*meranti melantai* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo.

Ecology. In mixed dipterocarp forest on clay soils over sedimentary and igneous rocks, and on sandy clay soils, at altitudes to 900 m. Not vulnerable.

Notes. Four subspecies, viz. subsp. *baillonii*, subsp. *macroptera*, subsp. *macropterifolia*, and subsp. *sandakanensis*, are recognised. Whereas subsp. *macroptera* is confined to Peninsular Thailand, Sumatra, Peninsular Malaysia, and Singapore, subsp. *baillonii*, subsp. *macropterifolia* and subsp. *sandakanensis* are endemic in Borneo.

Key to subspecies

1. Inflorescences singly or doubly branched. Twigs, petiole and inflorescences sparsely tufted-pubescent, glabrescent. Two outer fruit calyx lobes hardly auriculate at base. Leaf blade narrowly elliptic, base narrowly cuneate.....
 - subsp. **baillonii** (F.Heim) P.S.Ashton
(H.E. Baillon, 1827–1895, French botanist)
Gard. Bull. Sing. 20 (1963) 277, *op. cit.* (1968) 111, *op. cit.* (1982) 532; Brown *op. cit.* 137; Anderson *op. cit.* (1980) 127, *p.p.*; PROSEA *op. cit.* 165; Newman *et al. op. cit.* (1996) 165. Basionym: *Shorea baillonii* F.Heim *op. cit.* (1891) 973. Type: *Beccari PB 2891*, Borneo, Sarawak, Mt. Matang (holotype P). Synonym: *Shorea macroptera auct. non* Dyer: Merrill *op. cit.* (1921) 405, Masamune *op. cit.* 495, *p.p.*
Endemic in Borneo; recorded in Sarawak from Belaga, Bintulu, Kapit, Kuching, Marudi, Miri, Simunjan, Song, and Tatau districts (e.g., *S 1490*, *S 11090*, *S 15581*, *S 25020*, and *S 43607*). Abundant in mixed dipterocarp forest on clay and sandy clay soils over sedimentary rocks, at altitudes to 600 m. Occurring in Bako, Kubah and Lambir NPs; not vulnerable.
 - Inflorescences exclusively doubly branched. Twigs, petiole and inflorescences densely persistently even-pubescent. Two outer fruit calyx lobes prominently auriculate at base. Leaf blade narrowly ovate or narrowly oblong, base obtuse.....2
2. Leaf blade narrowly ovate, 8–16 × 4–6 cm, apex gradually tapering; petiole to 1.5 cm long.....
 - subsp. **macropterifolia** P.S.Ashton
(Latin, with leaves resembling those of subsp. *macroptera*)
Gard. Bull. Sing. 20 (1963) 227, *op. cit.* (1964) 197, *op. cit.* (1968) 111, *op. cit.* (1982) 533; Meijer & Wood *op. cit.* 116, *p.p.*; Burgess *op. cit.* 182, *p.p.*; Anderson *op. cit.* (1980) 127, *p.p.*; PROSEA *op. cit.* 397; Coode *et al. (eds.) op. cit.* 79; Newman *et al. op. cit.* (1996) 166. Type: *G.H.S. Wood SAN 16255*, Borneo, Sabah, Sipitang district (holotype K; isotypes KEP, SAN).
Endemic in Borneo. Known in Sabah from Beaufort, Kota Kinabalu, Kinabatangan, Sipitang, and Tawau districts (e.g., *SAN 16453*, *SAN 16598*, *SAN 72371*, *SAN 76270*, and *SAN 97510*) and in Sarawak from Bintulu, Kapit, Lawas, Limbang, and Miri districts (e.g., *S 1514*, *S 10701*, *S 15888*, *S 22323*, and *S 66163*). Also occurring in Brunei (e.g., *BRUN 356*, *FMS 48102* and *S 2151*) and E Kalimantan (e.g., *Meijer 2555*). Much overlapping in distribution with subsp. *baillonii* but not on sandy clay soils and more frequent in the hills. Occurring in Kinabalu, Lambir and Mulu NPs; not vulnerable.

Leaf blade narrowly oblong, (9–)18–23 × (4–)6.5–9.5 cm, apex abruptly tapering; petiole to 2 cm long.....

subsp. **sandakanensis** (Symington) P.S.Ashton

(of Sandakan, Sabah)

Gard. Bull. Sing. 20 (1963) 111, *op. cit.* (1982) 532; PROSEA *op. cit.* 397; Newman *et al. op. cit.* (1996) 167. Basionym: *Shorea sandakanensis* Symington *op. cit.* (1938) 343. Type: *Agama FMS 38730*, Borneo, Sabah, Sandakan district, Kabili FR (holotype KEP). Synonym: *Shorea macroptera* auct. non Dyer: Slooten *op. cit.* (1929) 203, Masamune *op. cit.* 495, *p.p.*, Meijer & Wood *op. cit.* 116, *p.p.*, Burgess *op. cit.* 182, *p.p.*

Endemic in Borneo. Known in Sabah from Beaufort, Kinabatangan, Kota Kinabalu, Kudat, Labuk Sugut, Lahad Datu, Sandakan, and Tawau districts (e.g., *SAN 23978*, *SAN 35341*, *SAN 38380*, *SAN 63791*, and *SAN 75971*). Also occurring in Brunei (e.g., *FMS 35673*) and E Kalimantan (e.g., *Meijer 2043* and *Meijer 2560*). Occurring in Danum Valley Conservation Area and Sepilok FR; elsewhere vulnerable owing to land conversion.

74. *Shorea materialis* Ridl.

(of the Materials, *i.e.*, King's (1893) Materials for a Flora of the Malay Peninsula)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Agr. Bull. Str. & F.M.S. 9 (1910) 183; Ashton *op. cit.* (1964) 140, *op. cit.* (1968) 74, *op. cit.* (1982) 456; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 432; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al. op. cit.* (1998) 191. **Lectotype** (designated here): *Ridley 15209* (Sanger Davies), Peninsular Malaysia, Pahang, Kuala Baloh (hololectotype K). **Synonym**: *Shorea glauca* non King: Browne *op. cit.* 168, *p.p.*

Emergent tree, to 40 m tall, to 1.2 m diameter; bole straight; crown rather flat, diffuse, with a few large branches, pale from below; buttresses to 1.5 m tall, thin. **Bark** reddish to yellowish brown, cracked and irregularly oblong flaky. *Young twig, inflorescence, leaf bud, stipule, bracteole, leaf below, and petiole cream lepidote; parts of calyx exposed in bud, ovary, nut, and base of fruit calyx outside cream-buff puberulent. Twigs* terete, dark chocolate-brown, *c.* 1.5 mm diameter apically; stipule scars pale, short, falcate. Leaf buds linear, to 3 × 1 mm. **Stipules** linear, to 12 mm long, fugaceous. **Leaves** *thinly coriaceous, drying pale brown above, cream lepidote below with darker veins; blade broadly ovate, 8–15 × 3.5–8.5 cm, base unequal, cuneate to subcordate, apex with slender acumen to 1.5 cm long; midrib evident, flat above, broad but not prominently raised below; lateral veins 9–12 pairs, slender and elevated below; intercostal venation slender, densely scalariform, unraised; petiole 1.2–2 cm long. Inflorescences* terminal or axillary; rachis slender, to 15 cm long, singly branched, branchlets bearing to 12 flowers; bracteoles ovate, acute, to 2 mm long. **Flowers**: buds to 10 × 4 mm; corolla cream; *stamens c.* 30, *filament and anther glabrous, connectival appendage short, setose; ovary and stylopodium ovoid-conical, style short, glabrous. Fruits*: pedicel *c.* 2 mm long; *calyx lobes unequal, 3 longer lobes to 9 × 3 cm, tapering to 8 mm above the saccate base, 2 shorter ones linear-lobed, to 6 × 0.8 cm, similar at base. Nuts* broadly ovoid, to 1.2 × 1.2 cm, tapering to an acute 4 mm style remnant.

Vernacular name. Sarawak—*selangan batu pasir* (preferred name).

Distribution. E Sumatra?, East coastal Peninsular Malaysia and Borneo. In Sarawak recorded from Bintulu, Marudi and Miri districts (e.g., *S* 907, *S* 8254 and *S* 8661). Also occurring in Brunei (e.g., *BRUN* 513 and *FMS* 30553).

Ecology. Very local, there sometimes quite common in *kerangas* forest on white sand terraces and in mixed dipterocarp forest on leached greyish yellow sands on narrow ridges, at altitudes to 800 m. Occurring in Lambir NP; elsewhere endangered.

75. *Shorea maxwelliana* King

(Sir George Maxwell, 1871–1959, one-time Resident of Perak, Peninsular Malaysia)

(sect. *Shorea*, subsect. *Barbata*, *selangan batu*)

J. As. Soc. Beng. 62, 2 (1893) 114; Symington *op. cit.* (1933) 146, *op. cit.* (1934) 28, *op. cit.* (1938) 325, *op. cit.* (1943) 21; Masamune *op. cit.* 495; Browne *op. cit.* 169; Ashton *op. cit.* (1964) 141, *op. cit.* (1968) 74, *op. cit.* (1982) 465; Meijer & Wood *op. cit.* 182; Burgess *op. cit.* 203; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 432; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al.* *op. cit.* (1998) 193. **Lectotype** (designated here): *King's Collectors* 3744, Peninsular Malaysia, Perak (hololectotype K). **Synonyms:** *Shorea utilis* King *op. cit.* 119; *S. barbata* Brandis *op. cit.* 81; *S. alba* Ridl., J. Str. Br. Roy. As. Soc. 82 (1920) 171; *Balanocarpus ovalifolius* Ridl., J. Fed. Malay States Mus. 10 (1920) 130, *p.p.*

Large emergent tree, to 50 m tall, to 1.6 m diameter; bole tall, cylindrical; crown large, diffuse, cauliflower-shaped; buttresses to 4 m tall, thin, prominent. **Bark** reddish to greyish brown, becoming shallowly densely cracked and small thin oblong flaked, eventually sometimes shaggy. *Leaf bud, parts of perianth exposed in bud, fruit calyx, inflorescence, stipule, bracteole, ovary, and nut evenly buff-puberulent.* **Twigs** slender, much-branched, terete, smooth, *c.* 0.7 mm diameter apically. Leaf buds globose to conical, minute, *c.* 1 mm diameter. **Stipules** linear, to 4 mm long, fugaceous. **Leaves** *thinly coraceous, sometimes cream lepidote below, more or less shiny above, drying pale yellowish brown; blade ovate-lanceolate, 6–10 × 2.5–4 cm, base obtuse or broadly cuneate, apex caudate, acumen to 2 cm long; midrib raised below, evident, raised but shallowly furrowed above; lateral veins 8–10 pairs, slender, raised but not prominent below, with or without minute axillary domatia; intercostal venation very slender, scalariform; petiole 0.7–1 cm long, slender.* **Inflorescences** terminal or to 3-axillary; rachis terete, straight, to 5 cm long, singly branched, branchlets short bearing to 6 close flowers. **Flowers:** buds globose, to 2.5 mm diameter; petals cream; *stamens c. 30, filaments glabrous, anthers setose apically, connectival appendage as long as anther, setose apically; ovary and stylopodium ovoid to pyriform, style short glabrous.* **Fruits:** *calyx lobes unequal, 3 longer lobes to 10 × 1.5 cm, tapering to 4 mm above the saccate base, 2 shorter ones to 6 × 0.6 cm, otherwise similar.* **Nuts** ovoid, to 2 × 1.5 cm, tapering, apiculate.

Vernacular names. Sabah—*selangan batu asam* (preferred name). Sarawak—*kumus hitam* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, recorded from Beaufort, Kudat, Lahad Datu, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN* 15221, *SAN* 16644, *SAN* 28972, and *SAN* 66156) and in Sarawak from Bau, Belaga, Kapit, Kuching, Limbang, Lundu, Marudi, Miri, and Tatau districts (e.g., *S* 1816, *S* 7995, *S* 10195, *S* 19168, and *S* 46549). Also occurring in Brunei (e.g., *BRUN* 3397 and *BRUN* 5774) and SE Kalimantan (e.g., *bb.* 11212 and *bb.* 27761).

Ecology. Locally frequent in mixed dipterocarp forest and occasionally *kerangas*, on a wide range of soils and substrates including basalt, shale, porphyry dykes, granodiorite and sandstone, at altitudes to 600 m. Occurring in Bako, G. Gading, Kubah, Lambir and Mulu NPs, and Sepilok FR; not vulnerable.

76. *Shorea mecistopteryx* Ridl.

(Greek, *megisto-* = very big, *pteron* = wing; the fruit calyx lobes)

(sect. **Pachycarpae**, red meranti)

Bull. Misc. Inform. Kew (1925) 280, Slooten *op. cit.* (1929) 203; Symington *op. cit.* (1938) 348; Masamune *op. cit.* 495; Ashton *op. cit.* (1964) 198, *op. cit.* (1968) 111, *op. cit.* (1982) 525; Meijer & Wood *op. cit.* 119; Burgess *op. cit.* 154, 182; Anderson *op. cit.* (1980) 127; PROSEA *op. cit.* 397; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al. op. cit.* (1996) 168. **Type:** *Taha s.n.*, Borneo, Sabah, Kinabatangan (holotype K). **Synonym:** *Shorea chrysophylla* Ridl., Bull. Misc. Inform. Kew (1926) 202.

Large emergent tree, to 50 m tall, to 1.6 m diameter; bole tall, cylindrical or sometimes sinuous; crown large, becoming irregularly hemispherical, golden from below; buttresses to 2 m tall, large, stout. **Bark** long remaining smooth, hoop-marked, greyish brown, eventually cracking and thinly flaking, leaving a scroll-marked surface; inner bark dull rust-brown to orange-brown at the cambium; heartwood pinkish brown, light. *Young twig, inflorescence, stipule and bracteole outside (sparsely so within), petiole, and leaf below evenly persistently golden pubescent; nut yellowish buff-pubescent. Twigs compressed, to 6 × 2.5 mm apically; stipule scars cuneate, horizontal.* Leaf buds ovoid, 5–8 × 2.5–5 mm, obtuse, compressed. **Stipules** hastate, acute, to 25 × 7 mm, not immediately caducous. **Leaves** chartaceous, brittle when dry and turning rich reddish brown below, paler above; blade oblong, 13–20(–30) × 6–10(–12) cm, base cordate, apex with broad acumen to 0.8 cm long; midrib evident, more or less flat or shallowly furrowed above, prominent and terete below; lateral veins 16–20 pairs, slender but prominent below, arched; intercostal venation densely scalariform, elevated below; petiole 2.5–3.5 cm long, stout. **Inflorescences** terminal or axillary, rachis terete or compressed, to 12 cm long, singly branched; bracteoles oblong, subacute, c. 7 × 2 mm. **Flowers:** buds large, to 12 × 4 mm; connectival appendage more than 2x the length of anther; ovary ovoid-conical, glabrous, stylopodium slightly longer than ovary, cylindrical, thickened distally, style stout. **Fruits:** pedicel to 6 mm long, stout; calyx lobes unequal, glabrescent or puberulent towards base, 3 longer lobes to 23 × 3.3 cm, tapering to 1.8 cm above the saccate base, 2 shorter ones to 15 × 1.2 cm, otherwise similar. **Nuts** ovoid, to 4.2 × 2.5 cm, acute.

Vernacular names. Sabah—*kawang burung* (preferred name). Sarawak—*engkabang burung* (preferred name), *engkabang larai* (Iban), *kawang tikus* (Malay).

Distribution. Endemic in Borneo; widespread but infrequent and local. In Sabah recorded from Kinabatangan and Sandakan districts (e.g., *SAN 4975*, *SAN 4977*, *SAN 5493*, *SAN 20811*, and *SAN A 3150*) and in Sarawak from Kapit, Lundu, Marudi, and Miri districts (e.g., *S 14458*, *S 15441*, *S 29278*, and *S 49889*). Also occurring in Brunei (e.g., *BRUN 3284* and *S 1634*) and C Kalimantan (e.g., *Argent 9495*, *Newman et al. 625*, *Newman et al. 626*, and *Peters 1035*).

Ecology. Local but widespread in mixed dipterocarp forest on sandy clay soils, including on intermediate igneous rocks, at altitudes to 400 m. Recorded from G. Gading NP; elsewhere vulnerable owing to land conversion.

77. *Shorea micans* P.S.Ashton

(Latin, *micans* = gleaming; the shiny leaf)

(sect. *Shorea*, subsect. *Barbata*, *selangan batu*)

Gard. Bull. Sing. 31 (1978) 38, *op. cit.* (1982) 463; Newman *et al. op. cit.* (1998) 193. **Type:** Meijer SAN 39312, Borneo, NE Sabah, Karamuak, Bt. Meliau (holotype L; isotypes KEP, SAN).

Low emergent or main canopy tree. **Bark** flaky. **Inflorescence and nut** densely greyish puberulent, **fruit calyx** sparsely so; other known parts glabrous, shiny. **Twigs** terete, much-branched, slender, *c.* 1 mm diameter apically. Leaf buds minute. **Stipules** unknown. **Leaves** thinly coriaceous, shiny, drying dark tawny-brown below, greyish brown above; blade ovate-lanceolate, 5–10 × 1.8–4.7 cm, base subequal, broadly cuneate, margin narrowly subrevolute, apex subcaudate, acumen to 1.3 cm long; midrib slender, evident and raised on both surfaces; lateral veins 7–8 pairs, very slender, slightly elevated below; intercostal venation scalariform, obscure; petiole very slender, 0.7–1.2 cm long. **Inflorescences** terminal or subtiminal-axillary; rachis slender, straight, shortly branched, to 7 cm long. **Flowers** unknown. **Fruits:** pedicel *c.* 1 mm long, slender; **calyx lobes** unequal, 3 longer lobes to 5 × 1.5 cm, tapering to *c.* 4 mm above the saccate base, 2 shorter ones to 2.5 × 0.4 cm, otherwise similar. **Nuts** ovoid, to 1.9 × 0.7 cm, prominently apiculate.

Distribution. Endemic in Borneo. Known only in Sabah from Kuala Penyu, Labuk Sugut and Sandakan districts (e.g., SAN 24279, SAN 50994 and the type).

Ecology. In mixed dipterocarp forest on soils overlying ultrabasic rock, at altitudes to 500 m. Critically endangered.

78. *Shorea monticola* P.S.Ashton

(Latin: *montis* = mountain, *-cola* = -dweller; the habitat)

(sect. *Brachypterae*, red meranti)

Gard. Bull. Sing. 19 (1962) 297, *op. cit.* (1964) 200, *op. cit.* (1968) 111, *op. cit.* (1982) 519; Meijer & Wood *op. cit.* 121; Burgess *op. cit.* 166; Anderson *op. cit.* (1980) 127; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al. op. cit.* (1996) 169. **Type:** Clemens 31885, Borneo, Sabah, Mt. Kinabalu, Penibukan (holotype K; isotype L).

Low emergent tree to 40 m tall, to 1.2 m diameter; bole cylindrical, straight; buttresses to 1.5 m tall, stout; crown densely evenly hemispherical, golden suffused from below. **Bark** pinkish to reddish brown, becoming shallowly cracked and thinly patchily oblong flaked; inner bark reddish brown; heartwood dark red, hard. *Young twig, leaf bud, petiole, venation, inflorescence, and parts of perianth exposed in bud at first yellowish buff-pubescent, persistent on leaf bud, corolla and inflorescence, sparsely persisting in calyx base into fruit, elsewhere caducous.* **Twigs** terete, minutely warty lenticellate, stout, *c.* 3 mm diameter apically. Leaf buds narrowly ovate, acute, falcate, 5–10 × 2–4 mm. **Stipules** unknown.

Leaves thickly coriaceous, drying golden- to chocolate-brown below, tawny-brown above; blade elliptic, 8–13 × 5–8 cm, base obtuse to broadly cuneate, apex with broad, short, acumen to 0.5 cm long; midrib obscure, sunken above, prominent and sharply ridged below; lateral veins 13–16 pairs, prominent below, arched; intercostal venation densely scalariform, slender, hardly elevated or obscure; petiole 2–2.5 cm long, stout. **Inflorescences** terminal or axillary; rachis terete, to 12 cm long, branchlets bearing to 12 flowers; bracteoles unknown. **Flowers:** buds to 7 × 3 mm; connectival appendage 2–3x as long as anther; ovary and stylopodium pyriform, style as long as ovary, glabrous. **Fruits:** calyx lobes unequal, 3 longer lobes to 7 × 1.5 cm, tapering only slightly above the saccate base, 2 shorter ones narrowly oblong, to 3.5 × 0.6, similar at base. **Nuts** ovoid, to 1.6 × 1 cm, shortly acute.

Vernacular names. Sabah—*seraya burung* (preferred name). Sarawak—*meranti gunung* (preferred name).

Distribution. Endemic in Borneo; throughout the northern mountain chain from W Kalimantan and G. Penrissen, W Sarawak, to Kinabalu and Trus Madi Range in northern Sabah. In Sabah recorded from Keningau, Kota Belud, Papar, Ranau, Sipitang, and Tambunan districts (e.g., *SAN 16704*, *SAN 16914*, *SAN 24058*, *SAN 50206*, and *SAN A 4353*) and in Sarawak from Bintulu, Kapit, Kuching, Lawas, Miri, Sri Aman, and Tatau districts (e.g., *S 4525*, *S 8816*, *S 19169*, *S 26524*, and *S 67522*).

Ecology. Locally common in the upper limits of upper dipterocarp forest, on organic soils on various substrates including basalt, at 600–1500 m altitude. Common in Kinabalu NP, and occurring in Mulu NP; probably not vulnerable.

79. *Shorea mujongensis* P.S.Ashton

(of the Mujong, Ulu Tinjar, Rajang, Sarawak)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 292, *op. cit.* (1968) 87, *op. cit.* (1982) 484; Anderson *op. cit.* (1980) 122; Kessler & Sidiyasa *op. cit.* 106; Newman *et al. op. cit.* (1996) 170. **Type:** *Ashton S 19038*, Borneo, Sarawak, Hose Mountains, Base of Bt. Temedu (holotype K; isotypes KEP, L, SAR).

Vast tree to 70 m tall, to 1.6 m diameter; crown dense, cauliflower-shaped; bole tall, cylindrical; buttresses stout, large, to 5 m tall and wide. **Bark** fawn-brown, deeply cracked and small thin oblong-flaky; dammar in dark brown coxcombs. *Young twig, leaf bud, parts of perianth exposed in bud, ovary, and nut buff-puberulent, caducous other than on inflorescence, corolla and ovary.* **Twigs** terete, rugulose, c. 2 mm diameter apically. Leaf buds minute. **Stipules** unknown. **Leaves** glabrous, chartaceous, drying greenish grey; blade ovate or elliptic, 6–14 × 2.5–5.5 cm, base obtuse or cuneate, margin narrowly revolute, apex with acumen to 0.8 cm long; midrib evident, flat above, prominent and terete below; lateral veins 8–13 pairs, slender but prominent below; petiole 1–1.6 cm long. **Inflorescences** terminal or axillary; rachis terete, to 6 cm long, singly branched. **Flowers:** buds to 6 × 4 mm; *stamens 15, connectival appendage as long as anther, glabrous; ovary and stylopodium pyriform, style short, glabrous.* **Fruits:** pedicel to 2 mm long; *calyx lobes unequal, 3 longer lobes to 7 × 1.5 cm, tapering to 4 mm wide above the narrowly saccate tuberculate base, 2 shorter ones to 4.5 × 0.7 cm, otherwise similar.* **Nuts** narrowly ovoid, to 2.2 × 0.7 cm.

Distribution. Endemic in Borneo. Recorded in Sabah from Beaufort, Sandakan and Tawau districts (e.g., *SAN 4946*, *SAN 15429* and *SAN 27425*) and in Sarawak from Kapit and Kuching districts (e.g., *S 19038*, *S 19993* and *S 29569*). Also occurring in E Kalimantan.

Ecology. Frequent, but very local in mixed dipterocarp forest, and apparently mostly on basic to weakly acid volcanic rocks, on clay soils, at altitudes to 1000 m. Endangered by land conversion.

80. *Shorea multiflora* (Burck) Symington

Plate 4D.

(Latin, *multi* = many, *flos* = a flower; the many-flowered inflorescence)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. S. S. 9 (1938) 330, *op. cit.* (1943) 54; Slooten *op. cit.* 3 (1956) 320; Browne *op. cit.* 63; Ashton *op. cit.* (1964) 157, *op. cit.* (1968) 87, *op. cit.* (1982) 475; Meijer & Wood *op. cit.* 76; Burgess *op. cit.* 218; Anderson *op. cit.* (1980) 122; PROSEA *op. cit.* 420; Coode *et al.* (eds.) *op. cit.* 80; Newman *et al.* *op. cit.* (1996) 171. **Basionym:** *Doona multiflora* Burck *op. cit.* (1887) 234. **Type:** *Teijsmann HB 12063*, Sumatra (holotype BO). **Synonyms:** *Richetia latifolia* F.Heim *op. cit.* (1891) 976; *R. acuminata* F.Heim *op. cit.* (1891) 979; *R. oblongifolia* F.Heim *op. cit.* (1891) 979; *R. penangiana* F.Heim *op. cit.* (1891) 980; *Balanocarpus penangianus* (F.Heim) King *op. cit.* 131; *Hopea multiflora* (Burck) Brandis *op. cit.* 60; *H. multiflora* (Burck) Brandis var. *venosa* Boerl., Cat. Hort. Bog. 2 (1901) 102; *Balanocarpus latifolius* (F.Heim) Brandis *op. cit.* 112, Merrill *op. cit.* (1921) 407; *B. acuminatus* (F.Heim) Brandis *op. cit.* 115, Merrill *op. cit.* (1921) 407; *B. sibogae* Boerl., *op. cit.* 112; *B. multiflorus* (Burck) Symington *op. cit.* (1933) 153.

Low emergent or main canopy tree, to 40 m tall, to 1 m diameter; bole straight, cylindrical; crown diffusely hemispherical, with many ascending branches; buttresses short, stout. **Bark** dappled fawn, becoming densely cracked and thin oblong-flaky. *Young twig, petiole, stipule outside, inflorescence, leaf bud, parts of perianth exposed in bud, and usually ovary and nut, densely greyish buff-puberulent, persistent except on twig, petiole and calyx; ovary and nut sometimes glabrous.* **Twigs** slender, terete, smooth, much-branched, c. 1 mm diameter apically. Leaf buds small, ovoid, c. 2 × 1.5 mm. **Stipules** narrowly lanceolate, to 6 × 2 mm, fugaceous. **Leaves** thinly coriaceous, drying yellowish green to yellowish brown; blade ovate-lanceolate, 4.5–7.5 × 2–3.5 cm, base cuneate, equal or subequal, sometimes with paired basal domatia, apex caudate, acumen to 1.5 cm long; midrib narrowly shallowly sunken above, somewhat raised below; lateral veins 8–10 pairs, very slender, barely elevated below, distant; intercostal venation subreticulate; petiole slender, 0.7–1 cm long. **Inflorescences** terminal or axillary; rachis terete, lax, to 16 cm, branchlets short, bearing to 9 flowers; bracteoles minute, fugaceous. **Flowers:** buds small, to 2.5 mm long; petals pale yellow, linear; stamens (10–)15, connective appendage 1½–2x as long as anther, ciliate distally; ovary and stylopodium ovoid-tapering, style glabrous, with stylopodium as long as ovary. **Fruits:** calyx lobes subequal, deltoid, acute, saccate, thickened, to 0.5 × 0.4 cm. **Nuts** obovoid, to 2 × 1.2 cm, mucronate, pubescent or glabrous and shiny.

Vernacular names. Sabah—*banjutan* (preferred name). Sarawak—*lun jantan* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo (common throughout the island). In Sabah known from Beaufort, Kota Kinabalu, Labuk Sugut, Lahad Datu, Semporna, Sipitang, and Tawau districts (e.g., *SAN 15081*, *SAN 15503*, *SAN 16464*, *SAN 38705*, and *SAN 131979*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Limbang, Lubok Antu,

Lundu, Marudi, Miri, and Tatau districts (e.g., *S 13761*, *S 23812*, *S 37845*, *S 46588*, and *S 69656*). Also occurring in Brunei (e.g., *BRUN 2630* and *BRUN 5649*) and SE Kalimantan (e.g., *bb. 34427* and *Church et al. 427*).

Ecology. The most abundant of the yellow merantis: in *kerangas*, and mixed dipterocarp forest on the yellow sands of the coastal hills and the inland shale ridges; also on organic soil over karst limestone; but rare or absent from moist clay slopes and the deep friable clays of basic volcanic rocks and calcareous shale, at altitudes to 900 m. In Sabah, common in Sepilok FR and recorded from Kinabalu NP, and in Sarawak, common in Bako, Kubah, Lambir and Mulu NPs; not vulnerable.

Notes. *Shorea hopeifolia* can be confused with this species (see there).

81. *Shorea myrionerva* Symington ex P.S.Ashton

(Greek, *myrio-* = countless; Latin, *nervus* = vein; the many-veined leaf blade)

(sect. **Mutica**, subsect. **Auriculatae**, red meranti)

Gard. Bull. Sing. 19 (1962) 299, *op. cit.* (1964) 201, *op. cit.* (1968) 111, *op. cit.* (1982) 530; Meijer & Wood *op. cit.* 122; Burgess *op. cit.* 183; Anderson *op. cit.* (1980) 127; Coode *et al.* (eds.) *op. cit.* 80; Newman *et al. op. cit.* (1996) 173. **Type:** *Drahn S 1519*, Borneo, Sarawak, Lawas district, Merapok (holotype KEP; isotype L).

Canopy, occasionally emergent tree, to 45 m tall, to 1.2 m diameter; bole often leaning; crown loose, generally oblong, the branches pendent with upturned twig endings and hanging leaves; buttresses to 1.5 m but usually less, stout. **Bark** at first smooth, becoming shallowly v-section fissured then powdery flaky, often moss-covered; inner bark yellowish brown; heartwood pinkish brown. *Twig and petiole persistently sparsely coarsely pale fulvous hispid; venation below and stipule more shortly so; inflorescence sparsely so towards base; midrib above, stipule and bracteole outside puberulent; leaf blade glabrescent; other parts glabrous.* **Twigs** terete, straight, few-branched, stout, *c.* 3 mm diameter apically. *Leaf buds imbedded in a loose group of bud scales, compressed, to 10 × 7 mm.* **Stipules** broadly hastate, subauriculate, subpersistent, to 17 × 7 mm. **Leaves** chartaceous, drying reddish brown; blade narrowly oblong, 12–22 × 4.5–9 cm, base obtuse, apex tapering abruptly, acumen to 0.8 cm long; midrib obscurely sunken above, prominent below; lateral veins 24–28 pairs, prominent, arched towards margin; intercostal venation slender, scalariform; petiole stout, 1.2–2 cm long. **Inflorescences** axillary (rarely terminal) to ramiflorous; rachis terete to ribbed on drying, lax, singly branched, the branchlets short bearing to 5 flowers; bracteoles ovate, obtuse, to 8 × 1.5 mm. **Flowers:** buds to 5 × 3 mm; petals dark red with pale margin; stamens 15, connectival appendage short, becoming reflexed; ovary and stylopodium narrowly conical to pyriform, style shorter than both, columnar, glabrous. **Fruits:** calyx lobes unequal, 3 longer lobes oblong, obtuse, chartaceous, to 17 × 2.5 cm, not tapering, the thickened base surrounded by prominent lateral auricles, 2 shorter ones linear-lobed, to 8 × 0.7 cm, saccate but not auriculate. **Nuts** ellipsoid, to 2.5 × 1.3 cm, pruinose, with *c.* 1.5 cm tapering style remnant.

Vernacular names. Sabah—*seraya urat banyak* (preferred name). Sarawak—*langgai sepit udang* (Iban), *meranti sepit udang* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort district (e.g., *KEP 80268* and *KEP 80269*) and in Sarawak from Bintulu, Kapit, Lawas, Limbang, Marudi, and Miri districts (e.g., *S 15591*, *S 23302*, *S 29353*, *S 31986*, and *S 43166*). Also occurring in Brunei (e.g., *BRUN 5200* and *BRUN 5218*) and Kalimantan (e.g., *Argent et al. 9492*).

Ecology. Locally common in mixed dipterocarp and riparian forest on moist clay soils on lower hillsides and the banks of both fast and sluggish rivers, at altitudes to 400 m. Occurring in Lambir and Mulu NPs; elsewhere vulnerable owing to the loss of its habitat.

82. *Shorea obovoidea* Slooten

(Latin, *obovoideus* = obovoid; the fruit)

(sect. *Richetioides*, subsect. *Richetioides*, yellow meranti)

Reinwardtia 3 (1956) 332; Ashton *op. cit.* (1968) 88, *op. cit.* (1982) 477; Anderson *op. cit.* (1980) 122; Newman *et al. op. cit.* (1996) 477. **Type:** *Egon SA 616*, Borneo, Sarawak, Semengoh FR (holotype KEP).

Main canopy tree, to 35 m tall, to 60 cm diameter; bole straight, cylindrical; crown small, dense, hemispherical; buttresses low, stilt roots sometimes present. **Bark** dark tawny-brown, smooth to shallowly patchily flaky. *Leaf bud, twig, inflorescence, parts of perianth exposed in bud, and petiole densely somewhat unevenly golden brown puberulent; venation below sparsely so; ovary and nut evenly buff-pubescent.* **Twigs** terete, slightly rough, c. 2 mm diameter apically. Leaf buds ovoid, acute, to 2 × 1 mm. **Stipules** unknown. **Leaves** coriaceous, drying tawny brown below, greyish brown above; blade elliptic, 5–13 × 1.7–4.5 cm, base cuneate, margin minutely revolute, apex subcaudate, acumen to 1.2 cm long; midrib narrowly evident but furrowed above, prominent below; lateral veins 8–10 pairs, arched, slender but prominent below; intercostal venation subreticulate, elevated below; petiole slender, 0.5–1.1 cm long. **Inflorescences** terminal or axillary; rachis terete, singly branched, branchlets bearing to 5 flowers; bracteole minute, deltoid, acute, c. 1 mm long, fugaceous. **Flowers:** buds small, to 3 × 1 mm; corolla cream; stamens 15, connective appendage slightly longer than anther; ovary ovoid, without stylopodium, style columnar, stout, slightly shorter than ovary, puberulent in the basal half. **Fruits:** pedicel c. 1 mm long; calyx lobes subequal, ovate, acute, relatively thin, hardly saccate, to 1.2 × 0.9 cm. **Nuts** ellipsoid, to 2.3 × 1.6 cm, acute.

Distribution. Endemic in Borneo. Known in Sarawak from Kuching, Kapit and Samarahan districts (e.g., *S 9102*, *S 11072*, *S 14368*, *S 15225*, and *S 67572*). Also occurring in SE Kalimantan (e.g., *bb. 21243*).

Ecology. Very local in mixed dipterocarp forest, on leached sandy clay soil on low hills, at altitudes to 300 m. Endangered by forest conversion.

83. *Shorea obscura* Meijer

(Latin, *obscurus* = obscure; originally confused with *S. atrinervosa*)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Act. Bot. Neerl. 12 (1963) 333; Meijer & Wood *op. cit.* 184; Ashton *op. cit.* (1964) 142, *op. cit.* (1968) 74, *op. cit.* (1982) 457; Burgess *op. cit.* 203; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 432; Coode *et al.* (eds.) *op. cit.* 80; Newman *et al.* *op. cit.* (1998) 193. **Lectotype** (designated here): *G.H.S. Wood SAN 15166*, Borneo, Sabah, Bt. Sipitang (hololectotype K; isolectotypes KEP, L, SAN).

Emergent tree, to 60 m tall, to 1.3 m diameter; bole tall, straight; crown diffuse cauliflower-shaped, pale from below; buttresses to 6 m tall, thin. **Bark** greyish to reddish brown, closely cracked and evenly oblong flaky. *Leaf venation below, petiole, twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipule, bracteole, ovary, and fruit densely pale buff-brown puberulent, caducous except on inflorescence, buds, stipule and bracteole.* **Twigs** terete, slender, 1.5–2 mm diameter apically. Leaf buds ovoid to falcate, 2–4 × 1.5–2.5 mm. **Stipules** oblong, acute, to 7 × 2.5 mm, caducous. **Leaves** coriaceous, cream lepidote below with the veins drying darker brown, drying greyish brown above; blade ovate-lanceolate, 7–12 × 2.5–5 cm, base cuneate, apex with slender acumen to 1 cm long; midrib evident, flat or elevated above, more prominently so below; lateral veins 7–9 pairs, arched, distinctly raised below, intercostal venation scalariform, slender, hardly elevated, obscure; petiole slender, 1.2–2 cm long. **Inflorescences** terminal or axillary; rachis terete, to 12 cm long, singly branched, branchlets bearing to 5 flowers; bracteoles elliptic-ovate, acute, c. 3 mm long, fugaceous. **Flowers:** buds to 6 × 2 mm; *petals bright pink, cream at margin; stamens 35–45, filaments and anthers glabrous, connectival appendage almost as long as anther, setose; ovary and stylopodium ovoid, tapering into the short glabrous style.* **Fruits:** calyx lobes unequal, 3 longer lobes to 10 × 2 cm, tapering 5 mm broad above the saccate base, 2 shorter ones oblong, lobed, to 5 × 0.5 cm, similar at base. **Nuts** globose to ellipsoid, to 1.2 × 0.9 cm, abruptly apiculate.

Vernacular names. Sabah—*selangan batu tanduk* (preferred name). Sarawak—*selangan batu padi* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Kota Kinabalu (Gaya Is.), Ranau, Sipitang, Tawau, and Tuaran districts (e.g., *SAN 15166*, *SAN 16772*, *SAN 20651*, *SAN 22370*, and *SAN 99400*) and in Sarawak from Belaga, Limbang, Lundu, and Tatau districts (e.g., *S 1684*, *S 10179*, *S 25011*, *S 28236*, and *S 32331*). Also occurring in Brunei (e.g., *BRUN 5438* and *Prance 30589*) and SE Kalimantan (e.g., *bb. 16966* and *bb. 22911*).

Ecology. Locally frequent in mixed dipterocarp forest on leached sandy clay and well-drained clay soils, especially on spurs and ridges, probably most abundant at 600–800 m altitude, occasionally to 1400 m in upper dipterocarp forest. Occurring in Kinabalu and Mulu NPs; elsewhere vulnerable.

84. *Shorea ochracea* Symington

Fig. 26.

(Latin, *ochraceus* = the colour of ochre, warm yellow; the leaf undersurface)

(sect. **Anthoshorea**, white meranti)

Gard. Bull. S. S. 8 (1935) 285; Masamune *op. cit.* 495; Browne *op. cit.* 158; Ashton *op. cit.* (1964) 165, *op. cit.* (1968) 94, *op. cit.* (1982) 492; Meijer & Wood *op. cit.* 57; Burgess *op. cit.* 159; Anderson *op. cit.* (1980) 123; PROSEA *op. cit.* 412; Coode *et al.* (eds.) *op. cit.* 80; Newman *et al.* *op. cit.* (1996) 174. **Lectotype** (designated here): *Spurway S 167*, Borneo, Sarawak, Baleh, Merirai (hololectotype KEP).

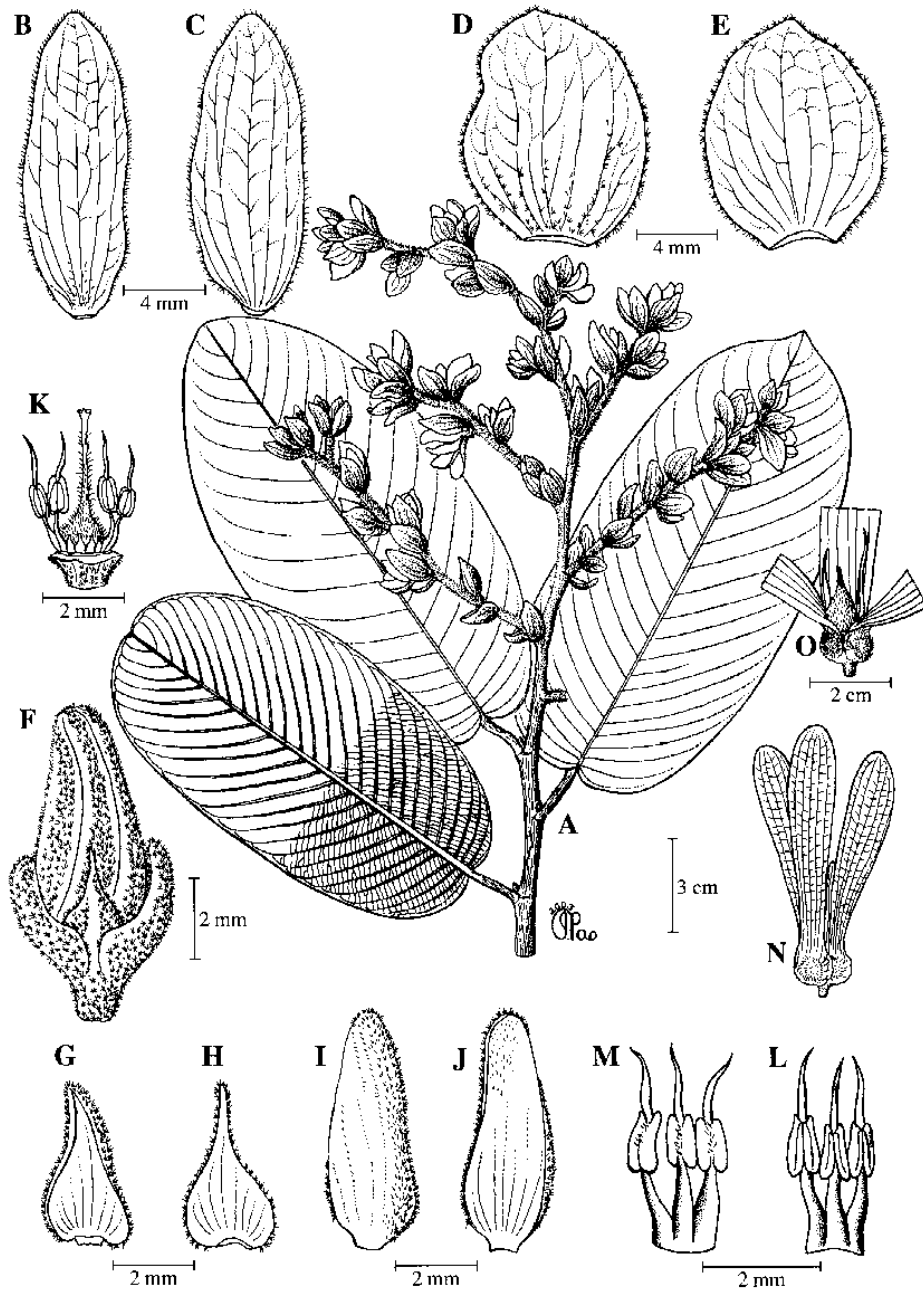


Fig. 26. *Shorea ochracea*. A, leafy twig with young shoots; B, abaxial view of bract; C, adaxial view of bract; D, abaxial view of bracteole; E, adaxial view of bracteole; F, flower bud; G, adaxial view of outer sepal; H, adaxial view of inner sepal; I, abaxial view of petal; J, adaxial view of petal; K, gynoecium and stamens; L, adaxial view of stamens; M, abaxial view of stamens; N, fruit; O, fruit with the nut partially exposed. (A from *S* 32359, B–O from *BRUN* 3274.)

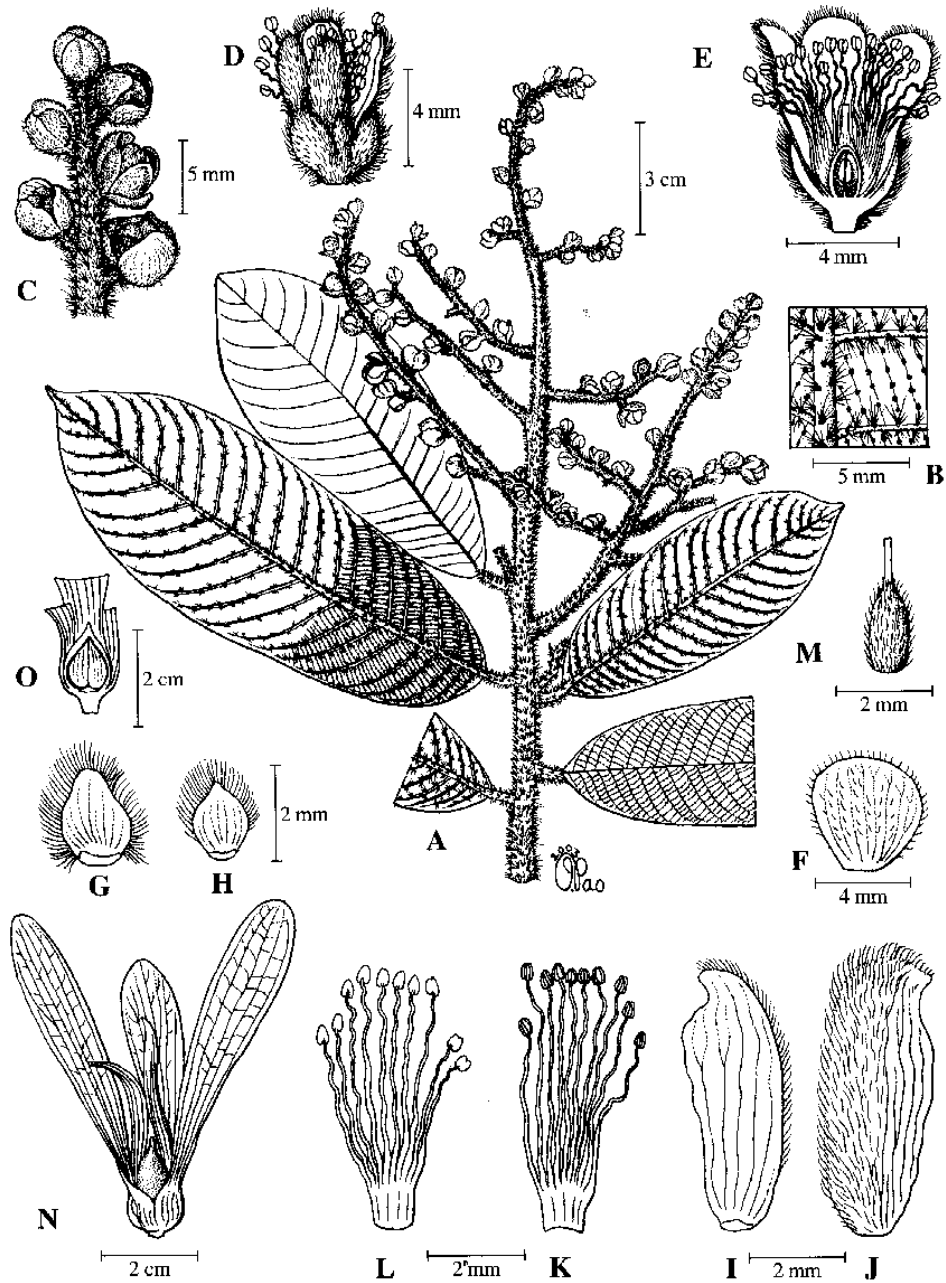


Fig. 27. *Shorea ovals*, subsp. *ovalis* (N–O) and subsp. *sarawakensis* (A–M). A, flowering leafy twig; B, detail of venation and indumentum on lower leaf surface; C, portion of inflorescence; D, opening flower; E, longitudinal section of open flower; F, abaxial view of bract; G, adaxial view of outer sepal; H, adaxial view of inner sepal; I, adaxial view of petal; J, abaxial view of petal; K, adaxial view of stamens; L, abaxial view of stamens; M, gynoecium; N, fruit; O, longitudinal section of fruit. (A–M from S 15159, N–O from SAN 16474.)

Large emergent tree, to 50 m tall, to 1.3 m diameter; bole straight or malformed; crown irregularly hemispherical, dense, large-leaved, pale yellowish from below; buttresses to 1.5 m tall, very stout. **Bark** mottled pale brown, becoming deeply prominently irregular-section fissured and eventually crumbly flaky, dark chocolate-brown; inner bark pale yellowish brown and cream-yellow laminated; dammar pale cream-yellow, as smears on bole. *Twig, leaf bud, inflorescence, parts of perianth exposed in bud, fruit calyx, stipule, bracteole, and petiole densely persistently rufous brown or greenish yellow powdery pubescent, partially caducous, sparse on leaf below; ovary and nut densely evenly cream pubescent.* **Twigs** terete, with horizontal or ascending stipule scars, stout, 4–5 mm diameter apically. *Leaf buds globose to ovoid, obtuse, 3–6 × 3–5 mm.* **Stipules** elliptic, obtuse, to 20 × 15 mm, caducous. **Leaves** thickly coriaceous and somewhat turned up along the midrib, bright yellow lepidote below (mature trees); blade broadly elliptic-oblong, 12–18 × 7–10 cm (larger in juveniles), base cordate, apex with broad acumen to 0.5 cm long; midrib obscure, sunken, above, prominently terete below; lateral veins 25–30 pairs, dense, arched, prominent below; intercostal venation densely scalariform, obscure; petiole stout, 1.3–2 cm long. **Inflorescences** terminal or axillary; rachis terete, lax, to 10 cm long, branchlets bearing to 8 flowers; bracteoles large, elliptic, obtuse, subpersistent, to 20 × 10 mm. **Flowers:** buds to 8 × 3 mm; *stamens 15, anther oblong, tapering, connectival appendage somewhat longer than anther; ovary ovoid, without stylopodium, style glabrous except towards base, as long as ovary.* **Fruits:** calyx lobes unequal, 3 longer lobes to 10 × 2 cm, oblong, tapering to 1 cm above the narrowly auriculate centrally thickened base, 2 shorter ones to 4.5 × 0.5 cm, unequal, otherwise similar. **Nuts** ovoid, to 1.5 × 1 cm, with to 2.5 mm style remnant.

Vernacular names. Sabah—*melapi daun besar* (preferred name). Sarawak—*raruk* (Iban).

Distribution. Endemic in Borneo. In Sabah recorded from Beaufort, Kinabatangan, Sipitang, and Tawau districts (e.g., *SAN 15229, SAN 16813, SAN 19537, SAN 27974, and SAN 93773*) and in Sarawak from Belaga, Bintulu, Kapit, Limbang, and Miri districts (e.g., *S 15117, S 29685, S 32359, S 46447, and S 69173*). Also occurring in Brunei (e.g., *BRUN 3274 and BRUN 5434*) and W and NE Kalimantan (e.g., *Arifin Berau 1092 and Kessler et al. Berau 891*).

Ecology. Scattered, usually as isolated individuals, in mixed dipterocarp forest on undulating land and hills, on sandy clay and clay soils, at altitudes to 750 m. Occurring in Lambir and Mulu NPs; elsewhere vulnerable owing to both land conversion and logging.

85. *Shorea ovalis* (Korth.) Blume (Latin, *ovalis* = oval; the leaf shape)

Fig. 27.

(sect. **Ovalis**, red meranti)

Mus. Bot. Lugd.-Bat. 2 (1852) 33; Merrill *op. cit.* (1921) 406; Symington *op. cit.* (1939) 370, *op. cit.* (1943) 80; Masamune *op. cit.* 495; Browne *op. cit.* 132; Ashton *op. cit.* (1963) 274, *op. cit.* (1982) 548; Meijer & Wood *op. cit.* 125 p.p.; Burgess *op. cit.* 154, 183; PROSEA *op. cit.* 398; Kessler & Sidiyasa *op. cit.* 106; Newman *et al. op. cit.* (1996) 176. **Basionym:** *Vatica ovalis* Korth., *Kruidk.* (1841) 73. **Type:** *Korthals s.n.* (= *RHL Sheet No. 902146618*), Borneo, Kalimantan, Prarawing (holotype L). **Synonyms:** *Vatica eximia* Miq., *op. cit.* 486; *V. sublacunosa* Miq., *op. cit.* 486; *Hopea aspera* de Vriese *op. cit.* 28; *Shorea eximia* (Miq.) Scheff., *Nat. Tijds. Ned. Ind.* 31 (1870) 349; *S. eximia* (Miq.) Scheff. var. *angustifolia* Burck *op. cit.* (1887) 218; *S. sublacunosa* (Miq.) Scheff., *op. cit.* 350.

Large emergent tree, to 50 m tall, to 1.3 m diameter; bole tall, cylindrical; crown hemispherical, rather even, with many ascending branches; buttresses to 1.5 m tall, stout. **Bark** pale pinkish brown and grey mottled, becoming shallowly v-section fissured, eventually patchily powdery flaky; inner bark pale reddish brown; heartwood pink, relatively light. **Twig, inflorescence, parts of perianth exposed in bud, stipule, bracteole, petiole, and leaf below densely persistently scabrid-puberulent to coarsely pubescent or tufted tomentose or sparsely so; ovary and nut densely evenly pubescent; fruit calyx sparsely puberulent.** **Twigs** terete, straight, sparingly branched, stout, c. 3 mm diameter apically; stipule scars cuneate, slightly ascending. Leaf buds ovoid, obtuse, to 8 × 6 mm. **Stipules** ovate, acute, prominently veined, to 13 × 7 mm, subpersistent. **Leaves** coriaceous, weakly blistered in juveniles, drying rich reddish brown below, pink-mauve above; blade narrowly oblong-ovate, 10–18 × 3–7 cm, or narrowly oblong, 12–17 × 2–4.5 cm, base obtuse, margin more or less narrowly revolute, apex with narrow acumens, to 0.8 cm long; midrib narrowly evident but furrowed above, prominent below; lateral veins (20–)22–25 pairs, prominent below, arched, dense; intercostal venation distinctly elevated, scalariform; petiole 0.7–0.9 cm long. **Inflorescences** terminal or axillary; rachis rigid, to 18 cm long, branchlets compact bearing to 8 flowers; bracteole broadly elliptic, obtuse, to 8 × 6 mm, concave round bud. **Flowers:** buds broadly ovoid to subglobose, to 5 mm long; petals cream, pink-tinged at base; stamens 50–70, connectival appendage short, vestigial; ovary and stylopodium narrowly conical, style short, cylindrical, glabrous. **Fruits:** calyx lobes unequal, 3 longer lobes to 11 × 1.4 cm, tapering to 7 mm above the saccate base, 2 shorter ones linear-lobed, to 6 × 0.4 cm, similar at base. **Nuts** ovoid, to 2.2 × 1.3 cm, with to 2.5 mm tapering style remnant.

Vernacular names. Sabah—*seraya kepong* (preferred name), Sarawak—*meranti kepong* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo.

Ecology. Frequent, sometimes common in mixed dipterocarp forest on fertile well-structured clay soils, on low hills, at altitudes to 500 m.

Notes. Two species, viz. subsp. *ovalis* and subsp. *sarawakensis*, are recognised.

Key to subspecies

Twigs and inflorescences densely persistently scabrid-puberulent to coarsely pubescent. Leaf blade narrowly oblong-ovate, 10–18 × 3–7 cm, densely scabrid-pubescent below; margin more or less revolute.....

subsp. **ovalis**

Absent from Brunei, Sarawak and W Sabah but widespread in E Sabah and known from Kinabatangan, Sandakan and Tawau districts (e.g., *SAN 16474*, *SAN 20906*, *SAN 23973*, *SAN 39114*, and *SAN 63079*). Also occurring in E and SE Kalimantan (e.g., *Ambriansyah & Arifin Berau 1072*, *bb. 34377*, *Meijer 2198*, and *Meijer 2222*). Ecology as the species. Occurring in Sepilok FR; elsewhere vulnerable owing to land conversion.

Twigs and inflorescences prominently tufted tomentose, tufts to 3 mm long. Leaf blade narrowly oblong, 12–17 × 2–4.5 cm, glabrous below; margin prominently revolute.....

subsp. **sarawakensis** P.S. Ashton

(of Sarawak)

Gard. Bull. Sing. 20 (1963) 275, *op. cit.* (1968) 111, *op. cit.* (1982) 549; Meijer & Wood *op. cit.* 126, *p.p.*; Burgess *op. cit.* 154, 183; Anderson *op. cit.* (1980) 127; PROSEA *op. cit.* 398; Coode *et al.* (eds.) *op. cit.* 80; Newman *et al.* *op. cit.* (1996) 177. Type: *Ashton BRUN 3281*, Borneo, Brunei, Andalau FR (holotype K; isotype KEP).

Endemic in Borneo; recorded in Sabah from Beaufort, Kota Merudu, Lahad Datu, Ranau, Sandakan, Semporna, Sipitang, and Tawau districts (e.g., *SAN 15182*, *SAN 16364*, *SAN 17850*, *SAN 18301*, and *SAN 63754*) and in Sarawak from Kuching, Lundu and Miri districts (e.g., *S 15159*, *S 29472*, *S 37800*, *S 46492*, and *S 49957*). Also occurring in Brunei (e.g., *BRUN 3281* and *S 1652*) and NW Kalimantan (e.g., *Suzuki K 9758*). As subsp. *ovalis*, but usually as scattered individuals, on leached clay and sandy clay soils. Occurring in Kubah, Lambir and Mulu NPs; not vulnerable.

86. *Shorea ovata* Dyer ex Brandis

(Latin, *ovatus* = ovate; the leaf shape)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

J. Linn. Soc. Bot. 31 (1895) 91; Merrill *op. cit.* (1921) 406; Symington *op. cit.* (1933) 140, *op. cit.* (1943) 82; Masamune *op. cit.* 495; Browne *op. cit.* 148; Ashton *op. cit.* (1964) 230, *op. cit.* (1968) 112, *op. cit.* (1982) 545; Meijer & Wood *op. cit.* 127; Burgess *op. cit.* 166; Anderson *op. cit.* (1980) 127; PROSEA *op. cit.* 398; Coode *et al.* (eds.) *op. cit.* 179. **Lectotype** (designated here): *Curtis 201*, Peninsular Malaysia, Penang Hill (hololectotype K). **Synonyms**: *Shorea plagata* Foxw., *op. cit.* (1918) 192; *S. agsaboensis* W.L. Stern, *Brittonia* 17 (1965) 36.

Main canopy or low emergent tree, occasionally to 50 m tall, to 1.4 m diameter but usually shorter; bole straight, cylindrical; crown hemispherical to cauliflower-shaped, usually with many radiating branches; buttresses to 1 m tall, usually short, stout. **Bark** at first mottled fawn, dark brown and ochreous reminiscent of *Calophyllum*, becoming deeply closely v-section fissured; inner bark deep pink to dark meat-red; heartwood dark reddish brown. *Young twig, inflorescence, parts of calyx exposed in bud, leaf bud, stipule, bracteole, petiole, midrib above, and leaf below densely persistently evenly ochreous to rust-puberulent, scabrous on inflorescence and venation below, sparsely so on fruit calyx; nut yellowish brown pubescent.* **Twigs** much-branched, terete, slender, *c.* 1 mm diameter apically; stipule scars short, descending. Leaf buds ovoid, obtuse, 3–6 × 1.5–3 mm. **Stipules** ovate, subacute, to 13 × 5 mm, caducous. **Leaves** *coriaceous, drying ashen-brown below, mauve-brown above; blade broadly ovate, 4–8 × 2.5–4.5 cm, base subequal, obtuse, margin subrevolute, apex with narrow acumen to 1 cm long; midrib obscurely sunken above, prominent below; lateral veins 8–10 pairs, prominent below, arched, with small pilose axillary domatia; intercostal venation hardly elevated, slender, densely scalariform; petiole 1–1.5 cm long.* **Inflorescences** terminal or axillary; rachis terete or slightly compressed, to 11 cm long, branchlets bearing to 8 flowers; bracteoles oblong, obtuse, to 3.5 × 2 mm. **Flowers**: petals pale pink with cream margin; *stamens 15, or 10 by abortion of outer 5, connectival appendage short, becoming reflexed; ovary ovoid, without stylopodium, tapering into the short glabrous style.* **Fruits**: *calyx lobes unequal, 3 longer lobes to 5.5 × 1 cm, tapering to 4 mm above the saccate base, 2 shorter ones linear-lobed, to 3 × 0.3 cm, otherwise similar.* **Nuts** broadly ovoid, to 1.1 × 0.8 cm; style remnant tapering, to 2.5 mm long.

Vernacular names. Sabah—*seraya punai bukit* (preferred name). Sarawak—*meranti pitis* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and the Philippines (Mindanao). Widespread in Borneo though not in the south. In Sabah recorded from Kota Belud, Sipitang and Tambunan districts (e.g., *KEP 80407*, *KEP 80433*, *SAN 15130*, and *SAN 16263*) and in Sarawak from Bintulu, Kuching, Lundu, Miri, Samarahan, and Simunjan districts (e.g., *S 15240*, *S 15542*, *S 17046*, *S 27765*, and *S 32052*). Also occurring in Brunei (e.g., *BRUN 551* and *Niga NN 227*).

Ecology. Locally common, in mixed dipterocarp forests on yellow sandy soil in the lowlands; also in the ecotone to *kerangas*, and in upper dipterocarp forest, at 600–1000 m altitude. Common in Bako NP and frequent in Kinabalu, Kubah, Lambir and Mulu NPs; elsewhere vulnerable in the lowlands owing to land conversion.

87. *Shorea pachyphylla* Ridl. ex Symington

(Greek, *pachy-* = thick, *phullon* = leaf; the leathery leaf)

(sect. **Brachyptera**, red meranti)

J. Malay. Br. Roy. As. Soc. 19 (1941) 163; Browne *op. cit.* 148; Anderson *op. cit.* (1963) 159, *op. cit.* (1980) 128; Ashton *op. cit.* (1964) 205, *op. cit.* (1968) 112, *op. cit.* (1982) 511; PROSEA *op. cit.* 399; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al.* *op. cit.* (1996) 180. **Type:** *Haviland 2228*, Borneo, Sarawak, near Kuching (holotype SING; isotype L).

Emergent tree, to 45 m tall, to 1.5 m diameter; bole cylindrical, often tapering; crown dense, irregularly hemispherical with a few large twisted branches; buttresses to 2.5 m tall, prominent, stout. **Bark** pinkish to mauve-brown, becoming deeply v-section fissured, the intervening ridges thinly flaky; inner bark yellowish brown; heartwood coffee-coloured, rather hard. *Exposed young parts evenly densely tawny puberulent, caducous on all but leaf bud, inflorescence and petal outside, sparse on stipule and bracteole; other parts glabrous.* **Twigs** terete to slightly compressed, ridged, stout, c. 4 mm diameter apically; *stipule scars horizontal, long to amplexicaul.* Leaf buds narrowly ovoid to broadly falcate, 5–8 × 2–4 mm. **Stipules** lanceolate, to 20 × 7 mm, fugaceous. **Leaves** *thickly coriaceous, shiny and drying rich tawny below, greyish brown above; blade broadly ovate to suborbicular, 10–20 × 9–16 cm, base obtuse or broadly cuneate, margin slightly but distinctly revolute, apex obtuse or with broad acumen to 0.5 cm long; midrib obscure, sunken above, stoutly prominent below; lateral veins 7–9 pairs, well-spaced, arched at margin, stoutly prominent below; intercostal venation slender, hardly elevated, densely scalariform; petiole 4–6 cm long, stout, hardly geniculate.* **Inflorescences** terminal or axillary; rachis compressed, to 11 cm long, doubly branched, branchlets bearing to 5 flowers; bracteoles ovate, acute, to 3 × 2 mm. **Flowers:** buds to 6 × 4 mm; *stamens 15, connectival appendage 3–4x as long as anther; ovary ovoid, without distinct stylopodium, style as long as ovary, filiform.* **Fruits:** calyx glabrous, lobes unequal, 3 longer lobes to 16 × 3.5 cm, tapering to c. 7 mm broad above the to 2 × 1.5 cm saccate base, 2 shorter ones to 8 × 0.6 cm, otherwise similar. **Nuts** ovoid, pruinose, to 3.3 × 1.8 cm, with c. 1.5 mm long tapering style remnant.

Vernacular names. Sarawak—*kerukup* (Malay), *meranti kerukup* (preferred name).

Distribution. Endemic in Borneo. Widespread where its habitat occurs; unknown from Sabah. In Sarawak recorded from Bintulu, Kuching, Lundu, Marudi, Miri, Samarahan, Sibuan and Tatau districts (e.g., *FMS 7173*, *S 9316*, *S 11245*, and *S 11753*). Also occurring in

Brunei (e.g., *BRUN 695*, *BRUN 5531*, *FMS 30556*, *Niga NN 116*, and *S 7882*) and Kalimantan (e.g., *bb. 17310*).

Ecology. Locally common, in mixed peat swamp forest and in *kerangas* forest on poorly drained podsols. Endangered by forest conversion.

88. *Shorea palembanica* Miq.
(of Palembang, Sumatra)

(sect. **Brachyptera**, red meranti)

Fl. Ned. Ind., Suppl. (1861) 487; Symington *op. cit.* (1933) 141, *op. cit.* (1943) 83; Masamune *op. cit.* 496; Browne *op. cit.* 141; Ashton *op. cit.* (1968) 112, *op. cit.* (1982) 513; Anderson *op. cit.* (1980) 128; PROSEA *op. cit.* 181; Newman *et al. op. cit.* (1996) 181. **Type:** *Teijsmann s.n.* (= *Herb. Utrecht no. 35907*), Sumatra, Palembang (holotype U). **Synonyms:** *Shorea aptera* Burck *op. cit.* 210; *S. brachyptera* F.Heim *op. cit.* (1891) 571; *Pachychlamys beccarianus* Dyer *ex Brandis op. cit.* 77; *P. brachypterus* Dyer *ex Brandis op. cit.* 77.

Main canopy tree, rarely large, to 45 m tall, to 1.3 m diameter; bole often leaning or misshapen, often mossy; crown dense, irregularly oblong to hemispherical; buttresses stout. **Bark** dark greyish brown, overall smooth, at first hoop-marked, becoming irregularly cracked and shallowly patchily flaky; inner bark pinkish brown to cream at cambium; heartwood pale pink, fairly soft. *Young twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipule and bracteole outside, ovary and nut, and midrib above densely evenly pale buff-puberulent; stipule and bracteole inside, petiole and leaf venation below sparsely so, more or less glabrescent. Twigs compressed, c. 2 mm diameter apically.* Leaf buds lanceolate-falcate, to 13 × 6 mm. **Stipules** lanceolate, to 15 × 3 mm, caducous. **Leaves** chartaceous, drying dark chocolate-brown below, purplish brown above, undulating; blade ovate to oblong, 8–25 × 4–10 cm, base broadly cuneate to subcordate, apex with broad acumen to 1 cm long; midrib slender but evident, shallowly furrowed or flat above, prominent below; lateral veins 12–16 pairs, slender but prominent below; intercostal venation scalariform, slender, dense; petiole 1.4–2.5 cm long. **Inflorescences** terminal or axillary; rachis terete, doubly branched, branchlets bearing to 10 flowers; bracteoles ovate, acute, to 4 × 2 mm, caducous. **Flowers:** buds to 7 × 3 mm; petals pale yellow; stamens 15, connectival appendage c. 2x as long as anther; ovary ovoid, without stylopodium, style c. 2x as long as ovary, filiform, pubescent in the basal quarter. **Fruits:** pedicel to 2 mm long; calyx lobes unequal but short, 3 longer lobes lorate, to 5 × 0.7 cm above the saccate base, 2 shorter ones to 3 cm long, otherwise similar. **Nuts** ovoid, to 3.5 × 2.5 cm, apiculate.

Vernacular name. Sarawak—*engkabang asu* (preferred name).

Distribution. E Sumatra, Peninsular Malaysia and Borneo. In Sabah known from Beluran, Sandakan, Semporna, and Tawau districts (e.g., *SAN 9264*, *SAN 24288* and *SAN 32503*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lundu, Marudi, Miri, Samarahan, Sibuluan, Simunjan, and Tatau districts (e.g., *S 15587*, *S 22289*, *S 23384*, *S 53529*, and *S 76331*). Also occurring in Kalimantan (e.g., *bb. 29273*, *Endert 4935* and *Kostermans 12686*). Vulnerable owing to forest conversion.

Ecology. Locally frequent on silty floodplains and hanging over the banks of sluggish rivers. Occurring in Kubah NP; elsewhere vulnerable owing to land conversion.

Uses. A minor source of illipe nuts.

89. *Shorea pallidifolia* P.S. Ashton

(Latin, *pallidus* = pale, *folius* = leaf; the pale leaf undersurface)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Gard. Bull. Sing. 22 (1967) 296, *op. cit.* (1968) 113, *op. cit.* (1982) 551; Anderson *op. cit.* (1980) 128; Newman *et al. op. cit.* (1986) 182. **Type:** *Rashid S 16054*, Borneo, Sarawak, Bako NP (holotype K; isotypes KEP, L).

Canopy tree, to 40 m tall, to 80 cm diameter; bole cylindrical, short; crown conical to hemispherical, pale from below, dense; buttresses to 1.5 m long, stout. **Bark** pale pinkish to greyish brown, becoming shallowly v-section fissured; inner bark pale yellowish brown, faintly laminated; heartwood pinkish brown, quite hard. *Twig, leaf bud, stipule, inflorescence, parts of calyx exposed in bud, petiole, and venation below persistently pale yellowish brown scabrid-pubescent; outside of petal and nut evenly cream-buff pubescent.* **Twigs** compressed and ribbed at first, stout, *c.* 6 × 3 mm apically. Leaf buds broadly ovoid-conical, compressed, to 10 × 8 mm. **Stipules** oblong, obtuse, to 7 × 5 mm. **Leaves** *thickly coriaceous, cream lepidote below (mature trees); blade broadly oblong to ovate or obovate, 13–22 × 7–13 cm, base obtuse or subcordate, apex with short acumen; midrib obscure and sunken above, prominent below; lateral veins 12–19 pairs, prominent below, arched; intercostal venation densely scalariform, hardly elevated below; petiole stout, 2–3.5 cm long.* **Inflorescences** axillary; rachis terete, shortly singly branched, branchlets bearing to 4 flowers. **Flowers:** buds to 6 × 4 mm; petals pinkish yellow; stamens 15; ovary ovoid, without stylopodium, glabrous, with somewhat longer columnar glabrous style. **Fruits:** pedicels *c.* 1 mm long; *calyx lobes unequal, 3 longer lobes to 7 × 1.5 cm, tapering to c. 7 mm above the saccate base, 2 shorter ones linear-lobed, to 4 × 0.3 cm, similar but smaller at base.* **Nuts** ovoid, to 1.2 × 0.9 cm, shortly apiculate.

Distribution. Endemic in Borneo. Known in Sarawak from Kuching, Lundu and Serian districts (e.g., *KEP 79314, S 6161, S 9315, S 13357, and S 22768*); also observed but not collected in the low hills between the lower Mukah and Balingian rivers. Also occurring in W Kalimantan north of Sg. Kapuas.

Ecology. Very local, rare overall, in *kerangas* on white sand terraces and over sandstone. Locally frequent in Bako NP; endangered elsewhere.

90. *Shorea parvifolia* Dyer

(Latin, *parvus* = small, *folius* = leaf)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Fl. Br. Ind. 1 (1874) 306; Slooten *op. cit.* (1929) 203; Symington *op. cit.* (1933) 137, *op. cit.* (1943) 85; Masamune *op. cit.* 496; Browne *op. cit.* 141; Ashton *op. cit.* (1963) 277, *op. cit.* (1964) 206, *op. cit.* (1968) 113, *op. cit.* (1982) 546; Meijer & Wood *op. cit.* 128; Burgess *op. cit.* 155, 183; Anderson

op. cit. (1980) 128; PROSEA *op. cit.* 399; Kessler & Sidiyasa *op. cit.* 107; Newman *et al. op. cit.* (1996) 183. **Type:** *Maingay 1577* (= *Kew Distr. No. 206*), Peninsular Malaysia, Malacca (holotype K; isotype L). **Synonyms:** *Shorea scutulata* King *op. cit.* 110; *S. gentilis* Parijs *op. cit.* 244.

Large emergent tree, to 65 m tall, to 2 m diameter; bole tall, cylindrical; crown immense, cauliflower-shaped; buttresses to 4 m tall, stout. **Bark** at first remaining smooth, dappled dark brown mottled with grey, becoming shallowly or deeply v-section fissured, chocolate-brown, eventually crumbly flaky towards the base; inner bark rich reddish brown; heartwood deep pink to reddish brown; dammar smears cream, abundant. *Young twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipule, bracteole, petiole and midrib above evenly pale brown puberulent, persistent or glabrous; ovary and nut buff pubescent.* **Twigs** terete, c. 2 mm diameter apically. Leaf buds ovoid, obtuse, to 3 × 2 mm. **Stipules** broadly ovate, obtuse, to 6 × 4 mm, caducous. **Leaves** thinly coriaceous, drying chocolate-brown below, mauve-brown above, veins glabrous or sparsely scabrid-pubescent below; *blade broadly ovate, ovate, or elliptic, 5–11 × 2.5–6 cm, base obtuse, cordate, or cuneate, sometimes with one or more pairs of opposite glabrous pale pit- or scale-like basal domatia, apex with acumen to 1 cm long; midrib obscure, sunken above, slender but prominent below; lateral veins 10–13 pairs, slender, hardly elevated or prominent below; intercostal venation slender, densely scalariform, hardly elevated; petiole 1–1.5 cm long.* **Inflorescences** terminal or axillary; rachis slender, terete or slightly compressed, to 12 cm long, branchlets short, bearing to 8 dense flowers; bracteole elliptic-oblong, obtuse, to 6 × 3 mm. **Flowers:** buds to 7 × 5 mm; petals cream suffused with pink at base; stamens 15, connectival appendage short, slender, becoming reflexed; ovary and stylopodium ovoid-conical, surmounted by short glabrous style. **Fruits:** *calyx lobes unequal, 3 longer lobes chartaceous, to 9 × 1.5 cm, tapering to c. 4 mm above the saccate base, 2 shorter ones linear-lobed, to 3.5 × 0.2 cm, similar at base.* **Nuts** ovoid, to 1.4 × 0.7 cm, with to 2.5 mm tapering style remnant.

Vernacular names. Sabah—*seraya punai* (preferred name). Sarawak—*meranti sarang punai* (preferred name).

Distribution. Peninsular Thailand (Pattani), Peninsular Malaysia, Sumatra, and Borneo.

Ecology. Common where it occurs, in mixed dipterocarp forest on yellow clay soils, usually well-drained, on shales and intermediate and acid volcanic rocks, but rare on base rich rocks such as basalt.

Notes. Two subspecies, *viz.* subsp. *parvifolia* and subsp. *velutina*, are recognised.

Key to subspecies

Bark becoming shallowly v-section fissured. Leaf blade broadly ovate, base obtuse or cordate, margin slightly revolute; veins glabrous and hardly elevated below.....
 subsp. **parvifolia**
 Sumatra, Peninsular Malaysia and Borneo. In Borneo occurring throughout the uplands, but confined to Tawau district in Sabah (e.g., *Elmer 21401* and *Elmer 21530*) and Belaga and Kapit districts in Sarawak (e.g., *S 29354* and *S 29509*). Vulnerable owing to land conversion.

Bark becoming deeply v-section fissured. Leaf blade ovate or elliptic, base obtuse or cuneate, margin frequently narrowly revolute; veins sparsely scabrid-pubescent and prominent below.....

subsp. **velutinata** P.S.Ashton

(Latin, *velutinatus* = somewhat velvety; the indumentum)

Gard. Bull. Sing. 20 (1963) 278, *op. cit.* (1982) 547; Newman *et al. op. cit.* (1996) 185. Type: *Awang Lela FMS 4502*, Peninsular Malaysia, Pahang, Temerloh, Belingo FR (holotype KEP).

E Sumatra, Peninsular Malaysia east of the main range (known there as the “Pahang Form”) and Borneo. In Borneo, widespread, and the prevailing form in Sabah (e.g., *SAN 21627* and *SAN 36950*) and Sarawak (e.g., *S 9612* and *S 29673*).

With *S. leprosula* the commonest red meranti in the mixed dipterocarp forest; with a similar ecological range and co-occurring with that species, but tending to be prevalent on slightly more leached soils, particularly in the lowlands near to the coast. In Sabah, common in Danum Valley Conservation Area and Sepilok FR and occurring in Kinabalu NP, and in Sarawak, common in G. Gading, Lambir and Mulu NPs; not vulnerable.

91. *Shorea parvistipulata* F.Heim

(Latin, *parvus* = small, *stipulatus* = with stipules; the small stipules)

(sect. **Brachypterae**, red meranti)

Bull. Mens. Soc. Linn. Paris 2 (1891) 974; Merrill *op. cit.* (1921) 406 (*‘parvistipula’*); Masamune *op. cit.* (*‘parvistipula’*); Meijer & Wood *op. cit.* 132; Burgess *op. cit.* 184; Ashton *op. cit.* (1968) 114, *op. cit.* (1978) 46, *op. cit.* (1982) 508; Anderson *op. cit.* (1980) 128; Kessler & Sidiyasa *op. cit.* 108; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al. op. cit.* (1996) 185. **Type:** *Beccari PB 2547*, Borneo, Sarawak, Matang (holotype P). **Synonyms:** *Shorea cristata* Brandis *op. cit.* 97, Ashton *op. cit.* (1964) 184, *op. cit.* (1968) 106, Meijer & Wood *op. cit.* 102, Burgess *op. cit.* 166, Anderson *op. cit.* (1980) 125; *S. nebulosa* Meijer *op. cit.* 337, Meijer & Wood *op. cit.* 123, Burgess *op. cit.* 183.

Huge emergent tree, to 70 m tall, to 2 m diameter; bole tall, straight, cylindrical; crown vast, diffuse but regularly hemispherical; buttresses to 5 m tall, prominent, stout. **Bark** mauve-brown, at first smooth, becoming shallowly cracked and flaky, eventually scalloped, prominently pale lenticellate; inner bark pale chocolate-brown; heartwood pink; dammar smears occasional, cream. *Leaf bud, parts of perianth exposed in bud, twig, inflorescence, stipule and bracteole outside, petiole and leaf venation below persistently pale yellowish to greyish brown scabrid-pubescent; stipule and bracteole inside and midrib above evenly so.* **Twigs** terete, c. 2 mm diameter apically; stipule scars pale, short, horizontal or ascending. Leaf buds ovoid, acute, to 6 × 4 mm. **Stipules** ovate, subacute, to 14 × 7 mm. **Leaves** chartaceous, drying rust- to chocolate-brown below, mauve-brown above; blade variable, more or less oblong, base cordate, sometimes obtuse or cuneate, apex with tapering acumen to 1 cm long; midrib evident, flat or shallowly furrowed above, prominent below; lateral veins 13–21 pairs, prominent below; intercostal venation scalariform, well-spaced; petiole 1.2–1.5 cm long. **Inflorescences** terminal or axillary; rachis terete, straight, lax, to 16 cm long, branchlets to 4 cm long bearing to 11 flowers; bracteoles deltoid, acute, to 5 × 3 mm, not at first caducous. **Flowers:** buds to 7 × 3 mm; petals cream suffused with pink at base; stamens 15, connectival appendage c. 2x the length of anther; ovary ovoid, stylopodium obscure, style equal to ovary, filiform, glabrous but for the base. **Fruits:** pedicels c. 2 mm long; calyx lobes unequal, 3 longer lobes lorate-spatulate, to 20 × 2.5 cm, tapering to 11 mm above the saccate base, 2 shorter ones linear-lobed, to 8 × 0.4 cm, similar at base. **Nuts** ovoid, to 2.5 × 2 cm, often with persistent filiform style remnant.

Vernacular names. Sabah—*kawang daun merah* (Malay), *seraya lupa* (preferred name). Sarawak—*meranti kawang pinang* (preferred name).

Distribution. Endemic in Borneo.

Ecology. Scattered in mixed and upper dipterocarp forest, particularly on hillsides, at altitudes to 1300 m.

Notes. Three subspecies, viz. subsp. *albifolia*, subsp. *nebulosa* and subsp. *parvistipulata*, are recognised, all occurring in Sabah and Sarawak.

Key to subspecies

1. Leaf blade silvery pink lepidote below.....
 - subsp. **albifolia** P.S.Ashton
(Latin, *albus* = white, *folium* = leaf; the silvery pink leaf undersurface)
Gard. Bull. Sing. 31 (1978) 46. Type: *Wright S 29276*, Borneo, Sarawak, Niah, Sg. Sekaloh (holotype K; isotype KEP).
Occur in widely separated localities from Niah, NE Sarawak (e.g., the type), to Brunei (e.g., *BRUN 5630*, *S 1689* and *S 1692*) and SE and W Kalimantan (e.g., *bb. 30193*, *bb. 34918* and *Latupeirissa 95003*). Locally common on periodically flooded alluvium, and adjacent moist hillsides, on silty clay soil. Vulnerable owing to suitability of its habitat for agriculture.
Leaf blade persistently pale yellowish to greyish brown scabrid-pubescent on the veins below.....2
- Tree at most 45 m tall, 1.2 m diameter. Leaf blade to 13 × 6 cm; lateral veins to 15 pairs.
Larger fruit calyx lobes to 9 × 1.8 cm.....
 - subsp. **nebulosa** (Meijer) P.S.Ashton
(Latin, *nebulosus* = clouded with unevenly blended colours: the difficulty of identification)
Gard. Bull. Sing. 31 (1978) 46; Newman *et al. op. cit.* (1996) 187. Basionym: *Shorea nebulosa* Meijer *op. cit.* 337; Meijer & Wood *op. cit.* 123; Burgess *op. cit.* 183. Lectotype (Ashton, 1978): *G.H.S. Wood & Charrington SAN 16355*, Borneo, Sabah, Ranau district, Poring (hololectotype L).
Endemic in Borneo; recorded from Ranau, Sipitang, Tambunan, and Tawau districts in Sabah (e.g., *SAN 16273*, *SAN 16357*, *SAN 16435*, *SAN 16769*, *SAN 17010*, and *SAN 31438*).
Locally frequent in upper dipterocarp forest, at 800–1300 m altitude. Occurring in Kinabalu NP; elsewhere vulnerable.
- Tree to 70 m tall, 2 m diameter. Leaf blade 6–20 × 3–9 cm; lateral veins 13–21 pairs.
Larger fruit calyx lobes to 20 × 2.5 cm.....
 - subsp. **parvistipulata**
Occurring throughout Borneo, except SW Kalimantan. In Sabah recorded from Beluran, Beaufort, Kota Belud, Kota Merudu, Kudat, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15108*, *SAN 17180*, *SAN 25601*, *SAN 43043*, and *SAN 99603*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 15388*, *S 27550*, *SAN 29596*, *S 32376*, and *S 49961*). Also occurring in Brunei (e.g., *BRUN 2005* and *BRUN 3382*) and E, C and W Kalimantan (e.g., *Ambriansyah & Arifin Berau 1045*, *bb. 29625*, *bb. 35337*,

Church et al. 1660, and *Laman et al. TL 1138*). Scattered in mixed dipterocarp forest on clay soils, particular on hillsides, most common on intermediate and basic igneous rocks and porphyry dikes near limestone hills, at altitudes to 1200 m. Occurring in G. Gading and Mulu NPs; not vulnerable.

92. *Shorea patoiensis* P.S.Ashton

(of Bt. Patoi, Brunei)

(sect. **Richetioides** subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 19 (1962) 302, *op. cit.* (1964) 159, *op. cit.* (1968) 88, *op. cit.* (1982) 476; Meijer & Wood *op. cit.* 78; Burgess *op. cit.* 218; Anderson *op. cit.* (1980) 123; Kessler & Sidiyasa *op. cit.* 109; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al. op. cit.* (1996) 188. **Type:** *Ashton BRUN 3324*, Borneo, Brunei, Bt. Patoi (holotype K; isotype KEP).

Main canopy or low emergent tree, to 45 m tall, to 1 m diameter; crown hemispherical; bole straight, cylindrical; buttresses to 2 m tall but usually less, somewhat slender. **Bark** tawny brown, oblong flaky. **Inflorescence and parts of perianth exposed in bud** shortly densely greyish puberulent; ovary and stylopodium cream puberulent; nut glabrescent; vegetative parts glabrous but for fimbriate bud scales and stipules, and more or less waxy pruinose young buds and twigs (mature trees). **Twigs** terete, smooth or rugulose, much-branched, very slender, c. 1 mm diameter apically. Leaf buds narrowly ovoid, c. 3 × 1 mm (to 4 × 2 mm in juveniles), with the bud scales typically somewhat patent. **Stipules** oblong, acute, c. 8 × 2 mm. **Leaves** more or less chartaceous, drying greyish green and curling; blade ovate, 5–8 × 2–3.5 cm, base cuneate, decurrent for c. 1 mm along the petiole, apex with slender acumen to 1 cm long; midrib evident, flat or slightly elevated within a shallow groove above, elevated but not prominent below; lateral veins 7–9 pairs, slender, elevated above, more so below, arched; intercostal venation subscalariform, hardly elevated; petiole 0.7–1 cm long. **Inflorescences** terminal or axillary; rachis very slender, terete, to 9 mm diameter, branchlets bearing to 6 secund flowers; bracteoles minute, fugaceous. **Flowers:** buds small, to 3.5 × 1.5 mm; corolla lemon yellow; *stamens* 15, connectival appendage equal to anther, ciliate towards apex; ovary ovoid, with cylindrical stylopodium, style short, glabrous. **Fruits:** calyx lobes subequal, shorter than nut, lobes broadly ovate, to 0.5 × 0.5 cm, appressed to nut and united into a 0.5–0.9 × 0.4–0.5 cm receptacle at base. **Nuts** oblong-ellipsoid, to 1.8 × 1 cm, with minute style remnant, subglabrous, striated.

Vernacular name. Sarawak—*lun hitam padi* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort, Lahad Datu, Sandakan, and Tawau districts (e.g., *SAN 16462*, *SAN 21498*, *SAN 23556*, *SAN 31475*, and *SAN 63055*) and in Sarawak from Belaga, Bintulu, Kapit, Limbang, Miri and Tatau districts (e.g., *S 15141*, *S 22477*, *S 29678*, *S 43644*, and *S 68918*). Also occurring in Brunei (e.g., *BRUN 3324*, *BRUN 5710*, *BRUN 5811*, and *Johns 7474*) and E Kalimantan (e.g., *Ambriansyah Berau 885*, *bb. 18967* and *Kostermans 13850*).

Ecology. Frequent on moist well-structured clay soils, especially on hill sides, over shale and especially basic volcanic rocks; abundant for instance on the Bt. Mersing, Sarawak, basalt; also on the Hose Mountain and Usun Apau dacite. Common in Lambir and Mulu NPs; probably not vulnerable.

93. *Shorea pauciflora* King

(Latin, *paucus* = few, *flos* = flower; a supposed few-flowered inflorescence)

(sect. **Brachypterae**, red meranti)

J. As. Soc. Beng. 62, 2, (1893) 116; Merrill *op. cit.* (1929) 203; Keith *op. cit.* 25; Masamune *op. cit.* 496; Symington *op. cit.* (1943) 87; Browne *op. cit.* 149; Ashton *op. cit.* (1964) 207, *op. cit.* (1968) 114, *op. cit.* (1978) 47, *op. cit.* (1982) 511; Meijer & Wood *op. cit.* 133; Burgess *op. cit.* 165; Anderson *op. cit.* (1980) 128; PROSEA *op. cit.* 400; Kessler & Sidiyasa *op. cit.* 109; Coode *et al.* (eds.) *op. cit.* 114; Newman *et al. op. cit.* (1996) 189. **Type:** *Curtis 1537*, Peninsular Malaysia, Penang Hill (holotype CAL; isotype K).

Huge emergent tree, to 60 m tall, to 2.2 m diameter; crown eventually immense, cauliflower-shaped; bole straight, tall, cylindrical; buttresses to 4 m tall, stout. **Bark** dark purplish brown eventually fawn-brown, shallowly densely cracked becoming thinly oblong flaky, flakes at first persisting and curling up, surface overall eventually appearing rather smooth; dammar smears greyish brown; inner bark meat-red; heartwood dark reddish brown. *Leaf bud, parts of perianth exposed in bud, inflorescence, stipule, and bracteole persistently evenly golden brown pubescent; venation below, petiole, fruit calyx, and young twig sparsely caducously so; ovary and nut buff pubescent.* **Twigs** terete, 1.5–2.5 mm diameter apically, becoming flaky; stipule scars pale, short, horizontal. Leaf buds ovoid, acute, 4–8 × 2–3.5 mm. **Stipules** hastate, to 13 × 4 mm. **Leaves** *thinly coriaceous, drying brick-red or purplish brown below; blade ovate, 9–15 × 4–5.5 cm, base frequently subequal, obtuse to broadly cuneate, apex with slender acumen 0.6–1.2 cm long; midrib obscurely sunken above, prominent below; lateral veins 8–9 pairs, slender but prominent below, generally drying paler than blade, ascending and arched, sometimes with small pore-like domatia; intercostal venation densely scalariform, very slender, hardly raised; petiole 1.3–1.8 cm long.* **Inflorescences** terminal or axillary; rachis ribbed or slightly compressed, lax, to 15 cm long, to trebly branched, branchlets bearing to 20 second flowers; bracteoles oblong, subacute, to 4 × 2.5 mm. **Flowers:** *petals pale yellow; stamens 15, connectival appendage c. 2x the length of anther, sericeous distally; ovary and stylopodium ovoid-conical, style slightly shorter than both, glabrous.* **Fruits:** *calyx lobes unequal, 3 longer lobes to 9 × 1.5 cm, tapering to c. 4 mm above the saccate base, 2 shorter ones linear-lobed, to 5 × 0.5 cm, similar at base.* **Nuts** broadly ovoid, c. 1.4 × 1.2 cm, with short apical style remnant.

Vernacular names. Sabah—*oba suluk* (preferred name). Sarawak—*nemesu* (preferred name), *perawan samak* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo widespread, recorded in Sabah from Beaufort, Kinabatangan, Kuala Penyu, Lahad Datu, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15082*, *SAN 16587*, *SAN 17773*, *SAN 27362*, and *SAN 134945*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Kuching, Lundu, Samarahan, and Sri Aman districts (e.g., *S 10183*, *S 22884*, *S 29242*, *S 36907*, *S 68724*). Also occurring in Brunei (e.g., *BRUN 3374* and *BRUN 5085*) and Kalimantan (e.g., *bb. 34256* and *Kostermans 6042*).

Ecology. Ubiquitous, locally common, usually as scattered trees, in mixed dipterocarp forest on yellow-red sandy, sandy clay and clay soils, including on the plateau sandstone and granodiorite of W Sarawak, the Arip rhyolite, and the inland sedimentaries. One of our most widespread dipterocarps. Occurring in Bako, G. Gading, Kinabalu, Kubah, Lambir, and Mulu NPs, and Danum Valley Conservation Area and Sepilok FR; not vulnerable.

94. *Shorea peltata* Symington

(Latin, *peltatus* = shield-shaped, the leaf)

(sect. **Richetioides**, subsection **Richetioides**, yellow meranti)

J. Malay. Br. Roy. As. Soc. 19 (1941) 158, *op. cit.* (1943) 56; Slooten *op. cit.* (1956) 337; Ashton *op. cit.* (1982) 473. **Type:** *Abdul Jaffar KEP 49356*, Peninsular Malaysia, Johor, Jemaluang FR (holotype KEP).

Subcanopy or canopy hardly buttressed tree, to 40 m tall, 30 cm diameter. **Bark** smooth or shallowly nobbly. *Inflorescences petals outside and nut persistently densely buff pubescent, caducous on calyx outside; parts otherwise glabrescent.* **Twigs** terete, smooth, c. 2 mm diameter apically. Leaf buds ovoid-acute, minute. **Stipules** unknown. **Leaves** deeply peltate, chartaceous to thinly coriaceous; blade oblong, 8–16 × 4–7.5 cm, apex with acumen to 1 cm long; midrib evident but slightly furrowed above, raised below; lateral veins 8–9 pairs, the first 3 of which opposite and radiating from the petiole insertion; intercostal venation subreticulate, elevated on both surfaces; petiole 1.8–3 cm long, slender. **Inflorescence** terminal or axillary; branchlets to 1 cm long bearing to 5 flowers. **Flower:** buds lanceolate, to 6 mm long; stamens 15, in 3 whorls, connectival appendage c. 1½x the length of anther, slender, scabrous distally; ovary ovoid sericeous distally, without stylopodium, style glabrous, columnar, equal to ovary. **Fruits:** sessile; calyx lobes short, subequal, ovate, tuberculate-incrassate, to 1 × 0.8 cm. **Nuts** obovoid, to 3 × 2 cm, subacute.

Vernacular name. Sabah—*seraya kuning keladi* (preferred name).

Distribution. Sumatra, Peninsular Malaysia (SE Johore) and Borneo. In Borneo known only from Labuk Sugut district, E Sabah (e.g., *SAN 70329* and *SAN 131964*).

Ecology. Very local, in mixed lowland dipterocarp forest on leached clay soil. Critically endangered.

95. *Shorea pilosa* P.S.Ashton

(Latin, *pilosus* = long hairy; the indumentum)

(sect. **Pachycarpae**, red meranti)

Gard. Bull. Sing. 19 (1962) 304, *op. cit.* (1964) 209, *op. cit.* (1968) 115, *op. cit.* (1982) 521; Meijer & Wood *op. cit.* 136; Burgess *op. cit.* 183; Anderson *op. cit.* (1980) 128; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al.* *op. cit.* (1996) 191. **Type:** *G.H.S. Wood SAN 16721*, Borneo, Sabah, Sipitang district, Ulu Mendalong (holotype K; isotypes KEP, L).

Medium-sized emergent tree, to 45 m tall, to 1.3 m diameter; crown golden suffused from below, dense, hemispherical; bole straight, cylindrical; buttresses occasionally to 4 m tall, stout. **Bark** pale yellowish brown, smooth, hoop-marked, eventually patchily cracked, flaking leaving scroll-marked surfaces; inner bark pale coffee-coloured; heartwood pale pink, fairly soft. *Twig, leaf bud, inflorescence, parts of calyx exposed in bud, petiole, midrib on both surfaces, and blade below persistently golden scabrid-tomentose; blade above and fruit calyx sparsely pubescent, glabrescent; part of corolla exposed in bud and nut evenly buff pubescent.* **Twigs** slightly compressed at apex, much-branched, 2–2.5 mm diameter apically. Leaf buds ovoid, 3–7 × 1.5–3 mm. **Stipules** hastate, to 35 × 15 mm. **Leaves** *thinly coriaceous, drying golden-tawny below, pinkish brown above; blade ovate-elliptic, 10–17 × 4–7.5 cm, base obtuse, margin usually narrowly revolute, apex with slender acumen to 1.3 cm long; midrib evident, slender but furrowed above, prominent below; lateral veins 12–15 pairs, arched, dense, with prominent axillary tufted tomentose domatia; intercostal venation densely scalariform with reticulate finer veins, minutely raised below; petiole 1–1.3 cm long.* **Inflorescences** terminal or axillary, singly branched; rachis terete, to 14 cm long. **Flowers:** buds to 8 × 3 mm; petals cream suffused with pink; stamens 15, connectival appendage *c.* 4x as long as anther; ovary ovoid, glabrous, style and stylopodium spindle-shaped. **Fruits:** *calyx lobes unequal, 3 longer lobes to 17 × 2.5 cm, tapering to c. 13 mm above the saccate base, 2 shorter ones to 12 × 1 cm, otherwise similar.* **Nuts** ovoid, to 2 × 1.8 cm, with short acute style remnant.

Vernacular names. Sabah—*kawang bulu* (preferred name). Sarawak—*kawang bulu* (Iban), *meranti bulu* (Malay).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Sipitang, Tawau, and Tenom districts (e.g., *SAN 24808*, *SAN 35890* and *SAN A 1748*) and in Sarawak from Bintulu, Kapit, Lawas, Miri, and Tatau districts (e.g., *S 1752*, *S 17792*, *S 18429*, *S 22235*, and *S 25018*). Also occurring in Brunei (e.g., *BRUN 2636* and *S 5777*).

Ecology. Rare, local, in mixed dipterocarp forest on lower slopes and undulating land, on sandy clay and well-structured clay soils, including the Bt. Mersing, Anap basalt. Occurring in Lambir and Mulu NPs; elsewhere vulnerable owing to land conversion.

96. *Shorea pinanga* Scheff.

(from an indigenous name—*pinang*)

(sect. **Pachycarpae**, red meranti)

Nat. Tijd. Ned. Ind. 31 (1870) 350; Beccari *op. cit.* 570; Merrill *op. cit.* (1921) 406, *op. cit.* (1929) 203; Masamune *op. cit.* 496; Ashton *op. cit.* (1963) 281, *op. cit.* (1964) 210, *op. cit.* (1968) 115, *op. cit.* (1982) 526; Meijer & Wood *op. cit.* 137; Burgess *op. cit.* 182; Anderson *op. cit.* (1980) 128; PROSEA *op. cit.* 400; Kessler & Sidiyasa *op. cit.* 109; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al. op. cit.* (1996) 192. **Lectotype** (designated here): *s.c. s.n.*, cult. in Hort. Bogor (hololectotype BO; isolectotypes L, U). **Synonyms:** *Shorea gysbertsiana* Burck var. *scabra* Burck *op. cit.* (1886) 17, *p.p.*; *S. compressa* Burck *op. cit.* (1886) 26.

Medium-sized emergent tree, to 45 m tall, to 1.3 m diameter; bole straight, cylindrical; crown loosely dome-shaped to oblong, the branch endings pendent; buttresses to 1.5 m tall, stout. **Bark** pale pinkish brown, smooth, hoop-marked, eventually becoming patchily cracked and irregularly flaked; inner bark pale pinkish brown; heartwood pale pink, relatively soft. *Young twig, inflorescence, leaf bud, parts of calyx exposed in bud, stipule,*

bracteole, petiole and sometimes blade below glabrous or fugaceously to persistently golden brown pubescent; nut yellowish buff pubescent. Twigs compressed, 4–6 × 2–3 mm apically; stipule scars prominent, falcate, descending. Leaf buds hastate, subacute, usually hidden in subsistent stipules, to 10 × 4 mm. Stipules hastate, to 10 × 4 mm, subsistent. Leaves thinly coriaceous, drying shiny coppery brown below (unless tomentose); blade elliptic to narrowly ovate, 11–24 × 4–9 cm, base broadly cuneate to subcordate, apex with tapering acumens to 1.5 cm long; midrib slender but evident, flat or shallowly furrowed above, prominent below; lateral veins 10–20 pairs, slender but raised below, arched; intercostal venation densely scalariform, hardly raised; petiole 1.5–2.3 cm long, slender. Inflorescences terminal or axillary; rachis lax, compressed, to 24 cm long, singly branched, branchlets bearing to 15 flowers; bracteoles broadly ovate, to 10 × 8 mm, subsistent. Flowers: petals deep pink; stamens 15, connectival appendage many times longer than anther; ovary ovoid, stylopodium obscure, style twice the length of ovary, columnar. Fruits: calyx lobes unequal, 3 longer lobes coriaceous, to 23 × 3.5 cm, tapering to c. 13 mm above the saccate base, 2 shorter ones linear-lobed, to 17 × 1.2 cm, similar at base. Nuts broadly ovoid, to 2.3 × 2.3 cm, with 2 mm slender style remnant.

Vernacular names. Sabah—*kawang pinang* (preferred name). Sarawak—*engkabang langgai bukit* (Iban), *meranti langgai bukit* (preferred name).

Distribution. Endemic in Borneo, occurring throughout the island. In Sabah recorded from Beaufort, Keningau, Kinabatangan, Labuk Sugut, Ranau, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 15260*, *SAN 18601*, *SAN 36509*, *SAN 39168*, and *SAN 99370*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Miri, Samarahan, Serian, and Sibuan districts (e.g., *S 14740*, *S 16429*, *S 22250*, *S 29060*, and *S 43616*). Also occurring in Brunei (e.g., *BRUN 3344* and *FMS 35682*), and throughout Kalimantan (e.g., *bb. 29665*, *Kessler et al. Berau 704* and *Meijer 2206*).

Ecology. Locally common, in mixed dipterocarp forest on leached clay and sandy clay soils, especially on ridges and low hills. Occurring in Mulu NP; probably not vulnerable.

Notes. A variable species, distinguished by its falcate stipule scar, many slender veins and very long fruit sepals. Typically, the vegetative parts are glabrous but one form, with stout twig and larger than normal leaf, is pubescent on twig and leaf below; in E Sabah the leaf is very large, with markedly cuneate base, and shares characteristics with *S. macrophylla* (see there).

97. *Shorea platycarpa* F. Heim

(Greek, *platy-* = flat, *karpos* = fruit; perhaps referring to the fruit calyx)

(sect. **Mutica** subsect. **Mutica**, red meranti)

Bull. Mens. Soc. Linn. Paris 2 (1891) 956; Beccari *op. cit.* 510; Merrill *op. cit.* (1921) 406; Symington *op. cit.* (1933) 133, *op. cit.* (1943) 88; Masamune *op. cit.* 496; Browne *op. cit.* 142; Anderson *op. cit.* (1963) 159, *op. cit.* (1980) 128; Ashton *op. cit.* (1964) 211, *op. cit.* (1968) 115, *op. cit.* (1982) 541; Meijer & Wood *op. cit.* 138; Burgess *op. cit.* 154; PROSEA *op. cit.* 400; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al.* *op. cit.* (1998) 194. **Type:** *Beccari PB 3302*, Borneo, Sarawak, Marop (holotype P). **Synonym:** *Shorea palustris* Ridl., *op. cit.* (1922) 224.

Emergent tree, to 50 m tall, to 1.2 m diameter; bole tall, straight; crown shallowly hemispherical, diffuse; buttresses to 4 m tall, stout. **Bark** greyish to pinkish brown, becoming deeply v-section fissured, eventually crumbly flaky; inner bark dull pinkish brown; heartwood pale reddish brown, relatively soft; dammar as pale yellowish cream smears. *Young twig, inflorescence, leaf bud, parts of calyx exposed in bud, and petiole densely persistently rust-brown scabrid pubescent; sparsely so on stipule, bracteole, midrib above and blade below, and base of fruit calyx; glabrescent on blade above; petals outside and nut densely buff pubescent.* **Twigs** ridged, verrucose, stout, c. 3 mm diameter apically. Leaf buds broadly ovoid, obtuse, 4–6 × 3.5–5 mm. **Stipules** ovate, subacute, to 10 × 6 mm. **Leaves** *thinly coriaceous, drying reddish brown; blade elliptic-oblong to broadly ovate, 9–17 × 5.5–10 cm, base obtuse, apex with broad acumen to 1 cm long; midrib slender, more or less flat above, prominent below, in juveniles furnished with pale scale-like domatia along part of its length from the base; lateral veins 16–20 pairs, dense, straight until approaching margin, slender but prominent, in juveniles with scale-like domatia; intercostal venation laxly scalariform, slender but distinctly elevated; petiole 1.5–2 cm long, stout.* **Inflorescences** terminal or axillary; rachis rigid, ribbed, to 9 cm long; bracteoles broadly ovate, acute, to 4 × 3 mm. **Flowers:** *petals pale yellow;* stamens 15, connectival appendage as long as anther, becoming reflexed; ovary and stylopodium narrowly ovoid, subglabrous, style as long as both, filiform, glabrous. **Fruits** subsessile; *calyx lobes unequal, 3 longer lobes chartaceous, to 6.5 × 1.2 cm, tapering to 4 mm above the saccate base, 2 shorter ones linear-lobed, to 2 cm long, similar at base.* **Nuts** ovoid, to 0.8 × 0.6 cm, acute.

Vernacular name. Sarawak—*meranti paya* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah known only from Sipitang district (e.g., *SAN 19001*, *SAN 27966* and *SAN 130246*) and in Sarawak from Bintulu, Daro, Kuching, Sibuluan, Simunjan, and Sri Aman districts (e.g., *S 261*, *S 452*, *S 7273*, *S 12853*, and *S 13501*). Also occurring in Brunei (e.g., *BRUN 371* and *FMS 28695*) and Kalimantan.

Ecology. Locally common, widespread, in mixed peat swamp forest, especially near the coast, and on poorly drained podsols on the former beach terraces on the lower Medamit, Ulu Limbang, Sarawak. Recorded from Mulu NP; elsewhere endangered by forest conversion.

98. *Shorea platyclados* Slooten ex Foxw.

(Greek, *platy-* = flat, *clados* = a shoot; the compressed twigs)

(sect. **Brachypterae**, red meranti)

Malay. For Rec. 10 (1932) 214; Symington, J. Malay. Br. Roy. As. Soc. 14 (1936) 336, *op. cit.* (1939) 377, *op. cit.* (1943) 89; Slooten Bull. Jard. Bot. Buitenz. 3, 16 (1941) 110; Masamune *op. cit.* 496; Ashton *op. cit.* (1964) 212, *op. cit.* (1968) 115, *op. cit.* (1982) 515; Meijer & Wood *op. cit.* 139; Burgess *op. cit.* 166; Anderson *op. cit.* (1980) 129; PROSEA *op. cit.* 401; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al.* *op. cit.* (1996) 195. **Type:** *Symington KEP 24416*, Peninsular Malaysia, Selangor, Ulu Gombak (holotype KEP).

Large emergent tree, to 50 m tall, to 1.8 m diameter; bole tall, cylindrical, but also often a small gnarled main canopy tree; crown large, hemispherical, eventually diffuse; buttresses to 4 m tall, stout. **Bark** dark warm chocolate-brown, deeply narrowly fissured and flaking; dammar incrustations pale yellow, conspicuous on bole; inner bark reddish brown to

yellowish brown within; heartwood deep crimson red. *Young parts pale grey sericeous, fugaceous except on stipule, bracteole and panicle.* **Twigs** compressed, glabrous, smooth, *c.* 3×1.5 mm apically. Leaf buds compressed, falcate, to 4×1.5 mm. **Stipules** hastate, to 13×3.5 mm. **Leaves** remaining distichous, thinly coraceous, satiny, drying dark chocolate-brown below; blade lanceolate, $6-9 \times 2-3$ cm, base cuneate owing to the revolute basal margin, margin undulate, apex with slender acumen *c.* 1 cm long; midrib obscurely sunken above, acute and sharply prominent below; lateral veins 15–18 pairs, very slender, hardly elevated below, ascending, with short intermediate veins; intercostal venation densely scalariform, very slender; petiole slender, laterally compressed, 1–1.5 cm long. **Inflorescences** terminal or axillary; rachis compressed, slender, to 7 cm long, singly branched, branchlets bearing to 7 flowers; bracteoles to 4×2 mm, elliptic, fugaceous. **Flowers:** petals pale yellow; *stamens 15, connectival appendage c. 4x the length of anther, glabrous; ovary and stylopodium pyriform, sericeous towards apex, style as long as both, glabrous.* **Fruits:** calyx lobes unequal, 3 longer lobes to 10×1 cm, tapering to 4 mm above the saccate base, 2 shorter ones linear-lobed, to 5×0.4 cm, similar at base. **Nuts** ovoid, to 1.5×1 cm, acute, glabrescent.

Vernacular names. Sabah—*seraya bukit* (preferred name). Sarawak—*meranti bukit* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. Throughout the mountain system of Sabah and Sarawak, wherever the habitat occurs. In Sabah recorded from Keningau, Ranau, Sipitang, and Tambunan districts (e.g., *SAN 16581, SAN 17026, SAN 22091, SAN 69102, and SAN 132706*) and in Sarawak from Kapit, Lawas and Limbang districts (e.g., *S 12108, S 17754, S 22212, S 26549, and S 33073*). Also occurring in Brunei (e.g., *BRUN 410 and BRUN 2541*) and SE and W Kalimantan (e.g., *bb. 20666, bb. 30194 and Endert 3691*).

Ecology. Locally common in upper dipterocarp forest, at 700–1300 m altitude, but only on deep friable red-brown fertile clay soils; on shale and basalt. Occasional on similar soils in valleys at the base of the mountains, at altitudes as low as 150 m. Occurring in Kinabalu and Mulu NPs; elsewhere vulnerable owing to logging.

99. *Shorea polyandra* P.S.Ashton

(Greek, *poly-* = many, *andra* = males; the many stamens)

(sect. **Richetioides**, subsect. **Polyandrae**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 286, *op. cit.* (1968) 88, *op. cit.* (1982) 470; Anderson *op. cit.* (1980) 123; PROSEA *op. cit.* 420; Newman *et al. op. cit.* (1996) 196. **Type:** *Bojeng S 10171*, Borneo, Sarawak, Lundu district, G. Gading FR (holotype K; isotype KEP).

Vast emergent tree, to 70 m tall, to 2 m diameter, with tall somewhat tapering bole and immense cauliflower-shaped crown pale from below; buttresses to 4 m tall, prominent, somewhat stout. **Bark** becoming chocolate-brown, deeply cracked and thickly oblong-flaky; inner bark purplish brown, laminated. *Twig, petiole and blade below persistently purplish rufous lepidote fading to grey (mature trees); leaf bud, stipule, inflorescence, parts of perianth exposed in bud, bracteole, ovary, style, and nut persistently shortly purplish-rufous pubescent; fruit calyx sparsely so towards base, glabrescent.* **Twigs** terete, smooth or rugulose-striated, slender, *c.* 1 mm diameter apically. Leaf buds ellipsoid, to 2×1 mm, acute. **Stipules** lanceolate, to 5×2 mm, fugaceous. **Leaves** chartaceous, undulate, drying

purplish brown with the venation darker and curling; blade lanceolate, 8–13 × 3–5 cm, base cuneate, margin minutely revolute, apex with slender acumen to 2 cm long; midrib and veins narrowly sunken and obscure above, slender but distinctly raised below; lateral veins 11–14 pairs, arched, ascending; intercostal venation laxly scalariform, slender, more or less obscure below; petiole 1.4–2 cm long, slender. **Inflorescences** terminal or axillary; rachis terete, to 6 cm long, singly branched, branchlets bearing to 3 flowers; bracteoles elliptic, subacute, to 4 × 3 mm, caducous. **Flowers:** buds broadly ovoid, to 5 × 4 mm; petals oblong, obtuse; stamens 102–107, anthers narrowly oblong, length c. 4x breadth, connective appendage stout but filiform, tapering, somewhat shorter in length than anther, densely ciliate apically, not reflexed; ovary ovoid, without stylopodium, surmounted by a short broadly columnar trifid style. **Fruits:** pedicels c. 1 mm long; calyx lobes unequal, 3 longer lobes to 8 × 1.4 cm, tapering to 8 mm above the saccate tuberculate base, 2 shorter ones linear-lobed, to 5 × 0.5 cm, similar at base. **Nuts** narrowly ovoid, to 3 × 1.3 cm, acute.

Vernacular name. Sabah—*seraya kuning Quoin* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Tawau district (e.g., *SAN 15265*, *SAN 16478*, *SAN 63027*, *SAN A 3465*, and *SAN A 3959*) and in Sarawak from Lundu and Miri districts (e.g., *S 7979*, *S 10174*, *S 10189*, *S 25298*, and *S 75394*). Also occurring in SE Kalimantan (e.g., *bb. 23349* and *Kostermans 13302*).

Ecology. In clusters of immense trees, on well-structured and well-watered fertile clay loams overlying calcareous shale, basic volcanic rock and granodiorite. Well represented in G. Gading NP and occurring in Lambir NP; elsewhere endangered by land conversion.

100. *Shorea praestans* P.S.Ashton

(Latin, *praestans* = preeminent; the striking stipules and leaf shape)

(sect. **Pachycarpae**, red meranti)

Gard. Bull. Sing. 22 (1967) 297, *op. cit.* (1968) 115, *op. cit.* (1982) 524; Anderson *op. cit.* (1980) 129; Newman *et al. op. cit.* (1996) 198. **Type:** *Brunig s.n.*, Borneo, Sarawak, Bintulu district, Nyabau FR (holotype K).

Subcanopy, possibly canopy tree, to 30 m tall, to 15 cm diameter. **Bark** smooth, hoop-marked, ochreous-brown and grey-mottled; inner bark pinkish brown. *All observed parts glabrous.* **Twigs** compressed, smooth, stout, c. 5 × 3 mm apically. Leaf buds falcate-lanceolate, to 25 × 7 mm. **Stipules** elliptic, subacute, very large, to 110 × 50 mm, not at first caducous. **Leaves** thickly coriaceous, drying greyish brown above, reddish brown shiny below; blade broadly oblong, 24–35 × 11–18 cm, base cordate, apex obtuse to shortly broadly acuminate; midrib broad but flat above, prominent below; lateral veins 11–13 pairs, prominent below; intercostal venation remotely subscalariform, slightly elevated below; petiole stout, weakly geniculate, 4–6.5 cm long. **Inflorescences** and **flowers** unknown. **Fruits:** pedicels to 5 mm long and stout; calyx lobes unequal, 3 longer lobes to 15 × 3 cm, tapering to c. 1.5 cm above the saccate base, 2 shorter ones to 10.5 × 1.5 cm, similar at base. **Nuts** ovoid, to 2 × 2 cm, glabrous, with to 4 mm long style remnant.

Distribution. Endemic in Borneo (C Sarawak); known from Bintulu and Mukah districts (e.g., *S* 19598, *S* 22074, *S* 22075, and *S* 37863).

Ecology. Rare and confined to deep yellow sandy soil on low hills of Neogene sandstone, in mixed dipterocarp forest; as scattered trees or small groups. Possibly extinct, otherwise critically endangered.

Notes. Central Sarawak has other distinctive, apparently small, trees representing undescribed entities in sect. *Pachycarpae*, the main section of red merantis yielding illipe (*engkabang*, *kawang*, *tengkawang*) nuts. As such they represent important genetic resources; yet all appear to be rare, and under present wide forest conversion gravely threatened with extinction. None have been sufficiently collected in flower or fruit for scientific description. One other such species is '63. *Shorea* sp.' (Ashton *op. cit.* (1968) 122), from Pelagus rapids and Bt. Alet, Nanga Bah, Kapit district.

101. *Shorea pubistyla* P.S.Ashton

(Latin, *pubi-* = downy, *stylus* = the floral style; the pubescent stylopodium)

(sect. **Brachypterae**, red meranti)

Gard. Bull. Sing. 22 (1967) 297, *op. cit.* (1968) 116, *op. cit.* (1982) 516; Anderson *op. cit.* (1980) 129; Newman *et al. op. cit.* (1996) 198. **Type:** *Anderson S 14930*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype K; isotypes KEP, L).

Large emergent tree, to 50 m tall, to 1.6 m diameter; bole straight, cylindrical; crown loosely hemispherical, with a few large branches, golden suffused from below; buttresses to 1.5 m tall, stout. **Bark** pale chocolate-brown mottled-grey, deeply irregularly fissured and chunkily flaky; dammar as frequent pale yellow incrustations; inner bark dark coffee-coloured; heartwood rich reddish brown. *Twig, leaf bud, inflorescence, parts of calyx exposed in bud, petiole, and midrib below densely dark fulvous scabrid-tomentose; more shortly sparsely so on venation below, midrib above, and stipule outside; stipule within, bracteole and fruit calyx densely pale fulvous pubescent, caducous on fruit; outside of petal, ovary, stylopodium, and nut evenly pale cream-brown pubescent.* **Twigs** prominently ribbed at first, stout, c. 7 mm diameter apically. *Leaf buds ovoid, compressed, to 1.3 × 1.3 mm.* **Stipules** lanceolate, to 25 × 7 mm, caducous. **Leaves** thickly coriaceous, drying warm chocolate-brown below; blade broadly oblong to obovate, 11–19 × 7–12 cm, base obtuse to cordate, margin shallowly subrevolute, apex retuse, obtuse or shortly acuminate; midrib slender and more or less evident, furrowed above, prominent below; lateral veins 14–18 pairs, stoutly prominent below, obscurely sunken above; intercostal venation remotely scalariform; petiole 2.5–4 cm long, stout, weakly geniculate. **Inflorescences** axillary, stout; rachis ribbed, lax, to 20 cm long, singly branched, branchlets bearing to 12 flowers; bracteoles oblong-ovate, subacute, to 8 × 5 mm, fugaceous. **Flowers:** *petals pink outside, crimson within; stamens 15, connectival appendage 2–3x as long as anther, glabrous; ovary ovoid, crowned by a slightly longer cylindrical stylopodium and short glabrous style.* **Fruits:** *pedicels to 3 mm long and diameter, stout; calyx lobes unequal, 3 longer lobes to 14 × 2.5 cm, tapering to c. 8 mm above the saccate base, 2 shorter ones lorate-lobed, to 12 × 1.2 cm, otherwise similar.* **Nuts** narrowly ovoid, to 3 × 1.8 cm, with to 4 mm long apical tapering stylopodium remnant.

Vernacular name. Sarawak—*meranti bulu merah* (preferred name).

Distribution. Endemic in Borneo (W and C Sarawak and presumably also in the Kapuas valley, W Kalimantan). In Sarawak known from Kuching, Miri and Tatau districts (e.g., *S* 16473, *S* 19575, *S* 32422, *S* 42349, and *S* 68407).

Ecology. Locally frequent, on deep leached yellow sandy clay soils in mixed dipterocarp forest, on low hills, at altitudes to 400 m, generally not far from the coast. Occurring in Lambir NP; elsewhere vulnerable owing to its accessible lowland habitat being liable to land conversion.

102. *Shorea quadrinervis* Slooten

(Latin, *quadri-* = four-, *nervis* = nerved; the four-veined leaf)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Bull. Jard. Bot. Buitenz. 3, 17 (1942) 220; Browne *op. cit.* 142; Ashton *op. cit.* (1964) 213, *op. cit.* (1968) 116, *op. cit.* (1982) 534; Meijer & Wood *op. cit.* 140; Burgess *op. cit.* 155, 183; Anderson *op. cit.* (1980) 129; PROSEA *op. cit.* 401; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al. op. cit.* (1996) 199. **Lectotype** (designated here): *bb.* 29450, Borneo, W Kalimantan, Sambas, Sg. Akar (hololectotype BO).

Medium-sized emergent tree, to 45 m tall, to 1.4 m diameter; bole straight, cylindrical, frequently quite short; crown hemispherical to oblong, the branch endings pendent; buttresses to 2.5 m tall, stout. **Bark** pinkish grey to pale brown, shallowly v-section fissured, eventually deeply so and powdery chunkily flaking; dammar as pale yellow incrustations; inner bark bright crimson, paler at cambium; heartwood pale reddish brown. *Young parts shortly densely tawny pubescent, more or less caducous on stipule, bracteole, leaf bud, and blade below, becoming sparse on fruit calyx; base of midrib above, inflorescence, parts of perianth exposed in bud, ovary, and nut persistently so.* **Twigs** *c.* 3 mm diameter apically, terete, stout, strongly ridged below stipule scars, becoming minutely cracked; stipule scars pale, prominent, falcate or descending-amplexicaul. *Leaf buds compressed, ovate-subcordate, to 20 × 13 mm, loosely enveloped in stipules.* **Stipules** *ovate to subcordate, to 25 × 13 mm, prominently ridged along their 5 veins, pairs sometimes united at base, subpersistent.* **Leaves** *strongly concave, thinly coriaceous, drying warm reddish brown below; blade broadly ovate to elliptic, 10–18 × 5–8 cm, base obtuse, margin more or less revolute, apex with tapering acumen to 1.3 cm long; midrib obscure, sunken above, prominent below; lateral veins c. 4 pairs, arched, ascending, prominent below with at least one prominent but shorter intermediate vein; intercostal venation slender, scalariform; petiole 0.8–1 cm long.* **Inflorescences** terminal or axillary; rachis lax, spreading, terete or angular, to 28 cm long, to trebly branched, branchlets bearing to 6 flowers; *bracts as the stipules, caducous.* **Flowers:** petals pink, paler at margins; stamens 15, connectival appendage shorter than anther, reflexed; ovary and stylopodium conical, style short, stigma relatively prominent. **Fruits:** *calyx lobes unequal, 3 longer lobes to 8 × 1.3 cm, tapering to c. 3 mm above the saccate base, 2 shorter ones to 5.5 × 0.7 cm, otherwise similar.* **Nuts** narrowly ovoid, to 1.5 × 0.7 cm, with *c.* 1.5 mm long slender style remnant.

Vernacular names. Sabah—*seraya sudu* (preferred name). Sarawak—*meranti sudu* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort and Sipitang districts (e.g., *SAN 15051*, *SAN 16291*, *SAN 16923*, *SAN 24821*, and *SAN 126703*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Limbang, Lubok Antu, Lundu, Marudi, Miri, and Simunjan districts (e.g., *S 10067*, *S 27135*, *S 32271*, *S 37822*, and *S 69660*). Also occurring in Brunei (e.g., *BRUN 1800* and *BRUN 3066*) and Kalimantan (e.g., *bb. 30222* and *Yamada K 9525*).

Ecology. Common in mixed dipterocarp forest on leached yellow shallowly sandy humic soils in the lowlands, and also on skeletal soils on ridges, at altitude to 700 m. Common in Bako, Kubah, Lambir and Mulu NPs; not vulnerable.

103. *Shorea resinosa* Foxw.

(Latin, *resinosus* = resinous; the resinous nut)

(sect. *Anthoshorea*, white meranti)

Malay. For. Rec. 10 (1932) 234; Symington *op. cit.* (1943) 40; Ashton *op. cit.* (1968) 94, *op. cit.* (1982) 496; Anderson *op. cit.* (1980) 124; PROSEA *op. cit.* 412; Newman *et al. op. cit.* (1996) 201. **Type:** *Symington FMS 17512*, Peninsular Malaysia, Ulu Selangor, Serendah FR (holotype KEP).

Large emergent tree, to 50 m tall, to 1.3 m diameter; bole tall, cylindrical; crown hemispherical; buttresses small or tall, rather sharp. **Bark** dark grey, coarsely fissured and eventually chunkily flaky; inner bark pale and dark yellow laminated. *Young twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipule outside, and petiole buff fugaceous puberulent.* **Twigs** terete, smooth, c. 2 mm diameter apically. Leaf buds ellipsoid, to 3 × 2 mm. **Stipules** elliptic, to 12 × 8 mm. **Leaves** *thinly coriaceous, undulate, drying tawny brown below; blade lanceolate to elliptic, base cuneate, apex with slender acumen to 1.2 cm long, midrib obscurely sunken above, slender but prominent below; lateral veins 10–13 pairs, slender but prominent below, not drying paler than blade; intercostal venation slender, hardly elevated below, scalariform; petiole 0.9–1.7 cm long.* **Inflorescences:** rachis terete, singly branched, to 8 cm long. **Flowers:** buds to 12 × 4 mm; corolla pale yellow; *stamens 15, connectival appendage c. 2½x as long as anther, glabrous; ovary ovoid, without stylopodium, glabrous, style c. 3x the length of ovary, trifid towards apex.* **Fruits:** pedicels to 4 mm long, to 3 mm diameter; *calyx lobes unequal, 3 longer lobes to 9.5 × 2.5 cm, tapering to c. 7 mm above the saccate base, 2 shorter ones linear-lobed, to 7 × 0.6 cm, similar at base.* **Nuts** ovoid, to 1.5 × 1.5 cm, with to 6 mm long filiform style remnant, frequently resin-coated.

Vernacular name. Sarawak—*meranti belang* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and NW Borneo. In Sarawak recorded from Bau and Lundu districts (e.g., *S 397*, *S 9616* and *S 27005*).

Ecology. Rare, apparently confined to mixed dipterocarp forest, on yellow sandy soils over sandstone. Probably endangered.

104. *Shorea retusa* Meijer(Latin, *retusus* = notched; the leaf apex)(sect. **Mutica**, subsect. **Mutica**, red meranti)

Act. Bot. Neerl. 12 (1963) 340; Meijer & Wood *op. cit.* 141; Burgess *op. cit.* 184; Ashton *op. cit.* (1968) 117, *op. cit.* (1982) 537; Anderson *op. cit.* (1980) 129; Newman *et al. op. cit.* (1996) 201. **Lectotype** (designated here): *bb.* 29715, Borneo, C Kalimantan, Muara Tewe, Barito Ulu (hololectotype BO).

Canopy to low emergent tree, to 40 m tall, to 80 cm diameter; bole straight, cylindrical; crown becoming hemispherical, diffuse; buttresses low, rounded. **Bark** greyish brown, becoming shallowly but distinctly v-section fissured; inner bark yellowish brown; heartwood pale brown; dammar as pale cream-brown exudations. *Young parts greyish sericeous, glabrescent except on leaf bud, parts of calyx and petals exposed in bud, ovary, stylopodium, and stipule outside.* **Twigs** terete, much-branched, c. 1 mm diameter apically. Leaf buds ellipsoid, to 3 × 2 mm. **Stipules** elliptic, to 7 × 3 mm, caducous. **Leaves** coriaceous, shiny, drying pale chocolate-brown, darker above; blade elliptic, 3–9 × 1.5–5 cm, base cuneate, apex shallowly retuse; midrib obscurely sunken above, slender and raised but not prominent below; lateral veins 7–10 pairs, arched, ascending, very slender and hardly raised below; intercostal venation slender, scalariform, obscure below; petiole short, 0.6–0.9 cm long. **Inflorescences** terminal or axillary; rachis terete, to 10 cm long, branchlets bearing to 7 flowers; bracteoles elliptic, to 3 × 2 mm. **Flowers:** buds to 8 × 3 mm; corolla pale yellow; stamens 15, connectival appendage slender, equal or 2–4x the length of anther, becoming reflexed; ovary and stylopodium narrowly conical, crowned with a short glabrous style. **Fruit:** pedicels to 1 mm long; *calyx lobes unequal, 3 longer lobes to 10 × 1.8 cm, tapering to c. 4 mm above the saccate base, 2 shorter ones lorate-lobed, to 5.5 × 0.4 cm, similar at base.* **Nuts** ovoid, to 1.3 × 1.2 cm with 3 mm long style remnant.

Vernacular names. Sabah—*seraya daun tumpul* (preferred name). Sarawak—*meranti telur* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Tawau district (e.g., *SAN 19569*, *SAN 21504* and *Villamal 87*) and in Sarawak from Bintulu, Kuching, Lundu, and Serian districts (e.g., *S 952*, *S 7579*, *S 10268*, *S 13373*, and *S 47099*). Also occurring in Kalimantan (e.g., *Ambriansyah & Arifin Berau 1067* and *bb.* 29716).

Ecology. Locally frequent in *kerangas* forest, mostly on shallow podsols over sandstone. Occurring in Bako NP; overall conservation status uncertain.

105. *Shorea revoluta* P.S.Ashton(Latin *revolutus* = turned in; the leaf margin)(sect. **Mutica**, subsect. **Mutica**, red meranti)

Gard. Bull. Sing. 19 (1962) 304, *op. cit.* (1964) 215, *op. cit.* (1968) 117, *op. cit.* (1982) 543; Meijer & Wood *op. cit.* 142; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 129; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al. op. cit.* (1996) 202. **Type:** *Smythies S 5914*, Borneo, Sarawak, Limbang district, Bt. Sagan (holotype K).

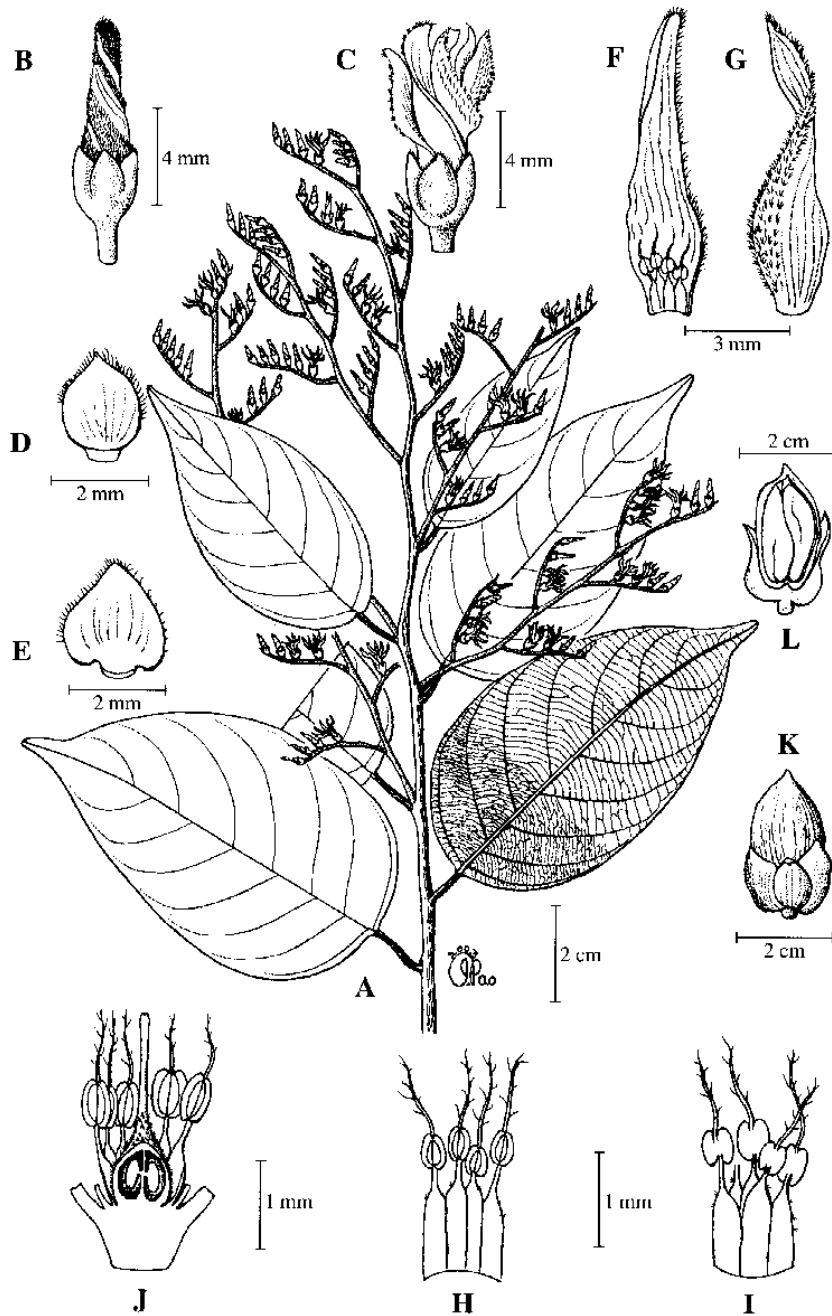


Fig. 28. *Shorea richetia*. A, flowering leafy twig; B, flower bud; C, opening flower; D, adaxial view of outer sepal; E, adaxial view of inner sepal; F, adaxial view of petal with stamens; G, abaxial view of petal; H, adaxial view of stamens; I, abaxial view of stamens; J, longitudinal section of open flower; K, fruit; L, longitudinal section of fruit. (A from *S* 109, B–J from *S* 563, K–L from *S* 15254.)

Low emergent tree, to 45 m tall, to 1 m diameter; bole cylindrical; crown hemispherical, diffuse; buttresses to 2 m tall, stout. **Bark** pale to dark chocolate-brown, frequently mottled with grey, prominently v-section fissured, the intervening ridges eventually crumbling in chunky flakes; dammar smears pale cream-yellow, common; inner bark and heartwood rust-red. *Twig, inflorescence, leaf bud, calyx and stipule outside, and petiole densely pale brown to fulvous scabrid-puberulent; veins below and midrib above sparsely so; parts of petal exposed in bud, nut and inside of stipules evenly pale buff puberulent.* **Twigs** at first slightly compressed and ribbed, c. 2–3 mm diameter apically. Leaf buds ovoid, compressed, subacute, 4–7 × 3–5 mm. **Stipules** elliptic to oblong, obtuse, to 15 × 7 mm, caducous. **Leaves** coriaceous, drying warm tan-brown; blade ovate, 10–15 × 5.5–10 cm, base obtuse to subcordate, margin prominently revolute, apex with slender acumen to 1.5 cm long; midrib more or less obscure and sunken above, prominent below; lateral veins 9–12 pairs, prominent below, arched, well-spaced, with glabrous axillary domatia; intercostal venation slender, scalariform, hardly elevated below; petiole 1.3–1.5 cm long. **Inflorescences** terminal or axillary; rachis rigid, to 22 cm long. **Flowers:** corolla dark red; stamens 15, connectival appendage slender, as long as anther, becoming reflexed; ovary and stylopodium narrowly ovoid, style half their length, slender, glabrous. **Fruits:** pedicels to 1.5 mm long; calyx lobes unequal, 3 longer lobes to 7.5 × 1.3 cm, tapering to 3 mm above the saccate base, 2 shorter ones linear-lobed, to 3.5 × 0.2 cm, similar at base. **Nuts** ovoid, to 1.5 × 0.8 cm, with c. 1.5 mm style remnant.

Vernacular names. Sabah—*seraya daun tajam* (preferred name). Sarawak—*meranti kerangas* (Malay).

Distribution. Endemic in Borneo. In Sabah known from Beaufort and Sipitang districts (e.g., *SAN 15135*, *SAN 55656*, *SAN 110013*, and *SAN 131905*) and in Sarawak from Lawas, Limbang and Marudi districts (e.g., *S 5618* and *S 11248*). Also occurring in Brunei (e.g., *BRUN 5646*, *S 5782* and *S 5814*).

Ecology. Locally frequent in *kerangas* forest, both on terraces and sandstone plateaux, at altitudes to 1200 m. Endangered by logging.

106. *Shorea richetia* Symington

Fig. 28.

(after the former genus *Richetia*, now *Shorea* sect. *Richetioides*)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. S. S. 9 (1938) 330; Slooten *op. cit.* (1956) 335; Ashton *op. cit.* (1968) 89, *op. cit.* (1982) 474; Anderson *op. cit.* (1980) 123; Newman *et al. op. cit.* (1996) 203. **Type:** *Beccari PB 2888*, Borneo, Sarawak, Matang (holotype P; isotype L).

Main canopy tree, to 40 m tall, to 80 cm diameter; bole straight, cylindrical; crown dense, rather small, hemispherical; buttresses to 1 m tall, small, stout. **Bark** dull greyish brown, tardily cracking, then thinly oblong-flaking eventually leaving a scroll-marked new surface. *Twig apices, inflorescence, leaf buds, and stipules puberulent; ovary and nut buff pubescent; other parts glabrous.* **Twigs** terete, smooth, 1–2 mm diameter apically. Leaf buds ovoid, subacute, to 2 × 2 mm. **Stipules** lanceolate, to 5 × 2 mm. **Leaves** thickly coriaceous, drying dark greyish green; blade broadly elliptic, 5–11 × 3–6.5 cm, base broadly cuneate to occasionally subcordate, margin narrowly subrevolute, apex with broad, tapering acumen to 1 cm long; midrib evident, flat to shallowly furrowed above, prominent below; lateral

veins 5–7 pairs, ascending, arched, prominent below; intercostal venation subscalariform; petiole stout, 0.6–1 cm long. **Inflorescences** terminal or axillary; rachis terete or compressed, glabrescent, lax, to 8 cm long, singly branched, branchlets bearing to 5 flowers; bracteoles deltoid, to 2 × 1 mm, fugaceous. **Flowers:** buds to 7 × 2 mm; petals lime-yellow; stamens 16–17, connectival appendage at least 1½x the length of anther; ovary ovoid, without stylopodium, style 2–3x the length of ovary, columnar, tapering, pubescent in basal half. **Fruits:** pedicels to 2 mm long, stout; calyx lobes subequal, narrowly ovate, to 1.7 × 1 cm, acute, saccate, tuberculate. **Nuts** obovoid, acute, to 2.5 × 1.5 cm.

Vernacular name. Sarawak—*lun melapi* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Tenom district (e.g., *SAN 64311*) and in Sarawak from Kuching and Lundu districts (e.g., *S 6404*, *S 15525*, *S 25451*, *S 32409*, and *S 32520*).

Ecology. Very local, in mixed dipterocarp forest on leached sandy clay soils, on low hills, at altitudes to 200 m. Recorded from Kubah NP; elsewhere endangered by land conversion.

107. *Shorea rotundifolia* P.S.Ashton

Plate 4E.

(Latin, *rotundus* = round, *folius* = leaf; the distinctive leaf shape)

(sect. **Pachycarpae**, red meranti)

Gard. Bull. Sing. 22 (1967) 299, *op. cit.* (1968) 117, *op. cit.* (1982) 524; Anderson *op. cit.* (1980) 129; Newman *et al. op. cit.* (1996) 204. **Type:** *Smythies S 9470*, Borneo, Sarawak, Kapit district, Pelagus, Sg. Iran (holotype K; isotype KEP).

Low emergent tree, to 40 m tall, to 70 cm diameter; bole straight, cylindrical; buttresses to 80 cm tall and out, stout. **Bark** greyish brown and chocolate-mottled with a crimson 'scrape', smooth, hoop-marked, inner bark pinkish brown with pale patches; sapwood pink, relatively soft. *Young twig, petiole and stipule pruinose; petals shortly pubescent on parts exposed in bud; parts otherwise glabrous.* **Twigs** terete or slightly compressed at first, c. 3 × 2 mm apically; stipule scars amplexicaul, prominent. *Leaf buds lanceolate, compressed, large, to 20 × 8 mm.* **Stipules** lanceolate-falcate, obtuse, to 60 × 20 mm, subpersistent. **Leaves** remaining distichous, coriaceous, shiny, drying dark purplish brown below; blade broadly ovate to orbicular, 9–21 × 8–14 cm, base obtuse to cordate, apex cuspidate, acumen to 1 cm long; midrib evident above, flat, prominent below; lateral veins 9–11 pairs, arched, slender but prominent below; intercostal venation remotely scalariform, elevated below; petiole 3–4 cm long, somewhat geniculate. **Inflorescences** terminal or axillary; rachis compressed, lax, to 15 cm long, regularly singly branched, branchlets bearing remote flowers; bracteoles elliptic-lanceolate, acute, to 10 × 6 mm. **Flowers:** buds to 10 × 4 mm; stamens 15, connectival appendage c. 3x the length of anther; ovary ovoid, glabrous, style and stylopodium spindle-shaped. **Fruits:** pedicels c. 6 mm long; calyx lobes unequal, 3 longer lobes spatulate, to 13 × 2.5 cm, tapering to c. 6 mm above the saccate base, 2 shorter ones narrowly lanceolate, to 8 × 0.7 cm, similar at base. **Nuts** ovoid, to 2.5 × 1.1 cm, with to 7 mm long style remnant.

Vernacular name. Sarawak—*langgai* (Iban).

Distribution. Endemic in Borneo. Confined to Bintulu and Kapit districts in C Sarawak (e.g., *S 22051* and *S 22053*).

Ecology. Local and rare, in scattered clumps on leached sandy clay soils along ridges, at altitudes to 400 m. Vulnerable.

Notes. It is possible that this entity may merely represent one or more varieties of *S. amplexicaulis*, with which it often grows. The small groups in which the species occur differ somewhat from one another, but their characters are internally constant. This extreme variation, unusual among dipterocarps, is nevertheless common among species in sect. *Pachycarpae* (see, for instance, under *S. macrophylla*, *S. pinanga* and *S. praestans*).

108. *Shorea rubella* P.S. Ashton

(Latin, *rubellus* = reddish; the drying leaf blade)

(sect. **Rubella**, red meranti)

Gard. Bull. Sing. 19 (1962) 307, *op. cit.* (1964) 216, *op. cit.* (1968) 118, *op. cit.* (1982) 500; Meijer & Wood *op. cit.* 143; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 129; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al.* *op. cit.* (1996) 205. **Type:** Ashton BRUN 3078, Borneo, Brunei, Andulau FR (holotype K; isotypes KEP, L).

Medium-sized emergent tree, to 45 m tall, to 1.4 m diameter; bole tall, cylindrical; crown hemispherical, spreading, diffuse, becoming pale from below; buttresses to 2 m tall, stout, prominent. **Bark** pinkish brown, becoming coarsely deeply v-section fissured, eventually chunkily oblong-flaked; dammar smears rare, cream; inner bark rust-brown; heartwood pale pink. *Young parts evenly pale cream-buff puberulent, persistent only on inflorescence; leaf bud, parts of perianth exposed in bud, ovary, nut, and fruit calyx glabrescent.* **Twigs** 2–3 mm diameter apically, ridged and compressed on drying, becoming terete, stout; stipule scars *c.* 1.5 mm long, narrow, horizontal. Leaf buds narrowly ovoid to subfalcate, acute, 6–9 × 2–3 mm. **Stipules** hastate to falcate, acute, to 18 × 6 mm, caducous. **Leaves** *thickly coriaceous, sparsely cream lepidote below (mature trees), drying rich pinkish brown; blade broadly ovate but often somewhat irregularly shaped, 9.5–14 × 6–8 cm, base obtuse or broadly cuneate, margin sometimes subrevolute, apex with tapering acumen to 1 cm long; midrib evident, flat or shallowly furrowed above, prominent below; lateral veins 5–7 pairs, arched, well-spaced, prominent below, sometimes with minute pore-like axillary domatia; intercostal venation densely scalariform, slender, more or less obscure; petiole 2.3–3.5 cm long.* **Inflorescences** terminal or axillary; rachis ribbed on drying, to 15 cm long, branchlets lax, bearing to 5 flowers. **Flowers:** buds to 7 × 3 mm; petals pale pink, darker towards base; *stamens 15, subequal, filaments lorate, abruptly tapering below the large narrowly oblong equal anthers, connectival appendage short, tapering, becoming somewhat recurved; ovary small, ovoid, stylopodium indistinct, style filiform, c. 3x the length of ovary.* **Fruits:** *calyx lobes unequal, 3 longer lobes to 8 × 1.5 cm, tapering to 5 mm above the saccate base, 2 shorter ones linear-lobed, to 5 × 0.6 cm, similar at base.* **Nuts** ovoid, to 1.8 × 1.2 cm, acute.

Vernacular name. Sarawak—*meranti laut putih* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort and Papar districts (e.g., *SAN 24812*, *SAN 24813* and *SAN A 1750*) and in Sarawak from Belaga, Bintulu, Kapit, Miri, and Tatau districts (e.g., *S 9474*, *S 15128* and *S 19577*). Also occurring in Brunei (e.g., *FMS 30574*, *FMS 35667*, *S 1925*, and *SAN 17564*).

Ecology. Locally frequent, on the deep yellow sandy soils of the subcoastal neogene sedimentary hills, the northernmost Rajang series, and the Arip rhyolite. Well represented in Lambir NP; elsewhere endangered.

109. *Shorea rubra* P.S.Ashton

(Latin, *ruber* = red; the leaf undersurface)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Gard. Bull. Sing. 19 (1962) 309, *op. cit.* (1964) 217, *op. cit.* (1968) 118, *op. cit.* (1982) 545; Meijer & Wood *op. cit.* 144; Burgess *op. cit.* 166; Anderson *op. cit.* (1980) 129; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al.* *op. cit.* (1996) 206. **Type:** *Smythies S 9475*, Borneo, Sarawak, Pelagus, Ulu Iran (holotype K; isotypes KEP, L, SAR).

Large emergent tree, to 50 m tall, to 1.3 m diameter; bole, tall, cylindrical; crown dense, cauliflower-shaped, brownish from below; buttresses to 2.5 m tall, stout. **Bark** dark chocolate to blackish, becoming deeply v-section fissured, eventually the ridges becoming chunkily flaky; dammar smears bright pale yellow; inner bark yellowish brown; heartwood deep purplish red. *Twig, inflorescence, bud, calyx outside, stipule, bracteole, petiole, midrib above, and leaf below densely persistently deep rufous brown scabrid puberulent.* **Twigs** terete, much-branched, to 1.5 mm diameter apically. Leaf buds compressed, ovoid, acute, 4–7 × 3–4.5 mm. **Stipules** hastate, to 16 × 5 mm. **Leaves** *thinly coriaceous, drying chocolate-brown overlain by deep rufous-brown tomentum; blade broadly ovate, 8–13 × 4–7.5 cm, base obtuse, margin narrowly revolute, apex with acumen to 1.3 cm long; midrib obscurely sunken above, slender but prominent below; lateral veins 11–13 pairs, prominent below, arched; intercostal venation densely scalariform, hardly elevated below; petiole 1–1.4 cm long.* **Inflorescences** terminal or axillary; rachis terete, rather rigid, to 14 cm long, branchlets compact, bearing to 5 flowers; bracteoles broadly ovate, subacute, to 4 × 3.5 mm. **Flowers:** buds to 7 × 4 mm; petals yellow; stamens 15, connectival appendage hardly reflexed; ovary and stylopodium ovoid-conical, with shorter glabrous style. **Fruits:** *calyx lobes unequal, 3 longer lobes to 11 × 1.6 cm, tapering to 5 mm above the saccate base, 2 shorter ones linear-lobed, to 4.5 × 0.4 cm, otherwise similar.* **Nuts** broadly ovoid, to 1 × 0.9 cm, with *c.* 2 mm style remnant.

Vernacular names. Sabah—*seraya bingkai* (preferred name). Sarawak—*meranti merah kesumba* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Keningau, Kinabatangan, Ranau, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 15193*, *SAN 22354*, *SAN 50702*, and *SAN 76795*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Marudi, Miri, Sibul and Tatau districts (e.g., *S 3551*, *S 15875*, *S 22241*, *S 29499*, and *S 31723*). Also occurring in Brunei (e.g., *BRUN 784* and *FMS 48492*) and Kalimantan (e.g., *Jarvie et al. 5066*).

Ecology. Scattered in mixed dipterocarp forest, usually on well-drained leached sandy and clay soils, both on coastal hills, and on inland ridges, at altitudes to 800 m. Occurring in Lambir and Mulu NPs; elsewhere vulnerable.

110. *Shorea rugosa* F. Heim

(Latin, *rugosus* = wrinkled; the appearance imparted by the rough tomentum)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Bull. Mens. Soc. Linn. Paris 2 (1891) 973; Merrill *op. cit.* (1921) 406; Symington *op. cit.* (1933) 132; Masamune *op. cit.* 496; Ashton *op. cit.* (1964) 218, *op. cit.* (1968) 118, *op. cit.* (1982) 540; Meijer & Wood *op. cit.* 144; Burgess *op. cit.* 154; Anderson *op. cit.* (1980) 129; PROSEA *op. cit.* 401; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al.* *op. cit.* (1996) 207. **Type:** *Beccari PB 2638*, Borneo, Sarawak, Matang (holotype P).

Emergent tree, to 50 m tall, to 1.3 m diameter; bole cylindrical, straight; crown dense, cauliflower-shaped; buttresses to 2.5 cm tall, prominent, rather stout. **Bark** dark chocolate to blackish, in young trees mottled with fawn and ochre, becoming densely deeply v-section fissured, eventually powdery chunkily flaky; dammar bright yellow, in bole incrustations; inner bark yellowish brown; heartwood deep purplish red. *Young twig, inflorescence, leaf bud, flower calyx and stipule outside, petiole, and venation below densely purplish brown coarsely scabrid-tomentose; stipule inside, midrib above and blade below shortly evenly so; blade above and fruit calyx sparsely caducously so; parts of corolla exposed in bud, ovary, stylopodium, and nut evenly fulvous pubescent.* **Twigs** ribbed at first, becoming terete, to 2.5 mm diameter apically. Leaf buds ovoid, subacute, 4–6 × 3–5 mm. **Stipules** oblong-elliptic, subacute, to 14 × 5 mm. **Leaves** thickly coriaceous, drying chocolate-brown scabrous below; blade oblong-ovate to oblong-obovate, 9–17 × 4–9 cm, base obtuse, margin more or less narrowly revolute, apex with broad acumen to 0.9 cm long; midrib obscurely sunken above, prominent below; lateral veins 14–19 pairs, prominent below; intercostal venation distantly scalariform, elevated below; petiole 1.3–2.3 cm long, stout. **Inflorescences** terminal or axillary; rachis terete or slightly compressed, lax, to 12 cm long, branchlets bearing to 6 flowers; bracteoles elliptic, subacute, to 4 × 3 mm. **Flowers:** buds to 7 × 4 mm; petals yellow; stamens 15, connectival appendage short, reflexed; ovary and stylopodium conical, style short glabrous. **Fruits:** *calyx lobes unequal, 3 longer lobes to 10.5 × 2.5 cm, tapering to 4–7 mm above the saccate base, 2 shorter ones linear-lobed, to 5 × 0.4 cm, similar at base.* **Nuts** ovoid, to 2.3 × 1.5 cm, acute.

Vernacular names. Sabah—*seraya buaya hantu* (preferred name). Sarawak—*meranti buaya hantu* (preferred name).

Distribution. Endemic in Borneo. Widespread but local in Sarawak and recorded from Belaga, Bintulu, Kapit, Kuching, Lundu, Miri, and Sibu districts (e.g., *S 7568*, *S 9466*, *S 15522*, *S 37854*, and *S 43398*). Reported from Sabah in Meijer and Wood (*op. cit.*) but collection now destroyed. Also occurring in Brunei (e.g., *BRUN 3036* and *S 2129*) and Kalimantan (e.g., *bb. 19974* and *bb. 29683*).

Ecology. Scattered, rarely common, in mixed dipterocarp forest on deep yellow sandy humic soils and grey leached sand in the ecotone to *kerangas*. Occurring in Bako, Lambir and Mulu NPs; endangered outside parks system.

111. *Shorea sagittata* P.S.Ashton

Fig. 29.

(Latin, *sagittatus* = with two basal lobes pointing downwards; the fruit calyx lobes)

(sect. **Mutica**, subsect. **Auriculatae**, red meranti)

Gard. Bull. Sing. 22 (1967) 299, *op. cit.* (1968) 118, *op. cit.* (1982) 531; Anderson *op. cit.* (1980) 130; Newman *et al. op. cit.* (1996) 209. **Type:** *Sibat S 23616*, Borneo, Sarawak, Simunjan district, Balingian, Arip, Bt. Ijok (holotype K; isotype KEP).

Emergent tree, to 45 m tall, to 1.1 m diameter; bole straight, tall; crown evenly hemispherical, diffuse; buttresses to 3 m tall, stout, prominent. **Bark** pinkish brown and grey-mottled, becoming shallowly fissured, eventually chunkily oblong-flaky; inner bark pale yellow; heartwood reddish brown. *Leaf blade below cream-buff sericeous; corolla, ovary and nut puberulent; other exposed fleshy parts densely pinkish brown scabrid-puberulent, persistent except on fruit calyx.* **Twigs** ribbed, becoming terete, c. 2 mm diameter apically; stipule scars short, ascending. Leaf buds broadly ovoid, to 7 × 7 mm. **Stipules** ovate, subacute, to 10 × 8 mm, caducous. **Leaves** *thinly coriaceous, drying pale greyish brown; blade narrowly oblong to lanceolate, 7–15 × 3–6 cm; midrib obscurely sunken above, prominent below; lateral veins 19–25 pairs, slender, dense, prominent below; intercostal venation densely scalariform, obscure; petiole 0.9–1.7 cm long.* **Inflorescences** terminal or axillary; rachis terete, to 7 cm long, branchlets short bearing to 3 flowers; bracteoles to 4 × 2 mm, narrow, acute. **Flowers:** buds to 6 × 3 mm; petals yellowish pink; stamens 15; ovary and stylopodium conical, style short, glabrous. **Fruits:** *calyx lobes unequal, 3 longer lobes lorate-spatulate, to 12 × 2.5 cm, hardly tapering to the prominently sagittate-auriculate base with incrassate centre, 2 shorter ones linear-lobed, to 2 × 0.3 cm, not auriculate.* **Nuts** ellipsoid, apiculate, to 1.5 × 0.8 cm, *glabrescent*.

Vernacular name. Sarawak—*meranti daun mata lembing* (preferred name).

Distribution. Endemic in Sarawak and known from Belaga, Bintulu, Kapit, Kuching, Mukah, Simunjan, and Tatau districts (e.g., *S 18316*, *S 23720*, *S 29166*, *S 53447*, and *S 60124*); not yet recorded from Sabah.

Ecology. Locally frequent, in mixed dipterocarp forest on moist leached clay hillsides, also floodplains, on sedimentaries and the Arip rhyolite. Endangered by land conversion.

112. *Shorea scaberrima* Burck

Fig. 30.

(Latin, *scaberrimus* = very rough; the indumentum)

(sect. **Brachypterae**, red meranti)

Med. Lands Pl. Tuin 3 (1886) 22; Merrill *op. cit.* (1921) 406; Masamune *op. cit.* 497; Browne *op. cit.* 143; Ashton *op. cit.* (1964) 219, *op. cit.* (1968) 119, *op. cit.* (1982) 515; Meijer & Wood *op. cit.* 145; Burgess *op. cit.* 183; Anderson *op. cit.* (1980) 130; PROSEA *op. cit.* 402; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al. op. cit.* (1996) 210. **Lectotype** (designated here): *s.c. s.n.*, Cult. Hort. Bog. VIII D 54 (hololectotype BO).

Main canopy tree, to 40 m tall, to 1.1 m diameter; bole often misshapen; crown dense, rather irregular, more or less hemispherical; buttresses to 1.5 m tall, fairly stout. **Bark** at first remaining smooth, hoop-marked, dappled grey, ochre and fawn brown, becoming shallowly cracked and thinly patchily flaky; inner bark and heartwood coffee-coloured. *Young twigs,*

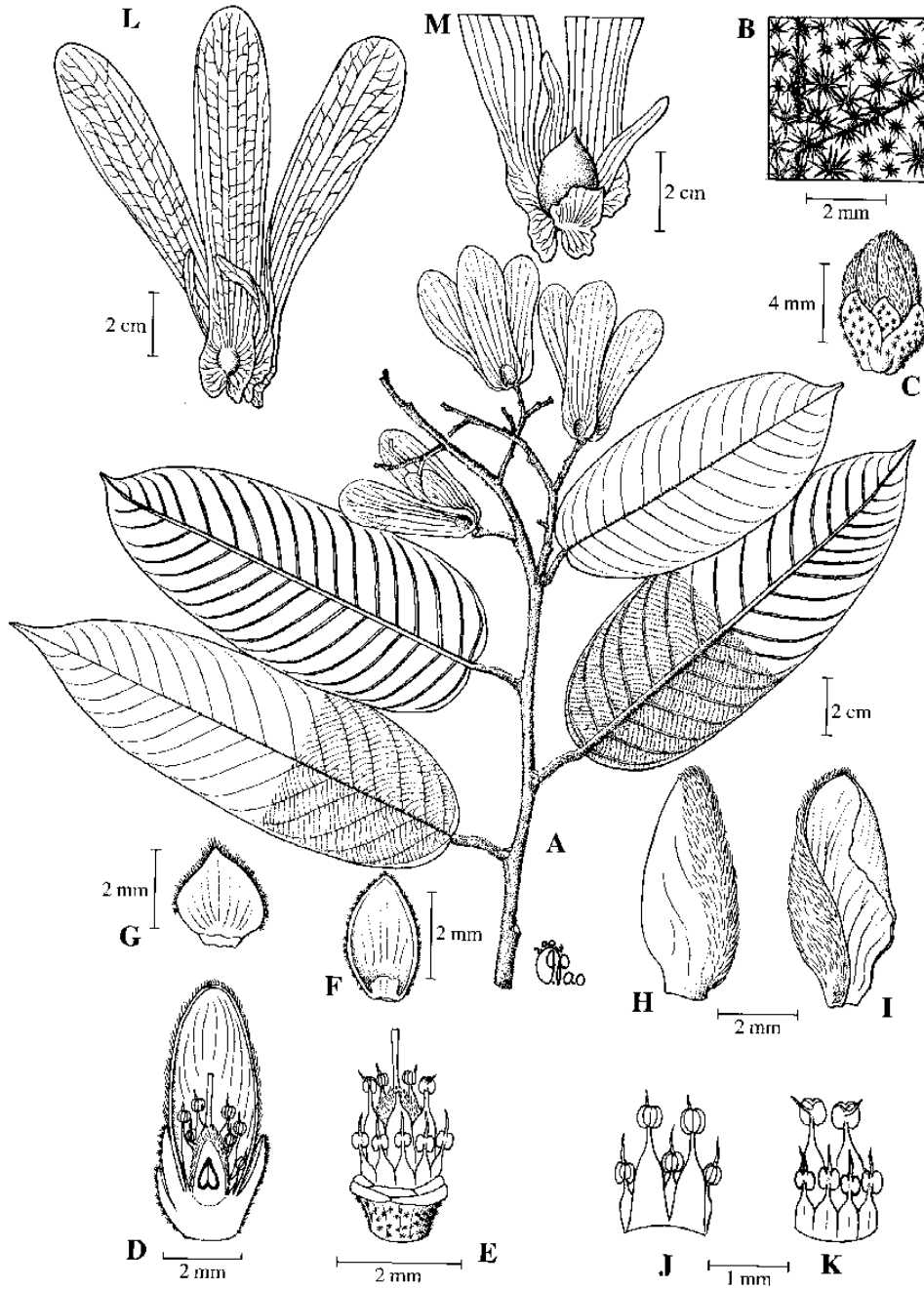


Fig. 29. *Shorea sagittata*. A, fruiting (young) leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, longitudinal section of flower bud; E, gynoecium and stamens; F, adaxial view of outer sepal; G, adaxial view of inner sepal; H, abaxial view of petal; I, adaxial view of petal; J, adaxial view of stamens; K, abaxial view of stamens; L, fruit; M, fruit with the nut partially exposed. (A–B from *S* 7609, C–K from *S* 29166, L–M from *S* 29652.)

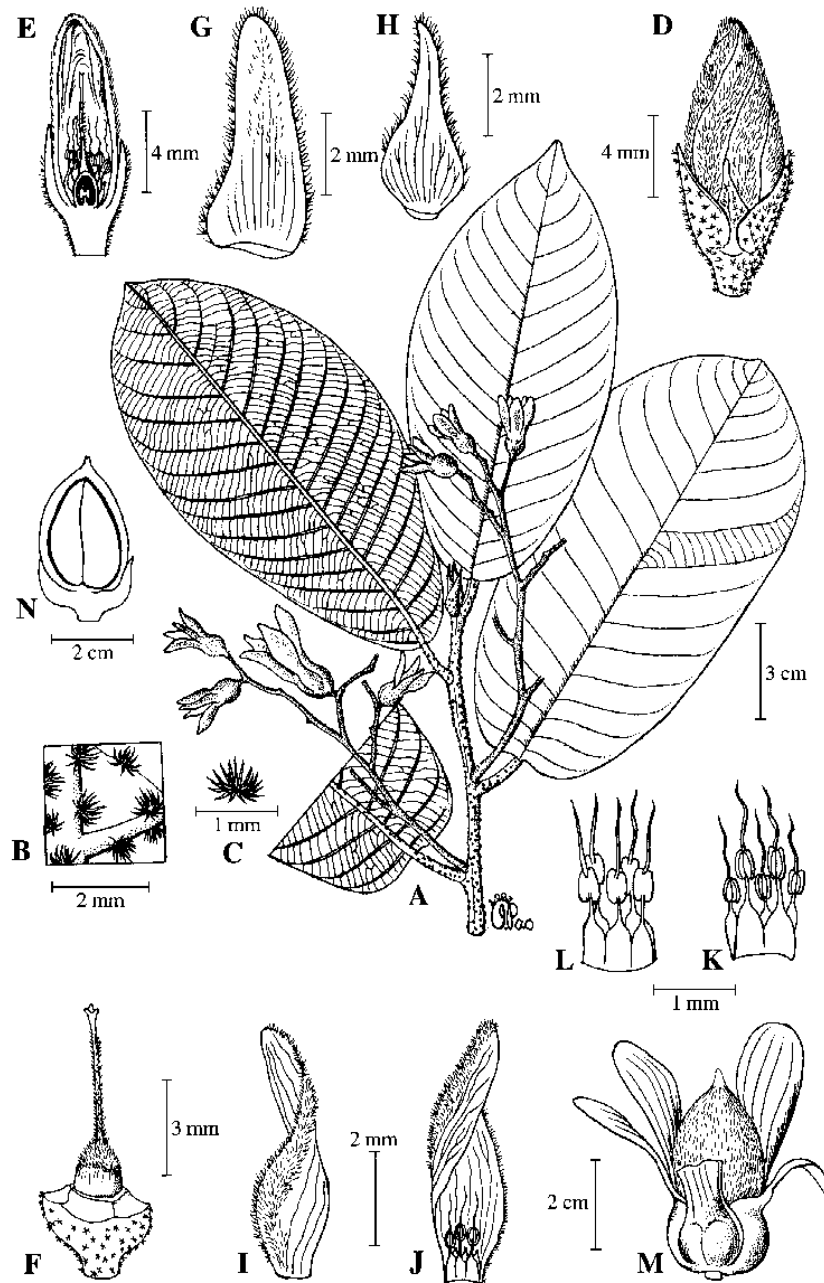


Fig. 30. *Shorea scaberrima*. A, fruiting (very young) leafy twig; B, detail of indumentum on lower leaf surface; C, side view of tufted hairs; D, flower bud; E, longitudinal section of flower bud; F, gynoecium; G, adaxial view of outer sepal; H, adaxial view of inner sepal; I, abaxial view of petal; J, adaxial view of petal; K, adaxial view of stamens; L, abaxial view of stamens; M, mature fruit with the nut partly exposed; N, longitudinal section of mature fruit. (A–B from *S* 3285, D–E from *S* 2132, F–N from *S* 36915.)

inflorescence, leaf bud, parts of calyx exposed in bud, stipule outside, petiole, leaf blade below, and midrib above more or less sparsely persistently golden brown scabrid-pubescent; parts of corolla exposed in bud, ovary, stylopodium, and nut evenly densely so; inside of stipule, bracteole and fruit calyx sparsely evenly so. Twigs ribbed at first, becoming terete, 2–3 mm diameter apically. Leaf buds broadly ovoid, subacute, slightly compressed, 4–6 × 4–5 mm. **Stipules** broadly hastate, to 18 × 8 mm, caducous. **Leaves** *thinly coriaceous to chartaceous, drying chocolate-brown below, purplish brown above; blade oblong-ovate to oblong-obovate, base obtuse, rarely subcordate, apex with tapering acumen to 0.8 cm long; midrib evident, flat to shallowly furrowed above, prominent below; lateral veins 14–17 pairs, slender but prominent below; intercostal venation scalariform, distinctly elevated below; petiole 1.8–2.5 cm long. Inflorescences* terminal or axillary; rachis ribbed to terete, to 8 cm long, singly branched, branchlets bearing to 3 second flowers; bracteoles narrowly deltoid, to 4.5 × 3 mm. **Flowers:** buds to 8 × 5 mm; corolla pink; stamens 15, *connectival appendage at least 2x the length of anther; ovary ovoid, small, stylopodium and style at least 3x the length of ovary, stoutly filiform with glabrous apex. Fruits:* calyx lobes unequal, 3 longer lobes nevertheless shorter than nut, to 4.5 × 1 cm, variable, tapering to c. 7 mm above the saccate base, 2 shorter ones linear-lobed, to 3 × 0.3 cm, similar at base. **Nuts** obovoid, to 5 × 2.5 cm, acute.

Vernacular names. Sabah—*seraya mempelas* (preferred name). Sarawak—*meranti paya bersisik* (preferred name).

Distribution. Endemic in Borneo. Recorded in Sabah from Beaufort, Labuk Sugut, Papar, Penampang, Sipitang, and Tenom districts (e.g., *SAN 15062, SAN 16339, SAN 24276, SAN A 3016, and SAN A 3285*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Lubok Antu, Lundu, Marudi, Miri, Mukah, Samarahan, and Tatau districts (e.g., *S 14974, S 15787, S 22218, S 25014, and S 47115*). Also occurring in Brunei (e.g., *BRUN 2001 and KEP 80085*) and Kalimantan (e.g., *Suzuki K 9757 and the type*).

Ecology. Locally common in mixed dipterocarp forest, on shallowly humic leached sandy clay, and well-drained skeletal clay soils; throughout the lowlands and along inland ridges, at altitude to 850 m. Common in Bako, Lambir and Mulu NPs; not vulnerable.

113. *Shorea scabrida* Symington

(Latin, *scabridus* = rough; the indumentum)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Gard. Bull. S. S. 8 (1935) 287; Masamune *op. cit.* 497; Browne *op. cit.* 143; Anderson *op. cit.* (1963) 159, *op. cit.* (1980) 130; Ashton *op. cit.* (1964) 221, *op. cit.* (1968) 119, *op. cit.* (1982) 543; Meijer & Wood *op. cit.* 146; Burgess *op. cit.* 155, 183; PROSEA *op. cit.* 402; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al.* *op. cit.* (1996) 211. **Type:** *Yusope S 171*, Borneo, Sarawak, Marudi district, Bt. Liman FR (holotype KEP).

Low emergent tree, to 45 m tall, to 1 m diameter; bole straight, cylindrical; crown becoming shallowly cauliflower-shaped, diffuse; buttresses to 1.5 m tall, stout. **Bark** at first mottled purplish brown and grey, becoming pink- to mauve-brown, widely v-section fissured; inner bark rich reddish brown with paler wedges; heartwood pinkish brown. *Young twig, inflorescence, leaf bud, midrib above, and blade and venation below persistently more or less sparsely tawny-brown scabrid-puberulent. Twigs* terete, much branched, c. 2 mm

diameter apically; stipule scars short, horizontal. Leaf buds ovoid, obtuse, compressed, 2.5–5 × 1.5–3 mm. **Stipules** oblong, obtuse, to 6 × 3 mm, fugaceous. **Leaves** coriaceous, drying orange-brown; blade obovate to elliptic, 5–9 × 3–5 cm, base broadly cuneate, occasionally obtuse, apex retuse to shortly acuminate; midrib obscure and sunken above, prominent below; lateral veins 8–11 pairs, slender, raised but hardly prominent below, arched, occasionally with small pore-like domatia; intercostal venation slender, scalariform, barely elevated; petiole 0.9–1.1 cm long. **Inflorescences** terminal or axillary; rachis terete or slightly compressed, to 8 cm long, branchlets short bearing to 7 flowers; bracteoles ovate, subacute, to 3.5 × 2.5 mm. **Flowers:** buds to 8 × 3.5 mm; petals cream, pink at base; stamens 15, connectival appendage slightly longer than anther, becoming reflexed; ovary and stylopodium narrowly conical, style almost as long as both, glabrous. **Fruits:** calyx lobes unequal, 3 longer lobes to 7 × 1.5 cm, tapering to c. 3 mm above the saccate base, 2 shorter ones linear-lobed, to 3 × 0.3 cm, similar at base. **Nuts** ovoid, to 1 × 0.8 cm, shortly apiculate.

Vernacular names. Sabah—*seraya lop* (preferred name). Sarawak—*meranti lop* (preferred name).

Distribution. Sumatra and Borneo. In Sabah widespread, known from Beaufort, Labuk Sugut, Papar, and Sipitang districts (e.g., *SAN 15854*, *SAN 16681*, *SAN 24343*, *SAN 25431*, and *SAN 27969*) and in Sarawak from Belaga, Betong, Bintulu, Kapit, Kuching, Lundu, Marudi, Miri, Samarahan, Sibul, Simunjan, Sri Aman, and Tatau districts (e.g., *S 14997*, *S 15114*, *S 23367*, *S 32578*, and *S 41125*). Also occurring in Brunei (e.g., *BRUN 3015* and *BRUN 5542*) and Kalimantan (e.g., *bb. 6399* and *Jarvie & Ruskandi 5091*).

Ecology. Locally frequent, in the edge of mixed peat swamp forest, in *kerangas* forest on podsols, often in poor drainage, but also in mixed dipterocarp forest on leached sandy and sandy clay soils, at altitudes to 1200 m. Occurring in Bako, Lambir, Mulu NPs; elsewhere vulnerable owing to land conversion.

Notes. A variable species. In dipterocarp forest the leaf is acuminate, the tomentum sparse, in *kerangas* and peat swamp forest the leaf is smaller, retuse, and the tomentum more dense; but there is much variation between the two.

114. *Shorea scrobiculata* Burck

(Latin, *scrobiculatus* = having the appearance of sawdust; the inflorescence indumentum)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Med. Lands. Pl. Tuin 3 (1886) 223; Merrill *op. cit.* (1921) 406; Masamune *op. cit.* 497; Browne *op. cit.* 169; Ashton *op. cit.* (1963) 272, *op. cit.* (1964) 144, *op. cit.* (1968) 74, *op. cit.* (1982) 449; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 432; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al.* *op. cit.* (1998) 195. **Lectotype** (designated here): *Beccari PB 2538*, Borneo, Sarawak, Matang (hololectotype K). **Synonyms:** *Shorea pierreana* F.Heim *op. cit.* (1892) 48; *S. meadiana* Symington *op. cit.* (1939) 366; *S. leptoderma* Meijer *op. cit.* 331 (Type: *Meijer SAN 21711*, Borneo, Sabah, Sepilok FR; holotype SAN; isotypes K, KEP, L, SAR), *syn. nov.*, Meijer & Wood *op. cit.* 180, Ashton *op. cit.* (1982) 450.

Main canopy or low emergent tree, to 40 m tall, tall 1.2 m diameter; bole straight, sometimes fluted; crown hemispherical, dense; buttresses to 0.7 m tall, thin, sometimes with flying buttresses. **Bark** dark yellowish to reddish brown, becoming cracked, oblong flaky, the flakes curling up from below, sometimes becoming shaggy. *Twig, inflorescence, leaf bud, parts of perianth exposed in bud, ovary, stylopodium, nut, bracteole, stipule, and petiole densely buff-puberulent; fruit calyx, midrib on both surfaces and veins below sparsely so.* **Twigs** terete, much-branched, slender, *c.* 1.5 mm diameter apically. Leaf buds ovoid, more or less compressed, 2–3 × 1–2 mm apically. **Stipules** hastate, *c.* 7 × 3 mm. **Leaves** *thinly coriaceous, drying yellowish brown below, mauve-grey above; blade narrowly ovate to oblong-lanceolate, 5.5–11 × 2.5–4 cm, base broadly cuneate, apex with narrow acumen to 1 cm long; midrib evident, elevated but somewhat furrowed above, slender but prominent with the veins below; lateral veins 10–12 pairs, ascending, dense; intercostal venation densely scalariform, hardly elevated; petiole c. 0.8 cm long.* **Inflorescences** terminal or axillary; rachis terete, slender, to 7 cm long, singly branched, branchlets bearing to 9 flowers; bracteoles elliptic, subacute, to 3 mm long, fugaceous. **Flowers:** buds to 6 × 2 mm; petals pink, cream at margin; *stamens 20–30, filament and anther glabrous, connectival appendage short, with 1(–2) apical bristle(s); ovary broadly ovoid, stylopodium narrowly cylindrical, shorter than ovary, style as long as stylopodium, tapering, columnar, glabrous.* **Fruits:** *calyx lobes unequal, 3 longer lobes to 5 × 1.2 cm, tapering to 3 mm above the saccate base, 2 shorter ones to 3.5 × 0.4 cm, otherwise similar.* **Nuts** ovoid, to 1 × 0.7 cm, with *c.* 1.7 mm style remnant.

Vernacular names. Sabah—*selangan batu kurap* (preferred name). Sarawak—*selangan batu zang* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Sabah recorded from Beaufort, Keningau, Kinabatangan, Lahad Datu, Ranau, Sandakan, and Tawau districts (e.g., *SAN 15012, SAN 21237, SAN 22848, SAN 76949, and SAN 126639*) and in Sarawak from Belaga, Bintulu, Kuching, Limbang, Lundu, and Miri districts (e.g., *S 9641, S 24694, S 32212, S 43462, and S 52753*). Also occurring in Brunei (e.g., *BRUN 740 and SAN 17530*) and Kalimantan (e.g., *bb. 29700 and Endert 2540*).

Ecology. In mixed dipterocarp forest on leached well-drained sandy and clay soils, on low hills and along shale ridges, at altitude to 700 m; locally frequent. Occurring in Bako, Kubah, Lambir and Mulu NPs; though its habitat is gradually reduced by land conversion, the species is not yet vulnerable.

115. *Shorea seminis* (de Vriese) Slooten
(of *Seminis*, W Kalimantan)

Plate 4F.

(sect. *Shorea*, subsect. *Shorea, selangan batu*)

In Merrill, PEB (1929) 204, op. cit. (1941) 117; Keith op. cit. 44; Masamune op. cit. 497; Browne op. cit. 170; Ashton op. cit. (1963) 272, op. cit. (1964) 145, op. cit. (1968) 75, op. cit. (1982) 451; Meijer & Wood op. cit. 185; Burgess op. cit. 203, 211; Anderson op. cit. (1980) 120; PROSEA op. cit. 433; Kessler & Sidiyasa op. cit. 110; Coode et al. (eds.) op. cit. 83; Newman et al. op. cit. (1998) 196. **Basionym:** *Hopea seminis* de Vriese *op. cit.* 32. **Type:** *de Vriese s.n.*, Borneo, W Kalimantan, Sambas, *Seminis* (holotype L). **Synonyms:** *Hopea lanceolata* de Vriese *op. cit.* 32; *Shorea schefferiana* Hance *op. cit.* 303; *Isoptera borneensis* Scheff. ex Burck *op. cit.* (1886) 27; *S. borneensis* (Scheff. ex Burck) Pierre, *For. Fl. Coch.* 3 (1889) t. 234; *Ridleyinda borneensis* (Scheff. ex Burck) Kuntze *op. cit.* 65; *I. seminis* (Scheff. ex Burck) Burkill, *Bull. Misc. Inform. Kew* (1935) 317.

Large emergent tree, to 45 m tall, to 1.3 m diameter, or more or less small leaning river bank tree; bole straight, cylindrical, or bowed; crown dense, oblong to hemispherical; buttresses to 2 m tall, thin. *Twig, inflorescence, leaf bud, parts of perianth exposed in bud, ovary, stylopodium, nut, stipule, bracteole, petiole, midrib on both surfaces, and veins below evenly more or less densely greyish brown puberulent; fruit calyx sparsely so.* **Twigs** at first ribbed, becoming terete, sparingly branched, slender, c. 1.5 mm diameter apically; stipule scars short, descending. Leaf buds ovoid to falcate, slightly compressed, 1.5–2.5 × 1–2 mm. **Stipules** oblong, to 7 × 3.5 mm. **Leaves** *thinly coriaceous, drying dull yellowish brown below with paler veins, mauve-grey above; blade oblong-ovate to lanceolate, 9–18 × 2.5–8 cm, base obtuse or cuneate, apex with slender acumen 0.8–2 cm long; midrib evident, flat to shallowly furrowed above, slender but prominent below; lateral veins 9–15 pairs, ascending, slender but prominent below; intercostal venation densely scalariform, sinuate, more or less obscure; petiole 1–1.5 cm long.* **Inflorescences** terminal, axillary, or ramiflorous; rachis terete, to 10 cm long, singly branched, branchlets bearing to 5 flowers. **Flowers:** buds to 8 × 2 mm; petals cream, pink towards base; *stamens 30–40, filaments with a few long bristles, anthers glabrous, connectival appendage short, setose; ovary and stylopodium conical to hourglass-shaped, style short, glabrous.* **Fruits:** *calyx lobes subequal, incrassate, orbicular, rotate, to 2 × 1.8 cm (usually smaller).* **Nuts** *ovoid to globose, to 1 cm diameter, with to 2 mm long stout tapering style remnant.*

Vernacular names. Sabah—*selangan batu terendak* (preferred name). Sarawak—*engkabang terendak* (preferred name).

Distribution. Borneo and the Philippines. Known in Sabah from Kinabatangan, Kota Belud, Pensiangan, Sandakan, and Tawau districts (e.g., *SAN 16345, SAN 30438, SAN 36214, SAN 36652, and SAN 97082*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, Sibu, Sri Aman, and Tatau districts (e.g., *S 13781, S 20883, S 36684, S 43629, and S 68019*). Also occurring in Brunei (e.g., *BRUN 3359, Coode MC 6446 and Forman 1166*) and Kalimantan (e.g., *Ambriansyah AA 2137, bb. 29271 and Kostermans 12640*).

Ecology. Locally common, on clay and silt alluvium river banks along lowland rivers; occasionally at altitude to 300 m. Occurring in Mulu NP; elsewhere vulnerable owing to land conversion.

116. *Shorea slootenii* Wood ex P.S.Ashton

(D.F. van Slooten, 1891–1953, student of dipterocarps at Bogor, Indonesia)

(sect. **Mutica**, subsect. **Auriculatae**, red meranti)

Gard. Bull. Sing. 19 (1962) 312, *op. cit.* (1964) 222, *op. cit.* (1968) 119, *op. cit.* (1982) 529; Meijer & Wood *op. cit.* 147; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 130; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al.* *op. cit.* (1996) 213. **Type:** *G.H.S. Wood SAN 15160*, Borneo, Sabah, Sipitang district, Mengalong FR (holotype K; isotypes KEP, L, SAN).

Low emergent or main canopy tree, to 40 m tall, to 1.6 m diameter; bole straight, cylindrical; crown hemispherical, *somewhat diffuse, the leaves hanging; buttresses to 1.5 m tall, stout.* **Bark** *becoming dark reddish brown, relatively deeply v-section fissured; inner bark yellowish brown; heartwood orange-brown.* *Twig, inflorescence, leaf bud, calyx and stipule outside, petiole, and leaf blade below densely persistently pale fulvous scabrid-*

tomentose, the hair tufts short, hard and knob-like; midrib above, inside of stipule, bracteole, parts of petal exposed in bud, ovary, stylopodium, and nut more or less densely shortly pubescent. **Twigs** compressed and ribbed at first, becoming terete but remaining verrucose, stout, to 5×3 mm apically; stipule scars long, cuneate, descending. *Leaf buds broadly ovate, 6–10 × 5–8 mm, obtuse, slightly compressed.* **Stipules** oblong, to 25×8 mm, caducous. **Leaves** coriaceous, deeply concave and more or less corrugated between the veins, drying rust-brown below; blade oblong, $11–22 \times 4–7$ cm, base obtuse, apex with abrupt, tapering acumen to 1.5 cm long; midrib evident but deeply furrowed above, stoutly prominent below; lateral veins (25–)27–34 pairs, dense, shallowly furrowed above, prominent below, arched near the margin; intercostal venation scalariform, elevated below; petiole 1.7–2.3 cm long. **Inflorescences** terminal or axillary; rachis stout, rigid, brittle, more or less compressed, to 18 cm long, branchlets short bearing to 4 flowers; bracteoles ovate to deltoid, obtuse, to 3×2 mm. **Flowers:** buds to 12×7 mm; petals pale yellow; stamens 15, connective appendage reflexed on 5 inner stamens only; ovary and stylopodium narrowly ovoid, style equal to ovary, broadly columnar, glabrous. **Fruits:** calyx shiny; calyx lobes unequal, 3 longer lobes oblong-lobate, to 17×1.8 cm, hardly tapering, the base forming a central incrassate disk bordered by to 4 mm wide lateral auricles, tapering abruptly at the pedicel, 2 shorter ones linear-lobed, to 5.5×0.7 cm, hardly auriculate at base. **Nuts** ovoid, to 3.5×1.3 cm, with to 4 mm long slender tapering style remnant.

Vernacular names. Sabah—*seraya kepong kasar* (preferred name). Sarawak—*meranti kepong kasar* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Sipitang district (e.g., *SAN 15160*, *SAN 16922* and *SAN A 4570*) and in Sarawak from Bintulu, Kuching, Lawas, Lundu, and Miri districts (e.g., *S 1516*, *S 11053*, *S 15140*, *S 27119*, and *S 44067*). Also occurring in Brunei (e.g., *BRUN 3070*, *BRUN 3175*, *BRUN 3270*, *BRUN 5436*, and *FMS 35560*) and W and E Kalimantan (e.g., *bb. 7097* and *bb. 14509*).

Ecology. Locally frequent in mixed dipterocarp forest on leached thinly humic yellow sandy and sandy clay soils, on low hills at altitudes to 400 m; mostly in the neogeosyncline (with one record at Bt. Tanggi) in the central and northern part of its range. Occurring in Lambir NP; endangered outside parks system.

117. **Shorea smithiana** Symington
(J.S. Smith, State Forest Officer in Brunei, 1933–1936)

Fig. 31, Plates 5A–B.

(sect. **Brachypterae**, red meranti)

Gard. Bull. S. S. 9 (1938) 345; Ashton *op. cit.* (1964) 223, *op. cit.* (1968) 119, *op. cit.* (1982) 503; Meijer & Wood *op. cit.* 148; Burgess *op. cit.* 155, 183; Anderson *op. cit.* (1980) 130; PROSEA *op. cit.* 403; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al.* *op. cit.* (1996) 213. **Type:** *Smith FMS 30472*, Borneo, Brunei, Labi Hills (holotype KEP).

Large emergent tree, to 60 m tall, to 1.6 m diameter; bole tall, cylindrical; crown dense, large, hemispherical; buttresses to 2 m tall and wide, stout, notably straight-ridged. **Bark** dull greyish brown to greyish tawny, becoming v-section fissured and thinly oblong flaky; dammar in pale cream-yellow smears; inner bark dull pinkish brown; heartwood rich

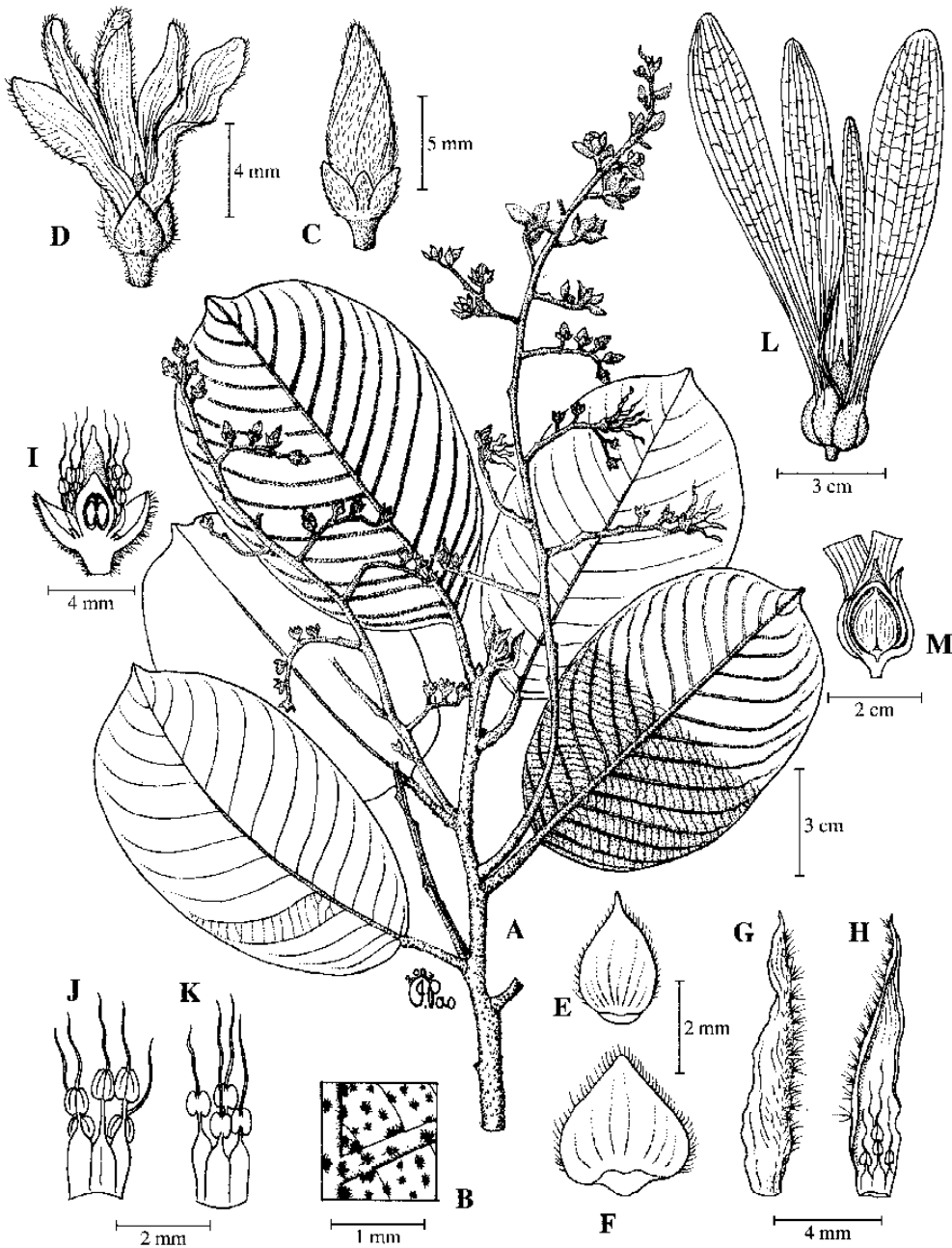


Fig. 31. *Shorea smithiana*. A, flowering leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, open flower; E, adaxial view of inner sepal; F, adaxial view of outer sepal; G, abaxial view of petal; H, adaxial view of petal with stamens; I, longitudinal section of gynoecium with sepals and stamens; J, adaxial view of stamens; K, abaxial view of stamens; L, fruit; M, longitudinal section of fruit. (A–K from S 46524, L–M from SAN 134957.)

pinkish brown, relatively soft. *Young twig, inflorescence, parts of calyx exposed in bud, leaf bud, stipule outside, petiole, leaf below, and midrib above persistently greyish brown to rust scabrid-pubescent; stipule inside, bracteole, parts of corolla exposed in bud, ovary, stylopodium, and nut evenly pubescent.* **Twigs** ribbed, stout, 3–4 mm diameter apically; stipule scars to 2 mm long initially, broad, falcate. Leaf buds ovoid, 5–8 × 3–4.5 mm, slightly compressed. **Stipules** broadly hastate, to 20 × 6 mm, caducous. **Leaves** thickly coriaceous, drying pinkish brown with greyish lepidote undersurface (mature trees); blade broadly obovate to oblong, sometimes ovate, 12–20 × 6.5–11.5 cm, base obtuse to subcordate, apex with broad, tapering acumens to 1.5 cm long; midrib broad, more or less flat or shallowly furrowed above, prominent below; lateral veins 14–17 pairs, prominent below, spreading, arched; intercostal venation scalariform, sinuate, elevated below; petiole 2.2–2.8 cm long. **Inflorescences** terminal or axillary; rachis terete, to 25 cm long, branchlets bearing to 7 secund flowers; bracteoles ovate, subacute, to 5 × 4 mm, caducous. **Flowers:** buds to 10 × 3 mm; petals pink; *stamens 22–26, connectival appendage at least 2x the length of anther, glabrous; ovary and stylopodium narrowly pyriform, style cylindrical, equal in length to both, glabrous.* **Fruits:** calyx glabrescent; *calyx lobes unequal, 3 longer lobes to 20 × 2.8 cm, tapering to c. 1.3 mm above the saccate base, 2 shorter ones linear-lobed, to 13 × 0.9 cm, similar at base.* **Nuts** ovoid, to 2.7 × 1.8 cm, with to 3.5 mm tapering style remnant.

Vernacular names. Sabah—*seraya timbau* (preferred name). Sarawak—*meranti rambai* (preferred name).

Distribution. Endemic in Borneo. In Sabah widespread, known from Beaufort, Kinabatangan, Kudat, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Semporna, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15168, SAN 15420, SAN 16427, SAN 19429, SAN 36587, and SAN 99912*) and in Sarawak from Belaga, Bintulu, Lawas, Limbang, Lundu, and Miri districts (e.g., *S 1833, S 24970, S 46531, and S 46763*). Also occurring in Brunei (e.g., *BRUN 5170 and Niga NN 201*) and E and S Kalimantan (e.g., *Ambriansyah & Priyono AA 2192, bb. 22636, bb. 34403, and bb. 34463*).

Ecology. Locally common in mixed dipterocarp forest, on deep well-drained sandy clay soils, on hills at altitude to 400 m. Occurring in Lambir and Mulu NPs; Danum Valley Conservation Area and Sepilok FR; elsewhere vulnerable owing to land conversion.

118. *Shorea splendida* (de Vriese) P.S.Ashton

(Latin, *splendidus* = splendid)

(sect. **Pachycarpae**, red meranti)

Gard. Bull. Sing. 20 (1963) 279, *op. cit.* (1968) 119, *op. cit.* (1982) 522; Anderson *op. cit.* (1980) 130; PROSEA *op. cit.* 403; Newman *et al. op. cit.* (1996) 215. **Basionym:** *Hopea splendida* de Vriese *op. cit.* 28. **Lectotype** (designated here): *de Vriese s.n.*, ‘Borneo’, Sambas (holotype L). **Synonym:** *Shorea martiniana* Scheff. *op. cit.* 408.

Main canopy tree, to 30 m tall, to 80 cm diameter; bole frequently misshapen; crown oblong to narrow hemispherical, with pendent branches and distichous hanging leaves; buttresses low, rounded. **Bark** smooth, hoop-marked, pale greyish brown; inner bark and heartwood pale pinkish brown. *Parts of corolla and nut densely cream pubescent, all parts otherwise glabrous.* **Twigs** compressed, ribbed, *c. 3 × 1 mm apically; stipule scars to 1 mm thick,*

prominent, amplexicaul. Leaf buds c. 8 × 6 mm, comprising loose aggregation of young leaves and stipules. Stipules ovate with cordate base, acute, subpersistent, prominent, to 25 × 15 mm. Leaves chartaceous, undulate, drying reddish brown, somewhat shiny; blade oblong, 8.5–23 × 4.2–11 cm, base typically cordate, sometimes obtuse or cuneate, apex with slender and tapering acumen to 1 cm long; midrib very slender, evident but shallowly sunken above, prominent below; lateral veins 9–12 pairs, slender but prominent below, well-spaced; intercostal venation remotely scalariform, sinuate, elevated below; petiole 1.1–2.2 cm long. Inflorescences terminal or axillary; rachis terete, to 20 cm long, singly branched, branchlets to 7 cm long, bearing to 10 flowers; bracts to 18 × 8 mm, caducous. Flowers: buds to 10 × 3 mm; petals pale pink; filaments connate along ¾ their length, connectival appendage 4–5x as long as anther; ovary ovoid, glabrous, style and stylopodium spindle-shaped. Fruits: pedicel to 7 mm long, to 4 mm diameter; calyx lobes unequal but hardly longer than nut, 3 longer lobes to 7.5 × 2.3 cm, tapering to c. 12 mm above the saccate base, 2 shorter ones to 6.5 × 1.2 cm, otherwise similar. Nuts ovoid, to 5.5 × 3 cm, acute.

Vernacular names. Sarawak—*engkabang bintang* (preferred name), *engkabang layar* (Iban).

Distribution. Endemic in Borneo. Known in Sarawak from Bau, Kuching, Lundu, Simunjan, and Sri Aman districts (e.g., *S 10307*, *S 22769*, *S 27347*, and *S 37048*). Also occurring in W Kalimantan (e.g., *bb. 29663*, *bb. 29717* and *bb. 31419*).

Ecology. Locally common, in dense clumps, on floodplains with sweet water. Occurring in Kubah NP; not vulnerable.

Uses. The secondmost important source of illipe nuts in NW Borneo, after *S. macrophylla*.

119. *Shorea stenoptera* Burck

(Greek, *steno-* = narrow, *pteron* = wing; the short narrow fruit calyx lobes)

(sect. **Pachycarpae**, red meranti)

Med. Lands Pl. Tuin 3 (1886) 11; Merrill *op. cit.* (1921) 407; Masamune *op. cit.* 497; Browne *op. cit.* 144; Ashton *op. cit.* (1968) 120, *op. cit.* (1982) 523; Anderson *op. cit.* (1980) 103; PROSEA *op. cit.* 403; Newman *et al. op. cit.* (1996) 216. **Lectotype** (designated here): *de Vriese s.n.*, Borneo, W Kalimantan, Sintang (hololectotype L).

Main canopy tree, to 30 m tall, to 70 cm diameter; crown conical to narrowly hemispherical, dense, with somewhat pendulous branches; bole straight, tapering, often branching low; buttresses low, concave, relatively thin. **Bark** purplish brown and grey-mottled, smooth, hoop-marked; inner bark thin, yellowish brown; heartwood pinkish brown. *Twig apex, base of inflorescence, petiole and midrib above densely ochreous puberulent in young trees, becoming glabrous in mature trees; stipules occasionally sparsely sericeous; nut densely cream-brown puberulent. Twigs* somewhat compressed to terete, smooth, 3–4 mm diameter apically; *stipule scars pale, prominent, descending-amplexicaul.* Leaf buds ellipsoid, to 4 × 3 mm, usually obscured within stipules. **Stipules** ovate-deltoid, obtuse, subauriculate at base, to 20 × 10 mm, subpersistent. **Leaves** thickly coriaceous, drying dark reddish-chocolate; blade oblong, 18–40 × 8–22 cm, base broadly cuneate to cordate, apex with prominent, tapering acumen to 2 cm long; midrib evident, more or less flat above, stoutly

prominent below as also the lateral veins; lateral veins 10–14 pairs; intercostal venation remotely scalariform, elevated below; petiole 2.3–4.5 cm long, stout. Inflorescences terminal or axillary, borne between leaf flushes at the axils of fugaceous rudimentary leaves along the twig, the twig there with short internodes (visible when not reproducing); bracteoles ovate, acute, to 6 × 4 mm, not at first caducous. **Flowers:** buds to 7 × 3 mm; petals deep pink; stamens 15, filaments connate along $\frac{3}{4}$ of their length, connectival appendage 3–4x as long as anther; style and stylopodium spindle-shaped. **Fruits:** pedicel to 4 mm long and diameter; calyx lobes unequal but hardly longer than nut, 3 longer lobes to 7.5 × 2 cm, tapering to 10 mm above the saccate base, 2 shorter ones to 5.5 × 0.8 cm, similar at base. **Nuts** ovoid, to 5 × 3 cm, apiculate.

Vernacular name. Sarawak—*engkabang rusa* (Iban, preferred name).

Distribution. Endemic in Borneo. Recorded in Sarawak from Betong, Kuching, Lundu, Simunjan, and Sri Aman districts (e.g., *S* 6506, *S* 10292, *S* 18010, *S* 27349, and *S* 34397). Also occurring in W Kalimantan (e.g., the type and *bb.* 29664).

Ecology. Locally common, on humic soils on seldom flooded sandy alluvium, and in *kerangas* forest on more or less poorly drained podsols. Occurring in Bako and Kubah NPs; probably not vulnerable.

Use. An important source of illipe nuts.

120. *Shorea subcylindrica* Slooten

(Latin, *sub-* = more or less, *cylindricus* = cylindrical; the nut shape)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Reinwardtia 3 (1956) 331; Ashton *op. cit.* (1968) 90, *op. cit.* (1982) 476; Anderson *op. cit.* (1980) 123; Newman *et al. op. cit.* (1996) 217. **Type:** *Egon SA 615*, Borneo, Sarawak, Semengoh FR (holotype KEP).

Main canopy tree, to 30 m tall, to 50 cm diameter; bole straight, cylindrical; crown oblong, dense, irregular, small; buttresses low, rather thin. **Bark** chocolate-brown mottled with grey, hoop-marked. *Young twigs, leaf bud, inflorescence, parts of calyx exposed in bud, stipule and bracteole outside, and petiole sparsely caducous pale greyish brown puberulent; parts of corolla exposed in bud, ovary and nut densely persistently cream-brown sericeous to pubescent. Twigs* terete or somewhat compressed, rugulose, c. 2 mm diameter apically. Leaf buds ovoid, obtuse, c. 3 × 2 mm. **Stipules** lanceolate, to 10 × 2 mm, fugaceous. **Leaves** coriaceous, somewhat shiny, drying tawny-brown below, greenish grey above; blade narrowly elliptic to lanceolate, 9–24 × 4–12 cm, base cuneate, rarely obtuse, apex subcaudate, acumen to 1.5 cm long; midrib evident but shallowly furrowed above, stout and elevated but not prominent below; lateral veins 8–11 pairs, ascending; intercostal venation subreticulate; petiole 0.9–1.8 cm long. **Inflorescences** terminal or axillary; rachis terete, lax, to 12 cm long, to trebly branched, branchlets bearing to 5 flowers; bracteoles deltoid, to 1 mm long, fugaceous. **Flowers:** buds to 3 × 1 mm; petals cream; connectival appendage somewhat longer than anther, glabrous; ovary ovoid, without stylopodium, style somewhat shorter than ovary, sericeous in the basal half. **Fruits:** pedicel c. 1 mm long; calyx lobes subequal, ovate, acute, relatively thin, hardly saccate, to 1.2 × 0.9 cm. **Nuts** ellipsoid, to 2.3 × 1.6 cm, acute.

Distribution. Endemic in Borneo. Known in Sabah from Beaufort district (e.g., *SAN 43270*) and in Sarawak from Kapit, Kuching and Lundu districts (e.g., *S 13708*, *S 29467*, *S 37781*, *S 44071*, and *S 68774*). Also occurring in W Kalimantan (e.g., *Suzuki 9669* and *Suzuki 9690*).

Ecology. Very local but common in mixed dipterocarp forest on leached sandy clay soils on low hills, at altitudes to 200 m. Critically endangered by forest conversion.

121. *Shorea superba* Symington

(Latin, *superbus* = magnificent; the stature and elegance of the tree)

(sect. *Shorea*, subsect. *Shorea*, *selangan batu*)

Gard. Bull. Sing. 17 (1960) 491; Ashton *op. cit.* (1964) 146, *op. cit.* (1968) 75, *op. cit.* (1982) 459; Meijer & Wood *op. cit.* 187; Burgess *op. cit.* 203, 211; Anderson *op. cit.* (1980) 121; PROSEA *op. cit.* 434; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al.* *op. cit.* (1998) 197. **Type:** *Puasa FMS 38853*, Borneo, Sabah, Sandakan, Betotan (holotype KEP; isotypes L, SAN, SING).

Vast emergent tree, to 75 m tall, to 3.1 m diameter; bole tall, cylindrical; crown vast cauliflower-shaped, diffuse, pale from below; buttresses initially thin, extending to 4 m tall, concave, stout. **Bark** yellowish brown, becoming cracked and peeling with small oblong thin flakes, retaining an overall smooth appearance. *Twig, inflorescence, leaf bud, calyx outside, stipule, bracteole, petiole, veins and midrib on both surfaces more or less densely evenly pinkish brown puberulent; fruit calyx sparsely so; leaf blade below silvery lepidote.* **Twigs** compressed and ridged at first, becoming terete, much-branched, c. 2.5 × 1 mm apically; stipule scars pale, linear, horizontal. Leaf buds ovoid, to 4 × 3 mm, subacute, compressed. **Stipules** ovate-lanceolate, to 12 × 5 mm, fugaceous. **Leaves** *thinly coriaceous, conspicuously silvery lepidote below; blade oblong, 7–12 × 4–7 cm, base broadly cuneate, apex with broad, tapering acumen to 1 cm long; midrib and veins slender but evident, more or less narrowly furrowed above, slender but prominent below; lateral veins 16–24 pairs, dense, straight, appearing like a fish skeleton; intercostal venation densely scalariform, obscure; petiole 1–1.5 cm long.* **Inflorescences** terminal or axillary; rachis somewhat compressed and ribbed, to 8 cm long, branchlets bearing to 8 flowers; bracteoles lanceolate, to 5 mm long, caducous. **Flowers:** buds to 7 × 2 mm; corolla cream; *stamens c. 30, filaments and anthers glabrous, connectival appendage short, setose; ovary and stylopodium cylindrical to conical, style short, glabrous.* **Fruits:** *calyx lobes unequal, 3 longer lobes to 6 × 1.2 cm, tapering to c. 8 mm at the saccate base, 2 shorter ones linear-lobed, to 1.2 × 0.7 cm, similar at base.* **Nuts** ovoid, to 1.2 × 0.7 cm, apiculate.

Vernacular names. Sabah—*selangan batu daun halus* (preferred name). Sarawak—*selangan batu tulang ikan* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Beaufort, Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 16910*, *SAN 19253*, *SAN 27146*, *SAN 33442*, and *SAN 61069*) and in Sarawak from Lawas, Limbang, Marudi, and Miri districts (e.g., *S 1538*, *S 1765*, *S 21411*, *S 24968*, and *S 26155*). Also occurring in Brunei (e.g., *KEP 80136*, *S 1660* and *S 1661*) and W and E Kalimantan.

Ecology. Scattered in mixed dipterocarp forest on well-structured clay soils in moist lower slope, low hill and floodplain sites. Occurring in Lambir and Mulu NPs, Danum Valley Conservation Area and Sepilok FR; elsewhere endangered owing to land conversion.

122. *Shorea symingtonii* Wood

(C.F. Symington, 1905–1943, master of the dipterocarps)

(sect. **Anthoshorea**, white meranti)

Gard. Bull. Sing. 17 (1960) 493; Meijer & Wood *op. cit.* 57; Burgess *op. cit.* 159; Ashton *op. cit.* (1982) 495; Newman *et al. op. cit.* (1996) 218. **Type:** *G.H.S. Wood & Charington FMS 35608 (= SH 16522)*, Borneo, Sabah, Sandakan district, Sepilok FR (holotype SAN; isotypes KEP, L).

Large emergent tree, to 50 m tall, to 1.5 m diameter; bole tall, cylindrical; crown hemispherical, somewhat irregular; buttresses large, stout. **Bark** greyish brown, cracked and crumbly flaky; inner bark cream and yellow laminated. *Twig apice, leaf bud, stipule, inflorescence, bracteole, flower calyx outside, and ovary sparsely caducously tawny puberulent; parts otherwise glabrous. Twigs compressed, stout, c. 4 × 2 mm apically.* Leaf buds ovoid-falcate, acute, c. 4 × 3 mm. **Stipules** lanceolate, to 12 × 5 mm, fugaceous. **Leaves** coriaceous, corrugated between lateral veins, drying yellowish tawny; blade oblong to narrowly obovate (9–)10–18 × (4–)5–8 cm, base obtuse to cordate, apex with tapering acumen to 1 cm long; midrib and lateral veins evident but furrowed above, slender but prominent below; lateral veins dense, 18–22 pairs; intercostal venation densely scalariform, evident below; petiole stout, 1–2 cm long. **Inflorescences** terminal or axillary; rachis singly branched, lax, to 17 cm long, branchlets bearing to 5 flowers; bracteoles ovate-elliptic, acute, to 3 × 2 mm, fugaceous. **Flowers:** buds large, to 10 × 4 mm; *stamens 15, connectival appendage c. 2½x the length of anther, scarious towards apex; ovary ovoid, without stylopodium, style stoutly columnar, obscurely trifid apically.* **Fruits:** pedicel c. 5 mm diameter, stout, expanding into the trumpet-shaped receptacle; calyx lobes unequal, 3 longer lobes to 18 × 2.5 cm, tapering into the concave incrassate base, 2 shorter lobes to 13 × 1.5 cm, narrower but otherwise similar. **Nuts** narrowly ellipsoid-ovoid, to 2.5 × 1 cm, glabrous, prominently apiculate, hidden within calyx lobe bases.

Vernacular name. Sabah—*melapi kuning* (preferred name).

Distribution. Endemic in Borneo; confined to the eastern parts of Sabah, occurring in Kinabatangan, Lahad Datu, Sandakan, Semporna, and Tawau districts (e.g., *SAN 15539*, *SAN 16208*, *16348*, *SAN 23713*, and *SAN 39295*).

Ecology. Scattered in mixed dipterocarp forest on undulating land, on clay rich soils. Occurring in Sepilok FR; possibly endangered.

123. *Shorea tenuiramulosa* P.S.Ashton

(Latin, *tenuis* = slender, *ramulus* = small twig; the slender twig)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 31 (1978) 42, *op. cit.* (1982) 478; Newman *et al. op. cit.* (1996) 219. **Type:** *Meijer SAN 39306*, Borneo, Sabah, Karamauk, Bt. Meliau (holotype K; isotypes KEP, SAN).

Small canopy tree, to 30 m tall, to 30 cm diameter. **Bark** greyish brown, smooth. **Inflorescence**, stipule, bracteole, calyx outside, ovary, and nut greyish puberulent; caducous on twig, becoming sparse on fruit calyx lobes. **Twigs** straight, sparsely branching, terete, rugulose, slender, pale, to 2 mm diameter apically. Leaf buds and stipule not seen. **Leaves** thinly coriaceous, drying pale greyish brown; blade elliptic to lanceolate 9–24 × 4–11 cm, base broadly cuneate to obtuse, margin prominently undulate, apex shortly broadly acuminate; midrib prominent on both surfaces; lateral veins 8–9(–11) pairs, very slender but distinctly elevated below, slightly so above, arched; intercostal venation lax, reticulate; petiole 1.1–2 cm long, 1.5 mm diameter, drying black but cream towards the end. **Inflorescences** terminal, or in axillary cluster of 3, or ramiflorous; rachis slender, many-flowered; bracteoles elliptic, to 2 mm long, fugaceous. **Flowers:** buds to 5 × 2 mm; stamens 15, anthers narrowly ellipsoid, connectival appendage c. 1/2x the length of anther; ovary ovoid, without stylopodium, tapering into the somewhat shorter columnar glabrous style. **Fruits:** subsessile; calyx lobes subequal, oblong, obtuse, incrassate, saccate, patent, to 0.4 × 0.3 cm. **Nuts** ellipsoid-cylindric, to 2.5 × 1.4 cm, apiculate.

Distribution. Endemic in Borneo. Known in Sabah from Lahad Datu, Sandakan and Tawau districts (e.g., SAN 21621, SAN 21626, SAN 31475, SAN 36031, and SAN 54801) and in Sarawak from Kapit and Lundu district (e.g., S 29666 and S 37815).

Ecology. In mixed dipterocarp forest, on yellow sandy soil in Sarawak, and on shallow ultrabasic soil near the coast in Sabah. Rare and probably endangered.

124. *Shorea teysmanniana* Dyer ex Brandis

(J.E. Teijsmann, 1808–1882, Curator of Buitenzorg (now Bogor) Botanic Garden and the paramount collector of living plants in tropical Asia)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

J. Linn. Soc. Bot. 31 (1895) 100; Symington *op. cit.* (1933) 134, *op. cit.* (1943) 94; Masamune *op. cit.* 497; Browne *op. cit.* 144; Anderson *op. cit.* (1963) 159, *op. cit.* (1980) 130; Ashton *op. cit.* (1964) 225 *p.p.*, *op. cit.* (1968) 121, *op. cit.* (1982) 538; Meijer & Wood *op. cit.* 152; Burgess *op. cit.* 155, 183; PROSEA *op. cit.* 403; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al.* *op. cit.* (1996) 220. **Type:** Teijsmann *s.n.*, Sumatra, Bangka (holotype K). **Synonyms:** *Shorea cochinchinensis* Pierre var. *oligoneura* Boerl., *op. cit.* 107; *S. balangeroides* Boerl., *op. cit.* 107; *S. paludosa* Foxw., *op. cit.* (1932) 277.

Emergent tree, to 45 m tall, to 1.3 m diameter; bole straight, cylindrical; crown cauliflower-shaped, diffuse; buttresses to 1.5 m tall, somewhat slender. **Bark** pinkish- to chocolate-brown, densely v-section fissured, hardly flaking; inner bark reddish brown; heartwood deep pinkish red. **Young twig**, leaf bud, inflorescence, bracteole, and flower calyx outside persistently greyish brown puberulent; petiole caducously so; ovary, nut and parts of corolla exposed in bud densely buff-pubescent. **Twigs** compressed at first, smooth, much-branched, c. 2 mm diameter apically; stipule scars pale, prominent, cuneate, 2 mm long. Leaf buds ovoid, subacute, depressed, 4–8 × 2–5 mm. **Stipules** ovate to oblong, subacute, to 14 × 5 mm, fugaceous. **Leaves** coriaceous, glabrous, shiny above, drying rich reddish brown below; blade ovate, 7.5–11 × 3.5–7 cm, base obtuse, apex with tapering acumen to 0.8 cm long; midrib and lateral veins obscurely sunken above, slender but prominent below; lateral veins 8–11 pairs, arched, with or without to 3 pairs of small axillary pore-like domatia; intercostal venation scalariform, hardly elevated, obscure; petiole 1.2–1.8 cm long, slender. **Inflorescences** terminal or axillary; rachis terete, to 8 cm long, singly

branched. **Flowers:** buds to 14×5 mm; stamens 15, connectival appendage short, becoming reflexed; ovary and stylopodium narrowly conical, style *c.* $\frac{1}{2}$ x the length of ovary and stylopodium, glabrous. **Fruits:** *calyx lobes unequal, 3 longer lobes to 8×1 cm, tapering to *c.* 8 mm above the saccate base, 2 shorter ones linear-lobed, to 3×0.5 cm, similar at base.* **Nuts** ovoid, to 1.2×0.8 cm, with *c.* 2 mm slender style remnant.

Vernacular names. Sabah—*seraya bunga* (preferred name). Sarawak—*meranti lilin* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah rare and confined to Sipitang district (e.g., *SAN 19003* and *SAN 27969*) but in Sarawak widespread and known from Kuching, Lawas, Lundu, Marudi, Miri, Sarikei, Sibuluan, Simunjan, and Sri Aman districts (e.g., *S 3280*, *S 12419*, *S 14608*, and *S 77025*). Also occurring in Brunei (e.g., *BRUN 5834* and *FMS 35661*).

Ecology. Very local, but often frequent, in mixed peat swamp forest; rare in *alan* (*S. albida*) forest; once recorded at 900 m from the sandstone plateau on G. Bubong Rumah, Lawas, Sarawak. Recorded from Mulu NP; elsewhere endangered by deforestation.

125. *Shorea uliginosa* Foxw.

(Latin, *uliginosus* = growing in swamps; the habitat)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Malay. For. Rec. 10 (1932) 210; Ashton *op. cit.* (1967) 294, *op. cit.* (1968) 121, *op. cit.* (1982) 539; Anderson *op. cit.* (1980) 130; PROSEA *op. cit.* 404; Newman *et al. op. cit.* (1996) 221. **Type:** Foxworthy CF 7938, Peninsular Malaysia, Selangor, Bt. Ceraka FR (holotype KEP). **Synonym:** *Shorea rugosa* (non F. Heim) Symington var. *uliginosa* Symington *op. cit.* (1939) 372, *op. cit.* (1943) 91, Anderson *op. cit.* (1963) 159.

Large emergent tree, to 45 m tall, to 1.5 m diameter; bole tall, straight, cylindrical; crown irregularly hemispherical, dense, the twigs and leaves pendent; buttresses to 4 m tall, spreading, stout. **Bark** chocolate to purplish brown mottled with fawn and grey, deeply v-section fissured, the ridges eventually becoming powdery chunkily flaky; dammar incrustations pale yellow; inner bark rich reddish brown; heartwood purplish red. *Twig, leaf bud, stipule outside, inflorescence, calyx outside, bracteole outside, petiole, and blade below persistently pale chocolate-brown scabrid-pubescent; stipule within, midrib and veins above puberulent.* **Twigs** at first prominently ribbed below the petiole insertions, stout, 3–4 mm diameter apically; stipule scars short, pale, horizontal. Leaf buds ovoid, subacute, compressed, to 6×4 mm. **Stipules** elliptic, subacute, to 14×5 mm. **Leaves** chartaceous, prominently concave; *blade elliptic-oblong, $12\text{--}22 \times 6\text{--}12$ cm, base broadly cuneate to subcordate, apex with acumen to 1 cm long; midrib barely evident, furrowed above, prominent below; lateral veins $16\text{--}21$ pairs, slender but prominent below, arched near margins, dense; intercostal venation scalariform, elevated below; petiole $2.2\text{--}3.5$ cm long.* **Inflorescences** terminal or axillary; rachis ribbed, to 16 cm long, doubly branched, branchlets bearing to 6 flowers; bracteole elliptic, subacute to 3×2 mm. **Flowers:** buds to 5×3 mm; petals pale yellow; stamens 15, connectival appendage about as long as anther, becoming reflexed; ovary and stylopodium conical, style the same length, columnar, glabrous. **Fruits:** *calyx lobes unequal, 3 longer lobes to 6×1.2 cm, tapering to 4 mm at the*

saccate base, 2 shorter ones linear-lobed, to 2 cm long, similar at base. Nuts ovoid, to 0.8×0.6 cm, acute.

Vernacular name. Sarawak—*meranti buaya* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo known in Sarawak from Bintulu, Marudi, Miri, Sarikei, Sibuluan, and Sri Aman districts (e.g., *S 7908*, *S 14507*, *S 23287*, *S 27901*, and *S 32001*). Also occurring in W Kalimantan.

Ecology. Formerly locally abundant in the mixed peat swamp forests of the Lower Rajang, local and rare elsewhere; rare in *alan* (*S. albida*) forest. Endangered.

126. *Shorea venulosa* Wood *ex* Meijer

(Latin, *venulosus* = with tiny veins; the slender leaf venation)

(sect. **Brachypterae**, red meranti)

Act. Bot. Neerl. 12 (1963) 342; Wood & Meijer *op. cit.* 153; Burgess *op. cit.* 166; Ashton *op. cit.* (1964) 510, *op. cit.* (1968) 122, *op. cit.* (1982) 510; Anderson *op. cit.* (1980) 130; PROSEA *op. cit.* 404; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al.* *op. cit.* (1996) 222. **Lectotype** (designated here): *G.H.S. Wood SAN 15134*, Borneo, Sabah, Sipitang district, Menggalong FR (hololecotype K; isolectotypes KEP, SAN).

Large emergent tree, to 55 m tall, to 1.3 m diameter; bole straight, often somewhat tapering; crown cauliflower-shaped, diffuse; buttresses to 3 m tall, stout, prominent. **Bark** becoming dark chocolate-brown, deeply v-section fissured, the ridges becoming oblong flaky; dammar incrustations pale yellow; inner bark yellowish brown; heartwood dark brown. *Young parts at first grey sericeous, fugaceous except on leaf bud and stipule outside; inflorescence, parts of perianth exposed in bud, bracteole, ovary, and nut towards apex persistently cream puberulent.* **Twigs** terete, much-branched, slender, c. 1 mm diameter apically; *stipule scars pale, more or less horizontal, amplexicaul.* Leaf buds lanceolate-falcate, to 7×2 mm. **Stipules** hastate, to 20×3.5 mm, fugaceous. **Leaves** coriaceous, drying chocolate-brown, *often shiny above; blade ovate, $6-10 \times 3-5$ cm (sometimes smaller on exposed peaks, larger on E Sabah ultrabasics), base obtuse, margin sometimes narrowly revolute, apex with slender acumen to 0.6 cm long; midrib obscure, sunken above, slender but prominent below; lateral veins 15-18 pairs, very slender, hardly elevated as also the scalariform intercostal venation, often with small glabrous pore-like, sometimes prominent and pustular, axillary domatia; petiole 1.7-3 cm long, slender, geniculate.* **Inflorescences** terminal or axillary; rachis terete, slender, lax, to 11 cm long, branchlets short, bearing to 10 flowers; bracteoles ovate, obtuse, to 3.5×2 mm. **Flowers:** buds to 5×2.5 mm; corolla pink; stamens 15, connectival appendage more than 2x the length of anther; ovary ovoid, without stylopodium, style somewhat shorter, filiform, puberulent at base. **Fruits:** *calyx lobes unequal, chartaceous, 3 longer lobes to 6×1.3 cm, tapering to c. 3.5 mm above the saccate base, 2 shorter lobes linear-lobed, to 3×0.3 cm, similar at base. Nuts* narrowly ovoid, to 2×0.8 cm, acute.

Vernacular names. Sabah—*seraya kerangas* (preferred name). Sarawak—*meranti tangkai panjang padi* (preferred name).

Distribution. Endemic in Borneo. In Sabah widespread and recorded from Keningau, Kinabatangan, Kota Marudu, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Sipitang, Tambunan, and Tawau districts (e.g., *SAN 15501*, *SAN 16359*, *SAN 26168*, *SAN 37855*, and *SAN 39323*) and in Sarawak from Bau, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, and Mukah districts (e.g., *S 10128*, *S 23287*, *S 26552*, *S 28977*, and *S 60087*).

Ecology. Locally common, on podsols in *kerangas* forest, and forest on ultrabasic rock throughout E Sabah; also common in lower montane *kerangas* at 1000–1600 m altitude, including on the Batu Tibang andesite. Occurring in Bako, Kinabalu and Mulu NPs; vulnerable elsewhere in the lowlands, less so on the mountains.

127. *Shorea virescens* Parijs

(Latin, *virescens* = becoming green; inference unclear)

(sect. *Anthoshorea*, white meranti)

In Fedde, Rep. 33 (1933) 244; Slooten *op. cit.* (1949) 240; Rojo, *Kalikasan* 5 (1976) 99; Ashton *op. cit.* (1978) 44, *op. cit.* (1982) 492; Anderson *op. cit.* (1980) 124; PROSEA *op. cit.* 413; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al. op. cit.* (1996) 223. **Type:** *Frijd bb. 13898*, Borneo, W Kalimantan, Sanggau (holotype L; isotype BO).

Large emergent tree, to 50 m tall, to 1.6 m diameter; crown hemispherical, diffuse, large; bole tall, cylindrical; buttresses to 3 m tall, stout, prominent. **Bark** greyish tawny, becoming shaggily flaky, the flakes adhering and thick; dammar incrustations cream; inner bark cream and yellow laminated. *Twig, inflorescence, leaf bud, parts of perianth exposed in bud, bracteole, stipule, petiole, midrib on both surfaces, and venation below persistently densely greyish buff-pubescent; ovary minutely puberulent; nut glabrescent. Twigs compressed, stout, 2.4–4 × 1.5–3 mm apically; stipule scars to 2.5 mm long, horizontal. Leaf buds globose to stoutly ovoid, 2–3 × 4 mm. Stipules linear, acute, to 25 × 4 mm, caducous. Leaves coriaceous, drying dull tawny-grey; blade obovate, 8–15 × 4–8 cm, base obtuse to subcordate, apex with broad acumen to 7.5 mm long; midrib evident but deeply furrowed above, slender but prominent below as also the lateral veins; lateral veins 20–26 pairs, dense, ascending; intercostal venation very slender, scalariform; petiole 1.5–2 cm long. Inflorescences terminal or axillary; rachis more or less compressed, to 10 cm long, singly branched; bracteoles narrowly lanceolate, to 8 mm long. Flowers: buds to 6 × 3 mm; stamens 15, connectival appendage c. 2x the length of anther; ovary ovoid, without stylopodium, style filiform, equal to ovary. Fruits: calyx lobes unequal, 3 longer lobes to 8 × 1.3 cm, tapering to 6 mm above the saccate base, 2 shorter ones linear-lobed, to 5.5 × 0.5 cm, similar at base. Nuts ovoid, to 2.2 × 1.2 cm, with c. 3 mm long tapering style remnant.*

Vernacular name. Sarawak—*meranti sulang sulang* (preferred name).

Distribution. Borneo and the Philippines. In Sabah uncommon and known only from Lahad Datu, Sandakan and Tawau districts (e.g., *SAN 19573*, *SAN 34788* and *SAN 62950*) and in Sarawak recorded from Kapit, Lawas, Marudi, Miri, Serian, and Tatau districts (e.g., *S 29661* and *S 41149*). Also occurring in Brunei (e.g., *BRUN 323* and *SAN 17067*).

Ecology. Rare and scattered in mixed dipterocarp forest on clay soils, at altitude below 600 m, especially on low hills and slopes. Occurring in Lambir and Mulu NPs; highly vulnerable elsewhere owing to land conversion.

Note. The species was formerly confused with *S. confusa* and *S. lamellata* by me (Ashton *op. cit.* (1964) 164, 167, Meijer & Wood *op. cit.* 60, 66 and Burgess *op. cit.* 159).

128. *Shorea waltonii* Wood *ex* Meijer

(A.B. Walton, 1904–?, Conservator of Forest at Sandakan, 1952–1954)

(sect. **Brachypterae**, red meranti)

Act. Bot. Neerl. 12 (1963) 344; Wood & Meijer *op. cit.* 155; Burgess *op. cit.* 182; Ashton *op. cit.* (1982) 510; Newman *et al. op. cit.* (1996) 224. **Type:** *G.H.S. Wood SAN 16508*, Borneo, Sabah, Sandakan district, Sepilok FR (holotype K; isotypes A, KEP, SAN).

Large emergent tree; bole straight; crown spreading; buttresses large, stout. **Bark** deeply fissured and thinly oblong flaky; inner bark pale reddish brown; heartwood pink. *Twigs, leaf bud, stipule, petiole, venation below, and inflorescence more or less densely cream lepidote; flower calyx caducously so; ovary, nut, parts of petals exposed in bud, midrib, and sometimes veins above persistently cream-brown puberulent.* **Twigs** terete, smooth, stout, *c.* 3 mm diameter apically. Leaf buds small, conical. **Stipules** elliptic-lanceolate, acute, to 20 × 8 mm. **Leaves** coriaceous, *drying cream lepidote to mauve-brown below; blade oblong to ovate or obovate, 10–25 × 5.5–12 cm, base obtuse or shallowly cordate, apex abruptly acuminate, acumen to 1 cm long; midrib very slender but evident, deeply furrowed above, slender but prominent below as also the lateral veins; lateral veins 18–22 pairs, ascending except at base; intercostal venation remotely scalariform, hardly elevated below; petiole stout, 2.5–4.5 cm long.* **Inflorescences** stout, terminal or axillary; rachis to 12 cm long, branchlets to 5 cm long; bracteoles to 10 cm long, amplexicaul. **Flowers:** buds to 8 × 3 mm; stamens 15, connectival appendage *c.* 2x the length of anther; ovary broadly ovoid, without stylopodium, style of equal length, puberulent in the basal half. **Fruits:** pedicel *c.* 3 mm long, stout; *calyx lobes unequal, 3 major lobes to 14 × 2.3 cm, tapering to c. 11 mm wide above the saccate base, 2 shorter ones lorate-lobed, to 10 × 0.8 cm, similar at base.* **Nuts** ovoid, to 2.5 × 1.8 cm, apiculate.

Vernacular name. Sabah—*seraya kelabu* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from to Kinabatangan, Lahad Datu and Sandakan districts (e.g., *SAN 16903*, *SAN 17848*, *SAN 34486*, *SAN 36207*, and *SAN A 2985*). Also occurring in E Kalimantan (e.g., *Kostermans 13816*).

Ecology. Locally common in mixed dipterocarp forest on clay soils on low hills. Occurring in Sepilok FR; elsewhere endangered by forest clearance.

129. Shorea woodii P.S.Ashton

(G.H.S. Wood, forest botanist in Sabah 1953–1957 and a dipterocarp specialist)

(sect. **Pachycarpae**, red meranti)TFSS 5 (2004) 480, *op. cit.* (1968) 122 ('63. *Shorea* sp.'). **Type:** *s.c. A 56/36*, Sarawak (holotype FHO).

Medium-sized tree, to 40 m tall, to 60 cm diameter; bole frequently branching low. **Bark** at first smooth, hoop-marked, eventually shallowly patchily fissured, with bright yellow dammar smears. *Young twig and petiole evenly densely golden brown caducous sericeous; parts otherwise glabrous.* **Twigs** 3–4 mm diameter apically, terete to somewhat compressed, becoming pale brown, smooth; internodes to 9 cm long; stipule scars amplexicaul, down-curved, prominent. Leaf buds ovoid, to 3 × 2 mm. **Stipules** lanceolate, acute, to 40 × 13 mm, rich crimson-red. **Leaves** rich crimson-red when young, coriaceous, drying greyish brown; *blade ovate-elliptic, 20–37 × 11–20 cm, base to 1 cm peltate, apex tapering to 1.5 cm prominent slender acumen; midrib slightly raised above, prominently terete below; lateral veins 12–19 pairs, slender but prominent below; intercostal venation remotely scalariform, slender; petiole 3–7 cm long, terete, distally rugose.* **Inflorescences and flowers** unknown. **Fruits:** 3 longer calyx lobes narrowly spatulate, to 20 × 1.5 cm, obtuse, tapering to *c.* 5 mm above the saccate base; 2 shorter ones unequal, to 17 × 0.8 cm, otherwise similar. **Nuts** ovoid, lustrous, to 3 × 2 cm, tapering to an apiculate style remnant.

Vernacular name. Sarawak—*engkabang lajan* (Iban).**Distribution.** Endemic in Borneo; known only in Sarawak from Belaga and Kapit districts (e.g., *S 17801* and *S 22318*).**Ecology.** Rare, as scattered individuals and small groups in mixed dipterocarp forest on damp sandy clay soils, on hillsides, at altitudes below 200 m. Critically endangered by land conversion.**Notes.** Named after Geoffry Howarth Spencer Wood, who introduced me to the dipterocarps but whose inspiring stay with me in Brunei ended in tragedy.**130. Shorea xanthophylla** Symington(Greek, *xanthos* = yellow, *phullon* = leaf; the yellowish dry leaf)(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)Gard. Bull. S. S. 9 (1938) 342; Browne *op. cit.* 164; Slooten *op. cit.* (1956) 344; Ashton *op. cit.* (1964) 160, *op. cit.* (1968) 91, *op. cit.* (1982) 479; Meijer & Wood *op. cit.* (1964) 79; Burgess *op. cit.* 218; Anderson *op. cit.* (1980) 123; PROSEA *op. cit.* 420; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al. op. cit.* (1996) 225. **Type:** *Puasa FMS 36776 (= SH 3998)*, Borneo, Sabah, Sandakan district, Betotan (holotype KEP).

Canopy tree, to 40 m tall, to 65 cm diameter; bole straight or often misshapen; crown dense, irregular, twigs somewhat pendent; buttress to 1 m tall, somewhat stout. **Bark** reddish fawn, smooth, hoop-marked, eventually vertically cracked and patchily thinly oblong-flaky; with small snail-like blackish dammar exudations. *Young twig and petiole buff caducous*

puberulent; inflorescence, stipule and bractole outside, leaf bud, parts of perianth exposed in bud, ovary, and nut persistently cream puberulent. Twigs straight, terete, stout, drying black, 2–3 mm diameter apically. Leaf buds conical, to 3 × 1.5 mm. **Stipules** narrowly deltoid, concave, *c.* 8 × 3 mm. **Leaves** *bright crimson on opening, thinly coriaceous, often somewhat blistered between the veins, shiny, drying tawny brown; blade oblong-lanceolate, 12–25 × 4–7 cm, base subcordate, obtuse or broadly cuneate, margin often narrowly subrevolute, apex with tapering acumen to 1 cm long; midrib broadly evident, more or less flat above, terete, prominent below; lateral veins 9–13 pairs, slender, raised below, arched and continuing within the margin, sometimes anastomosing to form a looped intramarginal vein; intercostal venation remotely subscalariform; petiole 0.8–1.5 cm long, drying black.* **Inflorescences** terminal, or in axillary cluster of 3, or ramiiflorous; rachis angular, to 20 cm long, branchlets zigzag bearing to 9 flowers; bracteoles minute, fugaceous. **Flowers:** buds to 4.5 × 1.5 mm; petals cream-yellow; stamens 15, connectival appendage 1–2x the length of anther, ciliate distally; ovary ovoid-conical, tapering into stylopodium, style short, glabrous. **Fruits:** *calyx lobes subequal, broadly ovate, thickened, somewhat patent, saccate, c. 0.7 × 0.7 cm. Nuts* obovoid, *c.* 2 × 1.3 cm, subacute.

Vernacular names. Sabah—*seraya kuning barun* (preferred name). Sarawak—*lun barun* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Kinabatangan, Kota Merudu, Kudat, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Tawau, and Tenom districts (e.g., *SAN 16002, SAN 22510, SAN 37850, SAN 45118, and SAN 76775*) and in Sarawak from Belaga, Bintulu, Kapit, Miri, Sri Aman, and Tatau districts (e.g., *S 21858, S 27543, S 29099, S 43639, and S 46514*). Also occurring in Brunei (e.g., *BRUN 2605 and BRUN 3126*).

Ecology. Locally common in mixed dipterocarp forest on clay soils over shale and basic volcanic rock at low altitude, rarely to 1000 m. Occurring in Lambir NP and Sepilok FR; vulnerable elsewhere owing to land conversion.

8. UPUNA Symington

(Iban name—*upun*)

Bull. Jard. Bot. Buitenz. 3, 17 (1941) 88; Meijer & Wood, Sabah For. Rec. 5 (1964) 327; Ashton, MDB (1964) 7, MDBS (1968) 3, FM 1, 9 (1982) 337; PROSEA 5, 1 (1993) 458.

Large main canopy trees with low stout buttresses in groups. **Bark** *dark brown, finely flaky; inner bark not laminated.* Young parts caducous, inflorescence persistently multicellular glandular tomentose and tufted tomentose. **Stipules** linear-tapering, *persistent and concealing the small leaf buds.* **Inflorescences** *cymose.* **Flowers:** sepals imbricate but fused into a shallow cup at base free from ovary; *stamens 25–30; filaments compressed, dilated at base and tapering to anthers; anthers oblong-ovoid, latrorse; connectival appendage aristate, erect, many times the length of anther; ovary small, ovoid, without stylopodium; style filiform, about twice as long as ovary, trifid towards apex; stigma minute.* **Fruits:** *calyx with a distinct basal cup enclosing the base of but free from nut; lobes valvate, thinly chartaceous, 2 much larger than the other 3.* **Nuts** ellipsoid, *triangular in cross-section, tapering at base, splitting loculicidally into 3 valves at germination.* **Seeds** *with arillode.* Germination epigeal; cotyledons subequal, cordate.

Distribution. A monotypic genus endemic in Borneo.

Uses. A heavy hardwood similar to *resak* but available in larger sizes. The timber is greasy and does not easily take glues.

Upuna borneensis Symington
(of Borneo)

Fig. 32, Plates 5C–D.

Bull. Jard. Bot. Buitenz. 3, 17 (1941) 88; Browne, FTSB (1955) 171; Ashton *op. cit.* (1964) 7, *op. cit.* (1968) 3, *op. cit.* (1982) 339; Meijer & Wood *op. cit.* 327; Burgess, TBS (1966) 228; Anderson, CLTS (1980) 131; PROSEA *op. cit.* 458; Coode *et al.* (eds.), CLBD (1996) 84; Newman *et al.*, MDFB-MHHW (1998) 201. **Type:** *Flemmich FMS 48158*, Borneo, Brunei, Sg. Mau-Kargu headwaters (holotype KEP).

Large main canopy, occasionally low emergent tree, to 45 m tall, to 1.5 m diameter; crown dark, dense, hemispherical; *buttresses low and concave but stout and grouped around the base of the bole*. **Bark** dark brown, densely cracked and flaking in narrow thin oblong pieces; inner bark cream, homogeneous. **Sapwood** pale yellow, hard; heartwood coffee-brown; dammar exudations pale yellow, opaque. *Young parts caducous multicellular glandular tomentose; exposed living surfaces, leaf blade surfaces excepted, and ovary densely persistently pale chocolate-brown tomentose; blade undersurface white-tomentose, upper surface glabrescent*. **Twigs** to 3.5 mm diameter apically; stipule scars small. *Leaf buds ovoid-falcate, to 12 × 6 mm, subacute*. **Stipules** linear, to 12 mm long. **Leaves** thinly coriaceous, frequently somewhat bullate; *blade oblong to ovate, 9–17 × 4–9.5 cm, base cordate, margin revolute, apex with tapering acumen to 0.5 cm long; midrib prominent below, sunken above; lateral veins 16–20 pairs, well-spaced, arched towards margin, prominent below, frequently with short intermediates; intercostal venation scalariform, well-spaced, distinctly raised below; petiole 1–2.5 cm long, distinctly geniculate*. **Inflorescences** to 3-axillary, to 15 cm long, much-branched; *bracts lanceolate, to 10 × 3.5 mm, caducous*. **Flowers:** buds narrowly ovoid, to 5 × 2 mm; sepals subequal, imbricate, the 3 inner ones more attenuate, *united at the base forming a shallow cup free from the ovary; corolla deep purple with dark yellow margin, petals broadly ovate, subacute, becoming reflexed apically at anthesis; stamens 25–30, filaments broad at base, tapering abruptly and filiform at the subglobose anthers, connectival appendage c. 3x the length of anther, aristate; ovary ovoid, without stylopodium, style c. 3x as long as ovary, filiform, more or less trifurcate at apex*. **Fruits:** calyx remaining sparsely pubescent towards base; *lobes chartaceous, united into a c. 1 cm wide and deep conical basal cup tapering into a short pedicel, 2 outer lobes lanceolate, to 13 × 2.7 cm, tapering gradually to subacute apex, 3 inner ones to 7.5 × 1.7 cm, otherwise similar, subequal*. **Nuts** narrowly ovoid, to 3.2 × 1.5 cm, *triangular in cross-section, tapering to 5 mm slender style remnant*.

Vernacular names. Sabah and Sarawak—*upun* (preferred name). Sarawak—*penyau* (Iban), *upun batu* (Iban).

Distribution. Widespread in its chosen habitat, hence absent in most parts of Sabah and coastal E Kalimantan. In Sabah confined to SW parts and known from Sipitang district (e.g., *SAN 15184*) and in Sarawak widespread and recorded from Bintulu, Kuching, Lawas, Lundu, and Serian districts (e.g., *Hotta 15808*, *S 1522*, *S 6876*, and *S 10064*). Also occurring in Brunei (e.g., *BRUN 3091*, *FMS 37075* and *FMS 48457*) and W and SE Kalimantan (e.g., *bb. 29206* and *bb. 30145*).

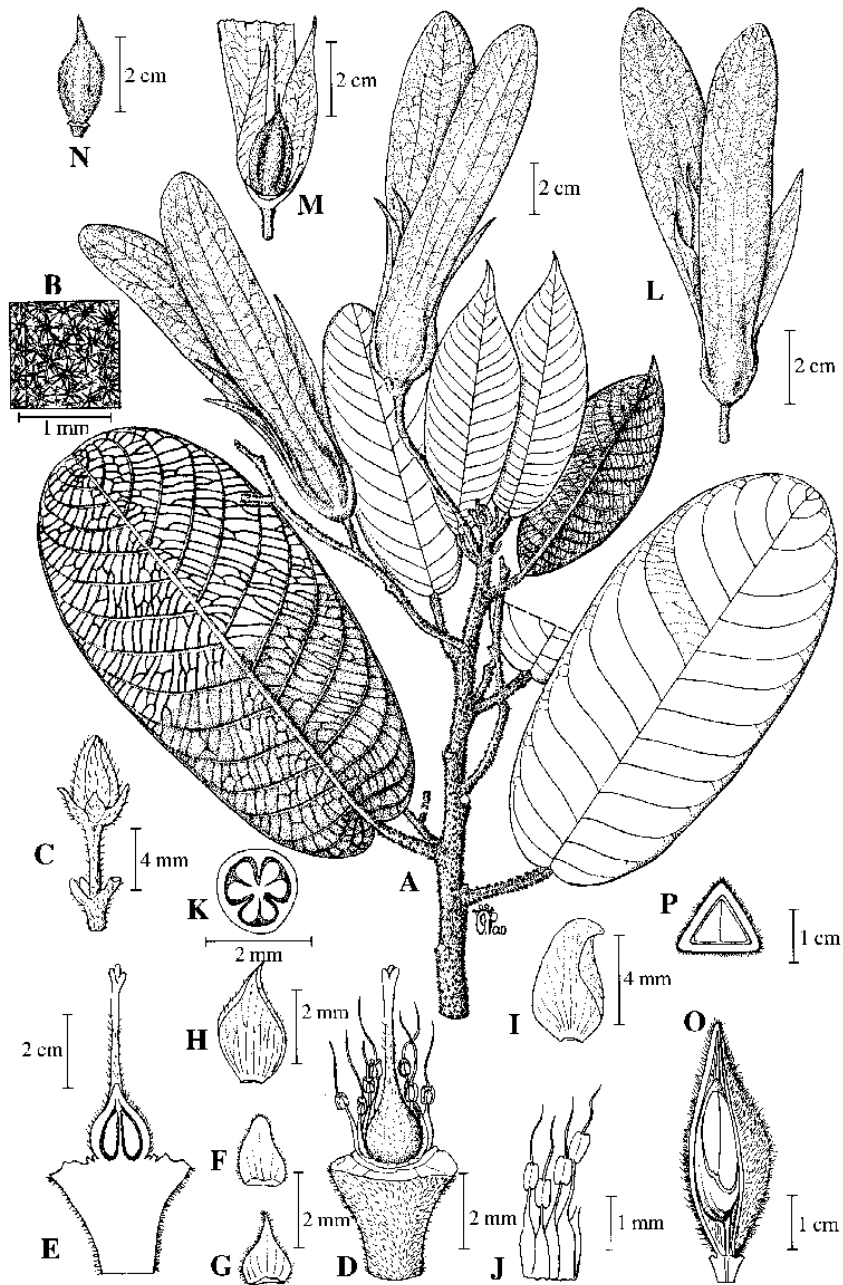


Fig. 32. *Upuna borneensis*. A, fruiting leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, gynoecium and stamens; E, longitudinal section of gynoecium; F, adaxial view of outer sepal; G, adaxial view of inner sepal; H, adaxial view of petal; I, abaxial view of petal; J, abaxial view of stamens; K, cross-section of ovary; L, fruit; M, fruit with exposed nut; N, nut; O, dissected nut to expose the embryo; P, cross-section of nut. (A–B from *KEP 19288*, C–K from *S 64513*, L–N from *S 26237*, O–P from *Niga NN 221*.)

Ecology. Scattered, locally frequent in mixed dipterocarp forest and the ecotone to *kerangas*, on deep yellow sandy soil on low hills, on sandstone and acid volcanics including the Arip rhyolite, at altitudes to 400 m. Occurring locally in Bako NP and recorded from Kubah NP; elsewhere vulnerable.

9. VATICA L.

(Latin, *vates* = prophet; alluding the use of dammar of one of the Indian species in Hindu religions ceremony)

resak (preferred name)

Mant. 2 (1771)152; Brandis, J. Linn. Soc. Bot. 31 (1895) 128; Merrill, EB (1921) 408; Slooten, Bull. Jard. Bot. Buitenz. 3, 9 (1927) 67; Masamune, EPB (1942) 297; Browne, FTSB (1955) 96; Ashton, Gard. Bull. Sing. 20 (1963) 243; MDB (1964) 61, MDBS (1968) 25, FM 1, 9 (1982) 345; Meijer & Wood, Sabah For. Rec. 5 (1964) 301; Burgess, TBS (1966) 226; Anderson, CLTS (1980) 131; PROSEA 5, 1 (1993) 461; Coode *et al.* (eds.), CLBD (1996) 84. **Synonyms:** *Retinodendron* Korth., Kruidk. (1840) 55; *Isauxis* Reichb., Nom. (1841) 210; *Pteranthera* Blume, Mus. Bot. Lugd.-Bat. 2 (1852) 30; *Sunaptea* Griff., Notul. 4 (1854) 516; *Synaptea* Kurz, J. As. Soc. Beng. 39, 2 (1870) 65; *Pachynocarpus* Hook.f., Trans. Linn. Soc. 23 (1860) 159; *Elaeogyne* Miq., Fl. Ned. Ind., Suppl. (1862) 460; *Retinodendropsis* F.Heim, C. R. Assoc. Fr. Pau 1892 (1893) 470; *Perissandra* Gagnep., Bull. Soc. Bot. Fr. 95 (1948) 27; *Brachypodandra* Gagnep. *op. cit.* 30.

Subcanopy to main canopy trees; bole frequently crooked; *buttresses stout, usually low*, concave; crown usually irregular, diffuse, juveniles irregularly branched. **Bark** usually greyish brown mottled, *smooth and hoop-marked*, in large trees becoming patchily flaked and occasionally scroll-marked, *with small lenticels hardly paler than bark surface*; *inner bark pale cream-brown*, fine-grained, homogeneous. **Sapwood** pale yellow, *dense, fine textured with ray ends not glistening on tangential surface*, hard or rarely soft; heartwood brown; dammar not generally present on bole, as whitish opaque smears if present. *Young parts usually more or less caducous powdery pubescent*. Leaf buds generally small, ovoid. **Twigs** usually pale greyish brown, smooth or rugose. Leaf buds generally small. **Stipules** variable. **Leaves** variable; *blade more or less coriaceous, flat or bullate*; midrib evident, usually more or less raised above though sometimes within a furrow (obscurely sunken in *V. rynchocarpa*); *lateral veins arched, distinctly raised but not usually prominent below, with short or no intermediate veins, not or obscurely joined into an intramarginal vein; intercostal venation usually reticulate but sometimes scalariform, more or less elevated on both surfaces, not drying darker than the leaf blade*; petioles variably but usually not geniculate. **Inflorescences** irregularly branched, racemose or partly cymose. **Flowers:** buds ovoid, spindle-shaped to lanceolate; *sepals more or less valvate*, subequal; petals narrowly oblong, usually cream often with a violet tinge, slightly contorted spreading at anthesis, not connate and falling separately; *stamens to 15 in 3 whorls*, filaments short, dilated at base, *anthers broadly oblong, glabrous, connectival appendage at most 1½x the length of anther*, stout, deltoid; *ovary ovoid-conical, superior or semi-inferior, pubescent, without stylopodium, style stoutly columnar, less than 2x the length of ovary, somewhat expanded apically with a conical 3-lobed stigma*. **Fruits:** calyx very variable; *lobes valvate and free to the base or united into a shallow cup enclosing less than 1/3 of the nut, if free 2 are longer than the other 3*, or all equal and revolute along the axis, or short, equal, reflexed to rotate, chartaceous to woody. **Nuts** variable, small or large, globose to ovoid with no persistent style remnant, *round in cross-section, thin-walled or corky; pericarp splitting loculicidally into 3 equal valves at germination*. **Germination** epigeal, or hypogeal and cryptocotylar;

cotyledons, if free, foliose, subequal, hardly photosynthetic, if remaining in the nut more or less fleshy, unequal.

Distribution. About 65 species, from South Asia and Indo-Burma to New Guinea. Thirty five species occur in Borneo, of which 23 are endemic and 33 occurring in Sabah and Sarawak.

Ecology. From brackish river banks to the lower edge of the upper montane forest, at altitudes to 1600 m; in all inland forest types except the *alan* peat swamps. Sometimes scattered, but usually quite common in the subcanopy, one or a small number of species common in any locality.

Uses. The larger hard-wooded species are used locally in construction. The seeds of the large fruited species were once used, though not apparently in Malaysia, for arresting the fermentation of rice and coconut wine.

Notes. *Vatica* species are the most difficult dipterocarps to recognise, and this explains why this common genus in our forests remains so poorly known. The smooth bark, absence of dammar smears, irregularly branched diffuse crown, and often nondescript leaves with reticulate intercostal venation can recall *Aporosa* or *Hydnocarpus*; but the scent of dammar is always discernable in freshly rubbed living tissue.

Key to *Vatica* species

(based on flowering and/or fruiting specimens)

1. Fruit calyx lobes equal or subequal, chartaceous or coriaceous, often becoming reflexed (sect. **Vatica**).....2
 Fruit calyx lobes unequal, 2 longer than the other 3, chartaceous, not becoming reflexed (sect. **Sunapteia**).....15
2. Fruit calyx lobes thickened, corky, coalescing and adnate to nut forming a cup more or less enclosing it.....**31. V. umbonata**
 Fruit calyx lobes free.....3
3. Fruit calyx lobes revolute but not reflexed, foliaceous and concealing the nut, subcordate.....4
 Fruit calyx lobes more or less reflexed or spreading or rotate not concealing nut, not subcordate.....6
4. Lateral veins at most 9 pairs, without distinct intermediates.....
**32. V. venulosa** (subsp. **venulosa**)
 Lateral veins at least 10 pairs, with distinct intermediates.....5
5. Twig and inflorescence caducous buff-puberulent; petiole glabrous.....**6. V. chartacea**
 Twig, petiole and inflorescence persistently fulvous somewhat flocculent tomentose; petiole otherwise.....**15. V. havilandii**

6. Nut ovoid, verrucose, 2.5–4 cm diameter.....7
 Nut more or less globose, smooth, at most 2.2 cm diameter.....9
7. Nut asymmetric; petiole at least 2 cm long.....**27. V. rassak**
 Nut symmetric; petiole at most 2 cm long.....8
8. Leaf blade to 20 × 7 cm; lateral veins at most 14 pairs.....**14. V. granulata**
 Leaf blade at least 22 × 7 cm; lateral veins at least 15 pairs.....**30. V. sarawakensis**
9. All parts glabrous.....**1. V. albiramis**
 Young parts and nut, at least, powdery tomentose to vinous-sericeous.....10
10. Tomentum rufous; leaves drying greyish to pinkish brown.....**13. V. globosa**
 Tomentum vinous; leaves at first drying bluish greyish green or mauve-brown.....11
11. Twigs compressed.....**21. V. oblongifolia**
 Twigs terete.....12
12. Fruit calyx lobes chartaceous, hardly revolute.....**10. V. dulitensis**
 Fruit calyx lobes incrassate, becoming revolute.....13
13. Nut to 2.2 cm diameter.....**25. V. pedicellata**
 Nut at most 1 cm diameter.....14
14. Lateral veins 9–11 pairs.....**28. V. rotata**
 Lateral veins at least 12 pairs.....**33. V. vinosa**
15. Fruit calyx lobes fused into a cup at base adnate to the nut.....16
 Fruit calyx lobes free.....17
16. Lateral veins 7–10 pairs.....**18. V. maritima**
 Lateral veins 11–15 pairs.....**22. V. odorata**
17. Twigs at first compressed.....**7. V. compressa**
 Twigs terete.....18
18. Leaf blade obovate, thickly coriaceous, apex usually obtuse or retuse, margin revolute
19
 Leaf blade elliptic, lanceolate, oblanceolate, ovate or obovate, chartaceous, thinly
 coriaceous, or coriaceous, apex acuminate to subcaudate, margin not revolute.....20
19. Inflorescence at most 3 cm long, fascicled and congested; petiole 1.2–2.5 cm long.....
**8. V. congesta**
 Inflorescence to 20 cm long, lax; petiole 1–1.5 cm long.....**9. V. coriacea**
20. Leaf undersurface persistently ochreous sericeous.....**5. V. brunigii**
 Leaf undersurface at most caducous pubescent.....21
21. Lateral veins hardly or not more prominent below than above.....22
 Lateral veins distinctly more prominent below than above.....26

22. Petiole at least 1 cm long.....	23
Petiole at most 1 cm long.....	24
23. Petiole, twig and leaf bud at first cream-puberulent, glabrescent; leaf blade drying greyish green to honey-coloured, often shiny.....	12. V. glabrata
Petiole, twig and leaf bud more or less densely persistently pinkish brown pubescent; leaf blade drying dull rich pinkish brown.....	3. V. borneensis
24. Ripe nut narrowly ovoid, tapering, acute, glabrous.....	29. V. rynchocarpa
Ripe nut subglobose or broadly ovoid, obtuse or shortly mucronate, densely pubescent.....	25
25. Midrib raised above; leaf base cuneate.....	17. V. mangachapoi
Midrib flat or slightly furrowed above; leaf base obtuse.....	23. V. parvifolia
26. Inflorescence, petiole, lateral veins and midrib below persistently shortly pale brown scabrid-pubescent.....	27
Inflorescence and sometimes petiole pink to rufous tomentose; lateral veins and midrib below caducously so, glabrescent.....	30
27. Inflorescence ramiflorous, fascicled.....	24. V. patentinervia
Inflorescence axillary, not fascicled.....	28
28. Petiole to 2 cm long.....	11. V. endertii
Petiole at most 1 cm long.....	29
29. Leaf elliptic-obovate, base narrowly cuneate.....	4. V. brevipes
Leaf elliptic-oblong to lanceolate, base obtuse.....	19. V. micrantha
30. Leaf blade narrowly oblong-obovate, with many intermediate veins.....	20. V. nitens
Leaf blade elliptic, lanceolate, oblanceolate, broadly elliptic, or obovate, with a few or without intermediate veins.....	31
31. Lateral veins prominently raised below; tomentum flocculent, long.....	16. V. maingayi
Lateral veins not prominent below; tomentum even, short.....	32
32. Petiole at least 2 cm long; leaf blade drying rich pinkish brown, glistening; fruit calyx lobes to 8 × 2.5 cm.....	2. V. badiifolia
Petiole at most 2 cm long; leaf blade drying dull greyish brown; fruit calyx lobes to 6 × 1.8 cm.....	26. V. perakensis

Key to *Vatica* species

(based on field characters)

1. Petiole glabrous or glabrescent, drying black.....	2
Petiole cinereous or tomentose, not drying black.....	9

2. Lateral veins at most 6 pairs..... **1. V. albiramis**
 Lateral veins at least 7 pairs..... 3
3. Leaf blade oblong-obovate..... 4
 Leaf blade ovate, elliptic or lanceolate..... 5
4. Leaf blade narrowly obovate, thickly coriaceous, concave, apex obtuse to retuse, margins revolute; petiole stout. In *kerangas* into the mixed dipterocarp forest ecotone..... **9. V. coriacea** (in part)
 Leaf blade oblong-obovate, chartaceous, flat, apex prominently acuminate; petiole slender. In moist valleys and on river banks..... **6. V. chartacea**
5. Midrib sunken above..... **29. V. rynchocarpa** (in part)
 Midrib flat or raised above..... 6
6. Lateral veins raised on both surfaces. In upper dipterocarp forests at altitudes above 1000 m..... **12. V. glabrata**
 Lateral veins unraised above. In lowland mixed dipterocarp forest..... 7
7. Leaf blade drying rust-brown; lateral veins 9–11 pairs, sharply prominent below.....
 **16. V. maingayi** (in part)
 Leaf blade drying pale greyish- or yellowish-brown; lateral veins 7–9 pairs, raised but not prominent below..... 8
8. Leaf blade *c.* 12 × 5 cm; midrib drying hardly paler than petiole; intercostal venation subscalariform; wood soft. On river banks and in mixed dipterocarp forest.....
 **31. V. umbonata**
 Leaf blade *c.* 9 × 4 cm, midrib drying paler than the dark petiole; intercostal venation reticulate; wood hard. In *kerangas* and mixed peat samp forest.....
 **17. V. mangachapoi** (in part)
9. Lateral veins hardly raised below, or no more than above..... 10
 Lateral veins distinctly raised below, more than above..... 19
10. Twig at first compressed..... **7. V. compressa**
 Twig terete..... 11
11. Tomentum vinous-sericeous..... 12
 Tomentum greyish, yellowish, pink, rufous, or ochreous..... 14
12. Leaf base cuneate..... **10. V. dulitensis** (in part)
 Leaf base obtuse..... 13
13. Leaf blade larger, 9–23 × 3.5–7.5 cm long, narrowly elliptic-lanceolate.....
 **25. V. pedicellata** (in part)
 Leaf blade smaller, 5.5–10 × 3–5 cm long, broadly elliptic-ovate..... **28. V. rotata**
14. Leaf blade elliptic, coriaceous, drying dull, pale, pinkish brown; petiole at least 1.5 cm long, slender. In mixed dipterocarp forest on yellow sandy soils..... **3. V. borneensis**
 Leaf blade drying dark-, tawny-, rufous-, yellowish- or greyish-brown; not coriaceous if elliptic; petiole at most 1 cm long. In river banks, peat swamp or *kerangas* forest..... 15

15. Leaf blade narrowly obovate, apex obtuse to retuse, thickly coriaceous, concave, margin revolute; petiole stout; tomentum ochreous. In *kerangas* into the mixed dipterocarp forest ecotone.....**9. V. coriacea** (in part)
 Leaf blade ovate, elliptic or lanceolate, apex acute, acuminate to caudate, coriaceous to thinly coriaceous, flat, margin not revolute; or, if obovate, not coriaceous and with slender petiole; tomentum otherwise. In different forest habitats.....16
16. Tomentum pale pinkish- to rufous-brown.....17
 Tomentum greyish brown or cream-yellow.....18
17. Lateral veins *c.* 8 pairs; midrib flat above; leaf blade narrowly ovate to lanceolate. In *kerangas* forest.....**23. V. parvifolia**
 Lateral veins 7–12 pairs; midrib sunken above; leaf blade elliptic to narrowly obovate. In forest on river banks.....**32. V. venulosa** (subsp. *venulosa*)
18. Tomentum cream-yellow, caducous; leaf blade at least 2.7 cm wide, broadly elliptic, base cuneate; lateral veins at most 9 pairs; petiole at least 0.5 cm long. In *kerangas* and mixed peat swamp forests.....**17. V. mangachapoi** (in part)
 Tomentum pale greyish brown, not at first caducous; leaf blade at most 2.5 cm wide, narrowly elliptic-lanceolate, base obtuse; lateral veins at least 10 pairs; petiole to 0.4 cm long. In forest on alluvium along river banks.....**29. V. rynchocarpa** (in part)
19. Petiole, midrib and veins below vinous-cinereous; fresh leaves distinctly bluish green below.....20
 Petiole, midrib and veins below rufous, pinkish brown or pale greyish or yellowish brown tomentose; fresh leaves not bluish green below.....23
20. Twigs at first compressed.....**21. V. oblongifolia**
 Twigs terete.....21
21. Petiole 2–3 mm diameter.....**25. V. pedicellata** (in part)
 Petiole less than 1 mm diameter.....22
22. Lateral veins 12–20 pairs, slender but more or less prominently raised below. In mixed dipterocarp forest on clay soils, at altitudes to 600 m.....**33. V. vinosa**
 Lateral veins 10–12 pairs, slender, hardly raised below. Mostly in upper dipterocarp forests on ridges, at altitudes to 1350 m.....**10. V. dulitensis** (in part)
23. Tomentum rufous- or pinkish-brown.....24
 Tomentum cream, pale greyish to yellowish brown, or yellowish.....30
24. Lateral veins 7–13 pairs, without or with a few short intermediate veins; leaf blade broadly ovate, elliptic, lanceolate, oblanceolate or obovate; petiole long, slender.....25
 Lateral veins 12–28 pairs, with many intermediate veins; leaf blade narrowly oblong to obovate; petiole short and stout, or long and slender.....27

25. Lateral veins sharply prominent below; tomentum rufous, flocculent, caducous.....
**16. V. maingayi** (in part)
 Lateral veins terete below; tomentum even, pinkish brown to pale yellowish brown,
 persistent.....26
26. Petiole at least 2 cm long; leaf blade drying rich pinkish brown, glistening.....
**2. V. badiifolia**
 Petiole at most 2 cm long; leaf blade drying pale greyish brown.....**26. V. perakensis**
27. Petiole at least 3 mm diameter, stout and short.....**30. V. sarawakensis** (in part)
 Petiole at most 2.5 mm diameter, slender.....28
28. Tomentum short, even, persistent; lateral veins narrowly grooved above..**13. V. globosa**
 Tomentum in part flocculent, caducous; lateral veins not grooved above.....29
29. Petiole to 1.2 cm long, hardly geniculate; leaf blade narrowly elliptic-obovate;
 intermediate and intercostal veins prominent below.....**15. V. havilandii**
 Petiole to 2 cm long, geniculate; leaf blade narrowly oblong; intermediate and
 intercostal veins hardly raised below.....**20. V. nitens**
30. Lateral veins at least 15 pairs; petiole at least 3 mm diameter.....31
 Lateral veins less than 15 pairs; petiole less than 3 mm diameter.....32
31. Petiole more than 2 cm long.....**27. V. rassak**
 Petiole shorter than 2 cm.....**30. V. sarawakensis** (in part)
32. Leaf blade below densely evenly ochreous sericeous. In *kerangas* forest..**5. V. brunigii**
 Leaf blade below glabrous or sparsely tomentose on venation only. Not in *kerangas*
 forest.....33
33. Leaf blade elliptic-obovate.....34
 Leaf blade ovate, narrowly elliptic, lanceolate, oblong, or obovate-oblong.....38
34. Lateral veins at most 8 pairs; petiole at least 1.5 cm long.....**24. V. patentinervia**
 Lateral veins at least 10 pairs or, if less, then petiole at most 1.1 cm long.....35
35. Leaf blade chartaceous.....36
 Leaf blade coriaceous to thickly coriaceous.....37
36. Lateral veins at most 10 pairs.....**4. V. brevipes**
 Lateral veins at least 11 pairs.....**11. V. endertii**
37. Lateral veins 12–24 pairs; tomentum scabrid.....**14. V. granulata** (in part)
 Lateral veins 10–13 pairs; tomentum even.....**8. V. congesta**
38. Intercostal venation prominent below; lateral veins and midrib below persistently
 shortly scabrid-pubescent; lateral veins arching and anastomosing to form an
 intramarginal vein.....**19. V. micrantha**
 Intercostal venation not prominent below; lateral veins and midrib glabrescent; lateral
 veins otherwise.....39

39. Midrib raised above.....**18. V. maritima**
 Midrib flat or furrowed above.....40
40. Leaf blade larger, 10–20 × 2.7–7 cm, narrowly obovate; twigs angular, peeling in small flakes; lateral veins stoutly prominent below.....**14. V. granulata** (in part)
 Leaf blade smaller, 8–16 × 2.7–5.5 cm, narrowly elliptic to ovate; twigs terete; lateral veins slender though raised below.....**22. V. odorata**

1. *Vatica albiramis* Slooten

(Latin, *albus* = white; *ramis* = twigs; with white twigs)

Bull. Jard. Bot. Buitenz. 3, 9 (1927) 101; Masamune *op. cit.* 498; Meijer & Wood *op. cit.* 305; Ashton *op. cit.* (1964) 66, *op. cit.* (1968) 30, *op. cit.* (1982) 355; Burgess *op. cit.* 227; Anderson *op. cit.* (1980) 131; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Elmer 21640*, Borneo, Sabah, Tawau district (holotype BO; isotypes KEP (fragment), L).

Subcanopy tree, to 25 m tall, to 35 cm diameter. *Parts glabrous but for caducous puberulent flower calyx and ovary.* **Twigs** c. 1 mm diameter apically, slender. **Stipules** hastate, to 16 × 3.5 cm, caducous. **Leaves** thinly coriaceous, drying dull greyish green; blade elliptic to lanceolate, 8–20 × 3–7 cm, base narrowly cuneate, apex with slender acumen to 1.5 cm long; *lateral veins 4–6 pairs*, rather broad, slightly raised on both surfaces though most prominently below, arched and continuing along margin at first; intercostal venation subscalariform; *petiole glabrous, drying black*, 1–1.5 cm long. **Inflorescences** to 28 cm long, terminal or axillary, lax. **Flowers:** corolla lemon yellow; other parts as the genus (typical). **Fruits** *calyx lobes free, subequal, ovate, to 1.2 × 0.4 cm, obtuse, coriaceous, glabrous, becoming reflexed.* **Nuts** *globose, to 1.2 cm diameter, smooth, fulvous puberulent.*

Vernacular names. Sabah—*resak putih* (preferred name). Sarawak—*resak ranting putih* (Malay).

Distribution. Endemic in Borneo. In Sabah, widespread and known from most districts (e.g., *SAN 15292*, *SAN 27873*, *SAN 36080*, *SAN 60181*, and *SAN 110318*) and in Sarawak recorded from Bintulu, Kapit, Lawas, Marudi, and Miri districts (e.g., *S 18091*, *S 41411*, *S 44632*, *S 57292*, and *S 61052*). Also occurring in Brunei (e.g., *BRUN 3048*, *Dransfield JD 7060* and *FMS 39647*).

Ecology. In mixed and upper dipterocarp forest, on clay-rich soils especially on ridges, at altitudes to 1400 m. Common and probably not vulnerable.

2. *Vatica badiifolia* P.S.Ashton

(Latin, *badius* = chestnut-brown, *folius* = leaf; the dry leaf colour)

Gard. Bull. Sing. 22 (1967) 266, *op. cit.* (1968) 30, *op. cit.* (1982) 367; Anderson *op. cit.* (1980) 131; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Ilias & Johnson S 15857*, Borneo, Sarawak, Similajau district, Labang FR (holotype K; isotype L). **Synonym:** *Vatica bantamensis auct. non* (Hass.) Benth. & Hook. ex Miq.: Ashton *op. cit.* (1964) 67.

Canopy tree, to 40 m tall, to 50 cm diameter. *Young twig, inflorescence, leaf bud, stipule, petiole, parts of flower exposed in bud, and ovary densely evenly pinkish brown puberulent. Twigs* to 3 mm diameter apically, *terete* or ribbed, becoming smooth. **Stipules** hastate, to 5 × 1.5 mm. **Leaves** *thinly coriaceous, caducously tomentose below, drying rich pinkish brown and frequently glistening; blade elliptic, 7.7–15 × 3–6.5 cm, base cuneate, margin not revolute, apex deltoid-acuminate, acumen to 0.5 cm long; lateral veins 9–12 pairs, arched, stout, terete and raised on both surfaces though most prominently below, without intermediate veins; intercostal venation prominent below; petiole 2–3.5 cm long, slender, not drying black, distinctly thickened in the distal half and geniculate. Inflorescences* terminal or axillary, singly or doubly branched, to 8 cm long. **Flowers:** buds to 1.3 cm long; calyx densely shortly cream pubescent; otherwise typical. **Fruits:** pedicels to 5 mm long, slender; *calyx lobes free to the plate-like base around the nut, unequal, chartaceous, 2 longer lobes oblong-spatulate, to 8 × 2.5 cm, constricted to 4 mm wide at base, not becoming reflexed, 3 shorter ones hastate, to 3 × 0.8 cm, similarly constricted. Nuts* globose, to 0.8 × 0.8 cm, persistently fulvous puberulent; apical style remnant often persisting.

Vernacular name. Sarawak—*resak bantam* (Malay).

Distribution. Endemic in Borneo. In Sarawak recorded from Bintulu, Kuching, Miri, and Tatau districts (e.g., *S 15133, S 16492, S 24826, S 32598, and S 46590*). Also occurring in Brunei (e.g., *FMS 39650 and S 2120*) and W Kalimantan (e.g., *bb. 10596, bb. 18312*).

Ecology. Locally frequent, in mixed dipterocarp forest on deep leached soils on coastal hills. Common in Lambir NP; elsewhere endangered by forest conversion.

3. *Vatica borneensis* Burck (of Borneo)

Ann. Jard. Bot. Buitenz. 6 (1887) 230; Merrill *op. cit.* (1921) 208; Slooten *op. cit.* (1927) 87; Masamune *op. cit.* 498; Browne *op. cit.* 100; Ashton *op. cit.* (1964) 68, *op. cit.* (1968) 30, *op. cit.* (1982) 363; Anderson *op. cit.* (1980) 131; PROSEA *op. cit.* 465; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Beccari PB 2623*, Borneo, Sarawak, Matang (BO). **Synonyms:** *Vatica urbanii* F.Heim, Bull. Mens. Soc. Linn. Paris 2 (1891) 956; *Sunaptea urbanii* (F.Heim) F.Heim, Rech. Dipt. (1892) 115; *S. borneensis* (Burck) F.Heim *op. cit.* (1892) 116.

Canopy tree, to 35 m tall, to 70 cm diameter. *Young twig, inflorescence, parts of flower exposed in bud, ovary, midrib below, and petiole densely evenly pinkish brown puberulent, more or less persistent. Twigs* c. 1.5 mm diameter apically, slender, *terete* or ribbed, smooth or rugulose. **Stipules** unknown. **Leaves** *coriaceous, drying dull pale pinkish brown; blade elliptic, 6–10 × 2.5–5 cm, base cuneate, margin not revolute, apex acuminate, acumen to 0.6 cm long; midrib prominent below, almost flat above; lateral veins 7–9 pairs, arched, distinct but hardly and subequally raised on both surfaces as also the intercostal veins; petiole 1.5–2.5 cm long, slender, hardly or not swollen distally, not drying black. Inflorescences* axillary, to 5 cm long. **Flowers:** buds to 1 cm long, densely pinkish brown pubescent; otherwise typical. **Fruits:** pedicels c. 5 mm long, slender; calyx glabrescent, *lobes free, unequal, chartaceous, 2 longer lobes oblong-spatulate, to 5.5 × 1.5 cm, to 0.4 cm wide at base, not becoming reflexed, 3 shorter ones unequal, narrowly ovate, tapering, to 1.8 × 0.7 cm. Nuts* globose, to 1 cm diameter, smooth, glabrescent, with persisting style remnant.

Vernacular name. Sarawak—*resak kemudi* (preferred name).

Distribution. Endemic in Borneo; recorded in Sarawak from Bau, Bintulu, Kuching, Lundu, and Simunjan districts (e.g., *S 6360*, *S 17877*, *S 19576*, *S 27136*, and *S 66788*). Also occurring in Brunei (e.g., *S 2134* and *SAN 17545*).

Ecology. Locally common, more often scattered, in mixed dipterocarp forest on poor yellow sandy soils; also in upper dipterocarp forest on coastal sandstone hills and, occasionally, inland ridges, at altitudes to 900 m. Locally common in Bako NP; elsewhere endangered.

4. *Vatica brevipes* P.S.Ashton

(Latin, *brevis*=short, *pes*= foot; the short petiole)

Gard. Bull. Sing. 31 (1978) 24, *op. cit.* (1982) 366. **Type:** *Othman S 29633*, Borneo, Sarawak, Kapit district, Ulu Baleh (holotype K; isotype KEP).

Main canopy or subcanopy tree, to 25 m tall, 30 cm diameter. *Buds, petioles and inflorescences densely persistently pale brown scabrid-puberulent; parts of corolla exposed in bud and ovary evenly so; sepals caducously evenly so; parts otherwise glabrous. Twigs* rugose and ribbed, becoming flaky, *terete*, dark brown, c. 2 mm diameter apically. **Leaves** chartaceous, *glabrous*, more or less concave between the lateral veins; *blade elliptic to obovate*, (4–)5–13 × (1.5–)2–5(–5.5) cm, *base narrowly cuneate, margin not revolute, apex with short, slender acumen to 0.6 cm long*; midrib slender, sharply raised on both surfaces; *lateral veins 7–10 pairs*, ascending, straight at first, arching and forming intermittent intramarginal connections, *slender but prominent below, elevated above*, with a few short intermediates; *intercostal venation distantly reticulate*, evident on both surfaces though more so below; *petiole somewhat stout, 0.5–1.1 cm long, not drying black. Inflorescences axillary or terminal*, to 1.6 cm long; *rachis very slender, hardly branched. Flower:* buds ellipsoid, to 3 × 2 mm; otherwise typical. **Fruits:** pedicel slender, to 6 mm long; *calyx lobes unequal free, 2 longer lobes spatulate, subacute or obtuse, to 5 × 1.4 cm, not becoming reflexed*, 3 shorter ones lanceolate, acute, to 1.2 × 0.3 cm. **Nuts** subglobose, to 0.8 cm diameter, apiculate.

Distribution. Endemic in Borneo. Known in Sarawak from Kapit district (e.g., *S 23943*, *S 29576* and *S 41495*). Also occurring in W Kalimantan (e.g., *Suzuki K 9766*).

Ecology. Apparently uncommon, in mixed and upper dipterocarp forest on clay soils over sedimentary rock, at altitudes between 250–1300 m. Vulnerable.

5. *Vatica brunigii* P.S.Ashton

(E.F.W.O. Brunig, forester in Sarawak and Brunei, 1954–1964)

Gard. Bull. Sing. 22 (1967) 267, *op. cit.* (1968) 30, *op. cit.* (1982) 362; Anderson *op. cit.* (1980) 131; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Ilias S 17045*, Borneo, Sarawak, Samarahan district, Sabal FR (holotype K; isotypes KEP, L).

Canopy tree, to 30 m tall, to 70 cm diameter. *Living exposed parts and ovary, leaf above excepted, persistently shortly yellowish buff scabrid-pubescent; leaf above fugaceous flocculent pubescent.* **Twigs** c. 2 mm diameter apically, *terete*. **Stipules** lorate, to 5×2 mm, obtuse. **Leaves** *thinly coriaceous, persistently ochreous pubescent below; blade ovate-elliptic to obovate, 6–12 × 2.5–6.5 cm, base cuneate to obtuse, margin not revolute, apex acuminate with tapering acumen to 1 cm long; lateral veins 9–12 pairs, unraised above, slender but prominent below as also the midrib and subscalariform intercostal venation; petiole 0.8–1.5 cm long, to 3 mm diameter, not drying black.* **Inflorescences** terminal or axillary towards twig endings; rachis singly or doubly branched, to 12 cm long. **Flowers** distichous; buds ellipsoid, to 8×2 mm; sepals densely ochreous-grey pubescent; petals narrowly oblong, sparsely pubescent outside, glabrescent within. **Fruits:** pedicels to 3 mm long, slender; *calyx lobes unequal, free, chartaceous, 2 longer lobes lorate to spatulate, to 6.5×1.5 cm, not becoming reflexed, 3 shorter ones ovate, acute, slightly recurved, to 1.5×0.6 cm.* **Nuts** ovoid, to 0.9×0.7 cm, subacute.

Distribution. Sumatra and Borneo. In Sarawak known from Bintulu, Kuching, Limbang, Lundu, Marudi, Samarahan, and Simunjan districts (e.g., *S 1484, S 6437, S 8256, S 17885, and S 69059*). Also occurring in Brunei (e.g., *S 1011 and S 12352*) and W Kalimantan (e.g., *Church et al. 987*).

Ecology. In *kerangas* forests, both on raised beaches and dry sandstone plateaux and cuestas, at altitudes to 700 m. Occurring in Bako and Mulu NPs; elsewhere critically endangered by forest conversion.

6. *Vatica chartacea* P.S.Ashton

(Latin, *chartaceus* = papery; the leaf blade)

Gard. Bull. Sing. 31 (1978) 18, *op. cit.* (1982) 351. **Type:** *Leopold SAN 46204*, Borneo, Sabah, Labuk Sugut district, Sapi FR (holotype K; isotype SAN).

Medium-sized tree. *Young parts buff puberulent, caducous except on parts exposed in bud and ovary.* **Twigs** c. 2 mm diameter apically, much-branched. **Stipules** lanceolate, to 7×2 mm, caducous. **Leaves** *thinly chartaceous, drying wrinkled and pale yellowish brown; blade oblong to obovate, 11–25 × 3–10 cm, base broadly cuneate to obtuse, apex acuminate with prominent acumen to 1 cm long; lateral veins 16–20 pairs, with short slender intermediates, slender but prominent below, distinctly elevated above as also the midrib, arched; intercostal venation subscalariform, sinuate, elevated on both surfaces; petiole 1–2.2 cm long, slender, drying black, glabrous.* **Inflorescences** to 5 cm long, in axillary cluster of 3, stout. **Flowers:** buds spindle-shaped, to 6×2 mm; sepals subequal, lanceolate; otherwise typical. **Fruits:** pedicels to 6 mm long, slender; *calyx revolute, lobes subequal, chartaceous, free, lanceolate, cordate, subacute, 5–7-veined, to 6×1.5 cm, ascending and concealing the nut.* **Nuts** ellipsoid, to 1.3×1.1 cm.

Distribution. Endemic in Borneo. In Sabah recorded from Kinabatangan, Kudat, Lahad Datu, Pensiangan, and Sandakan districts (e.g., *SAN 17654, SAN 18397, SAN 25451, SAN 57046, and SAN 97326*) and in Sarawak from Bintulu and Miri districts (e.g., *S 15808, S 40177 and S 60537*). Also in W Kalimantan (e.g., *bb. 35244 and bb. 35257*).

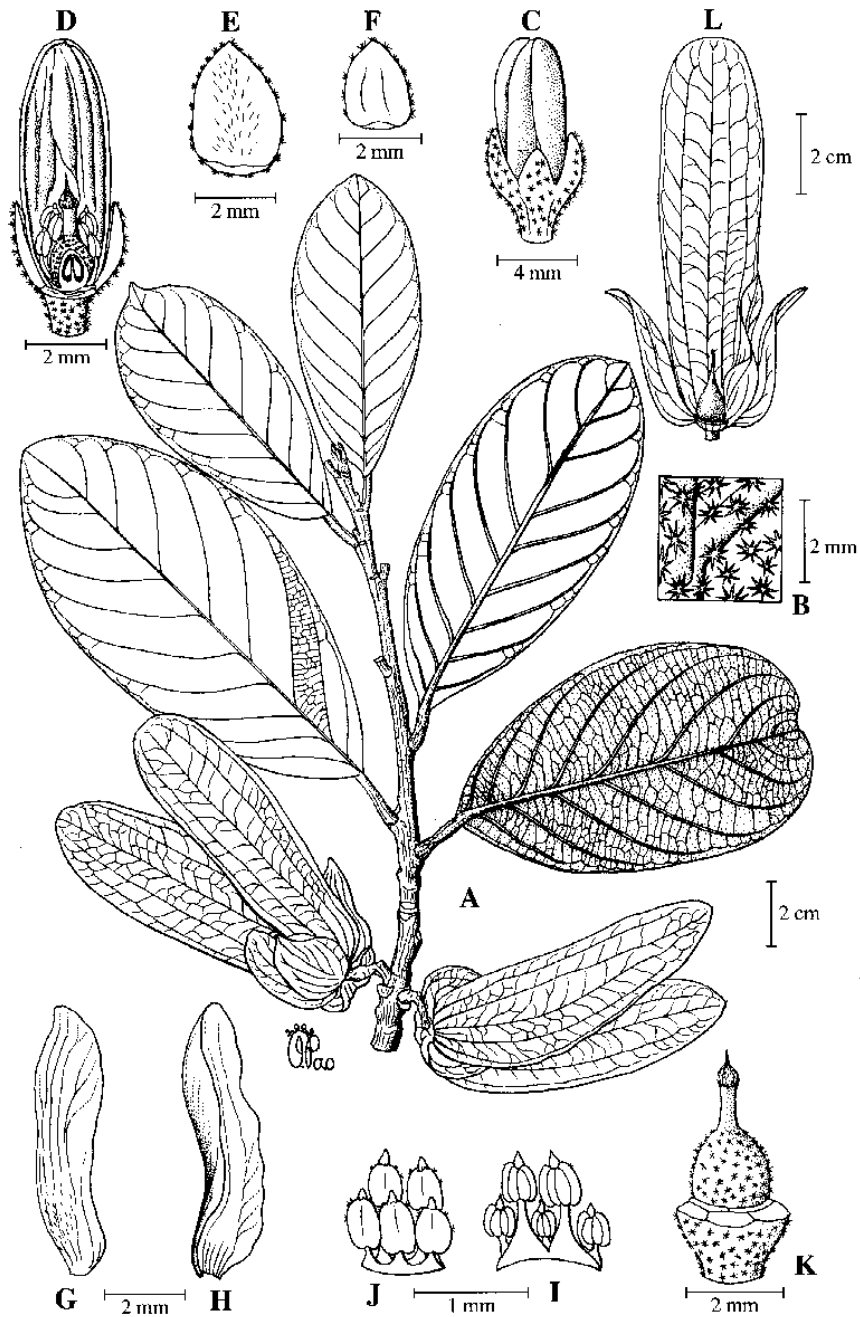


Fig. 33. *Vatica congesta*. A, fruiting leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, longitudinal section of flower bud; E, adaxial view of outer sepal; F, adaxial view of inner sepal; G, abaxial view of petal; H, adaxial view of petal; I, adaxial view of stamens; J, abaxial view of stamens; K, gynoecium; L, fruit with exposed nut. (A–B from S 29474, C–K from S 15021, L from S 9347A.)

Ecology. Very local, in forest on floodplains and alluvium banks of sluggish rivers. Critically endangered owing to land conversion.

7. *Vatica compressa* P.S.Ashton

(Latin, *compressus* = compressed; the young twig)

Gard. Bull. Sing. 22 (1967) 267, *op. cit.* (1968) 30, *op. cit.* (1982) 361; Anderson *op. cit.* (1980) 131. **Type:** *Daud & Tachun SFN 35618*, Borneo, Sarawak, Setapok Forest (holotype KEP; isotypes KEP, L).

Canopy tree, to 30 m tall, to 35 cm diameter. *Exposed young parts and ovary pale pinkish brown pubescent, caducous except on leaf bud and stipules. Twigs* at first *c.* 3 × 1 mm apically, *compressed*, smooth; stipule scars pale, horizontal, prominent. **Stipules** *not seen*. **Leaves** coriaceous; blade ovate-elliptic, 11–19 × 5–8.5 cm, base obtuse, apex with acumen to 1 cm long; midrib prominent below, flat or elevated above; *lateral veins 10–15 pairs*, with short indistinct intermediates, *slender and hardly elevated on either surface though more so below*, arched; intercostal venation subscalariform; *petiole 1.5–2.3 cm long*, slender, *not drying black*. **Inflorescences** to 7 cm long; rachis somewhat compressed, irregularly singly or doubly branched. **Flowers:** buds lanceolate, to 9 × 4 mm; otherwise typical. **Fruits:** pedicels to 8 mm long, slender; *calyx lobes free, unequal, chartaceous, 2 longer lobes lorate, obtuse, to 6.5 × 1 cm, tapering to 3 mm wide at base*, 3 shorter ones deltoid, acute, revolute, to 2 × 0.6 cm. **Nuts** broadly ovoid, to 0.5 cm diameter, with to 3 mm filiform style remnant.

Distribution. Endemic in Borneo. Confined to Sarawak, and recorded from Kuching, Lundu, and Sri Aman districts (e.g., *S 5984*, *S 6604*, *S 13275*, and *S 49944*).

Ecology. Rare and local, in *kerangas* forest, apparently at least sometimes with impeded drainage. Critically endangered, possibly extinct.

8. *Vatica congesta* P.S.Ashton

(Latin, *congestus* = heaped together; the inflorescences)

Fig. 33.

Gard. Bull. Sing. 22 (1967) 268, *op. cit.* (1968) 31, *op. cit.* (1982) 362; Anderson *op. cit.* (1980) 131. **Type:** *Yakup S 9347A*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype K; isotypes KEP, L, SAR).

Suncanopy or canopy tree, to 35 m tall, to 35 cm diameter. *Exposed fleshy parts mostly densely shortly pale ochreous brown scabrid-pubescent; leaf blade below and midrib towards base above sparsely so; leaf blade above glabrescent; parts otherwise persistently so. Twigs c.* 3 mm diameter apically, stout, *at first terete*, rugose, becoming striated and thinly flaky. **Stipules** deltoid, to 8 × 3 mm, acute. **Leaves** *thickly coriaceous, glabrous*, drying pale tawny brown; blade oblong, elliptic to obovate, 8–22 × 3.5–8 cm, base obtuse, *margin revolute, apex obtuse to retuse*; *lateral veins 10–13 pairs, prominent and stout below*, elevated above, as also the midrib; intercostal venation reticulate, similarly raised; *petiole 1.2–2.5 cm long, to 3 mm diameter*, stout, rugulose, *not drying black*. **Inflorescences** *axillary to ramiflorous, fascicled*; rachis angular, *to 3 cm long, short and congested, singly branched*. **Flowers** distichous; buds to 8 × 3 mm; sepals deltoid-acute; petals lorate-obtuse; otherwise typical. **Fruits:** pedicels to 4 mm long, scabrid-pubescent, fruit otherwise

glabrous; *calyx lobes free, unequal, chartaceous, 2 longer lobes lorate, obtuse, to 12 × 2.2 cm, not becoming reflexed, 2 shorter ones narrowly ovate, to 4.5 × 1.5 cm, tapering, acute, recurved. Nuts* ellipsoid, to 1.2 × 0.8 cm, with to 6 mm style remnant, glabrous.

Distribution. Endemic in Borneo. Known in Sarawak from Belaga and Kuching districts (e.g., *S 14936, S 15713, S 29476, S 32501, and S 56979*). Also occurring in W Kalimantan.

Ecology. Very local but frequent where it occurs, in mixed dipterocarp forest on poor sandy clay soil. Endangered.

9. *Vatica coriacea* P.S.Ashton

(Latin, *coriaceus* = leathery; the leaf texture)

Gard. Bull. Sing. 22 (1962) 314, *op. cit.* (1964) 68, *op. cit.* (1968) 31, *op. cit.* (1982) 362; Anderson *op. cit.* (1980) 131; PROSEA *op. cit.* 465; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Ariffin S 372*, Borneo, Sarawak, Lundu district, Bt. Sebandar (holotype K; isotype KEP).

Canopy tree, to 20 m tall, to 50 cm diameter. *Exposed young parts densely shortly ochreous puberulent, glabrescent except on buds. Twigs* to 5 mm diameter apically, *terete*, stout, ribbed. **Stipules** hastate, to 13 × 5 mm, subacute. **Leaves** *thickly coriaceous, drying tawny-brown to dark brown; blade narrowly obovate, 6.5–15 × 2.2–6 cm, concave, base narrow, obtuse or cuneate, margin revolute, apex obtuse to retuse; midrib stoutly prominent below, slightly raised above; lateral veins 10–11 pairs, with short slender intermediates, slightly and more or less equally elevated on both surfaces, arched; intercostal venation reticulate; petiole 1–1.5 cm long, stout, drying black or not. Inflorescences* axillary or terminal; rachis to 20 cm long, singly branched, often bearing small modified leaves at branch bases. **Flowers** to 18 mm long; calyx densely shortly pale greyish brown pubescent; otherwise typical. **Fruits:** pedicels to 7 mm long, slender; *calyx lobes free to base, unequal, chartaceous, 2 longer lobes oblong, obtuse, to 7 × 2.3 cm, tapering to 3.5 mm broad at base, not becoming reflexed, 3 shorter ones hastate, acute, to 0.6 × 0.2 cm. Nuts* globose, to 0.8 cm diameter, style remnant to 2 mm long.

Vernacular name. Sarawak—*resak daun tebal* (preferred name).

Distribution. Endemic in Borneo. In Sabah, known from a single collection from Tawai Plateau, Kinabatangan district (*SAN 39325*) and in Sarawak known from Kuching and Lundu districts (e.g., *S 6344, S 10296, S 15607, and S 15798*). Also occurring in Brunei (e.g., *BRUN 3155 and BRUN 5652*) and C Kalimantan (e.g., *Suzuki K 11483*).

Ecology. Locally common, in *kerangas* forest on giant humic podsols on Pleistocene raised beaches, and on organic soils over limestones. Well represented in Bako NP and recorded from Mulu NP; endangered outside parks system.

10. *Vatica dulitensis* Symington

(of G. Dulit, Sarawak)

Gard. Bull. S. S. 8 (1934) 35; Masamune *op. cit.* 498; Browne *op. cit.* 100; Ashton *op. cit.* (1964) 69, *op. cit.* (1968) 31, *op. cit.* (1982) 356; Meijer & Wood *op. cit.* 308; Burgess *op. cit.* 227; Anderson *op.*

cit. (1980) 131; PROSEA *op. cit.* 466; Coode *et al.* (eds.) *op. cit.* 84. **Type:** Richards 1343, Borneo, Sarawak, G. Dulit (holotype K).

Subcanopy to small canopy tree, to 30 m tall, to 50 cm diameter. *Exposed fleshy parts including petiole and leaf venation below dark vinous-sericeous, persistent except on venation.* **Twigs** *terete*, to 1 mm diameter apically, very slender, much-branched. **Stipules** narrowly hastate, to 3 × 1 mm, acute, deciduous. **Leaves** thinly coriaceous, drying pale greyish brown; blade narrowly obovate to lanceolate, 4–11 × 0.8–3.2 cm, *base cuneate*, apex caudate, acumen to 1.5 cm long; *lateral veins 10–12 pairs*, with short slender intermediates, *slender, hardly raised below*, arched; intercostal venation reticulate, evident but hardly raised; petiole 0.6–1 cm long, *to 1 mm diameter, slender, not drying black.* **Inflorescences** terminal or axillary; rachis singly or doubly branched, to 2.5 cm long. **Flowers:** buds to 6 mm long; sepals densely vinous-sericeous; petals cream; otherwise typical. **Fruits:** pedicels to 3 mm long, slender; *calyx lobes chartaceous, free, equal, oblong-obtuse, to 1.4 × 0.5 cm, vinous caducous cinereous within only, becoming rotate to reflexed.* **Nuts** *globose, to 0.8 cm diameter, smooth, vinous cinereous*, with short style remnant.

Vernacular names. Sabah—*resak bukit* (preferred name). Sarawak—*resak tiong* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Kota Belud, Labuk Sugut, Lahad Datu, Ranau, and Sipitang districts (e.g., *SAN 16267, SAN 26712, SAN 76253, SAN 78171, and SAN 116860*) and in Sarawak from Belaga, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 10184, S 14770, S 17738, S 36093, and S 43570*). Also occurring in Brunei (e.g., *BRUN 3042 and BRUN 3156*) and NE and E Kalimantan (e.g., *Kostermans 9095 and Kostermans 9248*).

Ecology. Local but often abundant on high ridges on shallow organic soil, in upper dipterocarp forest, at 600–1350 m altitude, and occasionally in lowland mixed dipterocarp forest on leached clay soils. Occurring in G. Gading and Mulu NPs; elsewhere vulnerable.

11. *Vatica endertii* Slooten

(F.H. Ender, 1891–1953, Dutch forester in Indonesia)

Bull. Jard. Bot. Buitenz. 3, 18 (1942) 248; Ashton *op. cit.* (1968) 32, *op. cit.* (1982) 366; Anderson *op. cit.* (1980) 131. **Type:** Ender 2775, Borneo, Kalimantan, W Kutei, Long Hoet (holotype BO; isotype L).

Canopy tree, to 30 m tall, to 60 cm diameter; bole sinuous. *Exposed young parts shortly pale brown caducous scabrid-puberulent, more or less persistent on inflorescence and sometimes on veins below; densely persistently so on ovary; parts otherwise glabrous.* **Twigs** *terete, c.* 1 mm diameter apically, much-branched, at first striated. **Stipules** not seen. **Leaves** *chartaceous*, drying pale buff-brown; *blade narrowly obovate, oblong or rarely lanceolate, 4.8–14 × 1.7–5.5 cm, base cuneate, margin not revolute, apex acuminate with slender acumen to 1 cm long; lateral veins 11–14 pairs*, without intermediates, *prominent below, unraised above as also the midrib*; intercostal venation subscalariform; *petiole 0.8–2 cm long, not drying black.* **Inflorescences** *terminal or axillary, not fascicled*; rachis singly branched, striated, to 3 cm long. **Flowers** typical. **Fruits:** pedicels to 8 mm long, slender; *calyx lobes unequal, free, chartaceous, 2 longer lobes oblong-spatulate, obtuse, to 8 × 2*

cm, not becoming reflexed, c. 3 mm wide at base, 3 shorter ones lanceolate, to 2 × 0.6 cm, acute, hardly recurved. Nuts subglobose, to 0.6 × 0.5 cm.

Distribution. Endemic in Borneo. Known in Sarawak from Kapit and Miri district (e.g., *S 14383, S 19036* and *S 19037*). Also occurring in E Kalimantan (e.g., the type).

Ecology. Scattered, local, in upper dipterocarp forest on acid volcanic rock (dacite) in Sarawak, occasionally also in lowland mixed dipterocarp forest in Kalimantan. Vulnerable owing to logging.

12. *Vatica glabrata* P.S.Ashton

(Latin, *glabratus* = smooth-skinned; the plant parts)

FM 1, 9 (1982) 370; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Tong S 36852*, Borneo, Sarawak, Marudi district, Dulit Range (holotype K).

Canopy tree, to 20 m tall, to 60 cm diameter. *Buds and ovary densely persistently ochreous puberulent, young parts fugaceously so; parts otherwise glabrous, more or less shiny. Twigs terete, c. 2 mm diameter apically, smooth. Stipules elliptic, obtuse, to 12 × 8 mm, not at first caducous, leaving a falcate scar. Leaves coriaceous, more or less concave, shiny, drying yellowish brown; blade lanceolate, 6–15(–22) × (2–)2.5–7 cm, base obtuse, margin not revolute, apex acuminate with prominent, attenuate acumen to 1.5 cm long; midrib flat or raised above; lateral veins 9–11 pairs, with more or less short intermediates, ascending, slender, raised on both surfaces but more so below; intercostal venation reticulate, distinctly raised on both surfaces; petiole 1–4 cm long, slender, prominently geniculate glabrescent, drying black. Inflorescences 1–several axillary or terminal; rachis to 7 cm long. Flowers typical. Fruits: calyx lobes unequal, free, chartaceous, not becoming reflexed.*

Distribution. Endemic in Borneo. In Sarawak known from Kapit and Marudi districts (e.g., *S 34842, S 34865* and *S 36383*). Also occurring in Brunei (e.g., *BRUN 2526* and *BRUN 2533*).

Ecology. Local but frequent, at the upper limits of upper dipterocarp forest, at 1200–1500 m altitude. One sterile and aberrant collection (*S 27283*) from the karst pinnacles on G. Subis, Niah, at altitude *c.* 600 m. Vulnerable.

13. *Vatica globosa* P.S.Ashton

(Latin, *globosus* = spherical; the nut)

Gard. Bull. Sing. 22 (1967) 269, *op. cit.* (1968) 32, *op. cit.* (1982) 358; Anderson *op. cit.* (1980) 132. **Type:** *Ashton S 18091*, Borneo, Sarawak, Labang, Ulu Stirau (holotype K; isotype L).

Subcanopy tree, to 20 m tall, 20 cm diameter. *Exposed fleshy parts and ovary, including entire fruit but not leaf blade and venation, densely persistently rufous-brown sericeous. Twigs c. 2 mm diameter apically, terete. Stipules unknown. Leaves* thinly coriaceous, usually somewhat concave between the lateral veins, *drying greyish to pinkish brown; blade obovate, 7–18 × 3–6.5 cm, base narrowly cuneate, apex caudate, acumen to 2 cm long; midrib prominent on both surfaces; lateral veins 12–16 pairs, with many intermediate veins,*

slender but prominent below narrowly grooved above; intercostal venation reticulate; petiole 0.7–1.5 mm long, slender, to 2.5 mm diameter, with distinct adaxial furrow, rugulose and not black on drying. Inflorescences terminal or 1–several axillary, congested; rachis to 3 cm long. **Flowers:** buds lanceolate, to 5×2 mm; calyx densely vinous pubescent outside, glabrous within; corolla sparsely so; otherwise typical. **Fruits:** *calyx lobes equal, free, oblong, obtuse, to 0.4×0.3 cm, reflexed, not concealing the nut. Nuts globose, to 2 cm diameter, 3-sutured.*

Distribution. Endemic in Borneo. In Sarawak recorded from Bintulu, Kapit, Kuching, Marudi, Miri, and Sri Aman districts (e.g., *Haviland & Hose 3159, S 14485, S 23751, S 42461, and S 64531*). Also occurring in W Kalimantan (e.g., *bb. 13931*).

Ecology. Locally frequent in mixed dipterocarp forest on yellow sandy clay soils, on low hills including the Arip rhyolite. Endangered by forest conversion.

14. *Vatica granulata* Slooten

(Latin, *granulatus* = appearing like tiny seeds; the nut surface)

Bull. Jard. Bot. Buitenz. 3, 9 (1927) 112, Bull. Jard. Bot. Buitenz. 3, 17 (1941) 136; Masamune *op. cit.* 498; Ashton *op. cit.* (1964) 70, *op. cit.* (1968) 32, *op. cit.* (1978) 21, *op. cit.* (1982) 354; Anderson *op. cit.* (1980) 132; PROSEA *op. cit.* 466; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Hallier 3399*, Borneo, W Kalimantan, G. Amai Ambit (holotype BO; isotype L).

Canopy tree, to 30 m tall, to 70 cm diameter. *Exposed fleshy parts including leaf venation below but not blade more or less densely shortly yellowish brown scabrid-pubescent; persistent except on venation. Twigs* c. 3 mm diameter apically, stout, angular, papery flaky. **Stipules** hastate, subacute, to 6×4 mm, caducous or oblong-lanceolate and acute to 30×20 mm, not at first caducous. **Leaves** coriaceous; blade narrowly obovate-oblong or elliptic-obovate, $10\text{--}20 \times 2.7\text{--}7$ cm, base narrowly obtuse, apex with tapering acumen to 0.6 cm long; midrib furrowed above; lateral veins 12–14(–24) pairs, prominent below, slightly sunken above, well-spaced; intercostal venation indistinct below, petiole 1.2–2 cm long, to 3 mm diameter, drying not black. **Inflorescences** variable. **Fruits** subsessile; calyx lobes free, subequal, chartaceous, deltoid, brittle, glabrous, reflexed, to 0.7×0.4 cm or elliptic, revolute, to 2×1.2 cm. **Nuts** ovoid, to 3.5×4 cm, acute or subacute, coarsely granulate, 3-furrowed.

Vernacular name. Sarawak—*resak ranting bersisik* (preferred name).

Distribution. Endemic in Borneo.

Ecology. In upper dipterocarp forest, on high ridges, at altitude between 500–1700 m.

Notes. Two subspecies, viz. subsp. *granulata* and subsp. *sabaensis*, are recognised in Sabah and Sarawak.

Key to subspecies

Stipules hastate, subacute, to 6×4 mm, soon caducous. Inflorescence to 3 cm long, axillary. Fruit calyx lobes deltoid, not revolute, to 0.7×0.4 cm.

subsp. **granulata**

Locally abundant in its suitable habitat. In Sabah recorded from Keningau and Tambunan districts (e.g., *SAN 115452* and *Wong WKM 2646*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Marudi, Serian, and Tatau districts (e.g., *S 15217*, *S 17658*, *S 22221*, *S 36347*, and *S 60381*). Also occurring in Brunei (e.g., *BRUN 2641* and *FMS 30578*) and W Kalimantan (e.g., *Argent et al. 93156* and the type). Occurring in Mulu NP; probably not vulnerable.

Stipules oblong-lanceolate, acute, to 30 × 20 mm, not at first caducous. Inflorescence to 15 cm long, lax, terminal or axillary. Fruit calyx lobes elliptic, revolute, to 2 × 1.2 cm.....

subsp. **sabaensis** P.S.Ashton

(of Sabah)

Gard. Bull. Sing. 31 (1978) 21, *op. cit.* (1982) 354; PROSEA *op. cit.* 466. Type: *G.H.S. Wood & Kilang SAN 16613*, Borneo, Sabah, Sipitang, Bt. Batanga north slope (holotype K; isotypes KEP, SAN). Synonym: *V. scortechinii auct. non* (King) Brandis: Meijer & Wood *op. cit.* 319.

Known in Sabah from Kota Belud, Labuk Sugut, Lahad Datu, Ranau, and Sipitang districts (e.g., *SAN 16708*, *SAN 17000* and *SAN 130634*) and in Sarawak from Limbang and Marudi districts (e.g., *Nooteboom & Chai 2233*, *S 37286* and *S 44403*). Also occurring in Brunei (e.g., *Prance 30578*) and E Kalimantan (e.g., *Kostermans 7465*). In upper dipterocarp forest, at altitudes to 1700 m. Occurring in Kinabalu NP; probably not vulnerable.

15. **Vatica havilandii** Brandis

Fig. 34.

(G.D. Haviland, 1857–1901, surgeon and naturalist in Sarawak)

J. Linn. Soc. Bot. 31 (1895) 133; Merrill *op. cit.* (1921) 409; Slooten *op. cit.* (1927) 95; Masamune *op. cit.* 498; Symington, J. Malay. Br. Roy. As. Soc. 19 (1941) 155, Malay. For. Rec. 16 (1943) 220; Browne *op. cit.* 100; Ashton *op. cit.* (1964) 71, *op. cit.* (1968) 33, *op. cit.* (1982) 351; Anderson *op. cit.* (1980) 132; PROSEA *op. cit.* 467; Coode *et al.* (eds.) *op. cit.* 85. **Type:** *Haviland 1848*, Borneo, Sarawak, near Kuching (holotype K).

Small to medium-sized tree, occasionally to 30 m tall, to 30 cm diameter. *Exposed fleshy parts but for leaf blade and ovary densely persistently deep fulvous-brown flocculent tomentose; indumentum glabrescent on fruit calyx lobes, sparse and early caducous on leaf venation below.* **Twigs** to 2.5 mm diameter apically, terete or slightly compressed, smooth or slightly flaky. **Stipules** linear, to 12 × 2.5 mm, caducous. **Leaves** thinly coriaceous, more or less bullate between lateral veins, drying reddish brown; *blade narrowly obovate-oblong, 8–17 × 2.5–5 cm, base cuneate, apex with slender acumen to 1 cm long; midrib terete, prominent below, flat or somewhat elevated above; lateral veins 15–20 pairs, with prominent short intermediates, slender, arched towards margin, flat to slightly raised above, prominent below; petiole 1–1.2 cm long, to 2.5 mm diameter, hardly geniculate, not drying black.* **Inflorescences** terminal or axillary; rachis terete, singly branched, to 8 cm long. **Flowers:** buds to 5 mm long; calyx densely rust-brown powdery tomentose; otherwise typical. **Fruits** pedicels to 5 mm long, hidden within calyx; *calyx lobes subequal, free, chartaceous, ovate, acute, cordate, revolute, to 2.5 × 1.5 cm.* **Nuts** globose, to 1.2 cm diameter, *concealed within calyx.*

Vernacular name. Sabah and Sarawak—*resak degong* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Sabah recorded from Sandakan district (e.g., *SAN 36684*, *SAN 37880* and *SAN 79480*) and in Sarawak from Kuching, Mukah and

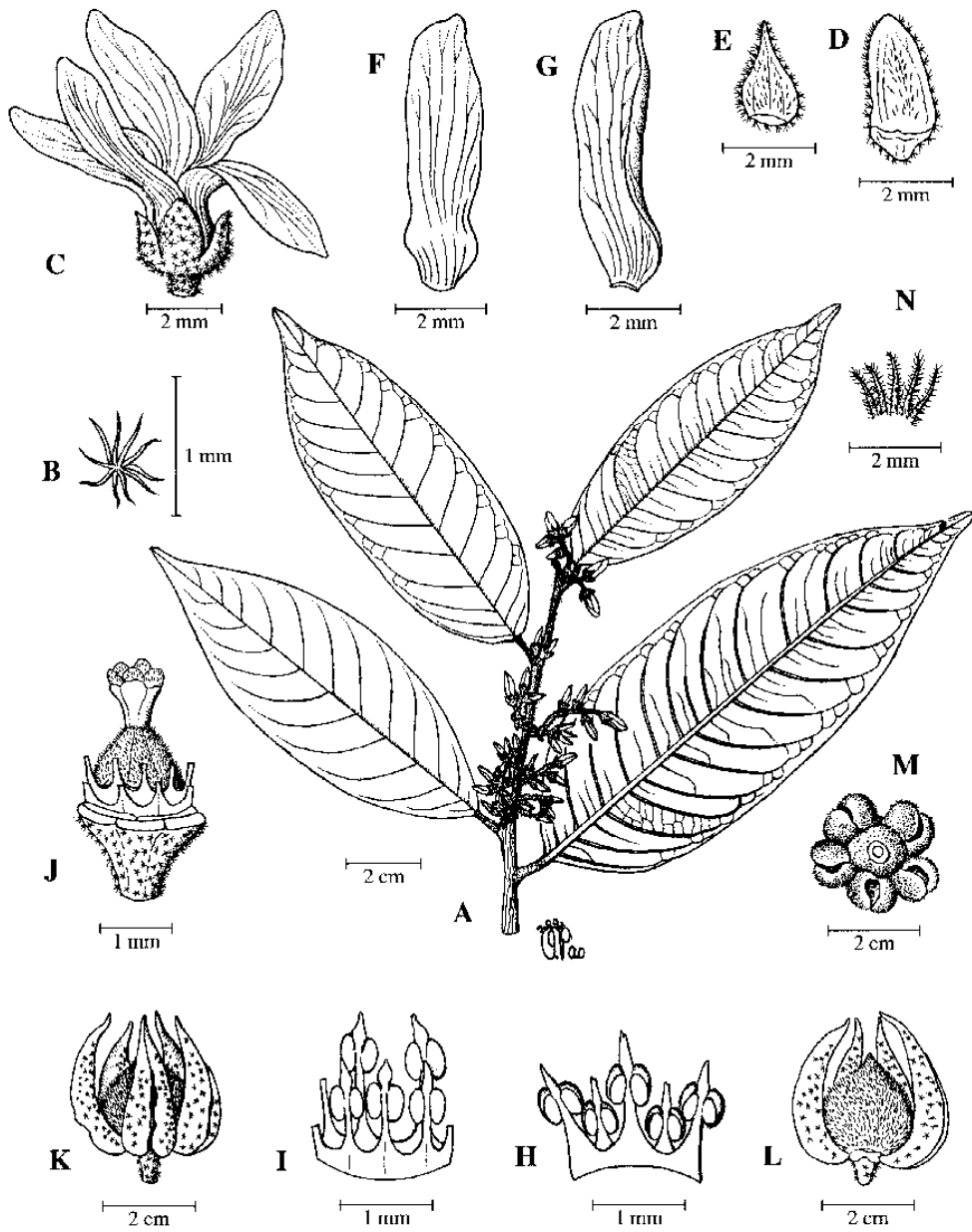


Fig. 34. *Vatica havilandii*. A, flowering leafy twig; B, tufted hair; C, open flower; D, adaxial view of outer sepal; E, adaxial view of inner sepal; F, abaxial view of petal; G, adaxial view of petal; H, adaxial view of stamens; I, abaxial view of stamens; J, gynoecium; K, fruit; L, fruit with exposed nut; M, basal view of fruit; N, hairs on nut. (A–J from SAN 36684, K–N from S 23244.)

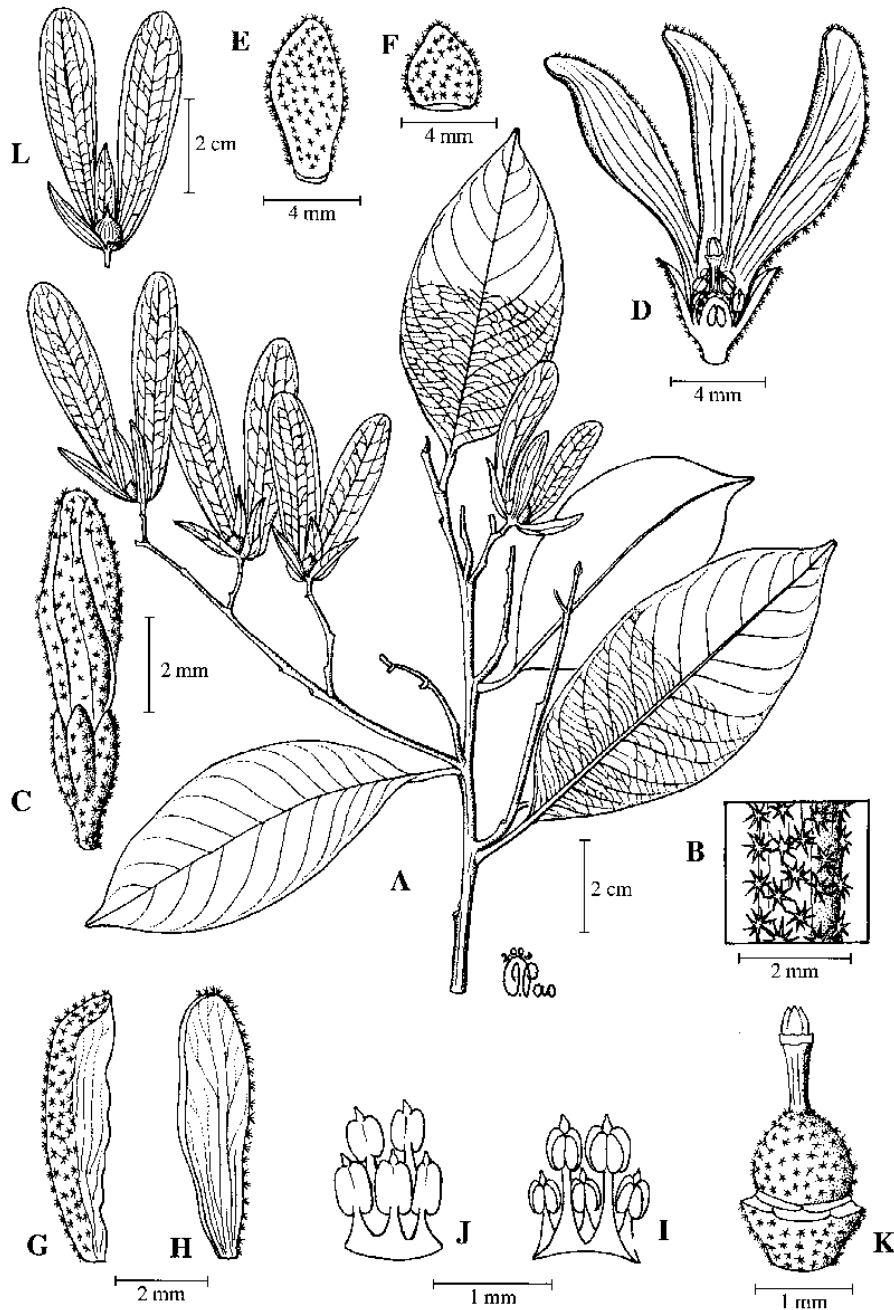


Fig. 35. *Vatica mangachapoi* subsp. *mangachapoi*. A, fruiting leafy twig; B, detail of indumentum of midrib on the lower leaf surface; C, flower bud; D, longitudinal section of open flower; E, abaxial view of outer sepal; F, abaxial view of inner sepal; G, abaxial side of petal; H, adaxial side of petal; I, adaxial view of stamens; J, abaxial view of stamens; K, gynoecium; L, fruit with exposed nut. (A–B and L from *FMS 41100*, C–K from *SAN 15459*.)

Simunjan districts (e.g., *S 23227*, *S 23244* and *S 42993*). Also occurring in Brunei (e.g., *BRUN 676* and *FMS 30517*) and Kalimantan.

Ecology. Rare and local, in mixed dipterocarp forest on sandy clay soil, apparently usually near water, sometimes, close to limestone. Likely critically endangered with extinction.

16. *Vatica maingayi* Dyer

(C. Maingay, 1836–1869, Superintendent of Malacca jail and naturalist)

Fl. Brit. Ind. 1 (1874) 302; Brandis *op. cit.* 131; Slooten *op. cit.* (1927) 85, *p.p.*; Symington *op. cit.* (1941) 151, *op. cit.* (1943) 223; Meijer & Wood *op. cit.* 309; Burgess *op. cit.* 227; Ashton *op. cit.* (1968) 33, *op. cit.* (1982) 369; Anderson *op. cit.* (1980) 132; PROSEA *op. cit.* 466. **Type:** *Maingay 209*, Peninsular Malaysia, Malacca (holotype K). **Synonyms:** *Synaptea maingayi* (Dyer) Ridl., FMP 1 (1922) 240, *p.p.*; *Vatica macroptera* Slooten *ex Thorenaar*, Med. Proefst. Boschw. 16 (1926) 120, Slooten *op. cit.* (1927) 83, *nomen in syn. sub V. lowii*; *V. aperta* Slooten *op. cit.* (1942) 250.

Medium-sized to large canopy tree, to 45 m tall, to 70 cm diameter. **Bark** eventually flaky. *Exposed young fleshy parts, leaf blade excepted, and ovary shortly rufous flocculent-tomentose; persistent on ovary and leaf bud, patchily caducous elsewhere.* **Twigs** terete, c. 2 mm diameter apically, smooth; *leaf buds prominent.* **Stipules** lorate, to 10 × 3 mm, leaving prominent horizontal scars. **Leaves** thinly coriaceous, *drying reddish brown; blade elliptic, 5.5–12.5 × 1.2–5 cm, base cuneate, margin not revolute, apex acuminate, with tapering acumen to 1 cm long; midrib prominent on both surfaces; lateral veins 9–11 pairs, with few short intermediates, slender but sharply prominent below, arched; intercostal venation slender, reticulate; petiole 1–2.5 cm long, slender, ribbed, prominently geniculate, drying black or not.* **Inflorescences** axillary; rachis ribbed, irregularly singly branched, to 4 cm long. **Flowers:** buds spindle-shaped, to 10 mm long; calyx rufous flocculent tomentose; corolla bright red; otherwise typical. **Fruits:** pedicels to 3 mm long; *calyx lobes unequal, free, chartaceous, 2 longer lobes lorate to narrowly ovate, obtuse, somewhat revolute at base, not becoming reflexed, to 8 × 2.5 cm, to c. 7 mm wide at base, 3 shorter ones narrowly ovate, acute, to 2.5 × 1 cm, to 3 mm wide at base.* **Nuts** globose, to 0.7 cm diameter, shortly mucronate.

Vernacular names. Sabah—*resak daun merah* (preferred name). Sarawak—*resak lidi* (preferred name).

Distribution. Peninsular Malaysia, Sumatra (Palembang) and Borneo. In Sabah recorded from Sipitang and Tambunan districts (e.g., *SAN 15105* and *SAN 17036*) and in Sarawak from Bau, Belaga and Kuching districts (e.g., *S 9425*, *S 15785* and *S 24826*).

Ecology. In lowland mixed dipterocarp forest on yellow sandy clay soils. Rare and endangered.

17. *Vatica mangachapoi* Blanco (a Philippine vernacular name)

Fig. 35.

Fl. Filip. ed. 1 (1837) 401; Slooten *op. cit.* (1927) 94; Merrill, PEB (1929) 205; Masamune *op. cit.* 499; Browne *op. cit.* 101; Anderson, Gard. Bull. Sing. 20 (1963) 159, *op. cit.* (1980) 132; Ashton *op. cit.* (1963) 253, *op. cit.* (1964) 71, *op. cit.* (1968) 33, *op. cit.* (1978) 22, *op. cit.* (1982) 364; Meijer & Wood *op. cit.* 310; Burgess *op. cit.* 227; PROSEA *op. cit.* 468; Coode *et al.* (eds.) *op. cit.* 85. **Neotype**

(designated here): *Merrill Sp. Blancoan. 866* (= *US 904562*), the Philippines, Luzon, Bataan Province (K, US). **Synonyms:** *Mocanera mangachapoi* Blanco *op. cit.* (1837) 450; *Vatica apterantha* Blanco, Fl. Filip. ed. 2 (1845) 156; *Dipterocarpus mangachapoi* (Blanco) Blanco *op. cit.* (1845) 313; *Shorea mangachapoi* (Blanco) Blume *op. cit.* 34; *Anisoptera mangachapoi* (Blanco) A.DC., Prodr. 16, 2 (1868) 616; *V. bureavi* F.Heim *op. cit.* (1891) 955; *Sunaptea bureavi* (F.Heim) F.Heim *op. cit.* (1892) 114; *V. reticulata auct. non* (Thwaites) A.DC.: King, J. As. Soc. Beng. 62, 2 (1893) 166; *Cotylelobium philippinense* F.Heim ex Brandis *op. cit.* 134; *V. obtusifolia* Elmer, Leafl. Philip. Bot. 4 (1912) 1471; *Synaptea reticulata* Ridl., *op. cit.* (1922) 243; *V. patula* Symington *op. cit.* (1941) 148.

Canopy tree, to 30 m tall, to 70 cm diameter; bole frequently crooked. *Exposed fleshy parts, leaf excepted, shortly densely cream-yellow puberulent; caducous except on inflorescence.* **Twigs** to 1.5 mm diameter apically, *terete*. **Stipules** narrowly oblong, to 5 × 2 mm, subacute. **Leaves** *thinly to thickly coriaceous*, somewhat shiny, *drying yellowish brown or pale greyish green; blade elliptic, 6–11 × 2.7–5 cm, base cuneate, margin not revolute, apex obtuse or subacute, or acute with tapering acumen to 0.7 cm long; midrib terete below, raised above; lateral veins 7–9 pairs, without intermediates, slightly raised on both surfaces, slightly arched; intercostal venation densely reticulate; petiole 0.5–1 cm long, drying black or not.* **Inflorescences** terminal or axillary; rachis *terete*, singly or doubly branched, to 14 cm long. **Flowers:** buds to 12 mm long; calyx shortly densely cream-buff pubescent; otherwise typical. **Fruits:** pedicels to 4 mm long, slender; *calyx lobes unequal, free, chartaceous, 2 longer lobes spatulate, obtuse, to 5.5 × 1.5 cm, to 3 mm wide at base, not becoming reflexed, 3 shorter ones lanceolate, acute, to 1 × 0.4 cm.* **Nuts** *subglobose, to 0.4 × 0.6 cm, shortly mucronate.*

Vernacular names. Sabah—*resak bajau* (preferred name). Sarawak—*resak julong* (Malay), *resak paya* (preferred name).

Distribution. Peninsular Thailand, Peninsular Malaysia, Borneo, and the Philippines.

Notes. Two subspecies, *viz.* subsp. *mangachapoi* and subsp. *obtusifolia*, are recognised in Sabah and Sarawak.

Key to subspecies

Leaves thinly coriaceous, apex with tapering acumen to 0.7 cm long. Inflorescence to 14 cm long. In forest on non-ultrabasic soils.....

subsp. **mangachapoi**

In Sabah known from Beaufort, Kinabatangan, Lahad Datu, Sandakan, Semporna, and Tawau districts (e.g., *SAN 15463*, *SAN 15504*, *SAN 29380*, *SAN 38937*, and *SAN 90785*) and in Sarawak from Kuching, Marudi, Mukah, Sibul, Simunjan, and Sri Aman districts (e.g., *S 3159*, *S 9429*, *S 12878*, and *S 77024*). Also occurring in Brunei (e.g., *KEP 80149*, *S 5813* and *Wong WKM 975*). Locally common, near the coast on dry ridges in *kerangas* forest on deep podsols on raised beaches and, particularly in Sarawak, in mixed peat swamp forest. Occurring in Bako NP; elsewhere vulnerable.

Leaves thickly coriaceous, apex obtuse or subacute. Inflorescence to 6 cm long. In forest on ultrabasic soils.....

subsp. **obtusifolia** (Elmer) P.S.Ashton

Gard. Bull. Sing. 31 (1978) 23, *op. cit.* (1982) 365. Basionym: *Vatica obtusifolia* Elmer *op. cit.* (1912) 1471. Lectotype (Ashton, 1978): *Elmer 12963*, the Philippines, Palawan, Puerto Princesa, Mt. Pulgar (hololectotype K; isolectotype NY).

Palawan and E Sabah, Bt. Masasan, Lahad Datu district (e.g., *SAN 25435*). On rocky hills, not far from the coast. Rare and endangered.

18. *Vatica maritima* Slooten

(Latin, *maritimus* = relating to the sea; the habitat)

Bull. Jard. Bot. Buitenz. 3, 17 (1942) 245; Ashton *op. cit.* (1964) 72, *op. cit.* (1968) 33, *op. cit.* (1982) 359; Meijer & Wood *op. cit.* 310; Burgess *op. cit.* 227; Anderson *op. cit.* (1980) 133; Coode *et al.* (eds.) *op. cit.* 85. **Type:** *Orolo* *SAN 1828*, Borneo, Sabah, Kudat, Lokapas (holotype BO).

Medium-sized canopy tree, to 25 m tall, to 35 cm diameter. *Exposed fleshy parts, leaf blade excepted, and ovary densely more or less persistently cream puberulent. Twigs ribbed or somewhat compressed, to 8 mm diameter apically. Stipules not seen. Leaves coriaceous, drying dull yellowish brown; blade broadly or narrowly ovate, 8–16 × 3–8 cm, base broadly cuneate to subcordate, apex with broad acumen to 1 cm long; lateral veins 7–10 pairs, with short slender intermediates, raised on both surfaces though more so below as also midrib and intercostal venation; petiole 2–2.7 cm long, to 3 mm diameter, slender, hardly geniculate, not drying black. Inflorescences axillary or rarely terminal; rachis singly branched, lax, angled, to 11 cm long. Flowers: buds to 14 mm long; calyx densely pale brown tomentose; otherwise typical. Fruits: pedicels to 4 mm long; calyx lobes unequal, chartaceous, united into a to 5 mm diameter shallow cup at base, 2 longer lobes lorate-spatulate, obtuse, to 11 × 1.8 cm, tapering to 4 mm wide at base, 3 shorter ones lanceolate, acute, to 1.8 × 0.6 cm. Nuts globose, to 0.6 cm diameter.*

Vernacular name. Sabah and Sarawak—*resak laut* (preferred name).

Distribution. Borneo and the Philippines (Palawan Is.). In Sabah known from Kudat, Kota Kinabalu, Lahad Datu, and Sandakan districts (e.g., *SAN 5495*, *SAN 28441*, *SAN 35663*, *SAN 36136*, and *SAN A 3183*). Also occurring in Brunei (e.g., *FMS 37066*).

Ecology. Rare, in forest on rocky or yellow sandy soils on headlands near the sea. Critically endangered.

19. *Vatica micrantha* Slooten

(Greek, *micros* = small, *anthos* = flower; the supposedly small flowers)

Bull. Jard. Bot. Buitenz. 3, 17 (1942) 246; Ashton *op. cit.* (1964) 73, *op. cit.* (1968) 33, *op. cit.* (1982) 366; Meijer & Wood *op. cit.* 312; Burgess *op. cit.* 227; Anderson *op. cit.* (1980) 132; PROSEA *op. cit.* 469; Coode *et al.* (eds.) *op. cit.* 85. **Type:** *bb. 29706*, Borneo, C Kalimantan, Pepas, Muara Teweh (holotype BO; isotype L).

Canopy tree, to 35 m tall, to 60 cm diameter. *Exposed fleshy parts, including venation below but not blade, and ovary more or less densely persistently pale brown scabrid-pubescent; glabrescent on fruit calyx. Twigs c. 2 mm diameter apically, terete, smooth or slightly striated. Stipules hastate, acute, to 7 × 3 mm. Leaves thinly coriaceous, drying greyish green; blade often bullate between lateral veins, elliptic-oblong to lanceolate, 4.5–16 × 1.5–6 cm, base obtuse, margin not revolute, apex acuminate with slender acumen to 1.5 cm long; lateral veins 8–11 pairs, with short slender intermediates, slender, arching and anastomosing to form intramarginal vein, prominent below, flat above as also the*

intercostal venation and midrib; petiole 0.5–1 cm long, to 3 mm diameter, not drying black.

Inflorescences terminal or axillary, not fascicled; rachis singly branched, terete, to 7.5 cm long. **Flowers:** buds to 13 mm long; calyx shortly pubescent; corolla cream, suffused with violet towards the base outside; otherwise typical. **Fruits:** pedicels to 2.5 mm long; *calyx lobes unequal, free, chartaceous, 2 longer lobes oblong-spatulate, subacute, to 5.8 × 1.5 cm, tapering to 3 mm wide, revolute base, 3 shorter ones ovate, caudate-acuminate, to 2.5 × 0.6 cm, similar at base.* **Nuts** ellipsoid, obtuse, to 1.4 × 0.8 cm; style remnant often absent.

Vernacular names. Sabah—*resak bulu* (preferred name). Sarawak—*resak hijau* (Malay).

Distribution. Endemic in Borneo; widespread. In Sabah recorded from Beaufort, Keningau, Kota Kinabalu, Kudat, Labuk Sugut, Lahad Datu, Sandakan, Semporna, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15486, SAN 20652, SAN 30889, SAN 90854, and SAN 131865*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, Sri Aman, and Tatau districts (e.g., *S 1754, S 15134, S 25016, S 32204, and S 60127*). Also occurring in Brunei (e.g., *BRUN 613 and Dransfield JD 6897*) and Kalimantan (e.g., *bb. 29706 and Jarvie & Ruskandi 5894*).

Ecology. The commonest *Vatica* in Sabah and Sarawak. Common in mixed dipterocarp forest, on a wide range of sandy and clay soils including on basic volcanics and on the base of limestone hills. Common in Lambir NP; not vulnerable.

20. *Vatica nitens* King

Plate 5E.

(Latin, *nitens* = shining; the leaf surface)

J. As. Soc. Beng. 2 (1893) 104; Slooten *op. cit.* (1927) 78; Ashton *op. cit.* (1964) 223, *op. cit.* (1968) 34, *op. cit.* (1982) 367; Anderson *op. cit.* (1980) 132; PROSEA *op. cit.* 469; Coode *et al.* (eds.) *op. cit.* 85. **Type:** *Curtis 1404*, Peninsular Malaysia, Penang, Government Hill (holotype CAL). **Synonym:** *Synaptea nitens* (King) Ridl., *op. cit.* (1922) 241.

Large canopy tree, to 40 m tall, to 70 cm diameter. *Exposed young fleshy parts densely powdery rufous pubescent, persisting only on leaf bud, stipule, inflorescence and ovary.* **Stipules** narrowly oblong, subacute, to 20 × 3.5 mm, caducous. **Twigs** terete. **Leaves** coriaceous, glistening, drying rich pinkish brown; *blade narrowly oblong, 35–55 × 10–17 cm, base obtuse or cuneate, margin not revolute, apex acuminate with tapering acumen to 1 cm long; lateral veins 12–22 pairs with many short intermediates, arched, raised below, flat or slightly elevated above as also the midrib and intercostal venation; petiole 1–2 cm long, to 2.5 mm diameter, not drying black, geniculate.* **Inflorescences** terminal or occasionally axillary; rachis singly, rarely doubly, branched, to 11 cm long. **Flowers:** buds spindle-shaped, to 7 × 3 mm; calyx densely pubescent on both surfaces; otherwise typical. **Fruits:** pedicels to 5 mm long, fruit base impressed; *calyx lobes unequal, free, pubescent at first, 2 longer lobes oblong, obtuse, slightly recurved, to 13 × 2 cm, tapering to 7 mm wide at base, 3 shorter ones hastate, acute, to 3.8 × 0.9 cm, to 7 mm wide at base.* **Nuts** globose, to 3 cm diameter.

Vernacular name. Sarawak—*resak daun panjang* (Malay).

Distribution. Sumatra (Riau), Peninsular Malaysia and Borneo. In Sabah known from Beaufort, Kota Kinabalu and Sipitang districts (e.g., *SAN 16831*, *SAN 23859*, *SAN 36767*, and *SAN A 4512*) and in Sarawak from Bau, Bintulu, Kapit, Kuching, Lundu, Miri, and Tatau districts (e.g., *S 10032*, *S 20281*, *S 25026*, *S 29201*, and *S 37855*). Also occurring in Brunei (e.g., *BRUN 3276* and *FMS 30528*) and E and W Kalimantan (e.g., *Arifin Berau 570* and *bb. 35295*).

Ecology. Locally frequent in mixed dipterocarp forest on well-drained sandy and sandy clay soils, on low ridges, at altitudes to 600 m. Common in Lambir NP and recorded from G. Gading NP; elsewhere vulnerable.

21. *Vatica oblongifolia* Hook.f.

(Latin, *oblongus* = rather long, *folius* = leaf; the leaf shape)

Trans. Linn. Soc. 23 (1862) 160; Merrill *op. cit.* (1921) 409; Slooten *op. cit.* (1927) 109, *op. cit.* (1941) 135; Masamune *op. cit.* 199; Browne *op. cit.* 101; Ashton *op. cit.* (1964) 75, *op. cit.* (1967) 264, *op. cit.* (1968) 34, *op. cit.* (1982) 355; Meijer & Wood *op. cit.* 314; Burgess *op. cit.* 227; Anderson *op. cit.* (1980) 132; PROSEA *op. cit.* 469; Kessler & Sidiyasa, TBSA-EK (1994) 113; Coode *et al.* (eds.) *op. cit.* 86. **Type:** *Lowe s.n.*, Borneo, Sabah (holotype K).

Canopy tree, to 35 m tall, to 50 cm diameter. *Exposed fleshy parts including young fruit densely evenly persistently vinous-sericeous. Twigs at first compressed, c. 2–4 × 1–2 mm apically, smooth. Stipules* oblong, obtuse, to 4.5 × 1.2 cm, fugaceous. **Leaves** thinly to thickly coriaceous, *bluish green with purplish venation below when fresh, drying dull greyish brown*; blade flate to somewhat concave, narrowly to broadly elliptic, or narrowly to broadly oblong, or narrowly obovate to obovate-oblong, 6.5–31 × 2.5–10.5 cm, base cuneate, obtuse, to more or less cordate, apex acute, acuminate, to subcaudate, acumen 1–1.5 cm long; midrib prominent and terete below, sunken above; *lateral veins 10–27 pairs, with short more or less prominent intermediates*, prominent below, arched within margin; petiole 1.4–5 cm long, stout, geniculate, drying not black. **Inflorescences** *compressed*, singly or doubly branched, terminal or in axillary cluster to 3, to 8 cm long. **Flowers:** buds to 15 mm long; petals cream, purplish towards the base; otherwise typical. **Fruits:** pedicels to 8 mm long; *calyx lobes equal, free, thickly coriaceous*, deltoid, oblong or obovate, *acute, obtuse or retuse, becoming reflexed, subrotate or revolute, to 0.3–1.5 × 0.2–1.2 cm. Nuts globose, to 2 cm diameter, smooth, faintly 3-furrowed.*

Vernacular names. Sabah—*resak daun panjang* (preferred name). Sarawak—*resak membangun* (preferred name).

Distribution. Endemic in Borneo.

Ecology. In mixed dipterocarp forest on well-drained sandy, sandy clay and shallow clay soils, at altitudes to 1000 m.

Notes. In Sabah and Sarawak, five subspecies are recognised, with distinct albeit overlapping ecological ranges.

Key to subspecies

1. Petiole at most 1.4 cm long; leaf broadly elliptic.....
 - subsp. **elliptifolia** P.S.Ashton
 (Latin, *ellipticus* = broadest at the middle with curved sides, *folius* = leaf; the leaf shape)
 Gard. Bull. Sing. 22 (1967) 265, *op. cit.* (1968) 34, *op. cit.* (1982) 356; Coode *et al.* (eds.) *op. cit.* 86. Type: *Ashton BRUN 925*, Borneo, Brunei, Bt. Kukub, Andulau hills (holotype K; isotypes KEP, L).
 Twigs *c.* 3 × 2 mm apically. *Leaf blade broadly elliptic, 12–20 × 3.5–7 cm*, base broadly cuneate, apex acute with slender acumen to 1 cm long; *petiole to 1.4 cm long*. Fruits: calyx lobes oblong, to 0.8 × 0.4 cm, obtuse, revolute.
 In Sarawak recorded from Miri district (e.g., *S 24432*). Also occurring in Brunei (e.g., the type). Rare, in mixed dipterocarp forest on deep sandy soils on coastal hills, and on the Arip rhyolite, at altitude below 300 m. Critically endangered.
 - Petiole at least 1.5 cm long; leaf various, not generally broadly elliptic.....2

2. Fruit calyx lobes at least 1.3 × 0.8 cm; leaf lateral veins 16–27 pairs.....3
 - Fruit calyx lobes at most 0.4 × 0.3 cm; leaf lateral veins 11–18 pairs.....4

3. Leaf blade broadly oblong, base obtuse to more or less cordate.....
 - subsp. **crassilobata** P.S.Ashton
 (Latin, *crassus* = thick, *lobatus* = lobed; the fruit calyx lobes)
 Gard. Bull. Sing. 22 (1967) 265, *op. cit.* (1968) 34, *op. cit.* (1982) 356; Coode *et al.* (eds.) *op. cit.* 86. Type: *Ashton BRUN 614*, Borneo, Brunei, Andulau FR (holotype K; isotypes KEP, L).
 Twigs *c.* 4 × 2 mm apically, stout. *Leaf blade thickly coriaceous, often somewhat concave, broadly oblong, 11.5–21 × 4.5–10.5 cm*, base obtuse more or less cordate, apex acute with short, broad acumen; *lateral veins stoutly prominent below, 16–23 pairs; petiole 1.8–2.8 cm long, stout. Fruit calyx lobes obovate, to 1.5 × 1.2 cm*, obtuse to retuse, subrotate.
 Known in Sarawak from Bintulu, Kapit, Miri, and Simunjan districts (e.g., *S 23225, S 27127, S 39618, S 59590, and S 63662*). Also occurring in Brunei (e.g., *BRUN 615 and BRUN 5157*) and W Kalimantan. Locally common in mixed dipterocarp forest, on deep yellow sands on hills behind the swamps or on the coast, at altitudes below 400 m. Common in Lambir NP and locally so in Mulu NP; elsewhere endangered by forest conversion.
 - Leaf blade narrowly obovate, base more or less cuneate.....
 - subsp. **multinervosa** P.S.Ashton
 (Latin, *multus* = many, *nervosus* = nerved; the many-veined leaf)
 Gard. Bull. Sing. 22 (1967) 265, *op. cit.* (1968) 34, *op. cit.* (1982) 356; Coode *et al.* (eds.) *op. cit.* 86. Type: *Meijer SAN 19713*, Borneo, Sabah, Sandakan, Sepilok FR (holotype K; isotypes KEP, L).
 Twigs *c.* 4 × 2 mm apically, stout. *Leaf blade narrowly obovate, 14–31 × 4–8.5 cm*, base narrowly obtuse or cuneate, apex, acuminate with slender acumen to 1.5 cm long; *lateral veins 18–27 pairs*, with prominent short intermediates, very prominent below; *intercostal venation distinctly elevated below; petiole 1.5–2.5 cm long. Fruit calyx lobes oblong, to 1.3 × 0.8 cm*, obtuse, reflexed.
 Recorded in E Sabah from Lahad Datu, Sandakan and Tawau districts (e.g., *SAN 22509, SAN 30052, SAN 34083, SAN 88089, and SAN 93092*) and in Sarawak from Belaga, Bintulu, Kapit, Limbang, Lundu, and Tatau districts (e.g., *S 12623, S 22240, S 41769, S 43465, and S 66118*). Also occurring in Brunei (e.g., *BRUN*

5786) and NE Kalimantan (e.g., *bb. 18163* and *Kostermans 8603*). Locally common in mixed dipterocarp forest on deep fertile clay-rich soils, especially on basic igneous rocks, at altitude to 800 m; also on shale, and on rhyolite. Occurring in Lambir and Mulu NPs; not vulnerable.

4. Leaf blade narrowly elliptic, base cuneate; petiole 1.5–2.5 cm long.....

subsp. **selakoensis** P.S.Ashton

(of Selako, W Sarawak)

Gard. Bull. Sing. 22 (1967) 265, *op. cit.* (1968) 34, *op. cit.* (1982) 356; Coode *et al.* (eds.) *op. cit.* 86. Type: *Ilias S 13340*, Borneo, Sarawak, G. Gading FR (holotype K; isotypes KEP, L).

Twigs *c.* 2 × 1 mm apically, slender. *Leaf blade* thinly coriaceous, *narrowly elliptic*, 6.5–22 × 2.5–6.5 cm, *base cuneate*, apex subcaudate, acumen to 1.5 cm long; *lateral veins 11–18 pairs*, with short indistinct intermediates, slender, hardly raised below; *petiole 1.5–2.5 cm long*. *Fruit calyx lobes oblong*, to 0.4 × 0.3 cm, obtuse.

Confined to mountains in Lundu district, W Sarawak (e.g., *S 13171* and *S 18466*). Common in upper dipterocarp forest on shallowly humic soils, at 600–1000 m altitude on granodiorite, mostly along ridges. Common in G. Gading NP, vulnerable to clearing on the summits.

Leaf blade obovate to oblong, base obtuse; petiole 2.5–5 cm long.....

subsp. **oblongifolius**

Twigs *c.* 4 × 2 mm apically, compressed, smooth. *Leaf blade* coriaceous, *obovate to oblong*, 10–31 × 4.5–10 cm, *base obtuse*, apex abruptly acute to broadly acuminate; *lateral veins 10–18 pairs*, with short more or less prominent intermediates; *petiole 2.5–5 cm long*, stout, geniculate. *Fruit calyx lobes deltoid*, to 0.3 × 0.2 cm.

Widespread throughout Borneo; in Sabah known from Beaufort, Kinabatangan, Kota Kinabalu, Kudat, Labuk Sugut, Ranau, Sandakan, and Sipitang districts (e.g., *SAN 16424*, *SAN 16845*, *SAN 20702*, *SAN 77868*, and *SAN 97513*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 13305*, *S 21550*, *S 32056*, *S 45513*, and *S 66998*). Also occurring in Brunei (e.g., *BRUN 2623* and *Wong WKM 84*) and Kalimantan (e.g., *Kostermans 7299* and *Kostermans 10624*). Frequent and locally common in mixed dipterocarp forest on sandy, sandy clay and shallow clay soils, at altitudes to 1000 m. Well represented in the parks system; not vulnerable.

22. *Vatica odorata* (Griff.) Symington

Plate 5F.

(Latin, *odoratus* = scented; the flowers)

J. Malay. Br. Roy. As. Soc. 19 (1941) 156, *op. cit.* (1943) 224; Ashton *op. cit.* (1964) 75, *op. cit.* (1967) 263, *op. cit.* (1978) 23, *op. cit.* (1982) 360; PROSEA *op. cit.* 470; Kessler & Sidiyasa *op. cit.* 113. **Basionym:** *Sunaptea odorata* Griff., *op. cit.* 516. **Type:** *Griffith s.n.*, Myanmar, Mergui, Tennaserim (holotype CAL). **Synonyms:** *Hopea grandiflora* Wall. ex A.DC., *op. cit.* 634; *Synaptea grandiflora* (Wall. ex A.DC.) Kurz *op. cit.* (1870) 65; *Anisoptera odorata* (Griff.) Kurz, *Flora* 30 (1872) 191; *Vatica grandiflora* (Wall. ex A.DC.) Dyer *op. cit.* (1874) 301; *V. faginea* Dyer *op. cit.* (1874) 301; *V. astrotricha* Hance, *J. Bot.* 14 (1876) 241; *Sunaptea astrotricha* (Hance) Pierre, *For. Fl. Coch.* (1891) t. 240; *Sunaptea dyeri* Pierre, *l.c.* (1891) t. 241; *Sunaptea faginea* (Dyer) Pierre *op. cit.* (1891) 242; *V. curtisii* King *op. cit.* 105.

Canopy tree, to 40 m tall, to 60 cm diameter. *Exposed fleshy parts, leaf blade and venation excepted, more or less densely pale yellowish to rust-brown pubescent; indumentum caducous on fruit calyx, more or less persistent elsewhere.* **Twigs** c. 1.5 mm diameter apically, *terete*, rugose, frequently finely flaky. **Stipules** oblong, obtuse, c. 8 × 2 mm, caducous. **Leaves** thinly coriaceous, drying pale yellowish brown or greyish brown; *blade narrowly elliptic to ovate, 8–16 × 2.7–5.5 cm*, base obtuse or cuneate, apex acuminate, acumen to 0.8 cm long; *lateral veins 11–15 pairs, raised below, flat above as also the midrib, not forming intramarginal vein; intercostal venation not prominent below; petiole 0.8–2 cm long, less than 3 mm diameter, geniculate or not, not drying black.* **Inflorescences** terminal or axillary; rachis singly branched, to 7 cm long. **Flowers:** buds to 8 mm long; calyx densely shortly pale greyish brown tomentose; otherwise typical. **Fruits:** pedicels c. 3 mm long, slender; *calyx lobes unequal, chartaceous, united at base in a to 8 mm diameter, 3 mm deep shallow cup, 2 longer lobes spatulate, obtuse, to 5.5 × 1.5 cm, tapering to 2.5 mm broad at base, not becoming reflexed, 3 shorter ones hastate, acute, to 1.4 × 0.4 cm.* **Nuts** globose, to 0.7 cm diameter, with 2 mm filiform style remnant, basal half adnate to the calyx cup.

Vernacular names. Sabah—*resak biabas* (preferred name). Sarawak—*resak ranting kesat* (Malay).

Distribution. S China, Myanmar (Tennasserim), Thailand, Indo-China, Peninsular Malaysia, Borneo and the Philippines.

Ecology. In aseasonal mixed dipterocarp forest and in seasonal mixed dipterocarp forest, at altitudes to 1900 m.

Notes. Two subspecies, *viz.* subsp. *mindanensis* and subsp. *odorata*, are recognised in Sabah and Sarawak.

Key to subspecies

Leaf blade drying pale yellowish brown; petiole not geniculate, 0.8–1.2 cm long. In aseasonal and seasonal mixed dipterocarp forest at altitudes to 700 m.....
subsp. **odorata**

In Borneo, known from Sipitang and Tawau districts in Sabah (e.g., *SAN 16714*, *SAN 17159* and *SAN 40586*) and E Kalimantan (e.g., *Ambri & Arifin 1016*). In mixed dipterocarp forest at altitudes to 700 m. In Sabah rare and endangered.

Leaf blade drying greyish brown; petiole geniculate, 1.5–2 cm long. In aseasonal mixed dipterocarp and upper dipterocarp forest at altitudes to 1900 m.....
subsp. **mindanensis** (Foxw.) P.S.Ashton

(of Mindanao, the Philippines)

Gard. Bull. Sing. 22 (1967) 263, *op. cit.* (1978) 24, *op. cit.* (1982) 361; PROSEA *op. cit.* 470; Coode *et al.* (eds.) *op. cit.* 86. Basionym: *Vatica mindanensis* Foxw. in Elmer Leaflet. Philip. Bot. 6 (1913) 1957, Slooten *op. cit.* (1927) 71, Meijer & Wood *op. cit.* 313, Burgess *op. cit.* 227. Lectotype (designated here): *Elmer 13398*, the Philippines, Mindanao, Mt. Urdaneta (hololectotype K). Synonyms: *V. sorsogonensis* Foxw., Philip. J. Sci. 13 (1918) Bot. 196; *V. aerea* Slooten *op. cit.* (1941) 133.

In Borneo and the Philippines. In Sabah recorded from Lahad Datu, Ranau, Sipitang, Tambunan, and Tawau districts (e.g., *SAN 16354*, *SAN 16667*, *SAN 17036*, *SAN 38436*, and *SAN 95838*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Lawas, Limbang, Lubok Antu, Lundu, Samarahan, Sri Aman, and Tatau districts (e.g., *S 10061*, *S 19014*,

S 24704, *S 36676*, and *S 68183*). Also occurring in Brunei (e.g., *BRUN 2540* and *BRUN 5237*) and W Kalimantan (e.g., *Suzuki K 9658* and *Suzuki K 9994*). In mixed and upper dipterocarp forest, at altitudes to 1900 m, on clays soils overlying shale, dacite, granodiorite, and basalt. Probably not vulnerable.

23. *Vatica parvifolia* P.S.Ashton

(Latin, *parvus* = small, *folius* = leaf)

Gard. Bull. Sing. 19 (1962) 316, *op. cit.* (1964) 76, *op. cit.* (1968) 35, *op. cit.* (1982) 365; Anderson *op. cit.* (1980) 133; Coode *et al.* (eds.) *op. cit.* 86. **Type:** *Ariffin S 371*, Borneo, Sarawak, Lundu district, Bt. Sebandar (holotype K; isotype KEP).

Canopy tree, to 35 m tall, to 35 cm diameter. *Exposed fleshy parts and ovary persistently densely rufous-brown powdery pubescent.* **Twigs** *terete*, to 1 mm diameter apically, slender, much-branched. **Stipules** linear, to 5 × 1 mm, caducous. **Leaves** *coriaceous*, drying reddish brown; *blade narrowly ovate to lanceolate*, 2.8–6 × 1–2.3 cm, *base obtuse*, *margin not revolute*, *apex caudate with acumen to 1 cm long*; *midrib slender*, *prominent below*, *flat above*; *lateral veins c. 8 pairs*, *hardly raised*, *indistinct*, *arched*; *petiole 0.6–0.9 cm long*, *not drying black*. **Inflorescences** terminal or axillary; *rachis terete*, singly branched, to 2 cm long. **Flowers:** buds to 6 mm long; *calyx greyish brown pubescent*; otherwise typical. **Fruits:** pedicels to 3 mm long, slender; *calyx lobes unequal*, *free*, *chartaceous*, *glabrescent except towards base*, *2 longer lobes oblong*, *narrowly obtuse*, *to 6 × 0.7 cm*, *revolute above the abruptly narrowly constricted base*, *not becoming reflexed*; 3 shorter ones broadly ovate, to 1 × 0.7 cm, acute, cordate, prominently revolute. **Nuts** *broadly ovoid*, *to 0.5 × 0.35 cm*, *obtuse*.

Vernacular name. Sarawak—*resak kerangas padi* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Sandakan district (e.g., *SAN 16370*) and in Sarawak from Kuching, Limbang and Lundu districts (e.g., *S 5318*, *S 6001*, *S 6833*, *S 7537*, and *S 12508*). Also occurring in Brunei (e.g., *BRUN 2007* and *FMS 34475*).

Ecology. Very local, in *kerangas* forest on shallow and giant podsols, at altitudes below 300 m. Critically endangered.

24. *Vatica patentinervia* P.S.Ashton

(Latin, *patens* = diverging from the axis at a wide angle, *nervia* = nerve; the lateral veins of the leaf)

Gard. Bull. Sing. 54 (2002) 214. **Type:** *Ilias S 15148*, Borneo, Sarawak, Bintulu district, Segan FR (holotype K; isotypes KEP, SAR).

Medium-sized canopy tree, to 35 m tall, to 35 cm diameter. *Young fleshy parts pale yellowish buff scabrid-puberulent*; *indumentum persistent on petiole*, *leaf venation below and midrib above*. **Twigs** *c. 2 mm diameter apically*, *terete*, more or less ribbed. **Stipules** not seen. **Leaves** *coriaceous*, drying dull pale yellowish brown; *blade elliptic to obovate*, 12–18 × 4.5–7 cm, *base obtuse*, *margin not revolute*, *apex obtuse to shortly acuminate*; venation including midrib somewhat elevated above, more or less prominently so below; *lateral veins 7–8 pairs*, *distinctly raised below*; *petiole to 2.5 cm long*, *to 3 mm diameter*,

drying pale buff brown, rugose. **Inflorescences** ramiflorous, in axillary clusters of 3, or terminal; rachis singly branched, to 3 cm long. **Flowers** unknown. **Fruits:** pedicels to 4 mm long, slender; calyx lobes unequal, free, chartaceous, 2 longer lobes lorate-oblong, obtuse, to 12×2.2 cm, constricted and somewhat revolute at base, 3 shorter ones hastate, to 4.5×1.5 cm, acuminate, revolute. **Nuts** ellipsoid, to 1.2×0.8 cm, mucronate, glabrous.

Distribution. Known only from the type locality in Sarawak, and Kuala Belalong, Temburong district in Brunei (e.g., S 5744).

Ecology. Apparently locally frequent in Temburong; in both localities in mixed dipterocarp forest on clay soils, at altitudes below 400 m. Conservation status uncertain.

25. *Vatica pedicellata* Brandis

(Latin, *pedicellatus* = with a prominent stalk; the flowers)

J. Linn. Soc. Bot. 31 (1895) 125; Merrill *op. cit.* (1921) 409; Slooten *op. cit.* (1927) 111; Masamune *op. cit.* 499; Browne *op. cit.* 101; Ashton *op. cit.* (1968) 35, *op. cit.* (1982) 356; Anderson *op. cit.* (1980) 133. **Type:** *Haviland 1041/869*, Borneo, Sarawak, Lundu district (holotype K; isotype KEP).

Small tree, to 15 m tall, to 15 cm diameter. *Exposed fleshy parts, leaf surface excepted, and ovary persistently densely vinous-sericeous.* **Twigs** c. 2 mm diameter apically, *terete* or slightly compressed only, hardly branched, smooth. **Stipules** lorate, subacute, to 7×2 mm, caducous. **Leaves** coriaceous, *bluish green with purplish venation below when fresh, drying mauve-brown; blade elliptic to lanceolate, $9-23 \times 3.5-7.5$ cm, base obtuse or rarely cuneate, margin narrowly revolute, apex with slender acumen to 2 cm long; midrib prominent below, elevated within a furrow above; lateral veins 9-15 pairs, with many short slender intermediates, slender, hardly raised on either surface though more so below, arched and anastomosing to form a faint looped intramarginal vein; petiole 1-2.5 cm long, 2-3 mm diameter, not or hardly geniculate, terete but rugulose and not turning black on drying.* **Inflorescences** axillary; rachis singly or doubly branched, compressed, ribbed, slender, to 8 cm long. **Flowers:** buds spindle-shaped, to 6×2 mm; calyx vinous puberulent; corolla cream with a purplish suffusion outside; otherwise typical. **Fruits** *vinous cinereous throughout; pedicels to 8 mm long, slender; calyx lobes free, subequal, oblong, to 0.6×0.4 cm, obtuse, incrassate, revolute, reflexed. Nuts subglobose, to 1.8×2.2 cm, subacute, with obscure sutures.*

Distribution. Endemic in Borneo; known only from Kuching, Lundu and Simunjan districts in Sarawak (e.g., S 4672, S 7252, S 15233, S 39416, and S 68078).

Ecology. Locally frequent in *kerangas* forest, usually on rocky slopes near the sea. Well represented in Bako NP; not vulnerable.

26. *Vatica perakensis* King

(of Perak, Peninsular Malaysia)

J. As. Soc. Beng. 62, 2 (1893) 103, *p.p. emend.* Symington *op. cit.* (1941) 152, *op. cit.* (1943) 226; Slooten *op. cit.* (1927) 86, *p.p.*; Ashton *op. cit.* (1978) 24, *op. cit.* (1982) 367. **Lectotype** (Symington, 1941): *King's Collectors 7549*, Peninsular Malaysia, Perak, Larut (hololecotype CAL). **Synonyms:** *Synaptea perakensis* (King) Ridl., *op. cit.* (1922) 242, *p.p.*; *Vatica songa* Slooten *op. cit.* (1927) 93.

Small to medium-sized tree, to 30 m tall, to 30 cm diameter. *Exposed fleshy parts, leaf blade excepted, and ovary persistently greyish pink to pale yellowish brown cinereous; leaf venation below and nut glabrescent.* **Twigs** c. 1 mm diameter apically, slender, terete, much-branched. **Stipules** fugaceous, not seen. **Leaves** thinly coriaceous, drying pale greyish brown; blade lanceolate to oblanceolate, 6–14 × 1.8–3.8 cm, base cuneate, margin not revolute, apex subcaudate, acumen to 2 cm long; lateral veins 11–13 pairs, slender but prominent below, evident above, as also the midrib, ascending; intercostal venation densely subreticulate, evident on both surfaces; *petiole slender, 1–2 cm long, not drying black.* **Inflorescence** slender; rachis singly branched, to 5 cm long. **Flowers** typical. **Fruits:** pedicels to 6 mm long, slender; *calyx lobes unequal, free, chartaceous, 2 longer lobes spatulate, obtuse, to 6 × 1.8 cm, tapering to c. 5 mm wide at the subrevolute base, 3 shorter ones lanceolate, acute, to 1.5 × 0.6 cm.* **Nuts** ovoid, apiculate, to 1 cm diameter.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo two tentative records from Lahad Datu and Tawau districts in SE Sabah (*i.e.*, SAN 20119 and SAN 41580).

Ecology. In ‘coastal hill dipterocarp forest’ of Symington (*op. cit.* (1943) 15, fig. 2) on dry ridges, especially near the coast. Conservation status unknown but likely endangered.

27. *Vatica rassak* (Korth.) Blume

(after the Malay common name—*resak*)

Mus. Bot. Lugd.-Bat. 2 (1852) 31 (incl. var. *subcordata* Blume); Merrill *op. cit.* (1921) 409; Slooten *op. cit.* (1927) 73, 104, *op. cit.* (1942) 223; Masamune *op. cit.* 499; Ashton *op. cit.* (1978) 20, *op. cit.* (1982) 353; PROSEA *op. cit.* 471; Kessler & Sidiyasa *op. cit.* 114. **Basionym:** *Retinodendron rassak* Korth., *op. cit.* 56. **Type:** *Korthals s.n.* (= RHL Sheet No. 900171121), Borneo, Kalimantan, banks of Sg. Barito, Lower Dyak (holotype L). **Synonyms:** *Vateria rassak* (Korth.) Walp., Rep. 5 (1845) 126; *Vatica papuana* Dyer, J. Bot. 16 (1878) 100, Slooten *op. cit.* (1927) 73, *op. cit.* (1942) 233, Meijer & Wood *op. cit.* 314, Burgess *op. cit.* 227, Ashton *op. cit.* (1968) 35, Anderson *op. cit.* (1980) 132; *Vatica moluccana* Burck *op. cit.* 226; *R. moluccanum* (Burck) F.Heim *op. cit.* (1892) 104; *Vatica schumanniana* Gilg, Bot. Jahrb. 18 (1894) Beibl. 45; *Vatica celebensis* Brandis *op. cit.* 126; *Vatica subcordata* (Blume) Hallier f., Med. Rijksherb. 36 (1918) 4, Slooten *op. cit.* (1942) 237; *Vatica celebica* Slooten *op. cit.* (1942) 237.

Large canopy tree, to 30 m tall, to 70 cm diameter. *Exposed fleshy parts, leaf surface excepted, and ovary persistently evenly pale buff-puberulent; fruit glabrescent.* **Twigs** c. 3 mm diameter apically, stout, crooked, ribbed, becoming rugose, flaky; stipule scars prominent. **Stipules** lorate, subacute, to 14 × 4 mm, subpersistent. **Leaves** thickly coriaceous, drying dull greyish brown; blade oblong to narrowly elliptic, 13–32 × 5–11 cm, base broadly cuneate to subcordate, apex with tapering acumen to 1.5 cm long; midrib prominent below, flat above; *lateral veins 16–20 pairs, prominent below, slightly elevated above; petiole 2–2.5 cm long, at least 3 mm diameter, stout, not geniculate, not drying black.* **Inflorescences** terminal or axillary; rachis ribbed, irregularly branched mostly from the base, appearing fascicled, to 14 cm long. **Flowers:** buds spindle-shaped, to 14 × 3 mm; calyx densely shortly pale buff pubescent; otherwise typical. **Fruits:** pedicels to 3 mm long, short, stout; *calyx lobes free, subequal, deltoid, acute, incrassate, reflexed, recurved, to 1.2 × 0.7 cm.* **Nuts** oblong to ovoid, to 5 × 3.5 cm, very variable, obtuse to tapering-apiculate, *frequently asymmetric, verrucose with thick corky pericarp, prominently 3-furrowed.*

Distribution. Borneo, Sulawesi, Maluku, New Guinea, and Sudest Is. In Sabah recorded from Beaufort, Kinabatangan, Lahad Datu, Papar, Sandakan, Semporna, and Sipitang districts (e.g., *SAN 25971*, *SAN 30718*, *SAN 57362*, *SAN 84454*, and *SAN 111491*) and in Sarawak from Belaga and Sibiu districts (e.g., *S 9727* and *S 39310*). Also occurring in S Kalimantan (e.g., *Kessler and Ambriansyah B1440* and *Sidiyasa PBU 443*). The furthest east known dipterocarp.

Ecology. On and near banks of sluggish including brackish rivers in Sabah and Sarawak, on low hills in lowland mixed forest elsewhere. Vulnerable owing to its accessible habitat.

28. *Vatica rotata* P.S.Ashton

(Latin, *rotatus* = like a wheel; the spreading fruit calyx lobes)

Gard. Bull. Sing. 22 (1967) 270, *op. cit.* (1968) 36, *op. cit.* (1982) 357; Anderson *op. cit.* (1980) 133. **Type:** *Ashton S 19594*, Borneo, Sarawak, Mukah, Ulu Kenyana (holotype K; isotypes KEP, L).

Small tree, *c.* 10 cm diameter. *Exposed fleshy parts, including midrib below and fruit but excluding leaf blade, persistently densely vinous-sericeous.* **Twigs** *c.* 1 mm diameter apically, slender, much-branched, *terete*, smooth. **Stipules** not seen. **Leaves** coriaceous, *bluish green with purplish midrib below when fresh, drying dull greyish brown; blade broadly elliptic-ovate, 5.5–10 × 3–5 cm, base obtuse, apex with slender acumen to 0.8 cm long; midrib slender but prominent below, evident towards base above, otherwise obscurely sunken; lateral veins 9–11 pairs, without intermediates, slender, arched, hardly raised; intercostal venation densely reticulate, evident below; petiole 0.8–1.2 cm long, slender, not drying black.* **Inflorescences** terminal or axillary; rachis slender, *terete*, singly branched, to 1.5 cm long. **Flowers** typical. **Fruits:** pedicels to 9 mm long, slender; *calyx lobes free, equal, suborbicular, incrassate, revolute, rotate, to 0.7 × 0.4 cm.* **Nuts** *subglobose, c. 0.4 cm diameter (immature), obtuse, indistinctly 3-sutured.*

Distribution. Endemic in Borneo. Known in Sabah from Labuk Sugut district (e.g., *SAN 128886* and *SAN 130743*) and in Sarawak from Bintulu and Mukah districts (e.g., *S 24533* and type). Also occurring in W Kalimantan.

Ecology. Rare, in mixed dipterocarp forest on deep yellow sands on low hills not far from the coast. Possibly extinct in Sarawak, otherwise critically endangered.

29. *Vatica rynchocarpa* P.S.Ashton

(Greek, *rynchos* = snout, *carpos* = fruit; the beaked nut)

Gard. Bull. Sing. 22 (1967) 270, *op. cit.* (1964) 80 ('19. *Vatica* sp. '), *op. cit.* (1968) 36, *op. cit.* (1982) 365; Anderson *op. cit.* (1980) 133; Coode *et al.* (eds.) *op. cit.* 86. **Type:** *Egon SA 514*, Borneo, Sarawak, Rajang, Nanga Temulang (holotype KEP).

Canopy tree, to 30 m tall, to 1 m diameter. *Exposed fleshy parts, leaf blade and venation excepted, and ovary shortly sparsely pale greyish brown puberulent.* **Twigs** *c.* 1 mm diameter apically, slender, *terete*, smooth. **Stipules** narrowly hastate, acute, to 2.5 mm long, fugaceous. **Leaves** *thinly coriaceous, drying reddish brown; blade narrowly elliptic-lanceolate, 5–8.5 × 1.3–2.5 cm, base obtuse, margin not revolute, apex acuminate with slender acumen to 1 cm long; midrib slender, raised below, obscurely sunken, especially*

towards base, above; lateral veins 10–14 pairs, with short obscure intermediates, hardly raised, well-spaced, arched within margin; petiole to 0.4 cm long, drying black or not. **Inflorescences** terminal or axillary; rachis singly branched, slender, to 3 cm long. **Flowers** unknown. **Fruits**: pedicels to 7 mm long, slender; calyx lobes unequal, free, chartaceous, 2 longer lobes spatulate, narrowly obtuse, to 6.2×1.4 cm, tapering to 2.5 mm wide at base, not becoming reflexed, 3 shorter ones hastate, acute, to 1.5×0.25 cm. **Nuts** ovoid, to 1.8×0.8 cm, tapering to 4 mm style remnant, glabrous, drying black.

Distribution. Endemic in Borneo. Recorded in Sabah from Kinabatangan district (e.g., *SAN A 4734*) and in Sarawak from Bintulu, Kapit, Kuching, and Miri districts (e.g., *S 12107*, *S 16568*, *S 27292*, and *S 68711*). Also occurring in Brunei (e.g., *BRUN 3354* and *Niga NN 289*) and Kalimantan (e.g., *Kostermans 10005*).

Ecology. Scattered, in forest on clay alluvium river banks. Vulnerable on account of its habitat loss.

30. *Vatica sarawakensis* F. Heim

(of Sarawak)

Bull. Mens. Soc. Linn. Paris 2 (1891) 109; Slooten *op. cit.* (1927) 106; Masamune *op. cit.* 499; Browne *op. cit.* 101; Ashton *op. cit.* (1963) 252, *op. cit.* (1964) 77, *op. cit.* (1967) 262, *op. cit.* (1968) 36, *op. cit.* (1982) 354; Meijer & Wood *op. cit.* 77; Burgess *op. cit.* 227; Anderson *op. cit.* (1980) 133; PROSEA *op. cit.* 471; Coode *et al.* (eds.) *op. cit.* 86. **Type:** *Beccari PB 3018*, Borneo, Sarawak (holotype P). **Synonyms:** *Retinodendropsis aspera* F. Heim *op. cit.* (1893) 470; *Vatica ramiflora* Slooten *op. cit.* (1927) 118, *p.p.*

Subcanopy tree, to 25 m tall, to 60 cm diameter. *Exposed fleshy parts, leaf blade excepted, densely pale yellowish- or rufous-brown scabrid-tomentose; leaf venation below sparsely so; ovary evenly so; fruit glabrescent.* **Twigs** to 5 mm diameter apically, stout, ribbed, finely cracked. **Stipules** narrowly hastate, acute, to 15×5 mm. **Leaves** thinly coriaceous, drying greyish brown; blade oblong to obovate, $22\text{--}35 \times 7\text{--}15$ cm, base obtuse, apex with tapering acumen to 1.4 cm long; lateral veins 15–28 pairs, with or without distinct intermediates, prominent below, flat or slightly raised above; petiole 1–2 cm long, to 4 mm diameter, stout, not drying black. **Inflorescences** in axillary cluster to 3 or ramiflorous, rarely terminal; rachis much-branched, to 12 cm long. **Flowers:** buds to 8 mm long; calyx shortly reddish brown pubescent, otherwise typical. **Fruits** glabrous; pedicels to 2 mm long; calyx lobes free, equal, oblong-hastate, obtuse or acute, thickly coriaceous, becoming reflexed and somewhat revolute, to 1.6×0.7 cm. **Nuts** symmetric, subglobose to ovoid, to 2.5×2.5 cm, acute with short but prominent style remnant, verrucose-lenticellate, prominently 3-furrowed.

Vernacular name. Sarawak—*resak daun besar* (preferred name).

Distribution. Endemic in Borneo. Recorded in Sabah from Beaufort, Keningau, Kota Kinabalu, Kuala Penyu, Kinabatangan, Lahad Datu, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 16480*, *SAN 16553*, *SAN 28080*, *SAN 81471*, and *SAN 114894*) and in Sarawak from Kapit, Kuching, Lawas, Lundu, Marudi, and Samarahan districts (e.g., *S 13187*, *S 24225*, *S 37787*, *S 41308*, and *S 60973*). Also known in Brunei (e.g., *Dransfield JD 7491* and *FMS 30382*) and E Kalimantan (e.g., *Argent et al. 93156*, *bb. 7029* and *bb. 10796*).

Ecology. Scattered in mixed dipterocarp forest on clay soils, on low hills, often in floodplains, at altitude to 1400 m. Locally common in Lambir NP and recorded from G. Gading and Mulu NPs; elsewhere vulnerable owing to forest conversion.

Notes. Fruit collected from E Sabah and E Kalimantan are prominently cuspidate, their sepals to 2 cm long, narrow and strongly reflexed, conforming with the type of *V. ramiflora*. Though immature fruit from Sarawak and W and C Kalimantan are similarly cuspidate, the ripe fruit there becomes obtuse, with sepals at most to 7 mm long, conforming with the type of *V. sarawakensis*. Further collections may justify the recognition of two subspecies.

31. *Vatica umbonata* (Hook.f.) Burck

Fig. 36

(Latin, *umbonatus* = with a central boss; the nut apex)

Ann. Jard. Bot. Buitenz. 6 (1887) 222; Slooten *op. cit.* (1927) 132; Ashton *op. cit.* (1963) 250, *op. cit.* (1964) 78, *op. cit.* (1968) 36, *op. cit.* (1978) 17, *op. cit.* (1982) 349; Meijer & Wood *op. cit.* 320; Burgess *op. cit.* 228; Anderson *op. cit.* (1980) 133; PROSEA *op. cit.* 472; Kessler & Sidiyasa *op. cit.* 115; Coode *et al.* (eds.) *op. cit.* 86. **Basionym:** *Pachynocarpus umbonatus* Hook.f., *op. cit.* (1860) 159, Merrill *op. cit.* (1921) 409. **Type:** Motley s.n., Borneo, Labuan (holotype K). **Synonyms:** *Vatica verrucosa* Burck *op. cit.* 232; *P. verrucosus* (Burck) F.Heim *op. cit.* (1892) 107; *V. blancoana* Elmer *op. cit.* (1912) 1473; *V. cupularis* Slooten *op. cit.* (1927) 132, Browne *op. cit.* 100; *V. ramiflora* Slooten *op. cit.* (1927) 118, *p.p.*

Medium-sized tree, to 30 m tall, to 70 cm diameter, often crooked and shrub-like. *Exposed fleshy parts, leaf blade excepted, and ovary more or less sparsely greyish brown puberulent, caducous except on bud and stipule.* **Twigs** to 3 mm diameter apically, stout, brittle, much-branched, striated, cracked and sometimes thinly flaky. **Stipules** hastate, subacute, to 4 × 2 mm, early caducous. **Leaves** somewhat coriaceous, *drying pale greyish brown; blade elliptic, often asymmetric, 8–16 × 3–6.5 cm, base cuneate, apex obtuse to shortly acuminate; midrib drying hardly paler than petiole, raised below, flat or raised above, lateral veins 7–8 pairs, without intermediates, raised below, unraised above, slightly arched; intercostal venation subscalariform; petiole 0.7–1.5 cm long, glabrescent, drying black.* **Inflorescences** axillary or terminal; rachis singly or doubly branched, brittle and falling apart as fruit develop, to 12 cm long. **Flowers:** buds to 10 mm long; calyx curved pubescent; otherwise typical. **Fruits:** pedicels 2–5 mm long; *calyx lobes equal, fused onto nut, as 5 oblong-elliptic corky verrucose plates to 2.6 × 1.8 cm, the whole with the corky verrucose nut apex subglobose, to 3 cm diameter; or nut ovoid, acute, with the sepals fused with it in the basal third only and reflexed.*

Vernacular name. Sarawak—*resak air* (preferred name).

Notes. In Sabah and Sarawak, two subspecies, *viz.* subsp. *acrocarpa* and subsp. *umbonata*, are recognised.

Key to subspecies

Nut subglobose, calyx lobes completely fused to it except the verrucose apex, not reflexed...

subsp. **umbonata**

Peninsular Malaysia, Borneo and Palawan (the Philippines). In Sabah recorded from Beaufort, Keningau, Kota Kinabalu, Lahad Datu, Pensiangan, Ranau, Sandakan, Sipitang, and Tenom districts (e.g., *SAN 20492, SAN 29348, SAN 43156, SAN 80943*,

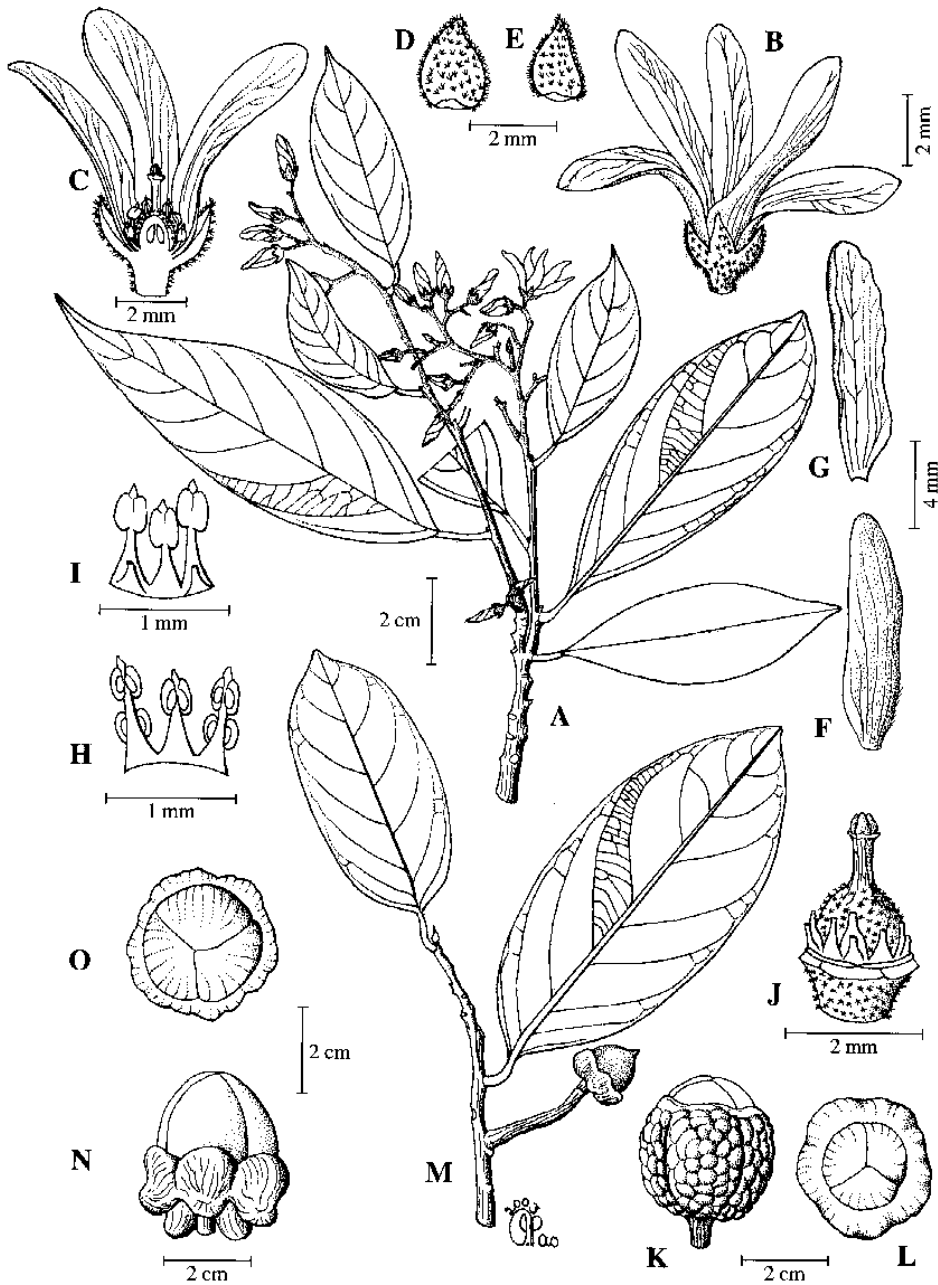


Fig. 36. *Vatica umbonata*, subsp. *umbonata* (A–L) and subsp. *acrocarpa* (M–O). A, flowering leafy twig; B, open flower; C, longitudinal section of open flower; D, abaxial view of outer sepal; E, abaxial view of inner sepal; F, abaxial view of petal; G, adaxial view of petal; H, adaxial view of stamens; I, abaxial view of stamens; J, gynoecium; K, side view of fruit; L, apical view of fruit; M, fruiting leafy twig; N, side view of fruit; O, apical view of fruit. (A–J from BRUN 1380, K–L from S 49284, M from SAN 15236, N–O from SAN 31657.)

and *SAN 125248*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Lundu, Marudi, Miri, Serian, and Sri Aman districts (e.g., *S 9346*, *S 18567*, *S 28108*, *S 39099*, and *S 68929*). Also occurring in Brunei (e.g., *BRUN 933* and *BRUN 5883*) and Kalimantan (e.g., *Argent et al. 93168* and *Kostermans 5580*).

Locally abundant on alluvium river banks and forming dense monospecific stands; also scattered in mixed dipterocarp forest, usually on poor sandy clay soils and in upper dipterocarp forest, at altitudes to 1300 m. Common on the Kelabit Highlands in Sarawak; not vulnerable.

Nut ovoid, acute, with calyx lobes fused to it in the basal third only and reflexed.....

subsp. **acrocarpa** (Slooten) P.S.Ashton

(Greek, *across* = terminal, *carpos* = fruit; perhaps referring to the position of the fruit in the type specimen)

Gard. Bull. Sing. 31 (1978) 17, *op. cit.* (1982) 349; PROSEA *op. cit.* 472. Basionym: *Vatica acrocarpa* Slooten *op. cit.* (1942) 241. Type: *Maidin SAN 4298*, Borneo, Sabah, Tawau, Umas-Umas (holotype K).

Endemic in Borneo. In Sabah known from Kinabatangan, Kudat, Labuk Sugut, Lahad Datu, Sandakan, Tawau, and Tenom districts (e.g., *SAN 15236*, *SAN 20014*, *SAN 25452*, *SAN 36146*, and *SAN 91909*). Also occurring in E Kalimantan (e.g., *Kostermans 5334* and *Kostermans 10757*). In forest along river banks or alluvium. Not vulnerable.

32. *Vatica venulosa* Blume

(Latin, *venulosus* = with tiny veins; the delicate leaf venation)

Mus. Bot. Lugd.-Bat. 2 (1852) 32; Merrill *op. cit.* (1921) 409; Slooten *op. cit.* (1927) 78; Masamune *op. cit.* 499; Ashton *op. cit.* (1964) 79, *op. cit.* (1968) 36, *op. cit.* (1978) 17, *op. cit.* (1982) 350; Anderson *op. cit.* (1980) 133; PROSEA *op. cit.* 473; Kessler & Sidiyasa *op. cit.* 115; Coode *et al.* (eds.) *op. cit.* 87. **Type:** Müller *s.n.* (= *RHL Sheet No. 902146794*), Borneo, S Kalimantan, Patai (holotype L). **Synonyms:** *Vatica bancana* Scheff., Nat. Tijd. Ned. Ind. 31 (1870) 348, Meijer & Wood *op. cit.* 305, Burgess *op. cit.* 227; *V. schouteniana* Scheff., *op. cit.* 408; *Dryobalanops schefferi* Hance *op. cit.* 307; *Retinodendron bancanum* (Scheff.) King *op. cit.* 129; *R. kunstleri* King *op. cit.* 129; *V. kunstleri* (King) Brandis *op. cit.* 127; *V. schefferi* (Hance) Brandis *op. cit.* 128; *V. lutea* Ridl., Bull. Misc. Inform. Kew (1926) 60.

Distribution. Sumatra, Peninsular Malaysia, W Java, and Borneo.

Notes. Two subspecies, *viz.*, subsp. *simalurensis* (Slooten) P.S.Ashton and subsp. *venulosa* are recognised but only subsp. *venulosa* occurs in Sabah and Sarawak.

subsp. **venulosa**

Medium-sized tree, to 25 m tall, to 50 cm diameter; bole frequently crooked or leaning. *Exposed fleshy parts, including midrib above and ovary densely persistently pale pinkish brown puberulent; blade below caducously so.* **Twigs** to 1.5 mm diameter apically, *terete*, smooth. **Stipules** hastate, to 5 mm long, fugaceous. **Leaves** *thinly coriaceous, drying dark reddish brown above, pale tawny below; blade elliptic, ovate-lanceolate to narrowly obovate, 4–12 × 1.5–5 cm, base cuneate, margin not revolute, apex shortly acuminate; midrib prominent below, slightly sunken above; lateral veins 7–12 pairs, without intermediates, slender, hardly raised below, unraised above, arched; petiole 0.5–0.9 cm long, slender, not drying black.* **Inflorescences** terminal or axillary; rachis singly branched, ribbed, to 3 cm long. **Flowers:** buds to 13 mm long; calyx pinkish brown pubescent;

otherwise typical. **Fruits:** pedicels to 2 mm long, hidden in the calyx base; *calyx lobes equal, free, chartaceous, ovate acute, cordate, revolute*, to 3 × 1.3 cm. **Nuts** globose, to 1 cm diameter, with to 1.5 mm long style remnant, pubescent, hidden within calyx.

Vernacular names. Sabah—*resak banka* (preferred name). Sarawak—*resak letup* (preferred name).

Distribution. In Borneo, recorded in Sabah from Kinabatangan and Papar districts (e.g., *SAN 17654* and *SAN 49554*) and in Sarawak from Kuching and Lundu districts (e.g., *Haviland 2440*, *SA 461* and *SA 577*). Also occurring in Brunei (e.g., *Awong AK 13* and *FMS 35704*) and Kalimantan (e.g., *bb. 22920* and *Kostermans 6087*).

Ecology. Apparently very local though possibly overlooked, on clay alluvium banks of sluggish rivers, at low altitudes. Vulnerable owing to its riparian lowland habitat.

33. *Vatica vinosa* P.S.Ashton

(Latin, *vinosus* = coloured like a grape; the tomentum)

Gard. Bull. Sing. 19 (1962) 318, *op. cit.* (1964) 79, *op. cit.* (1968) 37, *op. cit.* (1982) 357; Anderson *op. cit.* (1980) 133; PROSEA *op. cit.* 473; Coode *et al.* (eds.) *op. cit.* 87. **Type:** Ashton BRUN 764, Borneo, Brunei, Temburong district, Kuala Sekurop (holotype K; isotype KEP).

Small to medium-sized subcanopy tree, to 30 m tall, to 40 cm diameter. *Exposed fleshy parts, including leaf venation below and ovary persistently densely rich vinous-sericeous.* **Twigs** to 1.5 mm diameter apically, slender, *terete*, frequently cracked and flaky. **Stipules** oblong, subacute, to 5 × 2.5 mm, caducous. **Leaves** thinly coriaceous, *bluish green with purple venation and petiole when fresh, drying pale greyish brown*; blade elliptic to lanceolate, 6–15 × 1.5–4.5 cm, base narrowly obtuse to cuneate, apex subcaudate, acumen to 1.2 cm long; midrib slender but prominent below, flat above; *lateral veins 12–20 pairs*, with short slender intermediates, *slender but prominent below*, arched; *petiole 0.6–1.3 cm long, less than 1 mm diameter, slender, drying not black.* **Inflorescences** terminal or axillary; rachis singly or doubly branched, *terete*, to 7 cm long. **Flowers:** buds to 6 mm long; calyx sparsely vinous-sericeous; otherwise typical. **Fruits** vinous cinereous; pedicels to 4 mm long, slender; *calyx lobes free, equal, obovate, revolute, incrassate, reflexed at base but curving outwards and rotate apically*, to 0.9 × 0.8 cm. **Nuts** globose, to 0.8 mm diameter, with short style remnant.

Vernacular name. Sarawak—*resak tangkai ungu* (preferred name).

Distribution. Endemic in Borneo. Recorded in Sabah from Keningau, Kinabatangan, Lahad Datu, Pitas, Semporna, Sipitang, and Tawau districts (e.g., *SAN 26184*, *SAN 63072*, *SAN 85017*, *SAN 92359*, and *SAN 121351*) and in Sarawak from Belaga, Bintulu, Kapit, Marudi, and Miri districts (e.g., *S 13326*, *S 22287*, *S 34693*, *S 43707*, and *S 46571*). Also occurring in Brunei (e.g., *BRUN 3383* and *Coode et al. 7849*) and Kalimantan (e.g., *Arifin et al. 7847* and *Kostermans 9146*).

Ecology. In mixed dipterocarp forest on clay rich soils on hills, at altitudes below 300 m. Vulnerable owing to land conversion.

SYMPLOCACEAE

K.G. Pearce

32, Lorong Kumpang 4, Kuching, Malaysia

Desfontaines, Mém. Mus. Hist. Nat. Paris 6 (1820) 9; Merrill, EB (1921) 486, PEB (1929) 248; Masamune, EPB (1942) 607; Backer & Bakhuizen *f.*, FJ 2 (1965) 204; Nootboom, Leiden Bot. Ser. 1 (1975) 33, FM 1, 8 (1977) 205; Kochummen, TFM 3 (1978) 266; Anderson, CLTS (1980) 327; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 340; Coode *et al.* (eds.), CLBD (1996) 315; Argent *et al.* (eds.), MND-CK 2 (1997) 618.

A monogeneric family comprising about 260 species, widely distributed in tropical and subtropical S America, Asia, New South Wales (Australia), and Pacific Is. In Sabah and Sarawak, 29 species are known, representing about 50% of the total species occurring in the Malesian region.

Taxonomy. While in most recent systems of classification the Symplocaceae is included in the Ebenales, Nootboom (*op. cit.* 1975) considers the family more closely related to the Cornaceae *s.l.* and the Theaceae, with which it shares primitive wood anatomy and other characters.

SYMPLOCOS Jacq.

(Greek, *symploke* = interweaving; presumably referring to the indumentum found on parts of some species)

jirah (Iban), *kusi* (Bidayuh, Sadong), *loboh* (Dusun, Kadazan), *periaboh* (Murut)

Enum. Syst. Pl. (1760) 5, 24; Stapf, FMK (1894) 204; Brand *in* Engler, Pflanzenreich 6 (1901) 13; King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 231; Merrill, EB (1921) 486, PEB (1929) 248; Ridley, FMP 2 (1923) 298; Masamune, EPB (1942) 607; Backer & Bakhuizen *f.*, FJ 2 (1965) 204; Nootboom, Leiden Bot. Ser. 1 (1975) 33, FM 1, 8 (1977) 205; Kochummen, TFM 3 (1978) 266; Anderson, CLTS (1980) 327; Corner, WSTM 3rd edition 2 (1988) 718; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 340; Turner, Gard. Bull. Sing. 47 (1995) 479; Coode *et al.* (eds.), CLBD (1996) 315; Argent *et al.* (eds.), MND-CK 2 (1997) 618. **Synonyms:** *Cordyloblaste* Moritzi, Bot. Zeit. 6 (1848) 606; *Euginiodes* Kuntze, Rev. Gen. Pl. 2 (1891) 409 & 975.

Shrubs or trees to 35 m tall, 60 cm diameter. **Leaves** *alternate or spiral, simple, pinnately veined, often toothed, often drying discolourous or yellow-tinged.* **Stipules** *absent.* **Inflorescences** *spicate, racemose or panicle, rarely flowers solitary, mostly in the axils of upper leaves, sometimes condensed into clusters, sometimes terminal or in the axils of fallen leaves.* **Flowers** *subtended by a bract and 2 bracteoles (rarely several bracts and bracteoles by abortion of flowers), bisexual, radially symmetrical, those on a single flowering shoot opening almost simultaneously, sometimes fragrant; calyx tube very short, lobes 3–5, imbricate, persistent; corolla sympetalous, 3–5-lobed but divided almost to the base in the subgen. *Hopea*, lobes quincuncially imbricate, white, bluish or purplish; stamens*

4 to numerous, either connate into a long monadelphous tube (in subgen. *Symplocos*) or only connate at the very base into monadelphous or into pentadelphous (with the bundles alternate with the petals) tube (in subgen. *Hopea*), inserted on the base of the corolla, anthers globose, 2-loculed, lengthwise dehiscent, introrse; *ovary inferior to slightly semi-inferior*, 2–5-loculed, ovules 2–4 in each locule, pendulous, anatropous-epitropous or amphitropous, unitegmic, tenuicellular, style 1, stigma punctiform or peltate. **Fruit** a monopyrenous drupe crowned by the persistent calyx lobes, cylindrical to globose, flask-shaped or spindle-shaped; *in many species epicarp blue to deep violet, sometimes black*; mesocarp usually thin, sometimes thick and then often quite hard; stone sculptured or longitudinally ridged, occasionally smooth. **Seeds** straight or curved, one in each developed locule; embryo straight or curved, cotyledons short, linear; endosperm copious.

Ecology. In Sabah and Sarawak, species of *Symplocos* occur from sea level to *c.* 3600 m altitude. At lower altitudes, the genus is represented mostly by shrubs and small to medium-sized understorey trees and at higher altitudes by microphyllous, dwarf shrub species. Some species have a considerable altitudinal range while others are restricted to low-lying land or high altitudes. Many are found in more than one habitat although often showing a preference for a particular habitat. Some species are distinctly rare (e.g. *S. brachybotrys*, *S. colombonensis*, *S. deflexa*, and *S. gambliana*) while a few are common and widespread (e.g. *S. adenophylla*, *S. celastrifolia*, *S. crassipes*, *S. laeteviridis*, and *S. polyandra*). Self-pollination has been reported in a taxon from Java, and various insects including bees and bumble bees have been reported as visiting flowers, which in some species are fragrant and in some species open at night. Fruits of *S. celastrifolia* are water-dispersed.

Uses. In Sabah and Sarawak, species of *Symplocos* are hardly used. There are rare reports of various species providing timber and firewood, being used in magic (*S. cochinchinensis*) and to cure eye sores (*S. fasciculata*). Elsewhere in Borneo, a few species have been used as a mordant during dyeing, as the tissues (bark and leaves) contain aluminium. *Symplocos fasciculata* is used thus for dyeing rattans by the Dayaks of Borneo, while *S. adenophylla* in W Borneo is known locally as *kayu kain*—the name presumably alluding to its use in dyeing cloth. The Dayaks have extracted salt from the wood ash of *S. odoratissima* and in W Java the inner bark of this species is pulped and rubbed on the gums to treat thrush.

Taxonomy. *Symplocos* has two subgenera, *viz.* subgen. *Symplocos* and subgen. *Hopea*, which are differentiated on combinations of characters (connateness of corolla lobes, leaf arrangement, dry leaf colour and whether the seed and embryo are straight or curved). In Sabah and Sarawak, subgen. *Symplocos* is only represented by *S. henschelii* and *S. pendula*, and the other species belong to subgen. *Hopea*. Some *Symplocos* species show considerable morphological variation which is largely satisfactorily circumscribed by the recognition of subspecies and varieties.

Key to *Symplocos* species

1. Older parts of twigs with horizontal cracks.....2
- Older parts of twigs without horizontal cracks.....5

2. Twigs with pale or prominent and raised scars of fallen leaves.....3
 Twigs without such scars.....4
3. Twigs straight. Leaves ovate to elliptic, margin sharply to obscurely black-tipped toothed. Petiole 3–4 mm long. Fruits *c.* 1 × 0.5 cm.....
- S. brachybotrys** Merr.
 (Latin, *brachium* = a branch, Greek, *botrys* = a bunch of grapes; the form of the infructescence)
 J. Str. Br. Roy. As. Soc. 76 (1917) 110, *op. cit.* (1921) 486; Masamune *op. cit.* 608; Heine, Pfl. Samml. Clemens Kinabalu (1953) 87; Nootboom *op. cit.* (1975) 134, *op. cit.* (1977) 243; Anderson *op. cit.* 327. Type: *Clemens 10961*, Borneo, Sabah, Mt. Kinabalu, Marai Parai spur (holotype BO).
 Shrub to 1 m tall. *Twigs straight, marked with pale or prominent and raised scars of fallen leaves*; young parts finely striate with scattered, appressed hairs; *older parts with horizontal cracks*, glabrescent. Leaves spirally arranged, thin-coriaceous, slightly glossy below, drying olive-brown, both surfaces sparsely appressed-hairy to glabrescent; *blade ovate to elliptic*, 3.5–7 × 1.4–3.6 cm, base acute to rounded to barely cordate, *margin* plane to slightly recurved, *sharply to obscurely black-tipped toothed*, apex short-acuminate with acumen to 0.7 cm long or bluntly obtuse; midrib channelled above; lateral veins 6–9 pairs, distinct below, branching and joining near the margin to form a looped, double intramarginal vein; intercostal venation closely reticulate, raised on both surfaces but especially distinct below; *petiole 3–4 mm long*, deeply channelled to the base, rugulose. Inflorescence a short spike; axis to 0.7 cm long, 1–3-flowered, appressed-pubescent; bracts caducous, densely appressed golden-pilose, 2–4 mm long. Flowers sessile; calyx golden pilose, divided into elliptic lobes *c.* 3 mm long; corolla white in bud, *c.* 6 mm long; stamens *c.* 100; disk inconspicuous, glabrous; ovary *c.* 1 mm high, golden pilose, style glabrous, *c.* 4 mm long. *Fruits* ovoid to ellipsoid, *c.* 1 × 0.5 cm, intense indigo-blue.
 Endemic in Borneo. In Sabah, known only from Mt. Kinabalu, Kota Belud district (e.g., *Clemens 32525*). In Sarawak, recorded from G. Berumpit, Lundu district in the extreme SW (e.g., *S 47366*). In montane forest at 1300–1800 m altitude.
 Twigs curved or crooked. Leaves elliptic, broadly elliptic to obovate to almost orbicular; margin distantly blunt-toothed. Petiole (1–)4–10 mm long. Fruits *c.* 1 × 0.7 cm..... **20. S. pendula**
4. Twigs straight. Leaves obovate-elliptic, margin recurved from midpoint to base, sharply black-gland tipped denticulate from midpoint to apex, apex obtuse to rounded; lateral veins 4–6 pairs. Inflorescence axis 1.4–3 cm long..... **4. S. buxifolia**
- Twigs curved to zigzag. Leaves ovate-elliptic, margin obscurely toothed and revolute except sometimes at apex, apex acute, shortly apiculate; lateral veins (6–)7–8 pairs. Inflorescence axis 0.2–0.5(–0.9) cm long..... **5. S. buxifolioides**
5. Twigs and both leaf surfaces glabrous. Leaf margin entire.....6
 Either twigs or one or both leaf surfaces hairy. Leaf margin toothed or crenulate, occasionally entire.....8
6. Petiole to 4 mm long. Leaves to 2.5 cm wide..... **3. S. borneensis**
 Petiole at least 5 mm long. Leaves at least 2.5 cm wide.....7

7. Petiole at most 10 mm long. Lateral veins 6–8 pairs. Inflorescences to 6 cm long.....
- S. gambliana** Brand
(James Sykes Gamble, 1847–1925, forester and botanist of the Indian Forest Service)
Bull. Herb. Boiss. 2 (1906) 748; Merrill *op. cit.* (1921) 487; Masamune *op. cit.* 609; Nooteboom *op. cit.* (1975) 195, *op. cit.* (1977) 260; Anderson *op. cit.* 328. Type: *Haviland 1954*, Borneo, Sarawak, near Kuching (BM, BO, K). Synonym: *Symplocos havilandi auct. non* Brand: King & Gamble *op. cit.* 250.
Twigs straight, older parts grooved, glabrous. Leaves slightly glossy above, glabrous, drying olive-yellow-green; blade more or less elliptic, 6–9 × 3–4.5 cm, base acute, attenuate, margin entire, recurved, apex abruptly obliquely acuminate, folded when dry; lateral veins 6–8 pairs, joining into a looped, faintly prominent intramarginal vein; petiole 5–10 mm long, drying dark. Inflorescence a lax spike or basally branched raceme to 6 cm long; axis glabrous; bracts and bracteoles soon caducous. Flowers c. 10; pedicel less than 1 mm long; calyx entirely divided into semi-orbicular, ciliate, 0.75–1.5 mm long lobes, lobe margin markedly paler than the rest of the calyx and the ovary; corolla white when fresh, sweet-scented, ciliolate, often with some minute hairs on the outside, c. 5 mm long; stamens c. 50; disk 5-glandular; ovary glabrous, c. 1 mm high, style minutely pilose at the base, otherwise glabrous, c. 4 mm long. Fruits unknown.
Endemic in Sarawak. Only known from the type.
Petiole 6–35 mm long. Lateral veins 8–13 pairs. Inflorescences 5–17 cm long.....
- **18. S. odoratissima** (in part)
8. Twigs densely, minutely rufous to dark brown tomentose, drying dark grey to black. Petiole usually drying dark grey to black. Leaf margin bearing densely set but hardly raised pellucid glands (these occasionally absent) thus appearing shallowly toothed or crenulate. Similar glands occur on flanges of petiole at least near junction with leaf. Leaf apex attenuate with curved acumen to 3 cm long..... **1. S. adenophylla**
Twigs not densely rufous to dark brown tomentose, or if densely rufous to dark brown tomentose then glands, if present, not pellucid and acumen, if present, usually less than 2 cm long.....9
9. Leaf apex acuminate, acumen blunt-tipped. Inflorescences 5–17 cm long. Fruits obliquely ovoid to almost globular, *c.* 2.1 × 1.7 cm..... **18. S. odoratissima** (in part)
Leaf apex attenuate, obtuse, rounded or abruptly, shortly or sharply acuminate (apically rounded in *S. cochinchinensis* subsp. *laurina*). Inflorescences at most 9.5 cm long, often much shorter. Fruits smaller, if 2.1 cm or longer then ellipsoid, ovoid or obovoid but not almost globular.....10
10. Leaf margin entire.....11
Leaf margin toothed.....12
11. Petiole 4–13 mm long. Leaf apex acuminate. Lateral veins 5–9 pairs. Fruits to 5 × 2.6 cm..... **15. S. henschelii**
Petiole 15–32 mm long. Leaf apex rounded to bluntly obtuse. Lateral veins 11–14 pairs. Fruits to 1.2 × 0.7 cm..... **21. S. polyandra**
12. Twigs weakly curved. Leaf margin usually distinctly and coarsely crenate with black glandular teeth. Leaves drying olive-green, often with a pattern of fine, dark marks

- parallel to the veins, to almost black above, usually considerably paler below.....
 **6. S. celastrifolia**
 Twigs straight, crooked or obscurely zigzag, if curved then leaf margin almost entire, obscurely toothed or dentate, but not distinctly and coarsely crenate. Leaves not drying with fine dark marks parallel to the veins..... 13
13. Midrib flat or raised above, rarely flat with impressed channel near the base. Leaves drying yellow-brown, slightly glossy above..... **2. S. anomala**
 Midrib channelled above. Leaves drying not as above..... 14
14. Petiole terete, swollen along its length. Midrib swollen from junction with petiole for a distance to 9 mm. Lateral veins prominent below, looping and joining to form a distinct intramarginal vein at least 5 mm distant from the leaf margin. Fruits cylindrical with apex narrowed then expanded below persistent, erect calyx lobes.....
S. leochaii P.Chai
 (Leo Chai Chia Liang, former Director of Sarawak Forestry Department)
 Sandakania 7 (1996) 63. Type: *Chai S 33926*, Borneo, Sarawak, Lubok Antu district, Lanjak-Entimau Wildlife Sanctuary, Bt. Peninjau (holotype SAR; isotypes K, L).
 Treelet to 4 m tall. Bark brown. *Twigs slightly zigzag*, to 4 mm diameter, *glabrous; older parts without horizontal cracks*. *Leaves spirally arranged, chartaceous, glabrous or with scattered, appressed hairs below, drying buff to olive-green; blade ovate to narrowly elliptic, 10–32 × 4.5–10 cm, base obtuse to slightly cordate, margin plane to slightly recurved, finely serrate with shallow, brown-gland-tipped teeth, apex acuminate, acumen to 2.5 cm long; midrib deeply, finely channelled above, pilose below; lateral veins 6–16 pairs, prominent below, looping and joining into a distinct, intramarginal vein at least 5 mm distant from the margin; intercostal venation scalariform-reticulate, distinct, close, raised on both surfaces; petiole 4–12 mm long, terete, swollen along its length with the swelling sometimes continuing for up to 9 mm along the base of midrib, rugulose. Inflorescences simple or basally branched spikes to 3.7 cm long; axis densely golden pilose; bracts lanceolate, keeled, persistent after anthesis or not, to 3.5 mm long; bracteoles persistent or not, 0.8–1.2 mm long. Flowers closely set, sessile; calyx divided almost to the base, to 1.5 mm long, lobes ovate; corolla white when fresh, c. 5 mm long; stamens numerous; disk pilose; ovary golden or white pilose, to 1 mm high, style glabrous, c. 4 mm long. Fruits cylindrical, c. 1.6 × 0.5 cm, narrowing then expanding below persistent, erect calyx lobes, slightly ridged, sparsely short-pilose, pale greenish-white when young, becoming reddish, ripening blue.*
 Endemic in Sarawak. Known only from Bt. Peninjau, Lanjak-Entimau Wildlife Sanctuary, Lubok Antu district (e.g., *S 77540*, *S 78224* and the type collection) and Sg. Balui, Belaga district (e.g., *Zainuddin AZ 5700*). In primary or logged-over mixed dipterocarp forests, at 500–900 m altitude, on ridges or steep slopes on yellow sandy clay soil.
 Petiole, midrib and lateral veins not as above. Intramarginal vein, if present, distinct or faint. Fruits ovoid, ellipsoid, obovoid or cylindrical-ovoid or flask-shaped..... 15
15. Leaf apex with acumen to 2.2 cm long. Lateral veins ascending and curved for most of their length. Bracts broadly ovate or elliptic to semi-orbicular, hairy. Infructescences mostly with 1–2 fruits. Fruits to 1.5 × 0.8 cm, with persistent calyx lobes erect to incurved, forming a beak..... **11. S. crassipes**
 Not with the above combination of characters..... 16

16. Lateral veins fine, indistinct above, looping, branching and joining to form a faint, sometimes double, intramarginal vein. Inflorescences fascicles of several branched racemes, a set of immature inflorescences sometimes present above and distinct from a set of mature inflorescences below; bracteoles partly appressed or fused to the ovary....
 **13. S. fasciculata**
 Not with the above combination of characters..... 17
17. Leaf apex acuminate to attenuate, acumen to 2 cm long, often curved. Lateral veins indistinct above, curved towards the margin, forming a distinct, looped intramarginal vein sometimes with a second, less distinct intramarginal vein. Intercostal venation lax. Inflorescences simple or basally branched spikes or racemes to 2.7 cm long. Calyx lobe margin paler than other parts of calyx and ovary..... **19. S. ophirensis**
 Not with the above combination of characters..... 18
18. Twigs straight, curved or zigzag. Petiole at least 5 mm long..... 19
 Twigs zigzag. Petiole up to 4 mm long..... 25
19.
 Leaves drying markedly pale yellow-green or pale grey-green..... 20
 Leaves drying olive-yellow, olive-green, olive-brown, olive-grey or brown to almost black; if yellow-green then not markedly pale..... 23
20. Young twigs grooved to angular. Petiole 18–40 mm long. Fruits inversed pyriform.....
 **14. S. goodeniacea**
 Young twigs grooved and/or ridged. Petiole 5–20 mm long. Fruits ampulliform or ellipsoid or ovoid..... 21
21. Lateral veins not forming a distinct intramarginal vein except sometimes towards the leaf apex..... **23. S. tricoccata**
 Lateral veins joining to form an intramarginal vein 4 mm or more from the leaf margin
 22
22. Leaf base decurrent on petiole as sharp flanges which sometimes continue as fine ridges on twigs; acumen to 3 cm long. Lateral veins finely raised above or sunken so that leaf appears bullate. Intramarginal vein at least 4 mm from the leaf margin. Bracts persistent..... **16. S. iliaspaiensis**
 Leaf base slightly decurrent on petiole but not as sharp flanges; acumen to 2 cm long. Intramarginal vein 6–12 mm from the leaf margin at its furthest point. Bracts caducous
 **10. S. costatifructa**
23. Twigs glabrous or with scattered weak hairs to more than 2 mm long. Fruits ellipsoid-ovoid or ellipsoid-obovoid, *c.* 3.5(–4) × 2 cm..... **7. S. cerasifolia**
 Twigs densely rufous tomentose to almost glabrous. Fruits ampulliform, ovoid or globose; at most to 1.3 × 0.8 cm..... 24
24. Twigs terete, coarsely striate. Inflorescences spikes or racemes bearing numerous flowers. Bracts persistent after anthesis..... **8. S. cochinchinensis**
 Twigs deeply grooved, finely striate. Inflorescences spikes bearing 5–10 flowers, appearing cone-like in bud. Bracts caducous at anthesis..... **22. S. rubiginosa**

25. Shrub or tree to 23 m tall, 20 cm diameter. Inflorescences commonly arising simultaneously from the axils of 6–12 or more leaves at the shoot apex.....
 **17. *S. laeteviridis***
 Shrub or tree to 10 m tall. Inflorescences otherwise.....26
26. Leaves elliptic. Bracts persistent.....27
 Leaves ovate. Bracts caducous or sometimes persistent (in *S. johniana*).....28
27. Leaves alternate.....

***S. trichomarginalis* Noot.**

(Greek, *trichos* = hair, Latin, *margo* = border; the hairy leaf margin)

Leiden Bot. Ser. 1 (1975) 287, *op. cit.* (1977) 272. Type: *Clemens 33116*, Borneo, Sabah, Mt. Kinabalu, Marai Parai (holotype L; isotypes BM, BO, G).

Shrub 1–4 m tall. Twigs often zigzag, appressedly brown pilose. Leaves alternately arranged, sparsely appressedly pilose below; blade elliptic, 2–3.5 × 1.25–1.75 cm, base cuneate to rounded, margin recurved, finely glandular dentate, conspicuously densely appressedly brown-pilose below (as is midrib below), apex acuminate; lateral veins 5–7 pairs; petiole 2–4 mm long. Inflorescences: bracts brown-pilose, often several, persistent, the 2 uppermost 3–5 × 1–3 mm. Flowers solitary, pedicel to 1 cm long; calyx (and ovary) loosely appressed-pilose, divided into narrowly elliptic, acute lobes c. 3 mm long; corolla c. 4 mm long; stamens c. 50; disk glabrous; ovary c. 1 mm high, style glabrous, c. 5 mm long. Fruits sparsely pilose, ellipsoid to ovoid, c. 0.9 × 0.4 cm, green to deep indigo when ripe.

Endemic in Sabah. Known only from Mt. Kinabalu, Kota Belud district (e.g., *Clemens 32559*, *Clemens 40028* and the type), at 1500–2400 m altitude in open places and forest edges.

Leaves spirally arranged..... **12. *S. deflexa***

28. Shrub to 5 m tall. Leaf margin plane to recurved. Lateral veins joining into a looped intramarginal vein. Inflorescence a 1-flowered raceme.....

***S. johniana* Stapf**

(Spenser St. John, secretary to Rajah James Brooke, c. 1848)

FMK (1894) 206; Brand *op. cit.* (1901) 65; Merrill *op. cit.* (1921) 487; Masamune *op. cit.* 609; Heine, Pfl. Samml. Clemens Kinabalu (1953) 88; Nootboom *op. cit.* (1975) 208, *op. cit.* (1977) 261. Type: *Haviland 1161*, Borneo, Sabah, Ranau district, Mt. Kinabalu (holotype K; isotype BO).

Shrub less than 5 m tall. Twigs sometimes obscurely zigzag; young parts striate, with striation obscured by more or less dense, oblique to patent rusty hirsute tomentum; older parts glabrescent. Leaves spirally or alternately arranged, chartaceous to thin-coriaceous, glabrous above, rather densely appressed to patent pilose below, or only midrib and veins hairy, drying warm-brown to olive-brown; blade ovate, 1.2–7 × 0.6–3.5 cm, base rounded to cordate, margin plane to recurved, with coarse, sharp teeth on at least some leaves, apex acuminate to attenuate, acumen c. 1 cm long, often curved; midrib deeply, finely channelled above, pilose towards base; lateral veins 3–6(–8) pairs, curved from the base, usually markedly impressed above, joining into a looped intramarginal vein; intercostal venation lax, more or less transverse to lateral veins, reticulations fine, close; petiole 1–3 mm long, terete, indumentum as twig. Inflorescence a 1-flowered raceme; axis to 4 mm long at anthesis, rusty pilose; bracts and bracteoles persistent or not in fruit, loosely appressed rusty hirsute. Flowers with pedicel c. 1 mm long; calyx rusty long-pilose, ciliate, with lobes to 1.5 mm long; corolla white

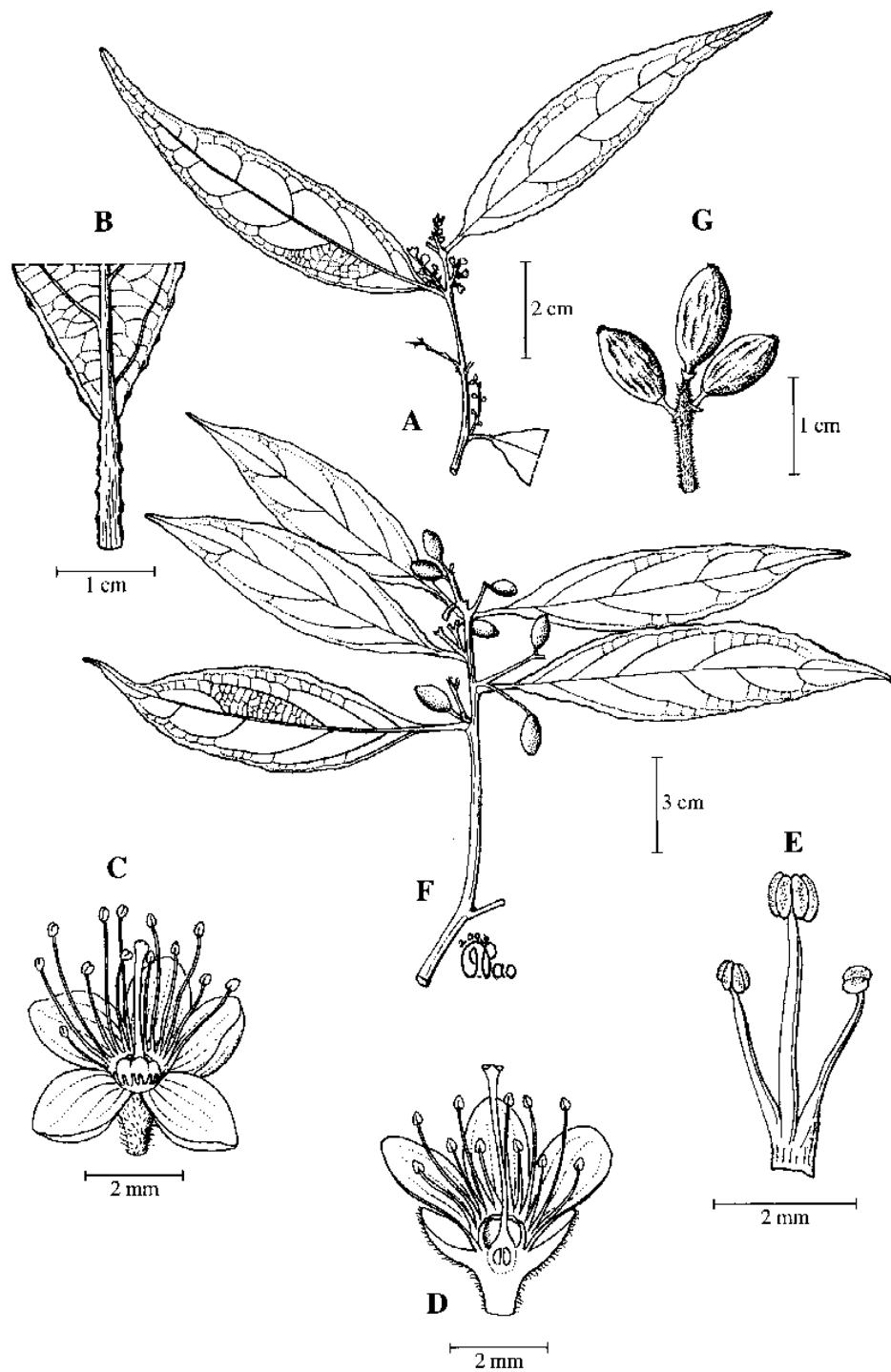


Fig. 1. *Symplocos adenophylla*. A, flowering leafy twig; B, detail of venation and gland on lower leaf surface; C, open flower; D, longitudinal section of open flower; E, stamens; F, fruiting leafy twig; G, infructescence. (A and C–E from *SPN 4065*, B from *S 26434*, F–G from *Sugau JBS 11*.)

when fruiting leafy twig; G, infructescence. (A from *SNP 4065*, B from *S 26434*, C–E from *SNP 4065*, F–G from *Sugau JBS 11*.)

fresh, c. 5 mm long; stamens 60–90; disk stellate, densely hirsute; ovary c. 1 mm high, somewhat obscured by bracteoles and rusty long pilose tomentum, style glabrous, c. 6 mm long. Fruits cylindrical-obovoid, slightly curved or narrowly flask-shaped, c. 1.3 × 0.4 cm, short-hairy, brilliant dark shiny blue when ripe, with erect calyx lobes.

Endemic in Borneo. In Sabah, known from Mt. Kinabalu in Ranau district and G. Lotung in Kinabatangan district (e.g., *Clemens 28795*, *RSNB 4953*, *SAN 76486*, *SAN 83258*, and *SPN 5168*) and in Sarawak, from Batu Lawi, Marudi district (e.g., *S 50549* and *S 50904*). Also occurring in E Kalimantan on G. Kemul, W Kutei (e.g., *Endert 3933*). In lower to upper montane forests at 1400–2500 m altitude, in the crevices of granite rocks in damp, shady places.

Shrub or treelet to 10 m tall. Leaf margin recurved to revolute; lateral veins merging with the reticulations towards the margin or forming an indistinct intramarginal vein. Inflorescence a 1–4-flowered raceme.....29

29. Petiole 3–4 mm long. Raceme 3-flowered. Pedicels 1–5 mm long. Calyx appressedly brown pilose.....**9. *S. colombonensis***
 Petiole channelled above, 1–2 mm long. Flowers solitary, pedicel 5–12 mm long, or a raceme with up to 4 very shortly pedicellate flowers. Calyx lobes sparsely pilose to glabrous.....**24. *S. zizyphoides***

1. *Symplocos adenophylla* Wall. ex G. Don

Fig. 1.

(Greek, *adeno* = gland, *phulon* = leaf; the glandular leaf margin)

Gen. Hist. 4 (1837) 3; C.B. Clarke in Hooker *f.*, Fl. Brit. Ind. 3 (1882) 575; Stapf *op. cit.* 204; Brand *op. cit.* (1901) 48; King & Gamble *op. cit.* 240; Merrill, Philip. J. Sci. 2 (1907) Bot. 298, *op. cit.* (1921) 486; Ridley *op. cit.* (1923) 303; Masamune *op. cit.* 607; Nooteboom *op. cit.* (1975) 121, *op. cit.* (1977) 239; Kochummen *op. cit.* 268; Anderson *op. cit.* 327; Whitmore, Tantra & Sutisna *op. cit.* 340; Turner *op. cit.* 479; Coode *et al.* (eds.) *op. cit.* 315. **Type:** *Wallich Cat. 4427A*, Peninsular Malaysia, Penang (holotype K-W; isotypes BM, CGE, E, FI, K, MEL, NY, W). **Synonyms:** *Symplocos bancana* Miq., Fl. Ned. Ind., Suppl. 1 (1861) 476; *S. iteophylla* Miq. *op. cit.* (1861) 476; *Eugeniodes adenophyllum* (Wall. ex G. Don) Kuntze *op. cit.* 410; *S. adenophylla* Wall. ex G. Don var. *virgata* Wall. ex Brand *op. cit.* (1901) 48; *S. constricta* Brand *op. cit.* (1901) 41; *S. beccarii* Brand *op. cit.* (1901) 49; *S. adenophylla* Wall. ex G. Don var. *atrata* Brand *op. cit.* (1906) 748; *S. fulvosa* King & Gamble *op. cit.* 2; *S. adenophylla* Wall. ex G. Don var. *merrittii* Brand, Philip. J. Sci. 3 (1908) Bot. 7; *S. palawanensis* Brand *op. cit.* (1908) 10; *S. pruniflora* Ridl., J. Fed. Mal. St. Mus. 4 (1909) 46; *S. brandii* Elmer, Leaf. Philip. Bot. 4 (1912) 1477; *S. pahangensis* Brand in Fedde, Rep. 14 (1916) 326; *S. adenophylla* Wall. ex G. Don var. *montana* Ridl. *op. cit.* (1923) 303. (For further synonyms, cf. Nooteboom *op. cit.* (1975) 122).

Shrub or tree, 15–30 m tall, 20–40 cm diameter. **Bark** smooth, often mottled, pale grey to dark brown or black; inner bark pale yellow, brown, pink or green. **Sapwood** yellow to brown, medium hard. **Twigs** straight, terete, (2–)3–4(–4.5) mm diameter; *young parts finely striate, densely minutely rufous to dark brown tomentose, grey to red-brown; older parts almost smooth, glabrescent, dark grey to black.* **Leaves** spirally arranged, thin-coriaceous, slightly glossy above, *sparsely puberulous to glabrous on both surfaces*, drying pale olive-green to rich chocolate-brown; blade ovate-elliptic, (4–)5–10(–15.5) × (0.7–)1.5–3(–5.5) cm, base slightly asymmetric, shortly attenuate, *margin slightly recurved, usually appearing very shallowly toothed or crenulate from base to apex due to the presence of densely set but*

hardly raised pellucid glands, apex attenuate, acumen curved, to 3 cm long; midrib finely channelled above, sharp below; lateral veins (5–)6–7(–11) pairs, obscure above, distinct below, distant, looping and joining to form an intramarginal vein; intercostal venation finely reticulate, distinct below; *petiole* (4–)6–9(–11) mm long, shallowly channelled almost to the base above, *flanges glandular as the leaf margin at least near junction with the blade*, glabrous or if pubescent the indumentum as that of the twig, slender, rugulose, *usually drying same colour as twig*. **Inflorescences** racemes or panicles with up to 3 basal branches, 0.9–4(–6) cm long, many-flowered; axis indument as twig, bracts, bracteoles and ovary; bracts and bracteoles with pellucid glands on margin, persistent in fruit, minute, to 1.2 mm and 0.5–0.8 mm long respectively. **Flowers:** upper ones sessile, lower ones sometimes shortly pedicellate (pedicels to 2.5 mm long), minute; calyx lobes triangular with rounded apex, more or less densely rufous or dark brown puberulent-tomentose but less densely so towards the sometimes pellucid-glandular margin, 0.3–0.7 mm long; corolla lobes oblong-ovate, white to yellow when fresh, fragrant, glabrous, to 3 mm long; stamens 25 or more, anthers yellow when fresh; disk glabrous; style glabrous, to 2 mm long. **Infructescences** often with rather few fruits. **Fruits** cylindrical-ellipsoid to slightly obovoid, to 1 × 0.6 cm, obscurely ridged, sparsely puberulent to glabrous, ripening blue, with remains of the calyx lobes incurved over the hardly sunken disk and style-base.

Vernacular names. Sabah—*jiak* (Malay), *loboh* (Kadazan), *pelawan-pelawan* (Sandakan). Sarawak—*jirah*, *jirak*, *kabang* (Iban).

Distribution. China (including Hainan), Indo-China, Thailand, throughout Malesia, except Java, the Lesser Sunda Is. and New Guinea. In Sabah, common and widely distributed from Kota Belud to Sipitang districts in the W to Ranau, Keningau, Kinabatangan, Lahad Datu, Sandakan, and Tambunan districts in the E (e.g., *RSNB 4459*, *SAN 53963*, *SAN 75934*, *SAN 117290*, and *SAN 140807*). In Sarawak, somewhat scattered, occurring in Belaga, Kuching, Lawas, Limbang, Lubok Antu, Lundu, Marudi, and Miri districts (e.g., *S 8430*, *S 12055*, *S 21441*, *S 26306*, and *S 46837*). Also occurring in Bt. Belalong, Brunei (e.g., *BRUN 3155*) and in C and SE Kalimantan (e.g., *Burley, Tukirin et al. 3275*, *Kostermans 10173* and *Mogea 3842*).

Ecology. In *kerangas* forest on coastal and lowland sites but more commonly in montane forest or high *kerangas* forest at 1300–3000 m altitude, with a marked preference for hillsides and exposed ridges and summits, preferring poor, sandy soils and occasionally found on limestone and ultrabasic soils.

Uses. The timber is locally used for beams and the bark for dyeing cloth in W Borneo, where it is known as *kayu kain*.

2. *Symplocos anomala* Brand

(Greek, *anomalos* = not according to rule; the midrib is raised or flat above, unlike other *Symplocos* species)

Bot. Jahrb. 29 (1900) 259, *op. cit.* (1901) 67; Nootboom *op. cit.* (1975) 126, *op. cit.* (1977) 239; Kochummen *op. cit.* 268; Anderson *op. cit.* 327; Whitmore, Tantra & Sutisna *op. cit.* 341; Turner *op. cit.* 479; Argent *et al.* (eds.) *op. cit.* 618. **Lectotype** (Nootboom, 1975): *Henry 7094*, E China, Szechuan (hololectotype E; isolectotype K). **Synonyms:** *Symplocos concolor* Brand *op. cit.* (1901) 65; *Bobua anomala* (Brand) Migo, Bot. Mag. Tokyo 56 (1942) 267. (For further synonyms, cf. Nootboom *op. cit.* (1975) 126).

Shrub or tree to 30 m tall, to 50 cm diameter. **Bark** smooth, grey or brown; inner bark yellow, pink or brown. **Sapwood** yellow to white, hard. **Twigs** *straight, sometimes crooked or slightly zigzag, terete to irregularly grooved*, to 5.5 mm diameter, *coarsely striate, shortly, densely, appressedly pale brown to rufous pilose*, pale to dark brown; *older parts glabrescent*. **Terminal buds** densely appressedly pale-brown pilose. **Leaves** spirally arranged, chartaceous to thin-coriaceous, *slightly glossy above, glabrous or virtually so, drying yellow-brown*; blade elliptic to ovate-elliptic, $3.5\text{--}10.5 \times 1.5\text{--}4$ cm, base shortly attenuate to cuneate, decurrent as flanges on petiole, *margin slightly recurved, obscurely, minutely dark-glandular toothed, apex sharply acuminate, acumen slightly curved, to 1.5 cm long*; midrib flat or raised above, glabrous or if with hairs, these often located in the channel; lateral veins 8–13 pairs, branching and joining towards margins to form an indistinct double intramarginal vein; intercostal venation finely reticulate, forming a loose network below; petiole (2–)4.5–6(–7.5) mm long, narrowly flanged to base, glabrous throughout or shortly pilose along axis above and sparsely pilose below, rugulose, drying same colour as twig or black. **Inflorescences** in the axils of upper leaves, *racemes to 1.5 cm long, 3–7-flowered*; axis, bracts, bracteoles, calyx and ovary densely, shortly, pale brown appressed-pilose; bracts and bracteoles persistent, minute. **Flowers**: pedicels to *c.* 2 mm long; calyx tube to 0.5 mm long, lobes shallow, rounded, ciliolate, to 0.5 mm long; corolla lobes ovate, white when fresh, glabrous, *c.* 3 mm long; stamens 50 or more; disk shortly hairy; ovary *c.* 0.8 mm high, style glabrous. **Infructescences** to 2.6 cm long. **Fruits** 1–3 per infructescence, *ellipsoid-obovoid, to 1.5×1 cm*, faintly ridged or not, sparsely, shortly pilose to glabrescent, ripening purple to black, drying dark brown, with brown to black, persistent, erect to apically incurved calyx lobes and persistent style base.

Distribution. China (including Hainan), Japan, Ryu Kyu Is., Taiwan, Myanmar, Indo-China, Thailand, N Sumatra, Peninsular Malaysia, and Borneo. In Sabah, common on Mt. Kinabalu and scattered in Keningau, Kinabatangan, Penampang, Sipitang, Tambunan, and Tawau districts (e.g., *RSNB 4612, SAN 16710, SAN 47214, SAN 66821, and SAN 76811*). In Sarawak, known from G. Murud, Lawas district (e.g., *S 26357*) and Datu Protected Forest, Lundu district (e.g., *S 41914*).

Ecology. Chiefly in primary lower montane or upper montane forests at 900–2000 m altitude but at Datu Protected Forest occur in mixed dipterocarp forest at *c.* 400 m. On mountain slopes or sometimes ridges or beside streams; prefers black, moist soils.

3. *Symplocos borneensis* Brand (of Borneo)

In Engler, *Planzenreich* 6 (1901) 56; Merrill *op. cit.* (1921) 486; Masamune *op. cit.* 608; Nootboom *op. cit.* (1975) 134, *op. cit.* (1977) 242; Anderson *op. cit.* 327; Whitmore, Tantra & Sutisna *op. cit.* 341. **Type:** *Beccari PB 3467*, Borneo, Sarawak (holotype P; isotypes K, L).

Twigs straight, *longitudinally grooved, glabrous*. **Leaves** spirally arranged, *glabrous*, drying dark olive-green above, paler below; blade narrowly elliptic, $5\text{--}8 \times 2\text{--}2.5$ cm, base acute, *margin entire*, recurved, apex rounded to slightly acuminate, acumen with a broad, rounded tip; midrib channelled above; lateral veins 6–9 pairs, faintly prominent below, joining into an intramarginal vein; intercostal venation reticulate, obscure below; *petiole 3–4 mm long*. **Inflorescences** lax racemes to 5 cm long, 7– more-flowered; axis minutely, sparsely hairy to glabrous; bracts and bracteoles caducous, glabrous, ciliolate, *c.* 1 mm and

0.5 mm long respectively. **Flowers:** pedicels to 2 mm long; calyx glabrous, lobes ciliate, *c.* 1 mm long; corolla lobes *c.* 5 mm long; stamens 60–80; disk 5-glandular, shortly pilose; ovary glabrous, 1–1.25 mm high, style *c.* 5 mm long, glabrous except for the conical, shortly pilose base. **Fruits** unknown.

Distribution. Endemic in Borneo. Known only by four collections from Sarawak (*Beccari PB 3467*) and W Kalimantan (*Hallier 2197*, *Teijsmann 8402* and *Teijsmann 8403*).

Ecology. Lowland mixed dipterocarp forest.

4. *Symplocos buxifolia* Stapf

(Latin, *Buxus* = the box tree, *folium* = leaf; with leaves like those of the box tree)

FMK (1894) 206; Brand *op. cit.* (1901) 64; Merrill *op. cit.* (1921) 486; Masamune *op. cit.* 608; Nooteboom *op. cit.* (1975) 136, *op. cit.* (1977) 243; Whitmore, Tantra & Sutisna *op. cit.* 341. **Type:** *Low s.n.*, Borneo, Sabah, Mt. Kinabalu (holotype K; isotypes CGE, LE).

Shrub or small tree to 10 m tall. **Twigs** *straight, stout*, to 6 mm diameter, *without prominently raised leaf scars*; young parts longitudinally ridged; *older parts becoming horizontally cracked*, glabrous or almost so, dark brown. **Leaves** spirally arranged, densely set, coriaceous, glabrous on both surfaces, drying olive-brown above, brownish green or yellow-green below; *blade obovate-elliptic*, 2–4.5 × 1–2.5 cm, base shortly attenuate, decurrent as flanges on petiole, *margin recurved only from midpoint to leaf base, plane and sharply black-gland-tipped denticulate from midpoint to apex, apex obtuse to rounded*; midrib narrowly channelled above; *lateral veins 4–6 pairs*, raised or impressed above, prominently raised below, looping and joining at some distance from margin; intercostal venation reticulate, raised or obscure above, prominently raised below; petiole *c.* 4(–5) mm long, channelled and sharply flanged to the base, glabrous, eventually rugulose. **Inflorescences** in the axils of upper leaves, 1–3-flowered racemes or flowers solitary; *axis 1.4–3 cm long*, glabrous or with sparse, appressed hairs distally, bearing a few to many subfoliose, elliptic, caducous, glabrous, ciliate-margined bracts to 6 × 2 mm. **Flowers:** pedicels to 4 mm long; calyx divided to base, *lobes ovate, blunt-tipped, membranous, glabrous, sometimes ciliate at base, 2.5–2.75 mm long*; corolla yellow to white when fresh, glabrous, lobes *c.* 5 mm long; stamens numerous; ovary glabrous, 1.5–2 mm high. **Fruits** ellipsoid-ovoid, *c.* 1.3 × 0.6 cm, hardly ridged, *glabrous*, purple when fresh, drying brown, with persistent, more or less erect calyx lobes.

Distribution. Endemic in Sabah. Only known from Mt. Kinabalu area (e.g., *Clemens 51123*, *RSNB 877*, *SAN 22064*, *SAN 29289*, *SAN 46551*, and *SAN 54687*).

Ecology. Montane to subalpine forests at 2600–4100 m altitude.

5. *Symplocos buxifolioides* K.G.Pearce

(resembling *Symplocos buxifolia*)

Gard. Bull. Sing. 55 (2003) 69. **Type:** *Chew & Corner RSNB 5882*, Borneo, Sabah, Mt. Kinabalu, Mesilau (holotype SING).

Tree to 10 m tall, to 10 cm diameter. **Twigs** weakly, irregularly curved, *smaller ones distinctly zigzag with nodes closely set*, slender, up to 4 mm diameter, dark brown to black; young parts longitudinally ridged and sparsely appressed long-pilose; *older parts becoming horizontally cracked, glabrescent, without prominently raised leaf scars*. **Leaves** spirally arranged; coriaceous, glabrous above, hairy to virtually glabrous below, drying olive-brown above, yellow-green below; *blade broadly ovate-elliptic, 2.5–4.5 × 1–3 cm, base shortly attenuate, margin revolute except sometimes at apex, shallowly, obscurely toothed from near base, apex acute, shortly apiculate*; midrib narrowly channelled above; *lateral veins (6–)7–8 pairs, joining to form an intramarginal vein; intercostal venation reticulate, raised above and prominently raised below*; petiole 3.5–5 mm long, sharply flanged to base. **Inflorescences** in the axils of upper leaves and below on leafless twigs, 1–3-flowered racemes; *axis 2–5(–9) mm long, shortly, moderately densely appressed-pilose*; bracts early caducous. **Flowers:** pedicels to 0.5 mm long; calyx tube *c.* 0.3 mm long, lobes broadly ovate, chartaceous, ciliate almost to apex, moderately densely to sparsely appressed-hairy, *c.* 1 mm long; corolla white, glabrous, 3.5–4 mm long; ovary sparsely to densely appressed hairy, 1.5 mm high. **Fruits** solitary on a pedicel to 9 mm long, ovoid to curved ellipsoid, 1–1.5 × 0.5–0.7 cm, hardly to shallowly ridged, sparsely appressed-pilose to glabrescent, drying yellowish brown, with persistent and erect calyx lobes.

Distribution. Endemic in Borneo. Only known from Mt. Kinabalu in Sabah (e.g., *Hotta 3840, RSNB 5882, RSNB 5911, SAN 46593, and SAN 54254*).

Ecology. Upper montane forest at 2400–3600 m altitude.

6. *Symplocos celastrifolia* Griff. ex C.B. Clarke (Latin, with leaves like those of *Celastrus*, Celastraceae)

Fig. 2.

*In Hooker f., Fl. Brit. Ind. 3 (1882) 575; Brand op. cit. (1901) 48; King & Gamble op. cit. 239; Merrill op. cit. (1921) 486; Ridley op. cit. (1923) 302; Merrill op. cit. (1929) 248; Masamune op. cit. 608; Nooteboom op. cit. (1975) 138, op. cit. (1977) 244; Kochummen op. cit. 269; Anderson op. cit. 328; Whitmore, Tantra & Sutisna op. cit. 341; Turner op. cit. 479; Coode et al. (eds.) op. cit. 315; Argent et al. (eds.) op. cit. 619. Type: Griffith 3651, Peninsular Malaysia, Malacca (holotype K). Synonyms: *Eugeniodes celastrifolius* (Griff. ex C.B. Clarke) Kuntze op. cit. 975; *Symplocos nigricans* Brand op. cit. (1901) 49; *S. candicans* Brand op. cit. (1901) 49; *S. hutchinsonii* Brand, Philip. J. Sci. (1909) Bot. 109; *S. peninsularis* Brand op. cit. (1909) 110.*

Tree to 30 m tall, to 60 cm diameter. **Bark** smooth to scaly and lenticellate, brown or grey; inner bark red to yellow, exuding white sap. **Sapwood** white to yellow, soft. **Twigs** weakly curved, terete, to 4(–5) mm diameter, *finely striate, glabrous*; young parts typically rich or dark brown; older parts grey-brown, sometimes with conspicuous pale, warty lenticels. **Leaves** spirally arranged, chartaceous to thin-coriaceous, *glabrous or sparsely appressed-pilose on midrib and veins below, drying olive-green often with a pattern of fine, dark marks parallel to the veins, to almost black above, usually considerably paler below*; blade elliptic to elliptic-obovate, (2–)6–8(–12) × (0.8–)2.5–4(–6) cm, base attenuate, decurrent on petiole, *margin usually distinctly, coarsely crenate with black glandular teeth, thickened, plane or slightly recurved, apex shortly acuminate, acumen to 1.3 cm long*; midrib above broadly, shallowly impressed at least near leaf base to flat near leaf apex; lateral veins (6–)8–9(–11) pairs, fine, obscure, branching and merging with the reticulations towards margin to form an indistinct intramarginal vein; petiole (3–)5–7(–12) mm long, flat or hardly channelled, flanged to base due to decurrence of lamina, glabrous or occasionally hairy, drying dark. **Inflorescences** in the axils of upper leaves, *many-flowered racemes to 9.5 cm*

long with up to 2 basal branches; axis slender, shortly appressed-pilose; bracts and bracteoles keeled, caducous or persistent at anthesis, glabrous to rarely shortly, sparsely appressed-pilose especially on the keel, ciliate, to 2 mm long and 1.5 mm long, respectively. **Flowers** sessile or pedicellate (pedicel to 4 mm long); calyx glabrous, tube to 1 mm long, lobes oblong-ovate, blunt, entire to minutely ciliate, drying pale, to 1.5 mm long; corolla oblong-obovate, white and fragrant when fresh, glabrous, to 4 mm long; stamens 25 to numerous; disk glabrous; ovary glabrous, drying darker than calyx, to 1 mm high, style glabrous. **Fruits** ovoid to almost globose, c. 1 × 0.7(–0.9) cm, smooth, ripening deep bluish-purple, drying warm-brown, glabrous, with conspicuous, erect and apically incurved to slightly spreading calyx lobes.

Vernacular names. Sabah—*dampol*, *enadak* (Dusun), *inderatan* (Bajau), *inderopis*, *kalasiwai* (Dusun), *kulim babok* (Malay), *lamai-lamai* (Dusun), *makulat*, *mata kinai*, *rinda-rinda*, *tukil-tukil* (Dusun). Sarawak—*jirak*, *maba* (Iban), *puruk*, *purup* (Dayak).

Distribution. Peninsular Thailand and throughout Malesia except Java, the Lesser Sunda Is., the northern islands of the Philippines, the northern half of Sulawesi, and most parts of Maluku. In Borneo, common in Sabah and frequently collected in most districts (e.g., *SAN* 98754, *SAN* 102576, *SAN* 127398, *SAN* 133557, and *SAN* A 4090). In Sarawak, less common and known from Bintulu, Kuching, Lundu, Mukah, and Saratok districts (e.g., *S* 8437, *S* 12023, *S* 18498, *S* 24530, and *S* 31589). Also recorded from Brunei (e.g., *BRUN* 693, *BRUN* 5361, *BRUN* 7829, *BRUN* 7859, and *Wong WKM* 198) and from Kalimantan (e.g., *Kostermans* 6108).

Ecology. Most common at or near sea level, on rocks by the sea or at the inland margin of sandy beaches, also in swamp forests and at the edge of mangrove forest, on flat or hilly land and often by rivers and on sandy soils. In Sabah, once collected at 1000 m altitude.

Uses. The timber is used for firewood.

7. *Symplocos cerasifolia* Wall. ex A.DC.

(Latin, *cerasus* = the cherry tree, *folium* = leaf; with leaves like those of cherry tree)

Prodr. 8 (1844) 257; Miquel, Fl. Ned. Ind. 1, 2 (1859) 466; C.B. Clarke *op. cit.* 580; Brand *op. cit.* (1901) 52; King & Gamble *op. cit.* 245; Ridley *op. cit.* (1923) 306; Nootboom *op. cit.* (1975) 140, *op. cit.* (1977) 245; Kochummen *op. cit.* 269; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 341; Turner *op. cit.* 479; Argent *et al.* (eds.) *op. cit.* 619. **Type:** *Wallich* 4434, Peninsular Malaysia, Penang (holotype G-DC; isotypes BM, CGE, K-W, LE). **Synonyms:** *Bobua cerasifolia* (Wall. ex A.DC.) Miers, J. Linn. Soc. Bot. 17 (1879) 304; *Eugeniodes cerasifolia* (Wall. ex A.DC.) Kuntze *op. cit.* 975.

Tree to 20 m tall, to 21 cm diameter. **Bark** smooth, grey to brown; inner bark fibrous, red to brown, exuding some watery sap. **Sapwood** white to yellow. **Twigs** fairly straight, glabrous or with scattered weak hairs to more than 2 mm long, minutely striate and shallowly grooved and red-brown near apex; older parts terete, coarsely striate, grey. **Terminal buds** with ovate to orbicular, dark, ciliate, sparsely to densely appressed long-pilose, keeled scales to 7 mm long. **Leaves** spirally arranged, chartaceous to thin-coriaceous, with a few scattered

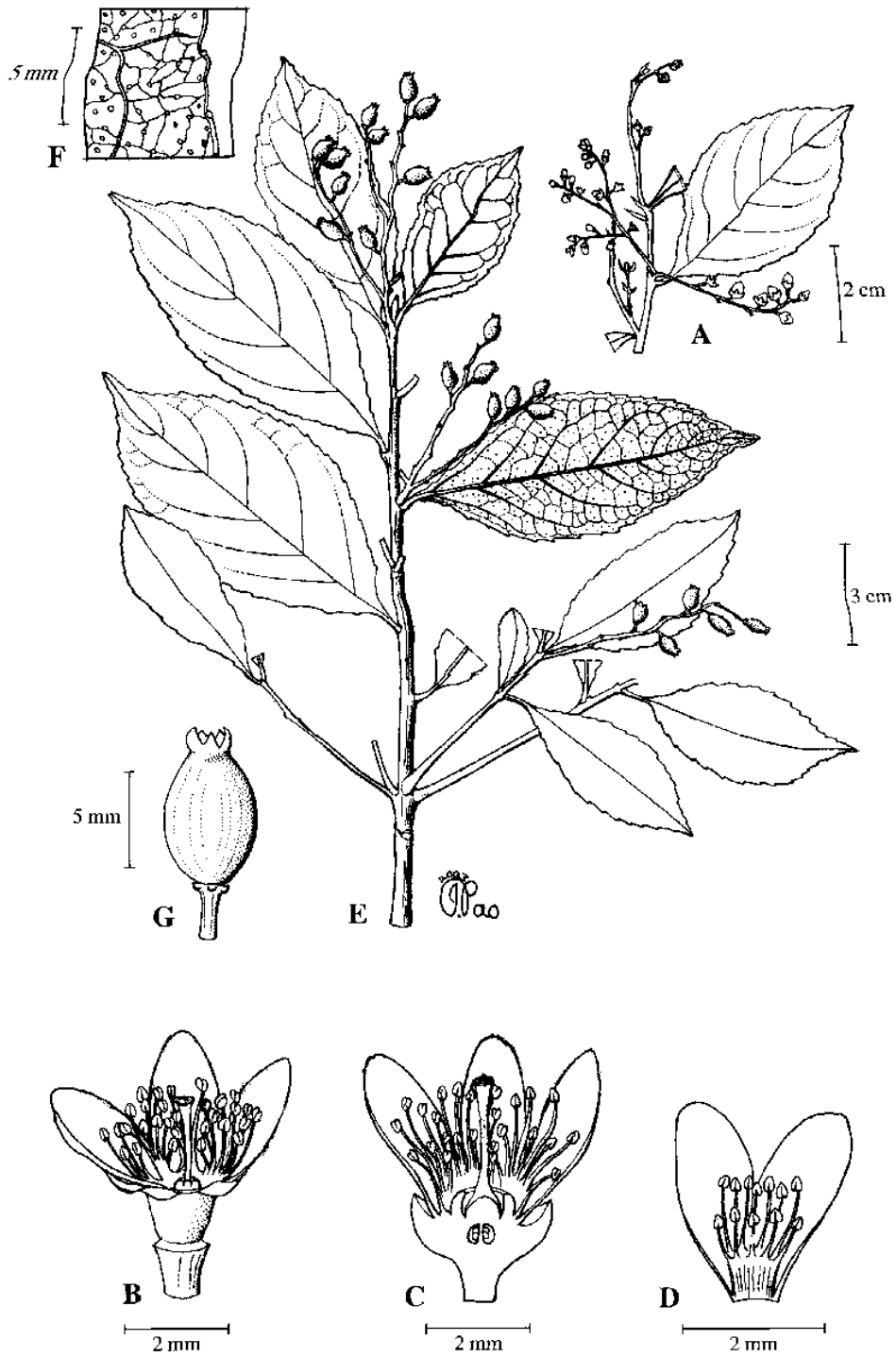


Fig. 2. *Symplocos celastrifolia*. A, flowering leafy twig; B, fully open flower with two petals removed; C, longitudinal section of open flower; D, adaxial view of stamen-bundle; E, fruiting leafy twig; F, detail of venation of lower leaf surface near margin; G, fruit. (A–D from SAN A 2120, E–G from SAN 84353.)

hairs to virtually glabrous except on midrib and veins below, drying olive-grey to olive-brown; blade elliptic to elliptic-obovate, (8–)11–17(–22) × (2.5–)3–6 cm, base narrowly to broadly cuneate-attenuate, margin plane, bluntly black-glandular-tipped serrate, often with 1 to several shallower teeth between longer ones, apex acuminate, acumen 0.7–2.2 cm long; midrib finely channelled above, sparsely long-pilose to virtually glabrous below, warm-brown below; lateral veins 9–12 pairs, more or less sunken above, looping and joining to form an indistinct intramarginal vein; intercostal venation fine, irregularly, distantly, wavy-scalariform; petiole 10–22 mm long, scarcely channelled, flanged near leaf blade or to base, glabrous or pilose as twig, drying same colour as twig. **Inflorescences** in the axils of upper leaves, 10(–15)-flowered spikes to 3.2 cm long, in bud spherical or resembling a short cone due to overlapping bracts; axis densely rufous-tomentose; bracts orbicular, rounded to emarginate, caducous, ciliate, outermost ones almost glabrous, inner ones densely pale or rufous appressed-tomentose except on margins, to 6 mm long; bracteoles oblong, ciliate, tomentose, keeled, caducous or occasionally persistent at anthesis, c. 3.5 mm long. **Flowers** sessile; calyx glabrous, green when fresh, to 3.5 mm long, lobes triangular, 1–1.2 mm long; corolla lobes oblong-elliptic, white when fresh, glabrous, to 4 mm long; stamens 50 or more, yellow when fresh; disk minutely hairy; ovary drying rich brown in contrast with paler calyx, glabrous, 0.7–1.5 mm high, style glabrous. **Fruits** solitary or two per infructescence, ellipsoid-ovoid, occasionally ellipsoid-obovoid, 3.5(–4) × 2 cm, glabrous, not or faintly ridged, white to green to bluish green; calyx lobes or their remains inclined over the deeply sunken style-base.

Vernacular names. Sabah—*madang* (Malay). Sarawak—*jirak* (Iban).

Distribution. Extreme southern parts of Peninsular Thailand, Sumatra (including Bangka), Peninsular Malaysia, Borneo, and W New Guinea. In Sabah, known from Kinabatangan, Lamag, Ranau, Sandakan, Sipitang, and Telupid districts (e.g., *SAN 45168*, *SAN 72919* and *SAN 79081*). In Sarawak, recorded from Kapit, Kuching, Lundu, and Simunjan districts (e.g., *S 36158*, *S 38599*, *S 41599*, *S 41966*, and *S 68486*). Also occurring in Kalimantan (e.g., *Veldkamp 8519*).

Ecology. Chiefly in lowland mixed dipterocarp forest but also in *kerangas*, hill mixed dipterocarp and lower montane forests to 1000 m altitude, on hillsides and ridges.

Notes. Nootboom (*op. cit.* (1975) 140) distinguished two varieties, viz. var. *cerasifolia* and var. *grandifolia* Noot. In Sabah and Sarawak, only var. *cerasifolia* has been recorded. Var. *grandifolia* is apparently rare and known only from Asahan in Sumatra.

8. *Symplocos cochinchinensis* (Lour.) S.Moore (of Cochin-china)

J. Bot. 52 (1914) 148; Nootboom *op. cit.* (1975) 141, *op. cit.* (1977) 245; Kochummen *op. cit.* 269; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 341; Turner *op. cit.* 480; Argent *et al.* (eds.) *op. cit.* 619. **Basionym:** *Dicalyx cochinchinensis* Lour., Fl. Cochinch. 1 (1790) 663. **Type:** Loureiro s.n., “Cochinchina” (holotype BM). **Synonyms:** *Symplocos ferruginea* Roxb., Fl. Ind. ed. Carey 2 (1832) 542; *S. spicata* Roxb., *op. cit.* 542; *S. laurina* Wall. ex G.Don *op. cit.* 3; *S. mollis* Wall. ex G.Don *op. cit.* 3; *S. spicata* Roxb. var. *malasica* C.B.Clarke *op. cit.* 573.

Tree to 35 m tall, to 50 cm diameter. **Bark** smooth, black, grey, brown or sometimes green; inner bark orange to yellowish green. **Sapwood** white to yellow, medium hard. **Twigs** straight to obscurely zigzag, terete, coarsely striate; younger parts densely shortly rufous

tomentose to almost glabrous, pale to dark brown; older parts glabrescent, grey to brown, sometimes with peeling bark. **Terminal buds** with pale to rufous indumentum. **Leaves** spirally arranged, chartaceous to coriaceous, with scattered hairs to virtually glabrous above and similar to more densely hairy below, drying olive-yellow, olive-green or olive-brown; blade elliptic to ovate-elliptic or obovate-elliptic to oblong, 6–18(–20) × 2–8(–9) cm, base cuneate to obtuse, hardly decurrent on petiole, margin faintly to distinctly toothed, apex short-acuminate; midrib channelled above at least near leaf base, glabrous to tomentose; lateral veins 6–14 pairs, inconspicuous above, prominently raised below, not forming a distinct intramarginal vein; intercostal venation reticulate, inconspicuous above, distinct below; petiole 6–20 mm long, channelled at least distally, tomentose as twig to glabrescent. **Inflorescences** in the axils of upper leaves, spikes or racemes bearing numerous flowers, to 9.5 cm long, with up to 3 basal branches; bracts and bracteoles 1–2 mm or longer, together forming a calicyle hiding the ovary or enveloping the base of the ovary, persistent after anthesis. **Flowers:** calyx appressedly pubescent to glabrous. **Fruits** flask-shaped to globose, 0.5–1 × 0.4–0.8 cm; calyx enlarged and forming a conical beak or not.

Vernacular names. Sabah—*kayu ara* (Kota Belud). Sarawak—*jirak* (Iban, Belaga), *kayu buyun* (Kelabit).

Distribution. India, Myanmar, Thailand, Indo-China, China (including Hainan), Japan, Ryu Kyu Is., Taiwan, throughout Malesia (except the Lesser Sunda Is., Sulawesi and Maluku) to Australia, the Solomons, New Hebrides and Fiji. In Borneo, recorded from Brunei, Kalimantan, Sabah, and Sarawak.

Ecology. In primary and secondary mixed dipterocarp to lower montane forests to 1800 m altitude but most commonly above 1300 m, on hillslopes and ridges and sometimes by streams, on brown soils.

Uses. In Sarawak, Kelabit women wear the seeds as beads, as protection against evil spirits after childbirth.

Notes. Nootboom (*op. cit.* (1975) 141) recognised four subspecies, viz. subsp. *cochinchinensis*, subsp. *laurina*, subsp. *leptophylla*, and subsp. *thwaitesii*, of which only subsp. *cochinchinensis* and subsp. *laurina* occur in Sabah and Sarawak.

Key to subspecies and varieties

Leaves with 10–14 pairs of lateral veins. Calyx lobes more or less densely hairy, often enlarged in fruit, forming a conical beak.....

subsp. **cochinchinensis** var. **cochinchinensis**

Nootboom *op. cit.* (1975) 150, *op. cit.* (1977) 246. Synonyms: *Symplocos ferruginea* Roxb., *op. cit.* 542; *S. mollis* Wall. ex G. Don *op. cit.* 3.

Twigs with young parts densely, shortly rufous tomentose. Leaves (6.5–)8–18(–20) × (2–)8(–9.4) cm, margin slightly recurved, distinctly, sharply dark-glandular toothed, apex sharp. Inflorescences spikes with up to 3 basal branches; axis indumentum similar to or denser than that of twig; bracts c. 2 mm long, bracts and bracteoles spreading and overlapping to form a shallow cup (persistent in fruit) round the short, glabrous to sparsely pilose, rugulose ovary which is thus entirely concealed at anthesis. Fruit flask-shaped to almost globose, to 0.9 × 0.8 cm, slightly rugulose or ribbed, drying dark brown to black, including the conical beak formed by the overlapping calyx lobes.

Distribution as for the species but not reaching Australia, the Solomons, New Hebrides and Fiji and scarce in the Philippines. In Sabah, recorded from Keningau, Kota Belud and Ranau districts (e.g., *SAN 29246*, *SAN 32350*, *SAN 32391*, *SAN 53958*, *SAN 76410*, and *SAN 87417*) and in Sarawak, from Marudi and Sri Aman districts (e.g., *S 42709*, *S 51083*, *S 51536*, and *S 51578*). Also known from C Kalimantan (e.g., *bb 13698* and *Hallier 1379*).

Leaves with 6–9 pairs of lateral veins. Calyx lobes, if hairy, then sparsely so, not enlarged in fruit.....

subsp. **laurina** (Retz.) Noot. var. **laurina**

(Latin, *Laurus* = a bay tree; like the bay tree)

Nooteboom, *Leiden Bot. Ser. 1* (1975) 156, *op. cit.* (1977) 248; Kochummen *op. cit.* 269. Basionym: *Myrtus laurinus* Retz., *Observ. Bot.* 4 (1786) 26. Type: *Herbarium Hermann*, Sri Lanka (holotype P, n.v.; isotype L). Synonyms: *Symplocos spicata* Roxb., *op. cit.* 542; *S. laurina* Wall. ex G.Don *op. cit.* 3; *S. spicata* Roxb. var. *malasica* C.B. Clarke *op. cit.* 573.

Twigs with young parts almost glabrous with a few long weak hairs. Leaves 6–11 × 2.5–4 cm; margin plane, hardly to bluntly toothed, acumen apically rounded. Inflorescences racemes, sometimes with a basal branch; axis minutely tomentose to glabrescent; bracts c. 1 mm long, mostly not persisting to fruiting stage. Fruits ovoid to almost globose, 0.6–0.8 × 0.8–1 cm, smooth, drying medium brown, with triangular, apically rounded calyx lobes not enlarged in fruit but inclined towards the remains of the style base or even flattened onto the apex of the fruit.

India, Sri Lanka, Myanmar, Thailand, Indo-China, China (including Hainan), Taiwan, Japan, Sumatra, Peninsular Malaysia, Borneo, Java, and Sulawesi. In Sabah, known only from Ranau district (e.g., *SAN 123332*) in hill ridge forest. In Sarawak also rare, recorded only from Belaga district at 500 m (e.g., *S 67907*). Also occurring in Brunei (e.g., *Coode 7936*) and Kalimantan (e.g., *Jaheri 1758* and *Main 2121*).

9. *Symplocos colombonensis* Noot.

(of the Kolombon R. basin, Sabah)

Leiden Bot. Ser. 1 (1975) 177, *op. cit.* (1977) 255; Whitmore, Tantra & Sutisna *op. cit.* 342. **Type:** *Clemens 33706*, Borneo, Sabah, Mt. Kinabalu, Kolombon R. basin (holotype L; isotypes BM, BO, G, K).

Shrub or treelet to 10 m tall. Twigs somewhat zigzag, dark brown appressed-tomentose. Leaves alternately arranged, glabrous above, *sparsely appressed-pilose below especially on the margin; blade ovate, 4–9 × 1.5–3.5 cm, base cuneate to rounded, often shortly attenuate, margin often revolute, often sharply glandular-dentate, apex acuminate, acumen (0.7–)0.9–1.6 cm long; midrib channelled above, prominent below, appressed-pubescent; lateral veins 7–11 pairs, arching upwards and joining with the reticulations towards the margin or into an inconspicuous intramarginal vein; intercostal venation prominent, rather coarsely reticulate; petiole 3–4 mm long, not swollen along its length, indumentum as that of twig.*

Inflorescences *lax, 3-flowered racemes to 3 cm long; bracts and bracteoles soon caducous, pubescent. Flowers: pedicel finely appressedly pubescent, 1–5 mm long; calyx appressedly brown pilose, tube 2–3 mm long, lobes triangular, 1.5–2.5 mm long; corolla glabrous or thinly red-hairy on the outside in bud, c. 5 mm long; stamens c. 90 or more arranged in 5 distinct bundles, up to 7 mm long; disk glabrous or with some hairs, 5-glandular; ovary appressedly brown-pilose, 1.5–2 mm high, style glabrous, thickened towards the base, 4–5 mm long. Fruits ovoid or ellipsoid, 1–1.5 × 0.6 mm, with persistent calyx lobes.*

Distribution. Endemic in Borneo and confined to the western slopes of Mt. Kinabalu in Sabah (e.g., *Clemens 33766*, *Clemens 51103*, *Nooteboom 1496*, and *SFN 27507*).

Ecology. Upper montane forest at 2100–3100 m altitude.

10. *Symplocos costatifructa* Noot.

Fig. 3.

(Latin, *costatus* = ribbed, *fructus* = fruit; the ribbed fruit)

Blumea 31 (1986) 277, FM 1, 10 (1989) 719; Whitmore, Tantra & Sutisna *op. cit.* 342; Coode *et al.* (eds.) *op. cit.* 315. **Type:** *Chai S 34756*, Borneo, Sarawak, Baram district, Ulu Tinjar (holotype L; isotypes K, KEP, SAR).

Treelet to 10 m tall, to 10 cm diameter. **Bark** smooth, hoop-marked, brown; inner bark white to pale brown, thin. **Sapwood** white or red-yellow. **Twigs** *more or less curved*, more than 4 mm diameter; *young parts grooved, drying pale yellowish-green; older parts terete, striate, virtually glabrous, dark brown.* **Terminal buds** *prominent, lanceolate, appressed-pilose, drying brown.* **Leaves** spirally arranged, *mostly located at or near apex of twig, coriaceous, slightly glossy at least above, both surfaces glabrous, drying pale, yellow-green or buff-green;* blade oblong-elliptic to obovate, 11–28(–35) × 4–8(–10) cm, *base shortly attenuate, slightly decurrent on petiole, margin recurved, obscurely toothed, apex acuminate, acumen to 2 cm long; midrib and veins sunken above; lateral veins 9–12 pairs, joining to form an intramarginal vein 6–12 mm from margin at its furthest point; intercostal venation reticulate, distinct, raised on both surfaces; petiole 12–16 mm long, shallowly channelled and shortly winged, glabrous, smooth, drying yellow-green.* **Inflorescences** axillary, erect, *simple or basally branched up to 10-flowered spikes, 1.5–2.5 cm long;* axis appressedly to obliquely short-pilose; *bracts lanceolate-ovate, caducous, leaving prominent crescent-shaped scars, appressedly long-pilose, to 5.5 × 1.5 mm; bracteoles triangular, caducous, to 0.3 × 0.6 mm.* **Flowers:** calyx glabrous, tube to 0.3 mm long, lobes broadly triangular, *c. 0.5 mm long;* corolla white when fresh, glabrous, tube to 0.75 mm long, lobes 5–6 × 2.5 mm; *stamens c. 35, cream when fresh; disk glabrous; ovary glabrous, c. 1.5 mm high, c. 1 mm diameter, stigma yellow when fresh.* **Infructescences** to 4.5 cm long, *bearing 1–2 fruits.* **Fruits** ovoid, *c. 3 × 1.5 cm, ribbed, glabrous, white or cream.*

Distribution. Endemic in Borneo. Rare in Sabah and known only from Keningau, Ranau and Sipitang districts (e.g., *SAN 72131*). In Sarawak, recorded from Belaga and Miri district (e.g., *S 39987*, *S 48183*, *S 48232*, and *S 80610*). Also occurring in Belait and Temburong districts, Brunei (e.g., *BRUN 216* and *Dransfield JD 7464*).

Ecology. In mixed dipterocarp and primary *kerangas* forests at 50–1300 m altitude, often on river-banks, gentle slopes and hills, on sandy, pebbly or rocky soils.

11. *Symplocos crassipes* C.B. Clarke

(Latin, *crassus* = thick, *pes* = foot; alluding to the thick stem)

In Hooker *f.*, Fl. Brit. Ind. 3 (1882) 580; Brand *op. cit.* (1901) 52; King & Gamble *op. cit.* 245; Ridley *op. cit.* (1923) 305; Nooteboom *op. cit.* (1975) 180, *op. cit.* (1977) 256; Kochummen *op. cit.* 269; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 432; Turner *op. cit.* 480; Coode *et al.* (eds.) *op. cit.* 315. **Type:** *Maingay 2597 (= Kew Distr. 960)*, Peninsular Malaysia, Malacca, Mt. Ophir (holotype K). **Synonyms:** *Symplocos curtisii* Oliv. *in* Hooker, Icon. Pl. Ser. 3, 18 (1888) *t.* 1757; *S. havilandii* Brand *op. cit.* (1901) 41; *S. ernae* Brand *op. cit.* (1901) 58; *S. monticola* King & Gamble *op. cit.* 235; *S. brandiana* King & Gamble *op. cit.* 242; *S. penangiana* King & Gamble *op. cit.* 245.

Shrub or tree to 15(–23) m tall, to 50 cm diameter. **Bark** smooth, brown to dark brown or grey; inner bark pale yellow to brown, thin, hard. **Sapwood** pale yellow to orange; heartwood medium hard. **Twigs** *straight to obscurely zigzag*, terete, *variously pubescent or pilose to glabrescent*, medium to dark brown or grey; young parts striate; *older parts almost smooth*. **Leaves** spirally arranged, chartaceous, virtually glabrous above, *glabrous to variously pilose below*; blade elliptic to ovate, 2–19 × 1–7.5 cm, base attenuate, cuneate, obtuse or rounded, *margin plane to recurved, obscurely to sharply toothed, apex acuminate with acumen to 2.2 cm long; midrib channelled above*, sparsely to densely hairy below; *lateral veins* 3–11 pairs, *ascending and curving for most of their length, joining to form an intramarginal vein or not*; petiole 2–12 mm long, *not swollen along its length*. **Inflorescences** contracted, to 10-flowered, *to 1.5 cm long*, or flowers sessile in the leaf axils; axis, where present, variously hairy; *bracts broadly ovate or elliptic to semi-orbicular, hairy*, persistent at anthesis. **Flowers:** calyx lobes hairy; ovary variously hairy. **Infructescences** *mostly with 1–2 fruits*. **Fruits** ovoid, ellipsoid, obovoid or cylindrical-ovoid, *to 1.5 × 0.8 cm*, somewhat curved, somewhat ridged, ripening pale or dark blue, *with erect to incurved calyx lobes forming a beak*.

Vernacular name. Sarawak—*jirak* (Iban).

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo.

Ecology. Most common in primary mixed dipterocarp forest, but also in *kerangas*, secondary, hill and lower montane forests, at altitude to 1500 m, on undulating lands, hillslopes and summits and sometimes near streams, on sandy, sandy clay and ultrabasic soils.

Notes. Nootboom (*op. cit.* (1975) 180) recognised seven different varieties in this species. Of these, four varieties, *viz.* var. *ernae*, var. *havilandii*, var. *penangiiana*, and var. *rufomarginata* occur in Sabah and Sarawak.

Key to varieties

1. Leaves to 4.8(–6) cm long, base rounded; lateral veins 3–6 pairs. Flowers solitary.....
 var. **havilandii** (Brand) Noot.
 (J.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)
 Leiden Bot. Ser. 1 (1975) 184, *op. cit.* (1977) 258. Basionym: *Symplocos havilandii* Brand
op. cit. (1906) 41. Type: *Haviland s.n.*, Borneo, Sarawak, Matang (holotype K; isotype BO).
 Treelet to 8 m tall. *Leaves* drying yellow-green; *blade broadly ovate, 3–5(–6) × 1–3 cm, apex long-acuminate with acumen to 1.6 cm long*; petiole 2–3.5 mm long.
Fruits with densely rufous tomentose, more or less erect calyx lobes.
 Endemic in Sarawak, only known from Mt. Matang and G. Serapi, Kuching district (e.g., *Haviland 632/247, Ridley 12297 and S 17783*). In hill and lower montane forests at 600–1400 m altitude.

At least some leaves 5.5 cm long or longer, base attenuate, cuneate, obtuse or, if rounded, then leaves usually at least 6 cm long. Flowers otherwise.....2

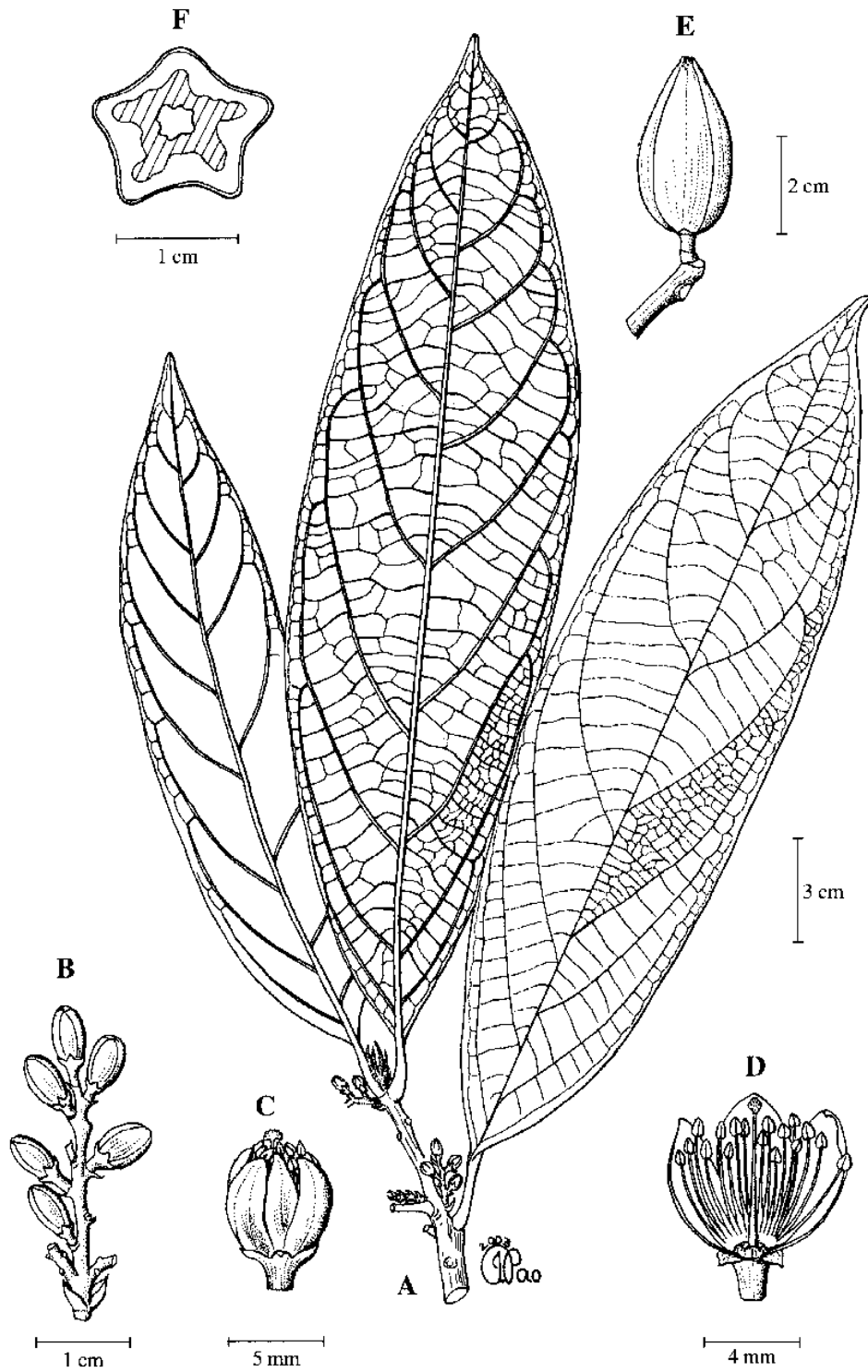


Fig. 3. *Symplocos costatifructa*. A, flowering (young) leafy twig; B, young inflorescence; C, opening flower; D, longitudinal section of opening flower; E, fruit; F, cross-section of fruit. (A–D from S 39987, E–F from S 34756.)

2. Leaves and veins glabrous to sparsely appressed-pilose below, drying warm brown.....

var. **ernae** (Brand) Noot.

(derivation unknown)

Leiden Bot. Ser. 1 (1975) 184, *op. cit.* (1977) 258; Kochummen *op. cit.* 270; Turner *op. cit.* 480; Coode *et al.* (eds.) *op. cit.* 315. Basionym: *Symplocos ernae* Brand *op. cit.* (1901) 58. Lectotype (Nootboom, 1975): *Beccari PB 3499*, Borneo, Sarawak, Kuching (holotype K; isotypes FI, G, P).

Tree to 23 m tall, to 50 cm diameter. *Leaf always drying distinctly warm brown*; blade elliptic to ovate-elliptic, 3.5–13.5(–18) × 1.5–5(–7.5) cm, apex acuminate, acumen to 2 cm long; lateral veins 4–6(–8) pairs; petiole 3–12 mm long. Fruits obovoid, ovoid or ellipsoid, c. 1.5 × 0.8 cm, more or less curved, obscurely ridged, with erect or incurved calyx lobes together forming a curved beak.

Peninsular Malaysia and Borneo. By far the most widespread variety in Sabah (e.g., *SAN 83805*, *SAN 119673*, *SAN 126641*, *SAN 130121*, and *SAN 135913*) and Sarawak (e.g., *S 13621*, *S 18859*, *S 26920*, *S 32893*, *S 46057*, and *S 52405*). Also known from Brunei (e.g., *BRUN 359* and *Simpson 2251*) and from C and E Kalimantan (e.g., *Endert 2580*, *Endert 3629*, *Kessler et al. 2499*, and *Sidiyasa & Arifin 1979*).

Leaves and veins moderately to densely appressed-hairy below, drying buff or greenish-buff below.....3

3. Twigs conspicuously, patently to obliquely brown hairy, hairs at least 1 mm long. Leaves drying buff to grey-buff below; lateral veins 6–11 pairs; intercostal venation prominent.....

var. **penangiana** (King & Gamble) Noot.

(of Penang, Peninsular Malaysia)

Leiden Bot. Ser. 1 (1975) 185, *op. cit.* (1977) 258; Kochummen *op. cit.* 270; Turner *op. cit.* 480. Basionym: *Symplocos penangiana* King & Gamble *op. cit.* 245. Type: *Curtis 325*, Peninsular Malaysia, Penang, West Hill (holotype SING).

Tree to 3 m tall. Twigs with very short pale pubescence as well as spreading rufous hairs to 5 mm long. Leaves (4.5–)6–19 × (2–)2.5–7 cm, base obtuse to rounded, margin sharply toothed, acumen to 2.2 cm long; *midrib and veins appressedly to obliquely long hairy below*.

Peninsular Malaysia and Borneo. In Sarawak, known from Tatau and Kapit districts (e.g., *S 40609*).

Twigs inconspicuously appressed-pubescent. Leaves drying distinctive pale buff-green below; lateral veins 4–6 pairs; intercostal venation fine, obscure.....

var. **rufomarginata** Noot.

(Latin, *rufus* = red or red haired, *margo* = a border; the rufous-hairy leaf margin)

Leiden Bot. Ser. 1 (1975) 185, *op. cit.* (1977) 258. Type: *Haviland 2314*, Borneo, Sarawak, Kuching (holotype K; isotype BO).

Shrub or small tree to 3.7 m tall. Twigs densely pubescent. Leaves (1.7–)4–10 × (0.9–)1.5–3.5 cm, *margin recurved, appressedly rufous hairy*, acumen to 2 cm long. Fruits almost sessile, long-ovoid with a narrow neck.

Endemic in Sarawak. Known from Kapit and Kuching districts (e.g., *S 13417*, *S 27059*, *S 36064*, *S 36971*, and *S 56090*). In primary mixed dipterocarp forest at 100–500 m altitude.

12. *Symplocos deflexa* Stapf

(Latin, *deflexus* = bend or turn downwards, droop; the infructescence axis)

FMK (1894) 205; Brand *op. cit.* (1906) 64; Gibbs, J. Linn. Soc. Bot. 42 (1914) 109; Merrill *op. cit.* (1921) 487; Masamune *op. cit.* 608; Nootboom *op. cit.* (1975) 188, *op. cit.* (1977) 258. **Type:** *Haviland 1105*, Borneo, Sabah, Mt. Kinabalu (holotype K; isotype SING).

Treelet to 6 m tall, 8 cm diameter. Twigs faintly zigzag, to c. 3 mm diameter, young parts apparently terete, striations, if any, obscured by a dense indumentum of oblique, rufous, pilose hairs from 0.2 to more than 1 mm long at a single point; older parts terete, glabrescent, dark brown. Leaves spirally arranged, chartaceous, virtually glabrous above, densely finely appressed to oblique pale pilose below, drying olive-brown above, paler green to olive-green below; blade elliptic, 2–5 × 1–2.5 cm, base rounded to obtuse, margin finely, sharply brown-gland-tipped toothed, recurved to revolute, densely appressedly long-pilose, apex shortly (to 8 mm long) acuminate; midrib finely channelled above, with some indumentum at base, densely pilose as twig below; lateral veins 5–8 pairs, merging into reticulations at margin, obscure above, distinct below; petiole to 3 mm long, shallowly channelled above, pilose as twig. Inflorescences lax, up to 6-flowered racemes 1–4 cm long, with or without a basal branch, all parts except corolla, stamens, disk and style densely appressedly to obliquely pale rufous pilose; bracts and bracteoles persistent, c. 5 × 3 and c. 3 × 1.5 mm respectively. Flowers fragrant; pedicels 2–4 mm long; calyx divided into obtuse and semi-elliptic to acute and triangular lobes c. 1.5 mm long; petals glabrous or outer ones minutely appressedly hairy, 4–7 mm long; stamens 60–90; disk low, 5-glandular, sparsely long-pilose; ovary 1.5–2 mm high, style gradually thickened towards base, sparsely long-pilose below, c. 5 mm long. Infructescence axis turning downwards. Fruits rather few, ovoid-ellipsoid, to 1 × 0.5 cm, slightly curved, obscurely ridged, sparsely appressed-pilose, drying pale, with persistent, erect, calyx lobes more densely pilose than the fruit.

Distribution. Endemic in Borneo; known only from the type locality near Paka Cave, Mt. Kinabalu, Kota Belud district in Sabah (e.g., *Clemens 28998*, *Nootboom 1489*, *SAN 46552*, and *SAN A 4481*).

Ecology. In low subalpine forest and mountain scrubs at 2400–3200 m altitude.

13. *Symplocos fasciculata* (Kuntze) Zoll.

(Latin, *fasciculatus* = bundled; the inflorescence is a bundle of branched racemes)

Syst. Verz. (1854) 136; C.B. Clarke *op. cit.* 574; Koorders & Valeton, Bijdr. Booms. Ned. Ind. 7 (1900) 150 (inclusive var. *blumeana* Koord. & Valeton *op. cit.* 151); Brand *op. cit.* (1901) 34; King & Gamble *op. cit.* 235; Koorders, Atlas 2 (1914) t. 383; Merrill *op. cit.* (1921) 487, *op. cit.* (1929) 248; Ridley *op. cit.* (1923) 301; Masamune *op. cit.* 609; Backer & Bakhuizen *f. op. cit.* 205; Nootboom *op. cit.* (1975) 191, *op. cit.* (1977) 259; Kochummen *op. cit.* 270; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 342; Turner *op. cit.* 480; Coode *et al.* (eds.) *op. cit.* 315; Argent *et al.* (eds.) *op. cit.* 621. **Basionym:** *Eugeniodes fasciculatum* Kuntze *op. cit.* 409. **Lectotype** (Nootboom, 1975): *Blume 2154*, Java (hololectotype L). **Synonyms:** *Dicalyx tinctorius* Blume, Bijdr. Fl. Ned. Ind. (1826) 1116; *Symplocos fasciculata* (Kuntze) Zoll. var. *genuina* Koord. & Valeton *op. cit.* 151.

Tree to 23(–35) m tall, to 45 cm diameter. **Bark** smooth, pale to dark grey or brown, sometimes greenish; inner bark white, pale yellow or green. **Sapwood** white or pale yellow. **Twigs faintly zigzag**, slender to stout; *young parts finely striate to distinctly grooved, pubescent, pilose to glabrescent*, drying pale or medium-brown to greenish buff; *older parts*

terete, *almost smooth*, glabrescent, pale to dark brown. **Leaves** alternately to spirally arranged, chartaceous, *sparsely hairy to glabrescent above, densely to sparsely appressed-pilose below, drying olive-green or olive-brown*, paler below; blade elliptic, oblong-elliptic or ovate-elliptic, (3.5–)5–16.5(–19) × (0.9–)1.5–6 cm, base shortly cordate or rounded to obtuse or cuneate, sometimes slightly asymmetric, hardly attenuate, *margin plane to slightly recurved, distinctly, closely glandular toothed to almost entire with obscure, hardly raised teeth, apex attenuate, acumen 1–2 cm long; midrib finely channelled*, pubescent on both surfaces; *lateral veins fine, (7–)8–10(–12) pairs, indistinct above, looping, branching and joining to form a faint (sometimes double) intramarginal vein*; intercostal venation laxly reticulate; *petiole 2.5–10 mm long, often drying dark*. **Inflorescences** axillary, *composed of fascicles to 3.5 cm long of several branched racemes; axis appressed-pilose; bracts broadly ovate to orbicular, boat-shaped, spreading, often persistent at anthesis, appressed pilose; bracteoles at base of ovary or sometimes fused with immature fruit, persistent after anthesis, often minute*. **Flowers:** pedicels 1–2.5 mm long; calyx less than 1 mm long, tube almost entirely divided into broadly ovate, moderately to sparsely pilose lobes; corolla oblong, white, glabrous, to 3.5 mm long; *stamens at most 20*, anthers yellow when fresh; disk minutely pilose; ovary with indumentum as inflorescence axis, to 0.7 mm high, style sparsely long-pilose, to 3 mm long. **Infructescence** to 1.8 cm long. **Fruits** ovoid, *c. 0.8 × 0.5 cm*, obscurely ridged, glabrescent, ripening blue to black, *with erect, apically incurved, glabrescent calyx lobes*.

Vernacular names. Sabah—*jiak* (preferred name), *leboh* (Kadazan), *loboh* (Dusun). Sarawak—*girak, jirah, jirak* (Iban).

Distribution. S Peninsular Thailand and throughout Malesia except the Lesser Sunda Is., Maluku and New Guinea. Widespread in Borneo. In Sabah common, occurring in all districts except those of the extreme northern parts (e.g., *SAN 24402, SAN 49936, SAN 73054, SAN 84271, and SAN 131005*). In Sarawak, known from Bintulu, Kapit, Kuching, Lawas, Limbang, Marudi, Miri, Simunjan, Sri Aman, and Tatau districts (e.g., *S 24299, S 39916, S 46403, S 49314, and S 60667*). Also occurring in Brunei (e.g., *BRUN 150, Coode 7919, Sands 5880, and Wong WKM 999*) and in Kalimantan (e.g., *Endert 2104 and Nedi 756*).

Ecology. In primary and secondary mixed dipterocarp and *kerangas* forests, at 10–1700 m altitude, usually on river banks, sometimes on swampy ground, occasionally on slopes, on alluvial sandy or clay soils. One of the most common *Symplocos* species in Sabah and Sarawak.

Uses. The bark is pounded, placed in a bowl, covered with another bowl and left outside the house from dusk to dawn to obtain the condensate, which is then applied to the sore eye. It has also been used by the Dayaks of Borneo to dye rattans.

Notes. *Symplocos fasciculata* is represented in Sabah exclusively by more robust, large-leaved and large-flowered specimens, whereas in Sarawak most specimens are slender and smaller-leaved, with smaller flowers. The variation appears continuous and it has not been possible to differentiate subspecific taxa.

14. *Symplocos goodeniacea* Noot. (resembling Goodeniaceae; the leaves and habit)

Leiden Bot. Ser. 1 (1975) 204, *op. cit.* (1977) 261, Blumea 31 (1984) 76, *op. cit.* (1986) 277; Whitmore, Tantra & Sutisna *op. cit.* 342. **Type:** Dewol *et al.* SAN 74567, Borneo, Sabah, Sandakan, Labuk Road (holotype L; isotypes K, SAR, SING).

Tree to 25 m tall, to 35 cm diameter. **Bark** lenticellate, hoop-marked, pale brown, *c.* 2.5 cm thick; inner bark yellow to brown or pale greenish. **Sapwood** white or orange-yellow. **Twigs** stout, curved, finely striate, glabrous or with a few scattered hairs, drying pale yellow-brown to green-brown; young parts grooved to angular. **Leaves** spirally arranged, loosely clustered at the ends of twigs and more distantly spaced below, coriaceous, slightly glossy, glabrescent or with a few scattered hairs on both surfaces, drying distinctly pale yellow-brown to pale yellow-green or yellow-grey; blade elliptic to elliptic-oblong or elliptic-obovate, 16–31 × 5–9 cm, base attenuate, decurrent on petiole, margin plane to recurved, obscurely toothed, apex shortly acuminate, often partially folded when dry; midrib deeply channelled above; lateral veins (9–)10–11(–15) pairs, joining at least towards the apex to form an intramarginal vein; intercostal venation laxly and finely reticulate; petiole 18–40 mm long, narrowly winged and distinctly channelled above. **Inflorescences** many-flowered, basally branched or simple spikes to 5.2 cm long; axis shortly appressed-pilose; bracts and bracteoles orbicular-ovate, slightly keeled, persistent, ciliate, glabrescent, to 2 × 2 and 1.5 × 1.3 mm respectively. **Flowers:** calyx glabrous, tube to 0.5 mm long with obtuse to rounded, ciliate lobes to 1.5 mm long; corolla white when fresh, to 8 mm long, lobes oblong, ciliate; ovary glabrous, to 1 mm high; stamens more than 100; disk annular, densely pilose to glabrescent. **Fruits** inversed pear-shaped, base almost globose, *c.* 1.3 × 1.2 cm, ridged, neck thick and more strongly ridged than the base, white ripening deep lilac, with erect, apically incurved calyx lobes.

Distribution. Endemic in Borneo. In Sabah, known from Sandakan and Tawau districts (e.g., SAN 74567 and SAN 94875). In Sarawak, recorded from Semengoh FR, Kuching district (e.g., S 36534, and S 53701). Also occurring in Bukit Raya, C Kalimantan (e.g., Veldkamp 8349).

Ecology. In primary and disturbed mixed dipterocarp forests at altitudes to 150 m on gentle slopes and hillsides on silty clay soils.

15. *Symplocos henschelii* (Moritzi) Benth. ex C.B. Clarke Fig. 4.
(A.W.E. Th. Henschel, 1790–1856, Lecturer in Botany at the Breslau University and writer of a key to Rumphius' Herbarium Amboinensis)

In Hooker *f.*, Fl. Brit. Ind. 3 (1882) 588; Brand *op. cit.* (1901) 89, *op. cit.* (1906) 750; Koorders *op. cit.* t. 390; Airy Shaw, Kew Bull. Misc. Inform. (1939) 508; Masamune *op. cit.* 608; Steenis, Bull. Bot. Gard. Buitenz. 3, 17 (1948) 440; Backer & Bakhuizen *f. op. cit.* 204; Nooteboom *op. cit.* (1975) 37, *op. cit.* (1977) 214; Kochummen *op. cit.* 270; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 342; Turner *op. cit.* 480; Coode *et al.* (eds.) *op. cit.* 315; Argent *et al.* (eds.) *op. cit.* 621. **Basionym:** *Cordyloblaste henschelii* Moritzi *op. cit.* 606. **Type:** Nagel in Herb. Zollinger 3195, Java, Bandung (L, P). **Synonyms:** *Eugeniodes henschelii* (Moritzi) Kuntze *op. cit.* 975; *Symplocos nagelii* Koord. & Valetton *op. cit.* 159; *S. maingayi* Benth. ex C.B. Clarke *op. cit.* 588; *E. maingayi* (Benth. ex C.B. Clarke) Kuntze *op. cit.* 975; *Cordyloblaste maingayi* (Benth. ex C.B. Clarke) Ridl., *op. cit.* (1923) 309; *S. scortechinii* King & Gamble *op. cit.* 250; *C. scortechinii* (King & Gamble) Ridl., *op. cit.* (1923) 309; *S. dolichantha* Merr., Sarawak Mus. J. 3 (1928) 545.

Tree to 20(–35) m tall, to 40(–60) cm diameter. **Bark** smooth, pale grey, sometimes grey-brown, grey-green or brown, thin, soft; inner bark brittle, yellow. **Sapwood** yellow or pale, moderately hard, moderately heavy. **Twigs** often slightly zigzag, to 6 mm diameter, glabrous to tomentose, normally drying pale buff in marked contrast to petioles and leaves; young parts grooved and striate; older parts terete and almost smooth. **Leaves** spirally

arranged, chartaceous, virtually glabrous above, *hairy to glabrescent below*, drying dark to pale olive-brown to black above, paler olive-brown below, or sometimes patchily greenish-grey, especially above; blade narrowly to broadly elliptic, (5.5–)7–16(–18.5) × (1–)3–6(–7.5) cm, slightly asymmetric at widest point, base cuneate, decurrent as blunt ridges to base of petiole, *margin entire, plane to recurved, apex acuminate, acumen to 2 cm long*; midrib finely channelled above; *lateral veins 5–9 pairs*, distant, indistinct above, usually forming a wide angle with midrib, branching and joining to form an indistinct, double intramarginal vein, tomentose as midrib below; intercostal venation laxly reticulate; *petiole (4–)7–13 mm long*, shallowly channelled to base, indumentum as or denser than that of twig, normally drying almost black. **Inflorescences** *many-flowered racemes to 6.5 cm long*, in the axils of apical leaves; axis, bracts, bracteoles, calyx, and ovary densely short grey-pilose; bracts and bracteoles ovate, bracts caducous, bracteoles persistent or not, to 5 and 2.5 mm long respectively. **Flowers** sessile or with pedicels to 5 mm long; calyx to 3.5 mm long with triangular to rounded lobes to 1.5 mm long; corolla white and fragrant when fresh, shortly, densely grey-pilose on the outside, to 33 mm long, tube to 23 mm long, lobes spatulate, to 14 mm long; stamens joined in staminal tube for most of their length, anthers yellow; disk absent; ovary to 5 mm high, style green, appressedly white-pilose, more densely so at its bulbous base, stigma yellow. **Infructescences** with 1–3 fruits. **Fruits** *ellipsoid to obovoid, to 5 × 2.6 cm*, appressed-pilose to glabrescent, green, with erect calyx lobes surrounding the appressed-hairy, bulbous style base.

Vernacular names. Sarawak—*girak* (Iban), *yum* (Kenyah).

Distribution. Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Borneo, the Philippines (Palawan Is.), and W Java.

Ecology. Common in hill mixed dipterocarp, lower montane and upper montane forests and also in high *kerangas* forest, from sea level to 2100 m altitude but seldom found lower than 800 m, on slopes, ridges and plateaux, most commonly on sandy soils.

Uses. Timber is locally used for construction material.

Notes. Nootboom (*op. cit.* (1975) 39) recognised two subspecies, *viz.* subsp. *henschelii* and subsp. *magnifica* (Fletcher) Noot. Only subsp. *henschelii* with two varieties occur in Sabah and Sarawak.

Key to varieties

Leaves and twig ends glabrous or sparsely hairy, occasionally moderately densely tomentose.....

var. *henschelii*

Synonyms: *Symplocos nagelii* Koord. & Valetton *op. cit.* 159; *S. scortechinii* King & Gamble *op. cit.* 250; *S. dolichantha* Merr., *op. cit.* (1928) 545.

Twigs when hairy with scattered, long, pale appressed hairs, sometimes hairs moderately dense and patent. Leaves virtually glabrous to sparsely appressed-hairy below; 5.5–18.5 × 1.5–6 cm, acumen to 2 cm long; midrib pubescent to virtually glabrous above and sparsely appressed-hairy to glabrescent below. Immature fruit obovoid, to 5 × 2.5 cm.

Distribution as for the species. In Borneo, known from various districts in Sabah (e.g., *SAN 15002*, *SAN 41843*, *SAN 91462*, *SAN 130774*, and *SAN 132763*), Sarawak (e.g., *S 21939*, *S 33860*, *S 39979*, *S 47835*, and *S 50823*), Brunei (e.g., *Prance 30538*, *Prance*

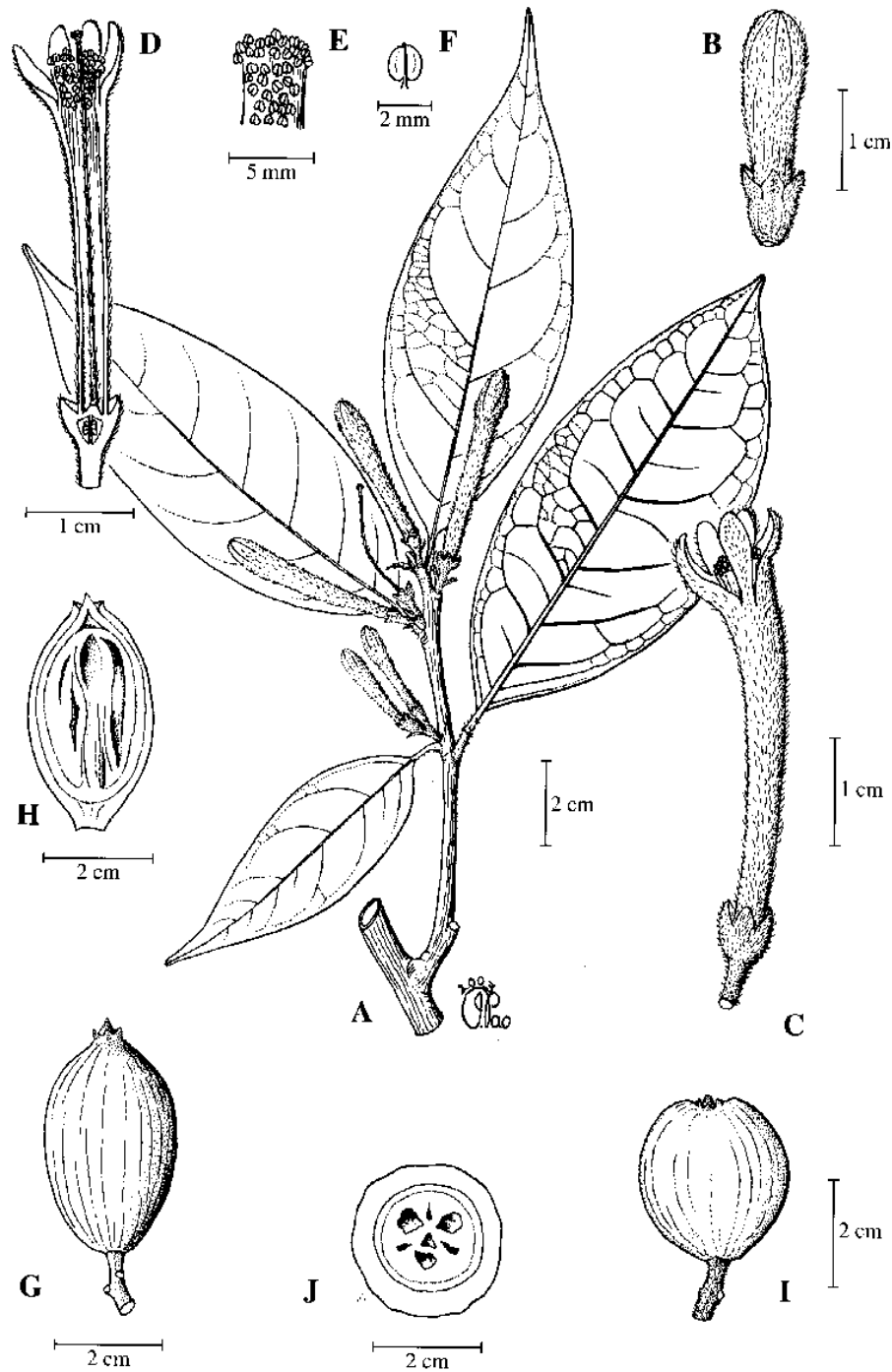


Fig. 4. *Symplocos henschelii*, subsp. *henschelii* var. *henschelii* (A–H) and var. *maingayi* (I–J). A, flowering leafy twig; B, flower bud; C, opening flower; D, longitudinal section of opening flower; E, adaxial view of apical part of staminal tube; F, stamen; G, fruit; H, longitudinal section of fruit; I, fruit; J, cross-section of fruit. (A–B from *S* 47835, C–F from *SAN* 132763, G–H from *SAN* 91462, I–J from *S* 37009.)

30549, Prance 30564 A, and Prance 30610), and Kalimantan (e.g., Endert 3926 and Endert 3969). Habitat as for the species, at 500–2100 m altitude.

Leaf undersurface patently pale hairy, twig ends densely rufous tomentose.....

var. **maingayi** (Benth. ex C.B. Clarke) Noot.

(A.C. Maingay, 1836–1869, British physician and botanist, sometime jail-warden in Malacca, Peninsular Malaysia)

Leiden Bot. Ser. 1 (1975) 39, *op. cit.* (1977) 214; Kochummen *op. cit.* 272; Anderson *op. cit.* 328. Basionym: *Symplocos maingayi* Benth. ex C.B. Clarke *op. cit.* 588. Type: *Maingay Kew Distr.* 961, Peninsular Malaysia, Malacca (holotype K). Synonym: *Cordyloblaste maingayi* (Benth. ex C.B. Clarke) Ridl., *op. cit.* (1923) 309.

Twigs with young parts densely rufous or pale brown tomentose; older parts glabrescent. Leaves moderately to densely pale brown pilose below; 8–16.5 × 3.5–7.5 cm, acumen to 1.3 cm long; midrib more or less pubescent above, densely tomentose below. Fruits ellipsoid to slightly obovoid, to 4 × 3 cm.

Peninsular Malaysia, Singapore and Borneo. In Borneo, known from Sabah (e.g., Pereira *JTP* 561), Bintulu, Kuching, Limbang, Marudi, and Miri districts in Sarawak (e.g., Nootboom & Chai 1932, *S* 37009 and *S* 50679), Berakas FR in Brunei (e.g., *S* 7826), and from NE Kalimantan (e.g., Kostermans 9328). Habitat as for the species, at 20–1700 m altitude.

16. *Symplocos iliaspaiensis* Noot.

(Ilias Paie, plant collector of the Sarawak Herbarium)

Blumea 31 (1986) 279; Whitmore, Tantra & Sutisna *op. cit.* 342. **Type:** *Ilias S* 42494, Borneo, Sarawak, Sri Aman district, Ulu Sg. Silantek Kiri, path to G. Silantek, (holotype L; isotypes A, K, SAR).

Shrub or small tree to 13 m tall, to 20 cm diameter. **Bark** smooth, pale; inner bark white to yellow, thick. **Sapwood** white. **Twigs** straight or curved, grooved, usually with fine, sharp ridges from petiole base, terete below, finely striate, glabrous or with scattered white hairs, drying pale greenish buff or greenish yellow. **Leaves** spirally arranged, chartaceous to thin-coriaceous, appearing bullate due to the raised or sunken lateral veins, entirely glabrous or with scattered appressed colourless hairs, drying pale grey-green to yellowish grey-green; blade elliptic, ovate-elliptic or obovate-elliptic, (6.5–)9.5–30.5 × (2.5–)3–8.5 cm, base cuneate to long-attenuate, shortly decurrent on petiole, margin plane to recurved, shallowly, distantly blunt-toothed, apex sharply acuminate, acumen to 3 cm long; midrib narrowly channelled above; lateral veins 5–11 pairs, curved from the base, finely raised or sunken above, looping and joining to form a distinct intramarginal vein 4 mm or more distant from the margin; intercostal venation fine, closely reticulate, raised and prominent on both surfaces; petiole 5–20 mm long, channelled above, with sharp flanges from decurrent leaf blade, diminishing to a finely raised line near petiole base, glabrous. **Inflorescences** in the axils of upper leaves, fascicles of sessile flowers or unbranched or branched racemes or fascicles of such racemes to 6.5 cm long; axis glabrous to moderately densely appressed-hairy; bracts and bracteoles broadly ovate, keeled, membranous, pale, persistent in fruit, glabrous or with appressed hairs on keel and ciliate margins, to 2(–2.5) mm and 1(–1.6) mm long respectively. **Flowers** almost sessile to pedicellate (pedicels to 8 mm long); calyx spreading, yellow when fresh, translucent when dry, to 1.7 mm long, almost completely divided into rounded or broadly ovate, overlapping, glabrous, ciliate lobes; corolla lobes oblong-elliptic, white when fresh, drying pale, glabrous, ciliate, to 5.5 mm long; stamens c. 30–100, anthers and filaments yellow; ovary glabrous, to 1.2 mm high, style white when fresh. **Immature infructescences** to 7 cm long. **Immature fruits** flask-

shaped with cylindrical neck, to 1.3×0.5 cm, somewhat ridged, glabrous, pale blue-grey, with erect calyx lobes.

Distribution. Endemic in Borneo.

Ecology. In primary and logged mixed dipterocarp forests, on flat or undulating land or hillsides, at 80–250 m altitude.

Key to varieties

Petiole base somewhat swollen and geniculate. Flowers sessile. Inflorescence axis entirely absent.....

var. **iliaspaiensis**

Treelet to 3.5 m tall. Leaves $15\text{--}30.5 \times 4.5\text{--}8.5$ cm, base long-attenuate, acumen to 3 cm long.

Known only from G. Silantek, Sarawak (e.g., *S 42494* and *S 42517*) in mixed dipterocarp forest at 180–250 m altitude on hillsides.

Petiole base slender and not geniculate. Inflorescences 1.5–6.5 cm long, basally branched or unbranched spikes or racemes or fascicles of such racemes.....

var. **pedunculata** K.G.Pearce

(Latin, *pedunculatus* = with peduncle; the inflorescence)

Gard. Bull. Sing. 55 (2003) 70. Type: *Fedilis SAN 95642*, Borneo, Sabah, Kalabakan district (holotype SAN; isotypes K, KEP, L, SAR, SING).

Tree to 13 m tall. Petiole slender throughout. Leaves $7.5\text{--}20 \times 2.5\text{--}6$ cm, base cuneate, acumen to 1.4 cm long.

In Sabah, known from Kalabakan, Sandakan and Tawau districts (e.g., *SAN 56798*, *SAN 56991*, *SAN 95642*, *SAN 136314*, and *SAN 141166*). Also occurring in Brunei (e.g., *Wong WKM 1079*). In primary and logged mixed dipterocarp forests at altitudes to 80 m, on flat or undulating land or ridges.

17. *Symplocos laeteviridis* Stapf

(Latin, *laetus* = bright, *viridis* = green; the bright green leaves of some dried specimens)

FMK (1894) 205; Brand *op. cit.* (1901) 53; Merrill *op. cit.* (1921) 487; Airy Shaw *op. cit.* 408; Masamune *op. cit.* 609; Heine, Pflz. Samml. Clemens Kinabalu (1953) 88; Nooteboom *op. cit.* (1975) 209, *op. cit.* (1977) 261; Kochummen *op. cit.* 272; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 343; Turner *op. cit.* 480; Coode *et al.* (eds.) *op. cit.* 316. **Type:** *Haviland 1320*, Borneo, Sabah, Mt. Kinabalu, Penokok (holotype K; isotype BO). **Synonyms:** *Symplocos forbesii* Brand *op. cit.* (1901) 63; *S. mjöbergii* Merr., *op. cit.* (1928) 546; *S. kinabaluensis* Heine, Mitt. Bot. Stantssamml. München 6 (1953) 217, Pflz. Samml. Clemens Kinabalu (1953) 88.

Shrub or tree to 23 m tall, to 20 cm diameter. Bark smooth, brown, green or grey; inner bark green to orange. **Sapwood** white to yellow. **Twigs** weakly zigzag, terete; *young parts grooved or striate and pubescent to patently short- or long-pilose to glabrous*; older parts less hairy to glabrescent, medium to dark brown. **Leaves** alternately to spirally arranged, chartaceous to subcoriaceous, *glabrous on both surfaces to variously tomentose below, drying olive-green, olive-brown or warm-brown*; blade ovate, lanceolate, oblong-ovate, oblong-lanceolate or elliptic, $1.5\text{--}13.5 \times 0.7\text{--}4.5$ cm, base cuneate, rounded, obtuse,

subcordate or cordate, sometimes somewhat asymmetric, *margin more or less entire to closely, bluntly or sharply dentate, apex short or long attenuate*, often asymmetric; *midrib channelled above; lateral veins 3–9 pairs, joining to form looped, intramarginal vein; petiole 1.5–4 mm long, variously tomentose*. **Inflorescences** commonly arising simultaneously from the axils of 6–12 or more distal leaves, simple or branched racemes, pairs of racemes or spikes to 6.5 cm long; axis hairy to glabrous; bracts and bracteoles soon caducous, appressed hairy. **Flowers:** calyx lobes hairy to virtually glabrous; ovary appressed hairy to glabrous. **Fruits** ovoid, to 1 × 0.7 cm, sometimes somewhat curved, smooth to ridged, reddish green ripening blue, with persistent, often somewhat twisted calyx lobes which may be spreading, erect and/or incurved on a single fruit.

Vernacular names. Sabah—*lobo* (Dusun, Kadazan). Sarawak—*buing* (Kenyah), *jirah* (Iban), *lupau* (Kelabit), *luroh* (Kayan).

Distribution. N Sumatra, Peninsular Malaysia, Borneo, and Sulawesi.

Ecology. In mixed dipterocarp, lower to upper montane forests including montane *kerangas* forest, sometimes in disturbed forest, at 10–2900 m altitude, though seldom below 600 m, on hillsides and ridges, sometimes beside streams, on sandy, stony or basalt-derived soils.

Notes. A common and widespread species with at least eight recognisable varieties.

Key to varieties

1. Young twigs and both leaf surfaces glabrous.....
 var. **alabensis** K.G.Pearce
 (of G. Alab, Sabah)
 Gard. Bull. Sing. 55 (2003) 71. Type: *Madani & Majawat SAN 119252*, Borneo, Sabah, Penampang district, G. Alab (holotype SAN).
 Treelet to 2 m tall. Leaves lanceolate, to 6 × 2 cm, base cordate; lateral veins 10 pairs; petiole *c.* 1 mm long.
 Only known from G. Alab in Sabah (e.g., the type and *Kamaruddin KMS 1431*).
 Young twigs and at least midrib below hairy.....2

2. Leaf base cuneate to rounded, leaves to 5.7 cm long. Young twigs, leaf undersurface and midrib densely rufous appressed pilose.....
 var. **alternifolia** Noot.
 (Latin, *alternus* = alternate, *folium* = leaf; with alternate leaves)
 Leiden Bot. Ser. 1 (1975) 211, *op. cit.* (1977) 263. Type: *Meijer SAN 20964*, Borneo, Sabah, Ranau district, Bt. Ampuan (holotype L; isotypes K, KEP, S).
 Tree to 8 m tall. Leaves ovate. Fruits pinkish-red.
 Only recorded in Sabah from Mt. Kinabalu, Ranau district, at 1200–1600 m altitude on ultrabasic soil (e.g., *RSNB 288*, *RSNB 4550*, *SAN 111608*, *SAN 123390*, and *SAN 123529*) and G. Trus Madi, Tambunan district (e.g., *Sugau JBS 129*).
 Leaf base cordate; if rounded or cuneate then leaves longer than 6 cm or undersurface not as above.....3

3. Leaves 6.5–12 cm long. Twigs velutinous with short, dense, patent tomentum of rufous hairs.....
- var. **velutinos** Noot.
(Latin, *velutinus* = velvety; the velvety-haired twig)
Leiden Bot. Ser. 1 (1975) 213, *op. cit.* (1977) 263. Type: *Kanis & Kuripin SAN 53955*, Borneo, Sabah, Mt. Kinabalu, above Kiau II, Gurulau spur (holotype L; isotype KEP).
Tree to 10 m tall, to 10 cm diameter. Leaves oblong, base rounded to slightly cordate.
In Sabah, known from Mt. Kinabalu, Ranau district and G. Trusmadi, Tambunan district (e.g., *Clemens 40355*, *SAN 51433* and *SAN 125614*). In Sarawak, occur in Melinau, Kapit district (e.g., *S 25870*), Batu Laga Plateau (e.g., *S 48250*) and Tama Abu Range (e.g., *S 51104*). In old secondary forest at 1000–1600 m altitude on hills on dark brown soil.
Leaves less than 6.5 cm long, or if more then twigs with some long, spreading hair
4. Leaf base cuneate to rounded; most leaves 6 cm or longer.....
- var. **laeteviridis**
Synonym: *Symplocos forbesii* Brand *op. cit.* (1901) 63.
Tree to 23 m tall, to 20 cm diameter. Leaves often drying bright green; blade narrow, lanceolate or oblong-lanceolate to elliptic, apex tapering and long-acuminate.
Sumatra, Peninsular Malaysia, Borneo and SW Sulawesi. In Borneo, widespread and common and known from various localities in Sabah (e.g., *SAN 65017*, *SAN 74483*, *SAN 83999*, *SAN 109990*, and *SAN 131332*), Sarawak (e.g., *S 21895*, *S 22188*, *S 36785*, *S 40900*, and *S 47350*) and Kalimantan (e.g., *bb. 6831*, *Church AC 543*, *Endert 3900*, and *Mogea 3817*). In mixed dipterocarp, *kerangas*, lower to upper montane forests, at 10–2900 m altitude, though seldom below 600 m, usually on slopes and ridges, sometimes besides streams, on sandy, stony or basalt-derived soils.
Leaf base cordate, or if cuneate or rounded then leaves less than 6 cm long.....5
5. Twigs with an indumentum of spreading hairs at least 1 mm long.....6
Twig indumentum not as above.....7
6. Leaves at least 6 cm long, if less then the base distinctly cordate to 2 mm deep or more.....
- var. **mjöbergii** (Merr.) Noot.
(Eric P. Mjöberg, 1882–1938, Director of Sarawak Museum 1922–1924, plant collector)
Leiden Bot. Ser. 1 (1975) 212, *op. cit.* (1977) 263. Basionym: *Symplocos mjöbergii* Merr. *op. cit.* (1928) 546. Type: *Mjöberg 97*, Borneo, Sarawak, G. Murud (holotype UC; isotypes BM, K).
Shrub or tree to 15 m tall, to 15 cm diameter. Leaves often appearing somewhat bullate above due to sunken veins, drying yellow-brown to brown, oblong.
In Sabah, recorded from Kota Belud and Ranau districts (e.g., *SAN 24193*, *SAN 32336*, *SAN 38541*, *SAN 60646*, *SAN 76485*, and *SAN 93908*). In Sarawak, only known in the northern parts from the Kelabit Highlands, including Batu Lawi and G. Murud (e.g., *Nooteboom 1909*, *Nooteboom 2191*, *S 26429*, and *S 50836*). Also

occurring in Brunei (e.g., *Niga MN 357*). In hill mixed dipterocarp, lower to upper montane forests at 1300–2000 m altitude, on slopes and ridges on yellow sandy soil.

Leaves to 5(–9.7) cm long, base rounded, or if cordate to less than 1 mm deep.....

var. **baserotunda** Noot.

(Latin, *basis* = base, *rotundus* = round; the rounded leaf base)

Leiden Bot. Ser. 1 (1975) 212, *op. cit.* (1977) 263. Type: *Nooteboom & Chai 1819*, Borneo, Sarawak, Kelabit Highlands, trail from Bario to Pa Ukat (holotype L; isotype KEP).

Shrub or treelet to 4 m tall. Leaves oblong to ovate, distinctly sharp-toothed.

In Sabah, known from Mt. Kinabalu, Ranau district and G. Trus Madi, Keningau district (e.g., *Kokawa & Hotta 5762*, *RSNB 1272* and *SAN 71910*). In Sarawak, recorded from Batu Lawi, G. Murud and the Kelabit Highlands, Lawas district (e.g., *Nooteboom 1864*, *Nooteboom 2329* and *S 26302*). Also known from Kalimantan (e.g., *Church AC 657*). In primary or disturbed lower montane forest at 1000–1800 m altitude, on slopes or ridges on sandy, humus-covered soils with rocks and exposed roots.

7. Leaf margin entire, rarely finely toothed, base cuneate to rounded.....

var. **pauciflora** Noot.

(Latin, *pauci* = few or sparse, *flos* = flower; the few-flowered inflorescence)

Leiden Bot. Ser. 1 (1975) 213, *op. cit.* (1977) 263. Type: *Fuchs 21064*, Borneo, Sabah, Mt. Kinabalu (holotype L; isotypes A, K, SAR).

Shrub or treelet to 10 m tall, to 14 cm diameter. Leaves broadly ovate to oblong. Petiole 2–4 mm long. Fruits reddish, ripening blue.

In Sabah, known from Sipitang district (e.g., the type collection and *SAN 132752*) and in Sarawak from Belaga, Lawas, Limbang, and Marudi districts (e.g., *S 32918*, *S 47811*, *S 50917*, *S 51105*, and *S 58294*). Also occurring in Brunei (e.g., *Coode MC 7580*). In hill and lower to upper montane (including *kerangas*) forests at 1200–2500 m altitude on slopes and ridges.

Leaf margin distinctly toothed, base minutely cordate.....

var. **kinabaluensis** (Heine) Noot.

(of Mt. Kinabalu, Sabah)

Leiden Bot. Ser. 1 (1975) 212, *op. cit.* (1977) 263. Basionym: *Symplocos kinabaluensis* Heine, Mitt. Bot. Staatssamml. München 6 (1953) 217. Lectotype (*Nooteboom*, 1975): *Clemens 29751*, Borneo, Sabah, Mt. Kinabalu (hololectotype K; isolectotypes BM, BO, L, SING).

Shrub or treelet to 7 m tall. Leaves ovate to oblong-ovate, to 5(–6.5) cm long.

Known only from Mt. Kinabalu, Ranau district, Sabah (e.g., *RSNB 2801*, *SAN 26789*, *SAN 32383*, *SAN 114355*, *SAN 117321*, and *SNP 3906*). In montane *kerangas* forest at 1500–2900 m altitude, on hillsides and ridges.

18. *Symplocos odoratissima* (Blume) Choisy ex Zoll.

(Latin, *odoratissima* = most fragrant; the flowers)

Syst. Verz. 2 (1854) 136; Koorders & Valetton *op. cit.* 148; Brand *op. cit.* (1901) 35; King & Gamble *op. cit.* 233; Merrill *op. cit.* (1921) 488; Koorders *op. cit. t.* 382; Ridley *op. cit.* (1923) 299; Masamune *op. cit.* 610; Backer & Bakhuizen *f. op. cit.* 205; *Nooteboom op. cit.* (1975) 245, *op. cit.* (1977) 266; Kochummen *op. cit.* 272; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 343; Turner *op. cit.* 481; Coode *et al.* (eds.) *op. cit.* 316; Argent *et al.* (eds.) *op. cit.* 621. **Basionym:** *Dicalyx odoratissimus* Blume *op. cit.* 1116. **Type:** *Blume 1947* (= *RHL Sheet No. 944235499*), Java,

G. Padang (holotype L; isotypes BO, NY, S). **Synonyms:** *Eugeniodes odoratissima* (Blume) Kuntze *op. cit.* 975; *D. aluminosa* (non Lour.) Blume *op. cit.* 1117, p.p.; *S. odoratissima* (Blume) Choisy ex Zoll. var. *aluminosa* Koord. & Valetton *op. cit.* 150; *S. aluminosa* Brand *op. cit.* (1901) 35; *Pygeum grandiflorum* King, J. As. Soc. Beng. 66, 2 (1897) 228; *S. odoratissima* (Blume) Choisy ex Zoll. var. *divaricata* Brand *op. cit.* (1901) 35; *S. pulverulenta* King & Gamble *op. cit.* 234; *S. wenzelii* Merr., Philip. J. Sci. 10 (1915) Bot. 282; *S. trichophlebia* Merr. *op. cit.* (1929) 248 (For further synonyms, cf. Nooteboom *l.c.* (1975) 245).

Tree to 28 m tall, to 50 cm diameter. **Bark** smooth to scaly, pale to dark brown or grey; inner bark white to yellow. **Sapwood** yellow to brown. **Twigs** straight to curved; young parts grooved, striate to almost smooth, *puberulous and/or patently pilose to virtually glabrous*, warm to dark brown; *older parts terete, striate to almost smooth, sparsely to moderately densely patent-pilose*, glabrescent. **Leaves** spirally arranged, chartaceous to coriaceous, *glabrous above, glabrous or pilose below*, especially on the veins, drying olive-brown, olive-green or chocolate-brown; *blade elliptic to obovate-elliptic, 6.5–32 × 2.5–13.5 cm*, base cuneate, acuminate to almost rounded, *margin toothed to entire*, plane to recurved, *apex blunt-tipped acuminate*; midrib finely channelled above; *lateral veins 8–13 pairs*, joining to form an intramarginal vein or only joined at apex; intercostal veins more or less perpendicular to lateral veins; *petiole 6–35 mm long*, shallowly channelled to almost terete, slender to stout, glabrous or puberulous. **Inflorescences** in the axils of apical leaves, *many-flowered panicles 5–17 cm long*, sometimes only branched near base; axis (as also bracts, bracteoles, ovary and calyx) rusty tomentellous; bracts early caducous, to 1.5 mm long; bracteoles caducous, to 1.2 mm long. **Flowers** sessile or with pedicels to 6 mm long, minute; calyx tube 0.3–1 mm long, lobes to 1.5 mm long, blunt; corolla oblong-ovate, white to yellow when fresh, usually tomentellous at least in bud, to 4 mm long; stamens more than 100, anthers yellow when fresh; disk hairy with 5 conspicuous glands; ovary 0.75–1.75 mm high, style pilose towards conical base, *c.* 4 mm long. **Infructescence** often with rather few fruits. **Fruits** pear-shaped, *obliquely ovoid to almost globular, 8–25 × 5–20 mm*, obscurely ridged, glabrous or tomentellous, ripening blue, with remains of calyx lobes spreading, erect or incurved over the hardly sunken disk and style base; pericarp thin and fleshy or thick and woody.

Vernacular name. Sabah—*lisang* (Dusun).

Distribution. Throughout Malesia except New Guinea. In Borneo found in C and E Sabah, Sarawak, Brunei, and Kalimantan.

Ecology. In primary and secondary mixed dipterocarp forests to 500 m altitude on flat, sometimes swampy land, usually on river banks, sometimes on hillsides on alluvial sandy to loamy soil.

Uses. In Borneo, local people extract salt from the wood ash. The bark is used for dyeing. The inner bark (*kayu* or *kulit seriawan*) is commonly sold in W Java as a medicine for thrush, pounded bark being applied to the gums or bark decoctions used; young leaves are pounded or used for decoctions and used likewise. The pulped leaves are also applied to the abdomen after childbirth and taken internally in a decoction.

Key to varieties

Twigs mostly glabrous. Petiole 6–15 mm long, slender, base not swollen. Leaves 2.5–5.5 cm wide, chartaceous. Fruits 5–10 mm diameter, with thin fleshy pericarp.....

var. odoratissima

Synonyms: *Dicalyx aluminosus* auct. non Lour.: Blume *op. cit.* 1117; *Symplocos aluminosa* Brand *op. cit.* (1901) 35; *Pygeum grandiflorum* King *op. cit.* 228; *S. odoratissima* (Blume) Choisy ex Zoll. var. *divaricata* Brand *op. cit.* (1901) 35; *S. pulverulenta* King & Gamble *op. cit.* 234.

Tree to 27 m tall, to 40 cm diameter. Twigs sparsely patent-hairy to virtually glabrous. Leaves drying dark chocolate-brown, margin plane, coarsely, bluntly, black-gland-tipped toothed except near the base; lateral veins joining to form an intramarginal vein. Throughout Malesia except New Guinea. In Borneo, known from Kinabatangan, Lahad Datu, Ranau, and Sandakan districts in Sabah (e.g., *SAN 31073*, *SAN 36600*, *SAN 88633*, *SAN 89153*, and *SAN 119889*), Simunjan district in Sarawak (e.g., *S 35656*) and W Kalimantan (e.g., *Kostermans 4848* and *Kostermans 4935*).

Twigs patently pilose or tomentose. Petiole (9–)17–35 mm long, more or less stout, base often swollen. Leaves (4–)5–13.5 cm wide, coriaceous. Fruits 12–20 mm diameter, with thick, woody mesocarp.....

var. wenzelii (Merr.) Noot.

(C.A. Wenzel, 1882–1929, professional plant collector in Mindanao, the Philippines) Leiden Bot. Ser. 1 (1975) 248, *op. cit.* (1977) 267. Basionym: *Symplocos wenzelii* Merr., *op. cit.* (1915) 282. Type: *Wenzel 1022*, the Philippines, Leyte (holotype GH; isotypes BM, G). Synonym: *Symplocos trichophlebia* Merr., *op. cit.* (1929) 248.

Tree to 27 m tall, to 50 cm diameter. Twigs sparsely to moderately densely patent-pilose. Leaves drying olive-brown to olive-green, margin plane, recurved or revolute, virtually entire; lateral veins usually not joining to form a distinct intramarginal vein except sometimes at apex.

Sumatra, Borneo, and the Philippines. In Borneo, recorded from Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Pensiangan, Sandakan, and Tawau districts in Sabah (e.g., *SAN 30117*, *SAN 48959*, *SN 66054*, *SAN 79216*, and *SAN 124714*), G. Api, Ulu Melinau in Sarawak (e.g., *S 30403*), Batu Apoi, Temburong district in Brunei (e.g., *Kirkup 945*), and E Kutei in Kalimantan (e.g., *Kostermans 5790*).

19. *Symplocos ophirensis* C.B. Clarke

(of Mt. Ophir = G. Ledang, Johor, Peninsular Malaysia)

In Hooker *f.*, *Fl. Brit. Ind.* 3 (1882) 579; King & Gamble *op. cit.* 243; Ridley *op. cit.* (1923) 305; Nooteboom *op. cit.* (1975) 249, *op. cit.* (1977) 267; Kochummen *op. cit.* 272; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 343; Turner *op. cit.* 481. **Lectotype** (Nooteboom, 1975): *Griffith 3650*, Peninsular Malaysia, Malacca, summit of Mt. Ophir (hololectotype K; isolectotype P). **Synonyms:** *Eugeniodes ophirensis* (C.B. Clarke) Kuntze *op. cit.* 975; *Symplocos cumingiana* Brand *op. cit.* (1901) 58; *S. perakensis* King & Gamble *op. cit.* 241; *S. caudata* auct. non Wall. ex G. Don: Ridley *op. cit.* (1923) 304.

Tree to 30 m tall, to 33 cm diameter. **Bark** smooth, brown or grey; inner bark pale brown. **Sapwood** white to yellow. **Twigs** straight to curved, occasionally obscurely zigzag, grooved; young parts virtually glabrous; older parts terete and striate. **Leaves** spirally arranged, chartaceous to thin-coriaceous, glabrous above, glabrous to sparsely appressed-hairy below, drying pale to dark olive-green or olive-brown; blade ovate-elliptic, elliptic to elliptic-obovate, 4.5–18 × 1.5–8 cm, base acute to obtuse, more or less attenuate, margin

almost entire to dentate, plane to recurved, apex shortly acuminate to long-attenuate, acumen to 2 cm long, often curved; midrib finely, sometimes shallowly channelled above; lateral veins 5–14 pairs, indistinct above, curved towards the margins, forming a distinct, looped, intramarginal vein, sometimes with a second, less distinct, intramarginal vein; intercostal venation lax; petiole 3–15 mm long, channelled or not, narrowly flanged to base or nearly to base, glabrous to sparsely pilose at base. **Inflorescences** simple or basally branched, 5–10 (or more)-flowered spikes or racemes, to 2.7 cm long; axis glabrous to more or less appressed-pilose, often less densely so near base; bracts and bracteoles ovate, keeled, persistent sometimes to fruiting stage or caducous, appressedly pilose to glabrescent, to 1.5(–4) mm long. **Flowers** minute, sessile or pedicellate with the pedicels to 3 mm long; calyx to 1.3 mm long, lobes rounded to blunt triangular, margin usually appearing paler than rest of calyx and ovary, ciliate, shortly appressed-pilose to almost glabrous at margin, usually markedly less hairy than ovary, or both calyx and ovary virtually glabrous, to 1 mm long; corolla white to yellow when fresh, 2–4.5 mm long; stamens more than 25, anthers yellow when fresh; ovary densely short-appressed-hairy to virtually glabrous, 0.5–1.3 mm high. **Infructescences** with up to exceptionally five fruits. **Fruits** ovoid, ovoid-ellipsoid to flask-shaped, c. 0.9 × 0.6 cm, with or without prominent irregular ridges especially near base, virtually glabrous or finely appressed-hairy, ripening blue to deep purple, with erect or apically incurved calyx lobes surrounding the persistent style base.

Vernacular names. Sabah—*loboh* (Pensiangan). Sarawak—*entulang jerak* (Iban), *lemasok* (Kenyah).

Distribution. Sumatra, Peninsular Malaysia, Borneo, the Philippines, and Sulawesi.

Ecology. In primary mixed dipterocarp, high *kerangas*, lower and upper montane forests, at 10–1700 m altitude, though usually found at 1200 m and above, on hillsides, ridges and by rivers on alluvial sand and clay-rich soils.

Uses. The timber is locally used to make planks.

Notes. Nootboom (*op. cit.* (1975) 249) distinguished three subspecies with seven varieties in this species. Of these, only two subspecies with two varieties occur in Sabah and Sarawak.

Key to subspecies and varieties

Leaf elliptic, elliptic-obovate or obovate; margin bluntly to sharply black-gland tipped;
lateral veins 8–14
pairs.....

subsp. **cumingiana** (Brand) Noot. var. **cumingiana**

(H. Cuming, 1791–1865, English traveller and naturalist, plant collector)

Leiden Bot. Ser. 1 (1975) 253, *op. cit.* (1977) 268; Anderson *op. cit.* 328. Basionym: *Symplocos cumingiana* Brand *op. cit.* (1901) 58. Type: *Cuming 1463*, the Philippines, Luzon, Prov. Camarines Sud (L).

Tree to 30 m tall. Leaf chartaceous to coriaceous, 7–18 × 2.5–6(–8) cm, base acute to attenuate, decurrent on petiole; petiole 4–15 mm long.

Distribution and ecology as for the species. In Sabah, known from Keningau, Kinabatangan, Kota Belut, Labuk Sugut, Penampang, Pensiangan, Ranau, Sipitang, and Tambunan districts (e.g., *RSNB 7040*, *SAN 48058*, *SAN 83658*, *SAN 127851*, and *SAN*

131431) and in Sarawak, from Limbang and Marudi districts (e.g., S 25848, S 26361, S 50492, S 50681, and S 55924). Also recorded from Kalimantan (e.g., *Enderi* 4135).

Leaf elliptic to ovate-elliptic, margin obscurely blunt-toothed to almost entire with unraised brown gland dots, lateral veins 5-8 pairs.....

subsp. **perakensis** (King & Gamble) Noot. var. **perakensis**

(of Perak, Peninsular Malaysia)

Leiden Bot. Ser. 1 (1975) 254, *op. cit.* (1977) 268; Kochummen *op. cit.* 273. Basionym: *Symplocos perakensis* King & Gamble *op. cit.* 241. Lectotype (Nootboom, 1975): *King's Collector 10985*, Peninsular Malaysia, Perak (holotype L; isotypes BM, CGE, W).

Shrub or treelet to 4 m tall. Leaf chartaceous, 5.5–10.5 × 2.5–4 cm, *base broadly acuminate to obtuse, hardly decurrent on petiole*, petiole 3–9 mm long.

In Sabah, known from Keningau, Kinabatangan and Pensiangan districts (e.g., *SAN 105254*, *SAN 106872* and *SAN 127989*) and in Sarawak, recorded from Limbang and Miri districts (e.g., *S 21400* and *S 42860*). Also occurring in Brunei (e.g., *Davis APD 514*). Ecology as for the species.

20. *Symplocos pendula* Wight

(Latin, *pendulus* = hanging down; the flowers)

Icon. Pl. Ind. Orient. 4 (1848) t. 1237; C.B. Clarke *op. cit.* 587; Brand *op. cit.* (1901) 88; Steenis *op. cit.* 437; Nootboom *op. cit.* (1975) 40, *op. cit.* (1977) 214; Kochummen *op. cit.* 273; Anderson *op. cit.* 329; Whitmore, Tantra & Sutisna *op. cit.* 343; Turner *op. cit.* 481; Coode *et al.* (eds.) *op. cit.* 316.

Syntypes: *Herb. Wight 2136*, India, Mt. Pulney (holotype K; isotypes E, L) and *Herb. Wight s.n.*, Sri Lanka (K). **Synonyms:** *Palura pendula* (Wight) Miers *op. cit.* 297; *Eugeniodes pendula* (Wight) Kuntze *op. cit.* 976; *Cordyloblaste pendula* (Wight) Alston, Fl. Ceyl. Suppl. (1931) 188; *Symplocos confusa* Brand *op. cit.* (1901) 88; *Symplocos albifrons* Brand *op. cit.* (1901) 88; *Symplocos capitellata* Brand *op. cit.* (1901) 88; *Symplocos foxworthyii* Brand *op. cit.* (1908) Bot. 3; *Styrax obovatus* Ridl., J. Str. Br. Roy. As. Soc. 61 (1912) 8; *Symplocos crenulata* Ridl., J. Fed. Mal. St. Mus. 6 (1915) 51; *Symplocos pulcherrima* Ridl., *op. cit.* (1915) 160.

Distribution. A species consisting of two varieties distributed in continental SE Asia, throughout Malesia except Java and the Lesser Sunda Islands.

Notes. In Sabah and Sarawak, only var. *hirtistylis* is known. The other variety, var. *pendula*, occurs in Sri Lanka, Deccan, Hainan and Peninsular Malaysia.

var. **hirtistylis** (C.B. Clarke) Noot.

(Latin, *hirtellus* = finely hairy, *stylus* = style; the hairy style)

Leiden Bot. Ser. 1 (1975) 42, *op. cit.* (1977) 215; Kochummen *op. cit.* 273. **Basionym:** *S. henschelii* C.B. Clarke var. *hirtistylis* C.B. Clarke *op. cit.* 588. **Type:** *Maingay 2586*, Peninsular Malaysia, Mt. Ophir (holotype K). **Synonyms:** *Symplocos capitellata* Brand *op. cit.* (1901) 88; *Symplocos confusa* Brand *op. cit.* (1901) 88; *Symplocos henschelii* auct. non Benth.: C.B. Clarke *op. cit.* 588; *Cordyloblaste confusa* (Brand) Ridl., *op. cit.* (1923) 307; *Bobua confusa* (Brand) Kanehira & Sasaki, List Pl. Form. (1928) 330; *Symplocos albifrons* Brand *op. cit.* (1901) 88; *Styrax obovatus* Ridl., *op. cit.* (1912) 8; *Symplocos crenulata* Ridl., *op. cit.* (1915) 51.

Tree to 24 m tall, to 30 cm diameter. **Bark** smooth to rugose, dark brown; inner bark red. **Sapwood** yellow or cream, hard. **Twigs** *crooked or curved, terete but with prominently raised petiole scars which when closely set give the twig a knobbly appearance*; young parts striate, sometimes ridged from below persistent petiole scars, sparsely to densely appressed short-pilose, brown to black, often with red tinge; *older parts horizontally cracked, glabrescent*. **Leaves** spirally arranged, thin-coriaceous, glabrous on both surfaces, drying grey-green, olive-brown, chocolate-brown or almost black; *blade elliptic, broadly elliptic-obovate to almost orbicular, 1.5–10 × 1–5 cm, base shortly attenuate to cuneate, decurrent on petiole, margin inconspicuously to conspicuously distantly blunt-toothed, plane to recurved, apex shortly blunt to sharp-acuminate to rounded; midrib above finely channelled, glabrescent or pubescent to pilose at least towards leaf base, with scattered appressed hairs, to glabrescent below; lateral veins 5–8(–10) pairs, inconspicuous above, branching towards margin to form an indistinct double intramarginal vein; intercostal venation lax, some almost as prominent as veins below; petiole (1–)4–10 mm long, shallowly channelled with narrow flanges to base, indumentum as twig, more or less rugulose, drying dark*. **Inflorescences** 1–5-flowered spikes or racemes to 2.2 cm long; axis contracted, densely appressed buff-pilose (as are bracts, bracteoles, calyx and ovary); bracts and bracteoles triangular, keeled, spreading at anthesis, persistent sometimes to fruit stage or not, to 2 mm and 1 mm long respectively. **Flowers** sessile or occasionally pedicellate with the pedicel to 3 mm long; calyx tube reddish-green when fresh, to 2.5 mm long, including rounded lobes to 1.3 mm long; corolla white, cream or pink and fragrant when fresh, to 13 mm long, forming a tube for part of its length, lobes spatulate, appressed-pilose on outer surface, less densely pilose to glabrous within; stamens joined in a tube for most of their length; ovary to 2 mm high, style base swollen, densely appressed-hairy. **Infructescences** bearing 1 or 2 fruits. **Fruits** ellipsoid, *c. 1 × 0.7 cm*, short-pilose, especially towards the apex, reddish green, with calyx lobes surrounding the protruding, swollen, densely pilose style base.

Vernacular name. Sarawak—*legai* (Iban).

Distribution. Myanmar, Indo-China, China, Japan, Taiwan, and throughout Malesia except Java and the Lesser Sunda Islands. In Sabah, recorded from Keningau, Kota Belud, Penampang, and Ranau districts (e.g., *SAN 29157, SAN 32316, SAN 56308, SAN 87176, and SAN 123381*). In Sarawak, known from Bau, Kuching, Limbang, Lundu, and Marudi districts (e.g., *S 35820, S 37069, S 47909, S 47961, and S 51023*). Also occurring in Kalimantan (e.g., *Burley 3061*).

Ecology. In high *kerangas* and lower to upper montane forests, at 800–3400 m altitude, typically on exposed mountain summits and also on hillsides. Recorded once on limestone on G. Mulu in Sarawak.

21. *Symplocos polyandra* (Blanco) Brand

Fig. 5.

(Greek, *pollos* = many, *andros* = male; with numerous stamens)

In Engler, Pflanzenreich Heft 6 (1901) 436; Merrill *op. cit.* (1921) 488, J. Arn. Arb. 32 (1951) 410; Steenis, Bull. Bot. Gard. Buitenz. 3, 12 (1932) 170; Masamune *op. cit.* 610; Nootboom *op. cit.* (1975) 264, *op. cit.* (1977) 269; Anderson *op. cit.* 329; Whitmore, Tantra & Sutisna *op. cit.* 343; Coode *et al.* (eds.) *op. cit.* 316; Argent *et al.* (eds.) *op. cit.* 622. **Basionym:** *Guettarda polyandra* Blanco, Fl. Filip. ed. 2 (1845) 500, ed. 3 (1879) 126. **Neotype** (Merrill, 1951): *Ramos & Edano BS 34206*, the Philippines, Luzon, Bulacan Prov., Angat (holoneotype A). **Synonym:** *Symplocos superba* Brand *op. cit.* (1901) 55.

Tree to 32 m tall, to 40 cm diameter. **Bark** deeply or finely fissured or cracked, occasionally scaly or smooth, pale to dark grey or brown to black, hard; inner bark white or pale yellow to brown. **Sapwood** white to pale yellow or brown, moderately heavy. **Twigs stout**, straight to curved, tapering, c. 5 mm diameter at apex; young parts somewhat angular due to a conspicuous sharp ridge from the base of each petiole scar, *densely short rufous-tomentose* to sparsely puberulous, red-brown; *older parts* more or less terete, *with many prominent, heart-shaped petiole scars and ridges from petiole scar bases still apparent*, glabrescent, becoming pale grey-brown. **Leaves** spirally arranged, crowded towards the end of twigs, coriaceous, slightly glossy above, *virtually glabrous or with scattered appressed hairs on both surfaces*, drying olive-brown, olive-green or olive-yellow; blade elliptic-obovate to elliptic-oblong, 9–23 × (3–)4–8.5 cm, base cuneate, attenuate, decurrent as sharp flanges on petiole, *margin entire*, thickened, recurved or not, *apex rounded or bluntly obtuse to bluntly acute*; midrib impressed above, sharp below; *lateral veins 11–14 pairs*, obscure, especially above, branching and joining towards margin to form an indistinct intramarginal vein; intercostal venation laxly reticulate, almost as prominent as lateral veins; *petiole 15–32 mm long*, sharply keeled beneath, sharply flanged to base, rounded and more or less ridged above, indumentum as twig, rugulose, drying dark. **Inflorescences** several to many, occurring on older twigs beneath leaves, *many-flowered spikes 2–8 cm long*; axis densely or sparsely rusty appressed-tomentose, as are bracts, bracteoles, calyx (except towards margins of lobes) and ovary; bracts and bracteoles persistent to fruiting stage, to 2 mm and 1.5 mm long respectively. **Flowers:** calyx to 3 mm long, lobes to 1.5 mm long, rounded and becoming glabrous towards apex; corolla white to cream when fresh, fragrant, glabrous to sparsely pilose on inner surface, to 6 mm long; stamens numerous, anthers yellow when fresh; disk sparsely hairy, pulvinate; ovary to 2 mm high. **Fruits ellipsoid-ovoid**, c. 1.2 × 0.7 cm, appressed short-tomentose to glabrescent, ripening violet, with erect, persistent calyx lobes.

Vernacular names. Sabah—*bundu-bundo* (Kadazan), *mundu-mundu* (Dusun), *salambuno* (Dusun). Sarawak—*entuyut* (Malay), *jirak* (Iban).

Distribution. Borneo and adjacent islands, the Philippines and SW Sulawesi. In Sabah widespread, known from Beaufort, Kota Belud, Kota Kinabalu, Kudat, Labuan, Papar, Penampang, Sandakan, Sipitang, and Tuaran districts (e.g., *SAN 30269*, *SAN 57841*, *SAN 94418*, *SAN 95142*, and *SAN 133719*). In Sarawak less common, recorded from Bintulu, Kuching and Lundu districts (e.g., *S 17287*, *S 36620*, *S 49870*, *S 59438*, and *S 68034*). Also occurring in Brunei (e.g., *BRUN 943*, *BRUN 944*, *BRUN 15029*, and *Wong WKM 194*) and in Kalimantan (e.g., *Polak 275*).

Ecology. In primary and secondary lowland or *kerangas* forests, from sea level to 170 m altitude, on flat or undulating land, hillsides or ridges, sometimes near streams, also on rocky cliffs, islands and headlands by the sea. Found on poor, well-drained sandy or rocky soils, occasionally on loam or clay and also on humic podzols.

Uses. Timber is locally used for light construction.

22. *Symplocos rubiginosa* Wall. ex A.DC.

(Latin, *rubiginosus* = rusty coloured; the indumentum)

Fig. 6.

Prod. (1844) 257; C.B. Clarke *op. cit.* 580; Brand *op. cit.* (1901) 53; King & Gamble *op. cit.* 247; Merrill *op. cit.* (1921) 488; Ridley *op. cit.* (1923) 306; Masamune *op. cit.* 610; Nootboom *op. cit.* (1975) 279, *op. cit.* (1977) 271, *op. cit.* (1984) 76; Kochummen *op. cit.* 273; Anderson *op. cit.* 392; Whitmore, Tantra & Sutisna *op. cit.* 343; Turner *op. cit.* 481; Coode et al. (eds.) *op. cit.* 316; Argent et al. (eds.) *op. cit.* 622. Type: Wallich 4432, Peninsular Malaysia, Penang (holotype G-DC; isotypes C, CGE, E, FI, K, L, LE, MEL). Synonym: *Lodhra rubiginosa* (Wall. ex A.DC.) Miers *op. cit.* 299.

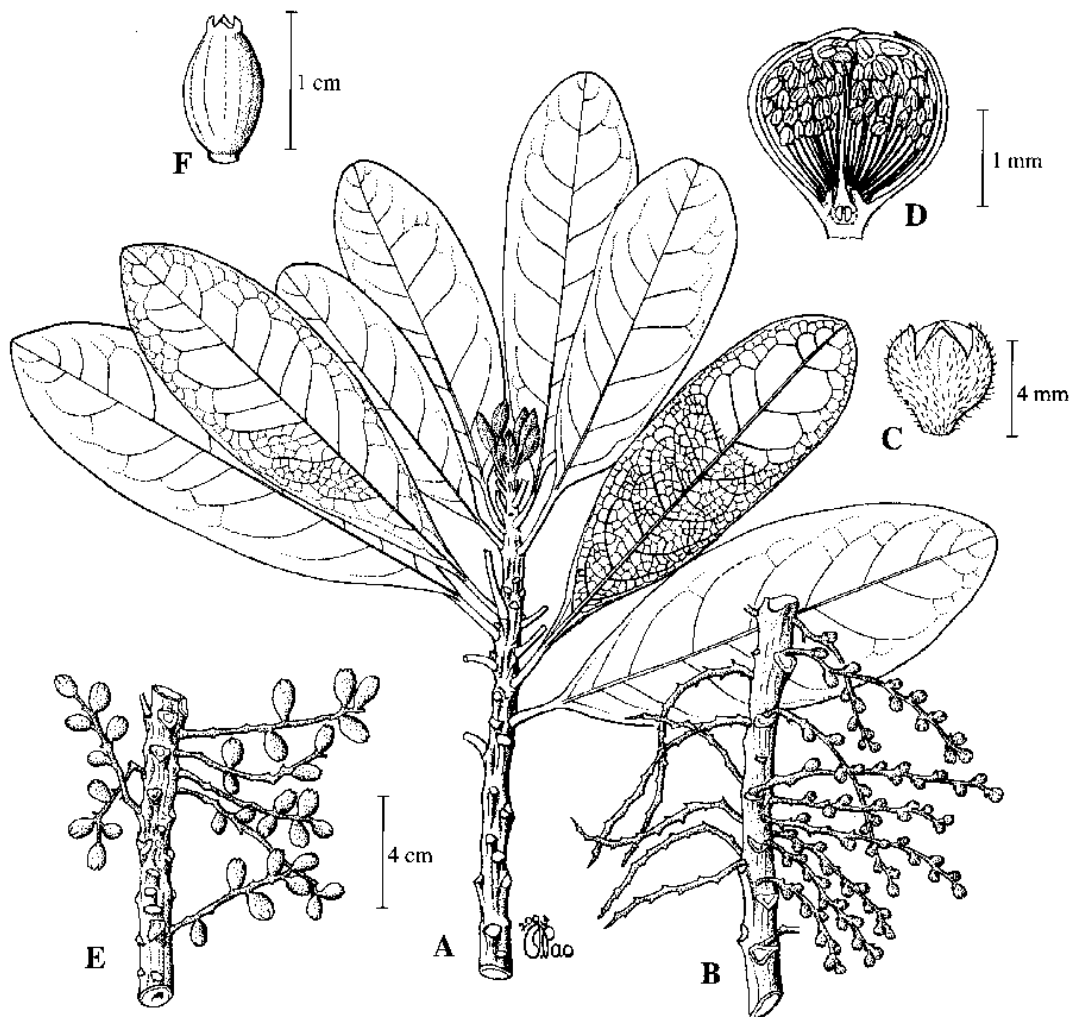


Fig. 5. *Symplocos polyandra*. A, leafy twig; B, lower part of twig with inflorescences; C, flower bud; D, longitudinal section of flower bud; E, lower part of twig bearing infructescences; F, fruit. (A and E–F from *S* 42163, B–D from *SAN* A 3070.)

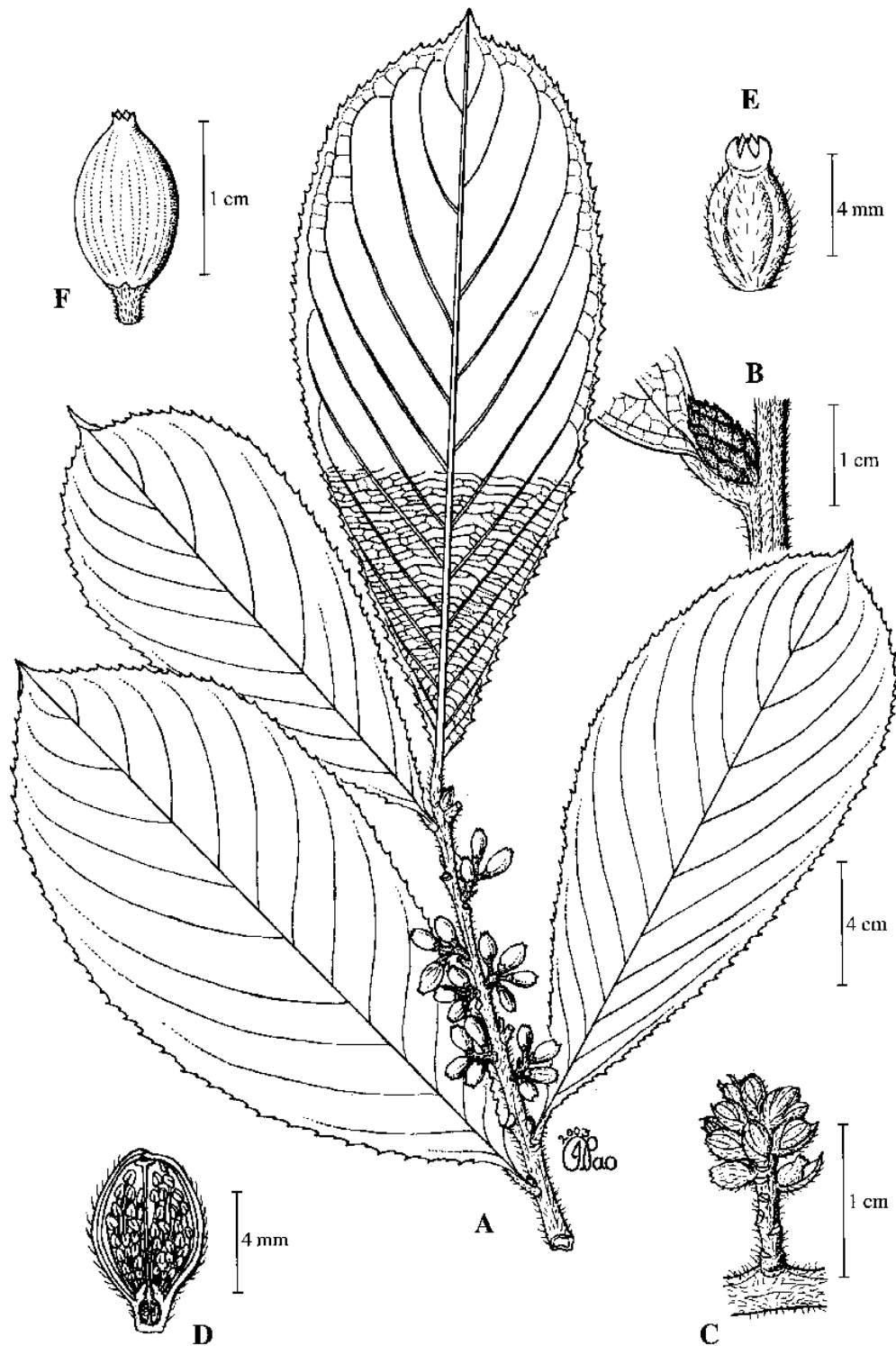


Fig. 6. *Symplocos rubiginosa*. A, fruiting leafy twig; B, young inflorescence; C, older inflorescence; D, longitudinal section of flower bud; E, young fruit; F, mature fruit. (A and F from S 39238, B from S 46063, C–E from S 34829.)

Tree 8–30 m tall, 15–50 cm diameter. **Bark** smooth, brown; inner bark brittle, cream. **Sapwood** pink, soft. **Twigs** *straight*, stout, to 5 mm diameter at apex; *young parts deeply grooved and finely striate, densely rufous-tomentose*, pale to warm-brown; *older parts terete, without horizontal cracks, glabrescent*, pale brown. **Leaves** spirally arranged, sometimes clustered at intervals along twig, chartaceous to thin-coriaceous, virtually glabrous above, *moderately densely appressed to patent-scabrous below, especially on midrib and veins, drying pale olive-green to yellow-green*; blade elliptic-obovate, 15–40 × 5.5–14 cm, *base cuneate*, shortly decurrent as narrow flanges only at top of petiole, *margin plane, coarsely sharply double-toothed, apex more or less abruptly acuminate, acumen to 2 cm long*; *midrib finely channelled above, prominent below*; *lateral veins 7–11 pairs, if joining to form an intramarginal vein then only towards the leaf apex and the intramarginal vein indistinct*; *intercostal venation distinct, veins more or less perpendicular to the lateral veins*; *petiole 7–15 mm long, flat or scarcely channelled above, thickened*, indumentum and colour as twig. **Inflorescences** *in the axils of upper leaves or lower down the twig, spikes to 3(–9) cm long, bearing 5–10 flowers and appearing cone-like in bud due to overlapping bracts before elongation of axis*; axis tomentose as twig; *bracts ovate, boat-shaped, caducous at anthesis* (as are bracteoles), *densely silky-pubescent* (as are bracteoles, calyx and ovary) to 7 mm long; bracteoles narrowly ovate-oblong, to 3.5 mm long. **Flowers**: calyx to 3.5 mm long, lobes narrowly triangular, *c.* 1.5 mm long, or appearing longer when symmetrically torn at sinus; corolla white when fresh, outer surface sparsely pilose at base, *c.* 6 mm long, lobes oblong-ovate; stamens more than 60; disk glabrous; ovary to 2 mm high. **Infructescence** *with up to 4 fruits*. **Fruits** *ovoid, to 1.3 × 0.8 cm*, patently pilose to glabrous, white ripening pale blue and drying pale brown, with erect, persistent calyx lobes.

Vernacular names. Sarawak—*girak, jirak* (Iban), *smuak* (Bidayuh).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known in Sarawak from Bau, Belaga, Kapit, Kuching, Lundu, Marudi, Serian, and Sri Aman districts (e.g., *S* 19769, *S* 29334, *S* 34829, *S* 41594, and *S* 73798), Brunei (e.g., *Kirkup DW* 888) and Kalimantan (e.g., *Amdjah* 472 and *Teijsmann* 8028).

Ecology. In mixed dipterocarp, *kerangas* and lower montane forests, at 50–1100 m altitude, mostly on hillsides and often on river banks, on yellow, sandy clay loam, limestone and granite rocks.

23. *Symplocos tricoccata* Noot.

(Greek, *tri* = three, *kokkos* = fruit cell; the three-celled fruit)

Leiden Bot. Ser. 1 (1975) 288, *op. cit.* (1977) 272; Kochummen *op. cit.* 274; Anderson *op. cit.* 329; Whitmore, Tantra & Sutisna *op. cit.* 344; Turner *op. cit.* 481; Coode *et al.* (eds.) *op. cit.* 316. **Type**: *Zain SAN* 61303, Borneo, Sabah, Tawau, Hot Spring FR (holotype L; isotypes K, SAN).

Shrub or treelet to 10 m tall, to 15 cm diameter. **Bark** smooth, pale green, pale brown, grey or black; inner bark pale green, yellow or brown. **Sapwood** white, pale yellow or brown, medium hard. **Twigs** *straight or curved, occasionally faintly zigzag, glabrous; young parts shallowly grooved and finely striate, drying pale green to pale yellow-green; older parts almost smooth and terete, drying with brown patches.* **Leaves** spirally arranged, thin-coriaceous, sometimes slightly glossy above, *virtually glabrous or with scattered white hairs on both surfaces, drying pale green, pale yellow-green or pale grey-green;* blade elliptic to ovate-elliptic, often somewhat asymmetric, 6–29 × 3–13 cm, base shortly attenuate to cuneate, *shortly decurrent on petiole as flanges only near junction with the blade, margin recurved, sharply or indistinctly brown-gland-tipped toothed with a hardly raised brown gland dot between most pairs of glandular teeth, apex acuminate, acumen sometimes curved, to 2 cm long; midrib channelled and glabrous or virtually so above; lateral veins 5–10 pairs, flat or sometimes shallowly channelled above, raised below, distant, ascending near margin but not forming a distinct intramarginal vein except sometimes towards the leaf apex; intercostal venation lax, more or less transverse to lateral veins, merging with reticulations, usually distinct and raised above; petiole 5–15 mm long, shallowly channelled almost to base, glabrous or with some hairs in the channel, drying the same colour as the twig.* **Inflorescences** *fascicles or very short spikes or racemes, 4–8-flowered; axis glabrous, to 0.5 cm long; bracts broadly ovate to orbicular, boat-shaped, early caducous (as are bracteoles) ciliate, glabrous or pilose, c. 1.75 mm long; bracteoles narrow oblong, ciliate and glabrous, to 0.3 × 1.5 mm.* **Flowers** sessile or with the pedicel to 1 mm long; calyx *c. 2 mm long, lobes often spreading to reflexed at anthesis, triangular, pale yellow-translucent contrasting with darker calyx tube and ovary, minutely ciliate, glabrous or with some hairs, 1–1.75 mm long; corolla oblong-ovate, white or purple when fresh, translucent, glabrous, to 8 mm long; stamens 40 to more than 100; disk 5-glandular; ovary glabrous, to 2 mm high, style glabrous, conical base with some hairs to softly short-pilose, to 7 mm long.* **Infructescences** *with up to 4 fruits.* **Fruits** *curved, ellipsoid-ovoid, to 2 × 0.6 cm, more or less triangular in cross section with 3 cells defined by grooves (sulci), surface coarsely rugulose, corky, becoming longitudinally fibrous ridged, glabrous to sparsely puberulent, white ripening purple to blue, with persistent, erect to apically incurved calyx lobes.*

Vernacular name. Sarawak—*atup* (Kenyah).

Distribution. Peninsular Malaysia and Borneo. In Sabah, recorded from Keningau, Kinabatangan, Lahad Datu, Ranau, Sandakan, and Tawau districts (e.g., *SAN 20132, SAN 33414, SAN 87192, SAN 88031, SAN 91905, and SAN 125631*). In Sarawak, known from Lawas and Marudi districts (e.g., *S 26305 and S 50914*). Also occurring in Kalimantan (e.g., *Endert 4151 and Winkler 977*).

Ecology. In lowland to montane primary or disturbed forests, at altitudes to 2300 m, mostly on hillsides, also in low, undulating or flat country, sometimes near streams, on rocky, black or brown soil. The corky, fibrous fruit of this species suggests adaptation for water dispersal.

Uses. In Sarawak, the wood is used to make knife handles.

24. *Symplocos zizyphoides* Stapf

(Latin, *Zizyphus* = the jujube; resembling the jujube)

FMK (1894) 205; Brand op. cit. (1901) 65; Merrill op. cit. (1921) 488; Masamune op. cit. 610; Heine, Pflz. Samml. Clemens Kinabalu (1953) 89; Nooteboom op. cit. (1975) 293, op. cit. (1977) 273; Whitmore, Tantra & Sutisna op. cit. 344. Type: Haviland 1088, Borneo, Sabah, Mt. Kinabalu (holotype K; isotypes BM, BO). Synonym: *Symplocos clementis* Merr., op. cit. (1917) 111.

Shrub or treelet to 10 m tall. Twigs often distinctly zigzag, terete, to 5 mm diameter, striate, appressed brown-pilose; older parts terete, without horizontal cracks, glabrescent, medium to dark brown. Leaves alternate, thin-coriaceous, slightly glossy, finely rugulose above, virtually glabrous or moderately dense appressed-pilose below, drying olive-brown above, pale yellow-brown or yellow-green below; blade ovate, 1.5–5.5 × 0.6–2.5 cm, base cuneate to rounded to slightly cordate, hardly decurrent on petiole, margin recurved to revolute, finely sharp-toothed, more densely appressed-pilose than the leaf undersurface, apex shortly acuminate; midrib finely channelled above, appressed pilose below; lateral veins (4–)6(–9) pairs, obscure above, merging with the somewhat lax reticulations towards the margin, intramarginal vein sometimes discernible; petiole 1–2 mm long, channelled above, indumentum as twig. Inflorescences 1–4-flowered racemes or flowers solitary; axis appressed brown-pilose (as are pedicels, bracts and bracteoles); bracts caducous, keeled, to 4 mm long; bracteoles caducous, 1.5–3 mm long. Flowers shortly pedicellate except sometimes the uppermost flower, pedicel 5–12 mm long; calyx to 2 mm long, lobes reflexed at anthesis, pale, triangular, ciliate, sparsely pilose to glabrous, to 1.5 mm long; corolla white when fresh, glabrous, 4–6 mm long; stamens 40 to more than 100; disk glabrous or with some minute hairs; ovary to 1.5 mm high, style glabrous or with some hairs. Fruits cylindrical-ellipsoid to ovoid, 1–1.2 × 0.5–0.6 cm, sometimes slightly curved, moderately dense short-pilose, ripening purple to blackish, drying dark brown.

Distribution. Endemic in Borneo, known mainly from Mt. Kinabalu, Ranau district in Sabah (e.g., *KEP 80388*, *RSNB 5954*, *SAN 23419*, *SAN 117238*, and *SNP 4122*).

Ecology. In open vegetation and primary subalpine shrub-forest, at 2400–3600 m altitude, on hillsides and ridges and in cracks on granite rock faces.

THYMELAEACEAE

C.S. Tawan

Universiti Malaysia Sarawak, Kota Samarahan, Malaysia

Bentham & Hooker *f.*, Gen. Pl. 3 (1883) 186; Hooker *f.*, Fl. Brit. Ind. 5 (1890) 192; Gamble, J. As. Soc. Beng. 75, 2 (1912) 256; Merrill, EB (1921) 416; Ridley, FMP 1 (1922) 321 ('Gonystylaceae'), FMP 3 (1924) 143; Domke, Bibl. Bot. 27, Heft 111 (1934) 30, 33, 103; Masamune, EPB (1942) 510; Airy Shaw, FM 1, 4 (1953) 349; Ding Hou, FM 1, 6 (1960) 1; Backer & Bakhuizen *f.*, FJ 2 (1965) 267, FJ 2 (1965) 401 ('Gonystylaceae'); Whitmore, TFM 2 (1973) 383; Cockburn, TS 1 (1976) 251; Anderson, CLTS (1980) 332; Corner, WSTM 3rd. edition 2 (1988) 729; Turner, Gard. Bull. Sing. 47 (1995) 484; Kessler & Sidiyasa, TBSA-EK (1994) 225; Coode *et al.* (eds.), CLBD (1996) 320; Argent *et al.* (eds.), MNDD-CK 2 (1997) 630.

Trees, shrubs, climbers, rarely herbs. **Wood** often with included phloem. **Bark** fibrous and tough. **Leaves** opposite, decussate, spiral or alternate, simple, entire, without stipules, with or without translucent glandular dots, mostly pinnately veined. **Inflorescences** terminal, axillary, extra-axillary, or sometimes on brachyblasts borne on the tree trunk or older branches, simple or branched, sessile or peduncled, paniculate, thyrsoid, racemose, umbellate, spicate, capitate, fascicled or condensed into glomerules, with or without bracts. **Flowers** bisexual, radially symmetrical; calyx tubular, campanulate or cupular, 4–5(–6)-lobed, aestivation imbricate or valvate or rarely equitant; corolla absent or represented by petaloid appendages of the same number and alternating with the calyx lobes or twice the number and arranged in pairs opposite calyx lobes, fleshy or membranaceous, filamentous or oblong, entire or lobed, free or rarely united into a ring, inserted at the throat of calyx tube or slightly lower; stamens 2, 4 or many, in one or two (rarely three) whorls, if in 2 whorls then inserted at 2 different levels, filaments filiform or slightly flattened, anthers 2-loculed, basifixed or dorsifixed, obtuse or apiculate, introse; disk hypogynous, membranaceous or subcarinose, annular, cupular, lobed, free and scale-like, or absent; ovary superior, 1–2-loculed or 3–5(–8)-loculed, sessile or short-stalked, style filiform, caducous, sometimes very short or obscure, terminal or excentric, sometimes provided with parastyles at the base, stigma capitate, subglobose, oblong, subclavate or pyramidal, entire or sometimes emarginate, sometimes pillose; ovules solitary in each locule, with an axial or parietal placentation, pendulous from the top. **Fruit** a drupe or drupaceous, a berry or a capsule, either apically or laterally emerging from the calyx tube; pericarp membranaceous, pulpy, coriaceous or fibrous. **Seeds** 1–2(–3) per fruit, with a caruncle-like or tail-like appendage or an aril, with or without endosperm; testa usually crustaceous, black, often with irregular ridges, smooth or with short hairs; embryo straight, cotyledons plano-convex, radicle short and superior.

Distribution. The family consists of about 50 genera with 500 species of almost cosmopolitan distribution but chiefly develop in tropical Australia and Africa. In Sabah and Sarawak, nine genera with 45 species (including 2 incompletely known species) are recorded.

Ecology. In Sabah and Sarawak, most species of the Thymelaeaceae occur in mixed dipterocarp, freshwater, peat swamp, and *kerangas* forests, at low to medium altitudes. A few, e.g. *Linostoma pauciflorum* and *Phaleria capitata*, occur in lowland to lower montane forests at altitudes to 1300 m, while *Wikstroemia brachyantha* is confined to lower and upper montane

forests at 1200–2800 m altitude, and *Drapetes ericoides* is restricted to subalpine vegetation at altitude above 3000 m (Mt. Kinabalu).

Uses. The whitish and light wood of several species of *Aquilaria* and *Gonystylus* is the main source of *karas* and *ramin* timber, respectively. The timber is highly prized and popular for making decorative cabinets and various types of interior decorative items. It is also suitable for veneer, plywood, block-board and particle-board manufacture. The *gaharu*, which is also known under trade names of agarwood or Malayan eaglewood or Malayan aloeswood, is the resin-containing heartwood of old and infected/diseased trees of several species, e.g. *Aëtoxylon sympetalum*, *Aquilaria beccariana*, *Aquilaria malaccensis*, *Enkleia malaccensis*, *Wikstroemia polyantha*, and *W. tenuiramis*. Of these, the wood of *Aquilaria malaccensis* is the most important source. In Asia, fragrance produced by burning the wood is widely used as incense for religious, ceremonial purposes. Essential oil extracted from *gaharu* wood and known commercially as agarwood oil is utilised in oriental, luxury perfumery industries. The silvery tough inner bark of *Aquilaria malaccensis*, *E. malaccensis*, *Phaleria capitata*, and *W. tenuiramis* is highly valued for its strength and durability and locally used for cloth, ropes and other binding material. (cf. PROSEA 5, 1 (1993) 221; *ibid.* 19 (1999) 64, 173, 183, and descriptions under genera and species for further information).

Taxonomy. Domke (*op. cit.* (1934) 103) subdivided the Thymelaeaceae into four subfamilies, viz. Aquilarioideae, Gilgiodaphnoideae, Gonystyloideae, and Thymelaeoideae, and placed *Gonystylus* in the family. The subdivision of the family as well as the placement of *Gonystylus* in it, which have been adopted by a number of subsequent authors, e.g., Airy Shaw (*op. cit.* 1953, FM 1, 6 (1972) 976), Ding Hou (*op. cit.* 1960), Whitmore (*op. cit.* 1973), Cockburn (*op. cit.* 1976), Brummitts (Fam. Gen. Vasc. Pl. (1992) 679), Turner (*op. cit.* 1995), Coode *et al.* (*op. cit.* 1996), Argent *et al.* (*op. cit.* 1997), Mabberley (PB (1998) 713), are accepted in the present treatment. Apart from the subfam. Gilgiodaphnoideae, the other three subfamilies have representatives in Sabah and Sarawak. The major distinguishing characters and the disposition of genera occurring in Sabah and Sarawak in the above subfamilies, are as follows:

Subfam. **Aquilarioideae:** Leaves without translucent glandular dots. Flowers with a short cylindrical calyx tube or sepals free; petaloid appendages scale-like, free or rarely united, inserted at the throat of the calyx tube or slightly below it, or absent; stamens at most 10, arranged in one or two whorls, filaments partly or entirely adnate to the calyx tube; disk absent, or ring-shaped; ovary 2-loculed; parastyles absent. Fruit a capsule. Seeds usually with conspicuous chalazal fold and a thin funicle, without aril; endosperm absent or present. The genus occurring in Sabah and Sarawak placed under this subfamily is *Aquilaria*.

Subfam. **Gonystyloideae:** Leaves with translucent glandular dots. Flowers with a short or inconspicuous calyx tube; petaloid appendages 8–65, deltoid to linear-subulate, rarely joined into a low, entire ring, inserted at the base of calyx tube; stamen 8–65, in one or two or three whorls; filaments free; disk absent; ovary (2–)3–5(–8)-loculed; parastyles sometimes present. Fruit a capsule, 3–5-valved. Seeds without chalazal fold, usually with orangy-reddish fleshy aril; endosperm absent. Genera included in this subfamily are *Aëtoxylon*, *Amyxa* and *Gonystylus*.

Subfam. **Thymelaeoideae:** Leaves without translucent glandular dots. Flowers with funnel-shaped or cylindrical calyx tube; petaloid appendages obscure and ridge-like or represented by scales; stamens at most 10, usually in two whorls, rarely in one whorl; filaments partly or entirely adnate to the calyx tube; disk absent; ovary 1–2-loculed; parastyles absent or present. Fruit a drupe or drupaceous. Seeds mostly without a small chalazal fold; endosperm absent.

Genera in Sabah and Sarawak placed under this subfamily are *Drapetes*, *Enkleia*, *Linostoma*, *Phaleria*, and *Wikstroemia*.

Key to genera
(based on sterile specimens)

1. Leaves with translucent glandular dots.....2
 Leaves without translucent glandular dots.....4
2. Leaves opposite or decussate.....**1. Aëtoxylon**
 Leaves alternate or spiral.....3
3. Lateral veins of leaves few in number, well-spaced, curving and disappearing towards margins..... **2. Amyxa**
 Lateral veins of leaves numerous, more or less parallel and straight, arching and forming intramarginal veins near margins..... **4. Gonystylus**
4. Leaves sessile, linear, small, 0.3–0.5 × 0.1 cm; lateral veins 5–9, more or less parallel to the midrib.....
 - Drapetes** Banks *ex* Lam.
 (Latinised Greek word, *drapetes* = illusive, deceptive)
 J. Hist. Nat. Paris 1 (1792) 188; Stapf, FMK (1894) 221; Gibbs, J. Linn. Soc. Bot. 42 (1914) 132; Merrill, EB (1921) 417; Masamune, EPB (1942) 511; Ding Hou, FM 1, 6 (1960) 43; Cockburn, TS 1 (1976) 251.
 Dwarf shrubs with creeping, radiating or more or less tufted stems. *Leaves* subopposite or spiral, *sessile, narrowly linear, without translucent glandular dots, with 5–9 striated longitudinal veins*. Flowers aggregated in small, sessile, terminal heads; pedicels short, articulated at apex; calyx tube pilose outside, glabrous inside, caducous, lobes 4, slightly spreading; petaloid appendages (0–)1–2, scale-like, inserted at the mouth of calyx tube; stamens 4, alternate with calyx lobes; ovary 1-loculed, style linear, lateral, caducous, stigma capitate and papillose when young. Fruits small drupes with thin pericarp. Seeds closely enveloped by the endocarp.
 A genus comprising four species distributed in Borneo (Sabah), New Guinea, Australia (including Tasmania), New Zealand, and S America (Fuegia and Falkland Is.). In Sabah, the genus is represented by *D. ericoides* Hook.f., which is confined to subalpine vegetation on Mt. Kinabalu at 3000–4000 m altitude.
 Leaves at least 1.5 cm long, pinnately veined, not linear, petiolate.....5
5. Lateral and intercostal veins more or less parallel.....6
 Lateral veins curved; intercostal veins reticulate or scalariform.....7
6. Leaves alternate or spiral. Shrubs, treelets or trees.....**3. Aquilaria**
 Leaves opposite, rarely subopposite. Climbers or rarely shrubs or small trees.....
 - Linostoma** Wall. *ex* Endl.
 (Greek, *linon* = flax, *i.e.* plant with long and small leaves, *stoma* = opening; alluding the long and narrow cleft of the calyx tube)
 Gen. Pl. (1837) 331; Bentham & Hooker *f.*, Gen. Pl. 3 (1883) 197, *p.p.*; Domke, Bibl. Bot. 27, Heft 111 (1934) 120; Ding Hou, FM 1, 6 (1960) 26; Nevling, J. Arn. Arb. 42 (1961) 295.

Woody climbers, rarely shrubs. Leaves opposite or subopposite, without translucent glandular dots; lateral veins fine and parallel. Inflorescences umbellate or paniculate, few-flowered, axillary or terminal on lateral branches; bracts 2(–4), opposite or alternate. Flowers: calyx tube cylindric, lobes 5, imbricate then spreading; pedicels articulated at base; petaloid appendages 10, long, club-shaped or filiform, inserted at the throat of calyx tube; stamens twice as many as calyx lobes, unequal, free; disk obscure, sometimes appearing as a short-toothed ring at the base of ovary; ovary stipitate, style filiform, long, stigma capitate. Fruits surrounded by the cleft base of calyx tube; pericarp crustaceous. Seeds with membranaceous testa.

A genus with about six species distributed in Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, and Borneo. In Sabah and Sarawak, the genus is represented by two species (*L. longiflorum* Hallier f. and *L. pauciflorum* Griff.), occurring in lowland mixed dipterocarp, peatswamp and lower montane forests, at altitudes to 1300 m.

7. Leaves alternate.....
- Enkleia** Griff.
(Greek, *enkleiein* = enclosed; the fruit being surrounded at base by the torn remain of calyx tube)
Calc. J. Nat. Hist. 4 (1844) 234; Gamble, J. As. Soc. Beng. 75, 2 (1912) 262; Ridley, FMP 3 (1924) 147; Merrill, PEB (1929) 212; Masamune, EPB (1942) 511; Ding Hou, FM 1, 6 (1960) 23, *ibid.* (1972) 982.
Woody climbers often provided with hooks. Leaves alternate, without translucent glandular dots, pinnately veined; lateral veins curved; intercostal venation subscalariform. Inflorescences paniculate, terminal, lax, few-flowered; bracts conduplicate or involute, linear, lanceolate or oblong, subopposite, opposite or alternate. Flowers 5-merous; pedicels articulated at base; calyx tube cylindric, lobes puberulous on both sides; petaloid appendages twice as many as calyx lobes, inserted at the throat of calyx tube; stamens twice as many as calyx lobes, in two whorls, sessile, subsessile or with short filaments; disk absent or obscure, sometimes represented by minute scales; ovary sessile, style terminal, distinct, stigma oblong. Fruits prominently ribbed, enclosed at base by the torn remains of calyx tube; exocarp thin, endocarp hard. Seeds with membranaceous testa.
A genus comprising three species, distributed in the Andaman Is., Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Borneo, the Philippines, and New Guinea. In Sabah and Sarawak, the genus is represented by one species (*E. malaccensis* Griff.), occurring in lowland forest.
Leaves strictly opposite or decussate.....8
8. Leaves smaller, c. 13 × 4 cm.....**6. Wikstroemia**
Leaves larger, 11–26 × 3.5–10 cm.....**5. Phaleria**

Key to genera

(based on flowering and/or fruiting specimens)

1. Leaves with translucent glandular dots. Stamens free. Petaloid appendages inserted on the receptacle. Fruits 3–5(–8)-loculed.....2

- Leaves without translucent glandular dots. Stamens and petaloid appendages adnate to or inserted on the calyx tube. Fruits 1–2-loculed.....4
2. Leaves decussate, sometimes subopposite. Inflorescences subumbellate. Calyx lobes valvate. Petaloid appendages fused into a ring.....**1. Aëtoxylon**
Leaves spiral or alternate. Inflorescences thyrsoid, paniculate or racemose. Calyx lobes imbricate or subvalvate. Petaloid appendages 7–65.....3
3. Leaves with a few, lax lateral veins. Petaloid appendages 10, more or less in pairs. Parastyles subulate-corniform (= horn-shaped). Fruits long-beaked.....**2. Amyxa**
Leaves with numerous parallel lateral veins. Petaloid appendages 8–65, not in pairs. Parastyles, if present, very small and clavate. Fruits not beaked.....**4. Gonystylus**
4. Stamens of the same number as calyx lobes.....**Drapetes** (see above)
Stamens twice the number of calyx lobes.....5
5. Fruit a loculicidal capsule. Petaloid appendages usually distinct and densely pubescent or puberulous.....**3. Aquilaria**
Fruits drupaceous. Petaloid appendages, if present, always glabrous.....6
6. Ovary 2-loculed (rarely one locule abortive). Fruits (1–)2-seeded. Petaloid appendages absent or if present, obscure and rim-like.....**5. Phaleria**
Ovary always 1-loculed. Fruits 1-seeded. Petaloid appendages not as above.....7
7. Erect shrubs or small trees. Inflorescences without leafy bracts. Petaloid appendages absent. Ovary glabrous or only hairy at the top.....**6. Wikstroemia**
Usually climbers. Inflorescences usually provided with 2 leafy bracts on each branch. Petaloid appendages well-developed. Ovary densely pubescent.....8
8. Stamens in two whorls. Style obscure or shorter than ovary.....**Enkleia** (see above)
Stamens in one whorl. Style several times as long as ovary.....**Linostoma** (see above)

1. AETOXYLON Airy Shaw

(Greek, *aetos* = eagle, *xulon* = wood; the eaglewood)

gaharu, gaharu buaya, ramin batu (Malay)

Kew Bull. (1950) 145, FM 1, 4 (1953) 365; Anderson, CLTS (1980) 332; Argent *et al.* (eds.), MNDC-CK 2 (1997) 630. **Synonym:** *Gonystylus* Teijsm. & Binn. sect. *Aëtoxylon* Airy Shaw, Kew Bull. (1947) 10.

Medium-sized trees. **Leaves** *decussate, opposite or sometimes subopposite, thick-coriaceous*, glabrous, *with translucent glandular dots*; venation numerous, very distinct. **Inflorescences** few-branched, axillary or terminal, *subumbellate*, tomentose; bracts absent. **Flowers** 5-merous, long-pedicelled; pedicels long-sericeous; calyx cupular, divided to about halfway, *lobes valvate*, slightly reduplicate, equal, setulose within; *petaloid appendages fused into a low, entire, slightly fleshy ring, inserted on the receptacle*; *stamens* 10–15, *free*, filaments short and slender, anthers basifixed, subspherical, 4-loculed; ovary sessile, 5-loculed, densely setulose; style filiform, wiry, contorted, pilose, stigma capitate; ovules apical, pendulous,

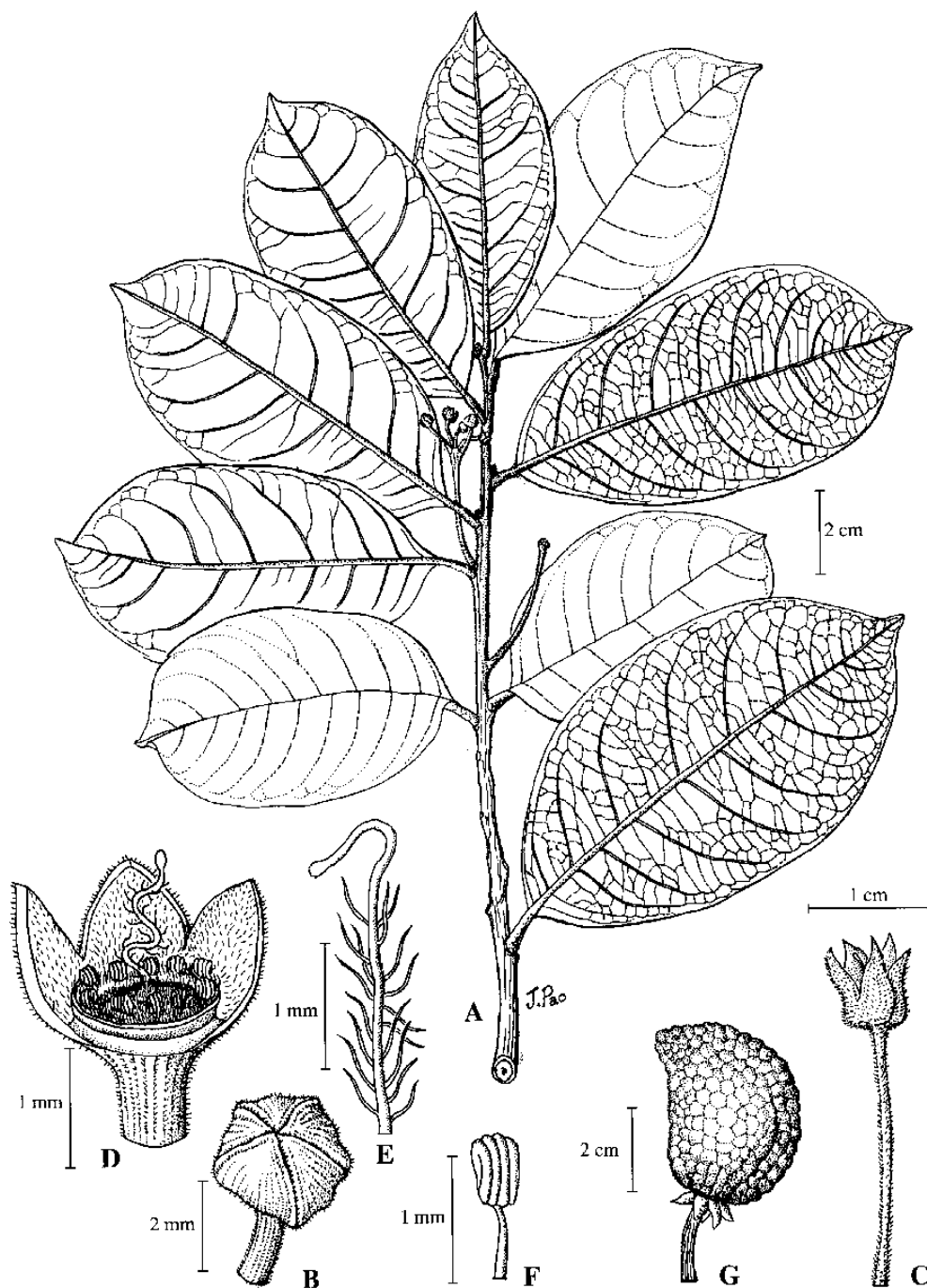


Fig. 1. *Aetoxylon sympetalum*. A, flowering leafy twig; B, flower bud; C, open flower; D, longitudinal section of open flower; E, style and stigma; F, stamen; G, fruit. (A–F from *S* 9630, G from *S* 4655.)

solitary. **Fruits** 1–3-seeded capsules, 3–5(–8)-*loculed*, subglobose or subpyriform, thin-walled, verrucate, tomentose, ferruginous or dull brown, dehiscent. **Seeds** subglobose; testa crustaceous, smooth, greyish brown, stony; endosperm absent.

Distribution. A monotypic genus endemic in Borneo and found only in Sarawak and Kalimantan.

Aetoxylon sympetalum (Steenis & Domke) Airy Shaw Fig. 1, Plate 6A.
(Latin, *sympetalum* = having united petals)

Kew Bull. (1950) 145, *op. cit.* (1953) 365; Anderson *op. cit.* 332; Argent *et al.* (eds.) *op. cit.* 630. **Basionym:** *Gonystylus sympetala* Steenis & Domke, Notizbl. Bot. Gart. Berlin 12 (1934) 233, Domke, Bibl. Bot. 27, Heft 111 (1934) 7, 33, 145, Airy Shaw *op. cit.* (1947) 10. **Type:** *Soelaiman bb. 17222*, Borneo, W Kalimantan, Kampung Mawa, Sanggau (holotype BO; isotypes KEP, L).

Tree 18–40 m tall, 30–60 cm diameter; trunk straight, sometimes with fluted base; buttresses absent. **Bark** finely fissured, warty, dark brown or almost black. **Twigs** terete, blackish, glabrous. **Leaves** drying brown to greyish brown above, dark brown below; blade elliptic, oblong or obovate, 6–13 × 2.5–5.5 cm, base obtuse, margin strongly revolute, apex acuminate or rarely retuse; midrib narrowly channelled above, rounded and prominent below; lateral veins 7–15 pairs, obscure on both surfaces; intercostal venation densely reticulate; petiole 0.7–0.9 cm long, glabrous, rugose, dark brown when dry. **Inflorescences** 2–5 cm long, bearing 5–6 flowers, glabrous. **Flowers:** pedicels 2–2.3 cm long, tomentose; buds subglobose, 5–6 × 4–4.5 mm, tomentose; calyx lobes deltoid, 2.5–3 × 1.5–2 mm, tomentose outside, densely velutinous within; petaloid appendage glabrous, 2–3 mm long; stamens *c.* 10, 1–1.5 mm long, free, in a single whorl, filaments 0.5–1 mm long, anthers *c.* 0.5 mm long, glabrous; ovary ovoid, *c.* 2 mm long, style *c.* 3 mm long. **Fruits** globose or subglobose, 4.3–5 cm diameter; pericarp thin, partly fibrous, rough, sparsely stellate, reddish brown hairy. **Seeds** ellipsoid, *c.* 3 cm long, with numerous oil ducts; testa smooth, cream-coloured to brownish, crustaceous; embryo very small.

Distribution. In Sarawak, fairly common and recorded from Kuching, Lundu, Serian, and Sri Aman districts (e.g., *S 4655*, *S 9598*, *S 9627*, *S 11711*, and *S 17452*). Also known from W Kalimantan (e.g., *bb. 16446*, *bb. 16703*, *Becking 16*, and the type).

Ecology. In lowland mixed dipterocarp and *kerangas* forests, at altitudes to 100 m.

Uses. In Sarawak, the infected heartwood is a very important source of *gaharu* incense. In Kalimantan, oil known as *minyak garu laka* is extracted from the heartwood.

2. AMYXA Tiegh. *ex* Domke

(Greek, *a* = without, *muxa* = exudate, mucilage; referring to the wood)

ramin bukit (Malay)

Bibl. Bot. 27, Heft 111 (1934) 116; Airy Shaw, Bull. Misc. Inform. Kew (1940) 261, Kew Bull. (1950) 146, FM 1, 4 (1953) 363; Ding Hou FM 1, 6 (1960) 47; Anderson, CLTS (1980) 332; Coode *et al.* (eds.), CLBD (1996) 120; Argent *et al.* (eds.), MNDT-CK 2 (1997) 631.

Small to medium-sized trees. **Leaves** alternate, chartaceous, with translucent glandular dots; lateral veins lax, arching and disappearing towards margins, obscure. **Inflorescences** much-branched thyrses, terminal or axillary, bearing numerous small tomentose flowers; bracts present; bracteoles absent. **Flowers:** pedicels long and sericeous, articulate at base; calyx tube short and broadly cup-shaped, lobes 5, unequal, deltoid, imbricate, tomentose on both surfaces; petaloid appendages 10, in pairs alternating with calyx lobes, inserted on the receptacle, subulate, setulose; stamens 10, free, alternating with petaloid appendages, filaments short, anthers rounded, basifixed, 4-loculed; ovary sessile, 3–5-loculed, style elongate, filiform, contorted, stigma capitate; parastyles 5–7, subulate-corniform, attached at the base of the style; ovules solitary in each locule, anatropous, pendulous. **Fruits** 3–5(–8)-loculed, 2-seeded, stalked, long-beaked, tomentose, thin-walled, dehiscent capsules. **Seeds** large, without endosperm; testa thinly coriaceous, smooth; funicle thickened but not expanded into an aril.

Distribution. A monotypic genus endemic in Borneo.

Amyxa pluricornis (Radlk.) Domke

Fig. 2, Plate 6B.

(Latin, *pluri* = many; *cornis* = horns; referring to the presence of many horn-shaped parastyles at the base of style).

Bibl. Bot. 27, Heft 111 (1934) 116; Airy Shaw *op. cit.* (1940) 261, *op. cit.* (1950) 146, *op. cit.* (1953) 363; Ding Hou *op. cit.* 47; Cockburn, TS 1 (1976) 253; Anderson *op. cit.* 332; Coode *et al.* (eds.) *op. cit.* 320; Argent *et al.* (eds.) *op. cit.* 631. **Basionym:** *Gonystylus pluricornis* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Akad. Wiss. München 16 (1887) 16; Merrill, EB (1921) 372; Hallier *f.*, Med. Rijksherb. 44 (1922) 155; Masamune, EPB (1942) 447. **Type:** *Beccari PB 563*, 'Borneo' (holotype M). **Synonyms:** *Amyxa kutcinensis* Tiegh., Ann. Sci. Nat. Bot. 7 (1893) 248; *A. taenoicera* Airy Shaw *op. cit.* (1950) 146.

Tree 10–21 m tall, 10–30 cm diameter. **Bark** reddish brown. **Twigs** terete, slender, rugose, glabrescent, dark brown. **Leaves** glabrous, drying brown; blade elliptic or obovate, 8–15 × 3–5 cm, base cuneate-attenuate, margin slightly revolute, apex acuminate; midrib impressed above; lateral veins 6–11 pairs, slender, obscure above, prominent below, sparsely tomentose; intercostal venation reticulate, obscure on both surfaces; petiole 0.8–1.6 cm long, glabrous, rugose, dark brown when dry. **Inflorescences** 8–27 cm long, each branch bearing 4–7, alternately arranged, clusters of flowers, each cluster consists of 3–6 flowers, densely tomentose; bracts linear, 5–8 × 2.5–3 mm, tomentose. **Flowers:** pedicels 3–3.5 mm long, tomentose; buds subglobose, 3–3.5 × 3–3.5 mm; calyx lobes 3–4 × 1.5–3.5 mm, tomentose on both sides, strongly recurved at anthesis; petaloid appendages subulate, 1.5–2 × 1 mm, epustulate, densely to moderately setulose, fleshy, rigid, reddish brown when dry; stamen *c.* 1.5 mm long, free, in a single whorl, filaments *c.* 0.5 mm long, anthers *c.* 1 mm long, glabrous; ovary ovoid, densely tomentose, styles *c.* 6 mm long, glabrous; parastyles *c.* 2 mm long, provided with 2–3 setae at the apex. **Fruits** 5–6 cm long, 3–4-valved, pericarp striate, densely shortly brown-velvety. **Seeds** oblong-ellipsoid, *c.* 3 × 1–1.5 cm, more or less plano-convex; cotyledons thick and fleshy, with numerous oil ducts; radicle conical.

Distribution. In Sabah, recorded from Beaufort, Labuk Sugut, Penampang, and Sipitang districts (e.g., *SAN 15064*, *SAN 50083*, *SAN 65225*, and *SAN 134077*) and in Sarawak, from Belaga, Bintulu, Kapit, Kuching, Marudi, Miri, Serian, and Sibu districts (e.g., *Jacobs 5376*, *S 15880*, *S 21408*, *S 34316*, and *S 41538*). Also occurring in Brunei (e.g., *BRUN 3088*, *BRUN 3157*, *Coode MC 6806*, *Dransfield JD 6845*, and *Forman LLF 871*) and Kalimantan (e.g., *Burley, Tukirin et al. 3166*, *Kostermans 10310*, *Kostermans 10674*, and *Mogea & de Wilde 4105*).

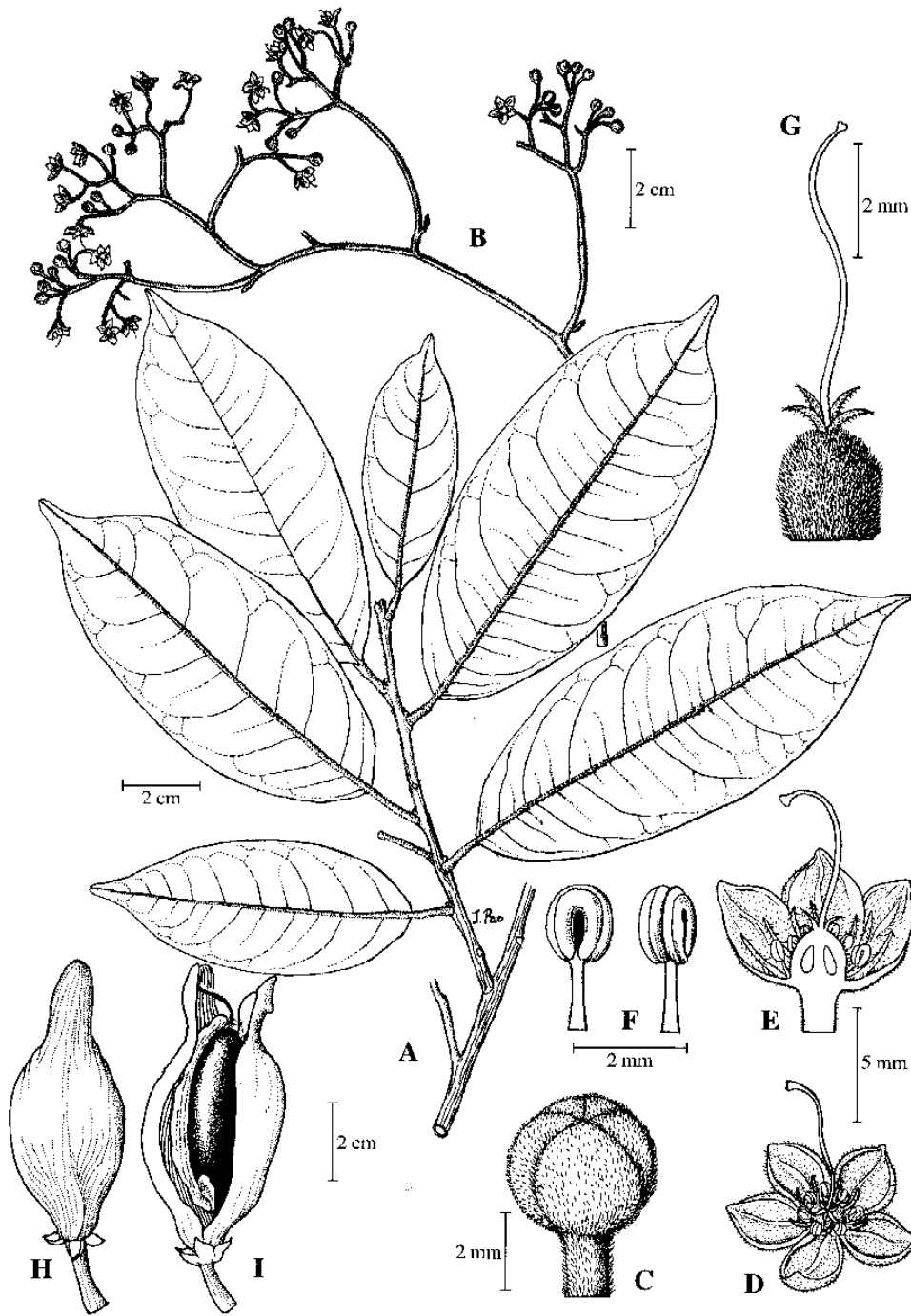


Fig. 2. *Amyxa pluricornis*. A, leafy twig; B, inflorescence; C, flower bud; D, open flower; E, longitudinal section of open flower; F, stamens; G, gynoecium; H, fruit; I, dehiscent fruit. (A and H-I from *S* 16671, B-G from *S* 24740.)

Ecology. In primary mixed dipterocarp forest on yellow sandy soil, at altitudes to 800 m.

Uses. In Sarawak, the timber is used for making planks.

3. AQUILARIA Lam.

(Latin, *aquila* = an eagle; Malayan eaglewood)

gaharu (preferred name), *engkaras* (Iban), *karas* (Malay),
lako (Punan Tutoh), *tangala* (Berawan)

Encycl. 1 (1783) 49; Domke, *Bibl. Bot.* 27, Heft 111 (1934) 118; Gamble, *J. As. Soc. Beng.* 75, 2 (1912) 263; Ridley, *FMP* 3 (1924) 147; Ding Hou, *FM* 1, 6 (1960) 6; Whitmore, *TFM* 2 (1973) 365; Cockburn, *TS* 1 (1976) 253; Anderson, *CLTS* (1980) 332; Corner, *WSTM* 3rd. edition 2 (1988) 729; Kessler & Sidiyasa, *TBSA-EK* (1994) 225; Turner, *Gard. Bull. Sing.* 47 (1995) 484; Coode *et al.* (eds.), *CLBD* (1996) 321; Argent *et al.* (eds.), *MNDT-CK* 2 (1997) 631. **Synonyms:** *Aquilaria* Tiegh., *Ann. Sci. Nat. Bot.* 7 (1893) 216; *Aquilaria* Lam. sect. *Agallochum* Hallier *f.*, *Med. Rijksherb.* 44 (1922) 15; *Aquilaria* Lam. sect. *Gyrinopsis* Hallier *f.*, *op. cit.* 16; *Aquilaria* Lam. sect. *Amphinoman* Hallier *f.*, *op. cit.* 18.

Trees, treelets or shrubs; young parts pubescent, glabrescent. **Bark** smooth, pale whitish, stripping off in long, fibrous pieces; inner bark white, cream, grey or pale brown, homogenous, without glistening fibres. **Leaves** alternate, pinnately veined, petioled, without translucent glandular dots, fibrous, drying not brittle; lateral and intermediate veins distinct or obscure, simple or sometimes branched, more or less parallel and running directly into the intramarginal veins; intercostal venation subscalariform. **Inflorescences** axillary, supra-axillary, terminal, or rarely borne on the tree trunk or older branches, sessile or short-peduncled, simple or rarely branched, umbellate or paniculate; bracts few and small or absent. **Flowers** 5-merous, pedicelled; pedicels articulated at base; calyx splitting on one side, outside glabrescent, inside puberulous with reflex hairs arranged in lengthwise lines towards the upper part, tube cup-shaped, cylindrical or bell-shaped, lobes (4-)5(-6), reflex or straight, usually shorter than or rarely as long as the calyx tube; petaloid appendages distinct, twice as many as calyx lobes, free or united into a ring, inserted at the throat of calyx tube, lanceolate, ovate, semi-orbicular, each pair opposite calyx lobes, densely pubescent or puberulous; stamens twice as many as calyx lobes, inserted at or slightly below the throat of calyx tube, filaments short or filiform, sometimes slightly swollen at the upper end, anthers linear-oblong, dorsifixed, free; disk none or rarely ring-like; ovary sessile or stalked, ovoid, oblanceolate or ellipsoid, densely short-puberulous, 2-loculed, style terminal, obscure or distinct, gradually dilated towards the ovary, densely puberulous towards the base, stigma distinct, globose, capitate, pyramidal or oblong; parastyles absent; ovules attached at the top of the septum and partly adnate to it. **Fruits** loculicidal capsules, 1-2-loculed, globose-obovoid or oblanceolate, rugose or smooth, sometimes slightly compressed laterally, protruding either from the top or from the split side of the calyx tube, distinctly stalked, densely puberulous to glabrous; pericarp coriaceous or woody. **Seeds** 1-2 per fruit, ovoid or ellipsoid; testa crustaceous, bearing a caruncle-like or tail-shaped appendage at the base; funicle obscure or distinct; cotyledons thick, plano-convex.

Distribution. About 15 species, distributed in India, Myanmar, Indo-China, SE China, and widespread in SE Asia. In Borneo, five species occur, of which four (3 well-known and 1 incompletely known) are recorded from Sabah and Sarawak.

Ecology. In lowland to lower montane forests, at altitudes to 1700 m.

Uses. Resin-containing heartwood obtained from old and infected/diseased trees of several *Aquilaria* species, e.g., *A. beccariana*, *A. crassna* Pierre ex Lecomte (from Thailand and Indo-China), *A. malaccensis*, and *A. sinensis* (Lour.) Sprengel (from SE China) is the most important source of *gaharu* or *karas* wood (also known, under the trade-names of agarwood, Malayan eaglewood or aloeswood). The fragrance produced by the burning of the wood has been highly valued for thousand of years, and its use as incense for ceremonial purposes in Buddhism, Confucianism and Hinduism is widespread throughout E and SE Asia. In western, Chinese and Indian medicines, the incense is used against cancer, especially of the thyroid gland. In China, it is applied as a sedative against abdominal complaints, asthma, colics and diarrhoea, and as aphrodisiac and carminative. The well-known agarwood oil is an essential oil extracted from the agarwood. The oil is used in luxury oriental perfumery. The timber of undiseased trees is very light and is suitable for making boxes, light indoor construction and veneer. The silvery inner bark is highly valued for its strength and durability and is used for making ropes and cloth. (cf. PROSEA 19 (1999) 64, for further details).

Key to *Aquilaria* species

1. Leaves generally larger, 7–27 × 3–8 cm; lateral veins (10–)15–28 pairs, strongly raised above. Calyx tube cylindrical. Petaloid appendages oblong, puberulous. Ovary with a distinct accrescent stalk of c. 2 mm long. Fruits ellipsoid-obovoid, narrowed towards the base into an elongated stalks, 10–12 mm long.....**1. A. beccariana**
 Leaves generally smaller, 4–12 × 1.5–5 cm; lateral veins 12–19 pairs, flat or obscure above. Calyx tube campanulate. Petaloid appendages ovate-oblong, oblong or linear, densely hairy. Ovary without stalk. Fruits obovoid or obovoid-oblong, base cuneate or subcordate, without distinct stalk.....2
2. Fruits larger, 3–4 × 2.5 cm, base cuneate. Seeds with a tail-like, slightly twisted, pubescent funicle.....**2. A. malaccensis**
 Fruits smaller, 0.8–1.2(–1.6) × 1–1.2(–1.5) cm, base subcordate. Seeds with caruncle-like, glabrous appendages of c. 2 mm long.....**3. A. microcarpa**

1. *Aquilaria beccariana* Tiegh.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Fig. 3.

Ann. Sci. Nat. Bot. 7 (1893) 217; Merrill, EB (1921) 416; Masamune, EPB (1942) 510; Ding Hou *op. cit.* (1960) 13; Whitmore *op. cit.* 385; Cockburn *op. cit.* 253; Anderson *op. cit.* 332; Turner *op. cit.* 484; Coode *et al.* (eds.) *op. cit.* 321; Argent *et al.* (eds.) *op. cit.* 632. **Type:** *Beccari PB 2339*, Borneo, Sarawak (isotype L; fragments). **Synonyms:** *Aquilaria grandifolia* Domke, Notizbl. Berl. Bot. Gart. 11 (1932) 348; *A. cumingiana* (Decne.) Ridl. var. *parvifolia* Airy Shaw, Bull. Misc. Inform. Kew (1940) 261; *Gyrinopsis grandifolia* (Domke) Quisumb., J. Arn. Arb. 27 (1946) 406.

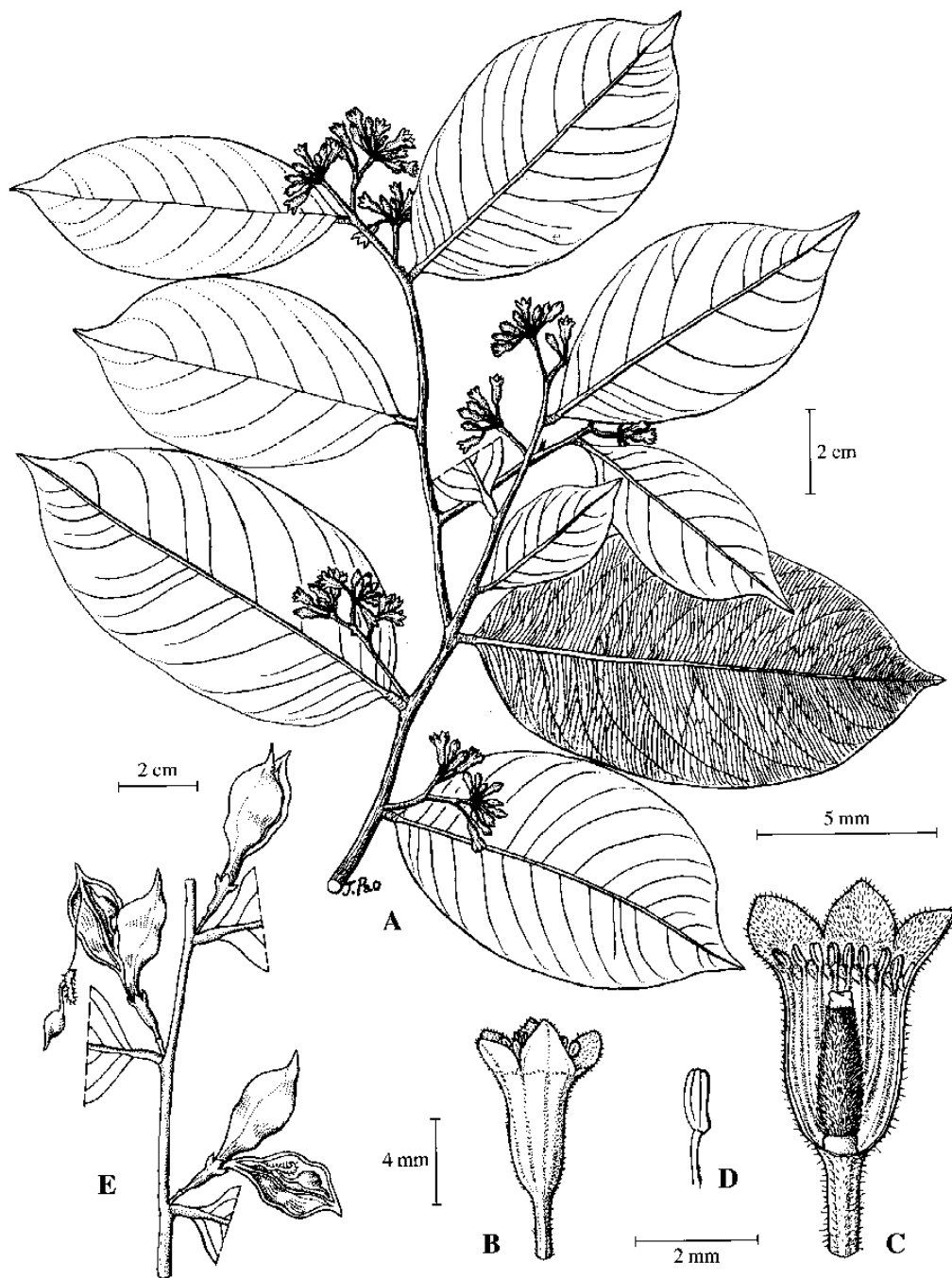


Fig. 3. *Aquilaria beccariana*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower; D, stamen; E, fruiting leafy twig. (A–D from *S* 23015, E from *S* 27069.)

Tree to 20 m tall, to 36 cm diameter; trunk sometime fluted at base. **Bark** smooth, pale grey, finely, irregularly fissured; inner bark creamy white, soft. **Twigs** greyish green, pubescent when young. **Leaves** chartaceous, glabrous; *blade* oblong, oblong-lanceolate or elliptic-oblong, 7–27 × 3–8 cm, base cuneate to attenuate, apex acute to acuminate; *lateral veins* (10–)15–28 pairs, curving and ascending towards the margins, elevated and prominent below, *distinctly raised above*; intercostal venation lax; petiole 0.5–0.7 cm long, pubescent. **Inflorescences** umbellate, axillary or extra-axillary, branched; peduncle to 1.5 cm long, bearing to 6 flowers, pubescent. **Flowers:** *calyx tube cylindrical*, 0.7–1.2 cm long, 10-ribbed, sparsely hairy outside, lobes ovate, 2–3 mm long, puberulous; *petaloid appendages oblong*, c. 1 mm long, *densely puberulous*; stamens usually sessile, rarely with very short filaments; *ovary* ellipsoid, attenuate at base, narrowing towards apex, *with a distinct stalk c. 2 mm long*, stigma small, capitate. **Fruits** protruding from the top of calyx tube, *ellipsoid-obovoid*, 2–3.5 × 1.5 cm, *narrowed towards the base into an elongated stalk*, 10–12 mm long, usually slightly contracted in the middle, glabrescent. **Seeds** black, ovoid, c. 1 × 0.5 cm, sparsely puberulous, apex acuminate; appendage bold densely pubescent, 3–4 mm long; stalk 3–4 mm long, blackish.

Vernacular names. Sarawak—*engkaras* (Iban), *gaharu*, *karas*, *kekaras* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, recorded from Beaufort, Kinabatangan, Lahad Datu, Pensiangan, Sandakan, and Tenom districts (e.g., *SAN 15218*, *SAN 31084*, *SAN 114524*, *SAN 120302*, and *SAN 130012*) and in Sarawak, from Bintulu, Kuching, Marudi and Miri districts (e.g., *S 23015*, *S 38014* and *S 71531*). Also occurring in Brunei (e.g., *Argent 91290*, *Coode MC 7648*, *Dransfield JD 7281*, *FMS 34453*, and *Simpson 2029*) and Kalimantan (e.g., *bb. 34916*, *Endert 3319*, *Kostermans 13204*, and *Purseglove P 4752*).

Ecology. In mixed dipterocarp forest on yellowish sandy loam soils, rarely in swampy forest, at altitudes to 1000 m.

2. *Aquilaria malaccensis* Lam. (of Malacca, Peninsular Malaysia)

Plate 6C.

Encycl. 1 (1783) 49; Gamble *op. cit.* 264; Merrill *op. cit.* 417; Ridley *op. cit.* 147; Masamune *op. cit.* 511; Ding Hou *op. cit.* (1960) 9, Blumea 12 (1964) 286; Whitmore *op. cit.* 385; Cockburn *op. cit.* 253; Anderson *op. cit.* 332; Corner *op. cit.* 729; Kessler & Sidiyasa *op. cit.* 225; Turner *op. cit.* 484; *Argent et al.* (eds.) *op. cit.* 632. **Type:** not solved. **Synonyms:** *Aquilaria agallocha* Roxb., Fl. Ind. ed. Carey 2 (1832) 422, Ding Hou *op. cit.* (1964) 286; *Agallochum malaccensis* (Lam.) Kuntze, Rev. Gen. Pl. 2 (1891) 583; *Aquilariella malaccensis* (Lam.) Tiegh., Ann. Sci. Nat. Bot. 7 (1893) 216.

Tree to 40 m tall, to 60 cm diameter. **Bark** smooth, whitish grey. **Twigs** slender, pale brown, pubescent, glabrescent. **Leaves** chartaceous to subcoriaceous, glabrous above, sparsely pubescent below, shining on both surfaces; *blade* elliptic-oblong to oblong-lanceolate, 6–7 × 3–4 cm, base acute, attenuate or obtuse, apex acuminate, acumen to 2 cm long; *lateral veins* 12–16 pairs, often branched, prominent below, *flat or obscure above*; intercostal venation distinct below, obscure above; petiole 0.3–0.6 cm long. **Inflorescences** terminal, axillary or supra-

axillary, usually branched with 2–3 umbels, each umbel bearing *c.* 10 flowers; peduncle 5–15 mm long. **Flowers:** pedicels slender, 3–6 mm long; *calyx tube campanulate*, 5–6 mm long, green or pale green, sparsely puberulous outside, glabrous within, distinctly 10-ribbed, *lobes ovate-oblong*, 2–3 mm long, densely puberulous within, reflexed; *petaloid appendages ovate-oblong*, *c.* 1 mm long, slightly incurved, *densely pilose*; stamens 1–2 mm long, epipetalous ones longer than the others, anther obtuse; *ovary* ovoid, 1–1.5 mm long, *without stalk*, densely pubescent; style obscure, stigma capitate. **Fruits** obovoid to obovoid-oblong, 3–4 × 2.5 cm, rounded at apex, *cuneate at base*, *without distinct stalk*, usually compressed, pubescent, glabrescent; pericarp woody, suture *c.* 6 mm wide. **Seeds** ovoid, including the beak *c.* 1 × 0.6 cm, hairy, *with tail-like, slightly twisted, pubescent funicle*.

Vernacular names. Sabah and Sarawak—*gaharu* (Malay). Sarawak—*engkaras* (Iban).

Distribution. India, Myanmar, Sumatra, Peninsular Malaysia, Singapore, Borneo, and the Philippines. In Borneo, known in Sabah from Kinabatangan, Sandakan and Tawau districts (e.g., *SAN 63887*, *SAN 83381* and *SAN A 3158*) and in Kalimantan (e.g., *Kostermans 5976*, *Kostermans 9547* and *Sidiyasa 459*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 270 m.

3. *Aquilaria microcarpa* Baill.

(Greek, *mikros* = small, *karpos* = fruit; with small fruit)

Adansonia 11 (1875) 304; Merrill *op. cit.* 417; Masamune *op. cit.* 511; Quisumbing *op. cit.* 403; Whitmore *op. cit.* 385; Cockburn *op. cit.* 254; Anderson *op. cit.* 332; Turner *op. cit.* 484; Argent *et al.* (eds.) *op. cit.* 632. **Type:** *Beccari PB 2886*, Borneo, Sarawak (isotype L; fragment). **Synonyms:** *Aquilariella microcarpa* (Baill.) Tiegh., *Ann. Sci. Nat. Bot.* 7 (1893) 216, *Bull. Soc. Bot. Fr.* 40 (1893) 217; *A. borneensis* Gilg, *Nat. Pflanzenfam.* 11, 6a (1894) 224, Merrill *op. cit.* 417.

Tree *c.* 21 m tall, *c.* 25 cm diameter. **Bark** greyish, superficially fissured. **Twigs** brownish, pubescent. **Leaves** subcoriaceous, shining and glabrous above, dull brown and sparsely pubescent below; *blade* elliptic-oblong to obovate-oblong, 5–7.5 × 2.3–3.5 cm, base cuneate to attenuate, apex acute to acuminate, acumen to 1 cm long; *lateral veins 12–19 pairs*, sometimes branched, slightly curved and ascending to the thickened margins, prominent below, *flat or obscure above*; petiole 0.3–0.5 cm long, pubescent. **Inflorescences** axillary, supra-axillary or terminal or on short lateral branchlets, usually branched, rarely simple; peduncle to 1 cm long, 6–7-flowered. **Flowers** white to cream; pedicels *c.* 5 mm long, puberulous; *calyx tube campanulate*, *c.* 5 mm long, puberulous outside, sparsely puberulous inside, lobes ovate-oblong, obtuse, densely puberulous on both surfaces; *petaloid appendages linear*, *c.* 1 mm long, *hairy*; stamens to 1.5 mm long, anthers *c.* 0.5 mm long; *ovary* densely pubescent, *without stalk*, style 1.5–2 mm long, stigma capitate. **Fruits** *subcordate*, slightly compressed, 0.8–1.2(–1.6) × 1–1.2(–1.5) cm, *without distinct stalk*, 1(–2)-seeded. **Seeds** ovoid, *c.* 0.6 × 0.4 cm, hairy; *caruncle-like funicle c.* 2 mm long, *glabrous*.

Vernacular names. Sarawak—*engkaras* (Iban), *gaharu* (Malay).

Distribution. Sumatra, Singapore and throughout Borneo. In Sabah, recorded from Beaufort, Sandakan and Tawau districts (e.g., *FMS 38762*, *SAN 15204*, *SAN 16965*, and *SAN A 3695*) and in Sarawak, from Bintulu and Kuching districts (e.g., *S 15838* and the type). Also occurring in Brunei (e.g., *FMS 30376* and *FMS 48217*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 200 m.

Incompletely known species

Aquilaria sp. 1.

Treelet to 2.5 m tall, to 6 cm diameter. **Bark** smooth, greyish green; inner bark green. **Twigs** slender, densely tomentose when young, becoming glabrous and rugose when older. **Leaves** chartaceous to subcoriaceous, glabrous and somewhat shiny above, dull greyish brown and pubescent below; blade oblong-oblongate, 12–19.5 × 3–7.5 cm, base obtuse, apex acuminate, acumen to 1.5 cm long; midrib channelled above, raised and pubescent below; lateral veins 16–20 pairs, often branched, flat above, raised below; intercostal venation densely scalariform, obscure above, distinct below; petiole *c.* 0.5 cm long, glabrous. **Inflorescences** (young) axillary or supra-axillary simple umbels, bearing 1–3 young flowers; peduncles 3–5 mm long. **Flowers** (mature) unknown. **Fruits** ovoid-obovoid, occasionally subglobose, 1.2–2 × 1.5–1.9 cm, with longitudinal lines and slightly constricted in the middle; beak 5–7 mm long; pericarp woody, glabrous, smooth and shiny inside. **Seeds** 1, 2 or 3 per fruit, ovoid, including beak 8–10 × 1–9 mm; testa blackish, crustaceous, glabrescent; stalk (stipe) elongate, hook-shaped, *c.* 8 mm long, glabrous, blackish.

Vernacular name. Sarawak—*gaharu engkaras* (Malay).

Distribution. So far known only by a single collection (*S 34204*) from Semengoh FR, Kuching district, Sarawak.

Notes. In vegetative characters, this species closely resemble *A. beccariana* but differs by its smaller, ovoid-obovoid to subglobose fruit, 1.2–2 × 1.5–1.9 cm (*vs.* ellipsoid-obovoid, 2–3.5 × 1.5 cm), shorter stalk, 5–7 mm long (*vs.* 10–12 mm long); its seed without bold appendage (*vs.* with bold appendage) but provided with hook-shaped stalk of *c.* 8 mm long (*vs.* with straight stalk, 3–4 mm long). More flowering and fruiting specimens are, however, needed to confirm its taxonomic status.

4. GONYSTYLUS Teijsm. & Binn.

(Greek, *goni-* = angled; Latin, *stylus* = style)

ramin (preferred name), *balet* (Punan Tutoh), *dukun* (Bidayuh, Bau)
gaharu melitan (Iban), *melitan* (Iban), *gatal* (Murut), *kaka* (Bidayuh, Padawan)
kayu liah (Kayan), *lamin ngalang* (Kayan)

Bot. Zeit. 20 (1862) 265; Gamble, J. As. Soc. Beng. 75, 2 (1912) 266; Ridley, FMP 1 (1922) 322; Domke, Bibl. Bot. 27, Heft 111 (1934) 35, 103, 116; Airy Shaw *in* Hooker *f.*, Icon. Pl. 35 (1947) *t.* 3474 & 3475, Kew Bull. (1947) 9, Kew Bull. (1950) 138, Kew Bull. (1952) 73, FM 1, 4 (1953) 350, Kew Bull. 17 (1964) 447, FM 1, 6 (1972) 976; Backer & Bakhuizen *f.*, FJ 1 (1964) 401; Whitmore, TFM 2 (1973) 387; Cockburn, TS 1 (1974) 254; Anderson, CLTS (1980) 332; Kessler & Sidiyasa, TBSA-EK (1994) 226; Coode *et al.* (eds.), CLBD (1996) 321; Argent *et al.* (eds.), MNDT-CK (1997) 633. **Synonym:** *Asclerum* Tiegh., Ann. Sc. Nat. Bot. 7 (1893) 245.

Trees; trunk usually without buttresses; bole straight. **Bark** finely to moderately fissured, sometimes smooth; inner bark pink, reddish brown or slightly orange, laminated, cut surface glistening with irritant, protruding silky fibres. **Leaves** *alternate*, chartaceous to thick-coriaceous, glabrous above, sparsely hairy below, *with translucent glandular dots, drying brittle; lateral veins numerous, more or less parallel and straight*, arching and joining near margins to form distinct intramarginal veins; intercostal veins reticulate. **Inflorescences** *terminal or axillary panicles with few to many branches*; main branches few, lateral branches short and consisting of extremely condensed racemes, often reduced to fascicles of flowers, or consisting of dense racemes of more or less unlimited growth; bracts sometimes present at the flower bud stage, usually caducous. **Flowers** long-pedicelled; calyx tube cupular, split to about one-third or one-fourth of its length, *lobes 5*, aestivation *imbricate, subvalvate* or rarely *equitans*, thick, tough, unequal, tomentose outside, densely hispid-setulose inside; *petaloid appendages 8–65, not in pairs*, deltoid or subulate, glabrous or hairy, sometimes pustulate, rigid, reddish brown when dry, *attached at the base of the receptacle*; *stamens 8–65, free*, mostly arranged in a single whorl, sometimes in two or three whorls, inserted on the receptacle close to the petaloid appendages, filaments short and slender, anthers basifixed, horseshoe-shaped, rarely rounded, rarely bearded; *ovary superior, sessile, globose to ovoid, densely setulose, 3(–5)-loculed*, style elongate, filiform, wiry, sinuate-contorted, hairy or glabrous, stigma clavate or capitate; *parastyles absent or 3–7, small, clavate or geniculate*; ovules solitary in each locule, apical-pendulous. **Fruits** capsules, rounded, *not beaked*, thick-walled, fibrous, woody, 1–3-seeded, dehiscent into 2–5 valves. **Seeds** large, glossy, smooth, with black crustaceous testa, partially enclosed by red aril arising from the funicle, stony when dry, without endosperm.

Distribution. A genus with about 30 species distributed from the Nicobar Is. to Sumatra, Peninsular Malaysia, Borneo, Java, Sulawesi, the Philippines, New Guinea, Solomon Is., and Fiji. In Sabah and Sarawak, the genus is represented by 27 species (26 well-known and 1 incompletely known), mostly occurring in Sarawak.

Ecology. In Sabah and Sarawak, most species of *Gonystylus* are trees of the lowland and hill mixed dipterocarp forest at altitudes to 700 m. A few, e.g., *G. bancanus* and *G. maingayi* are confined to but locally gregarious in freshwater and peat swamp forests at altitudes to 100 m. In these habitats, trees of these two species produce well-developed specialised “breathing” roots known as pneumatophores. *Gonystylus bancanus* is an important component and often the dominant species of the mixed swamp forest. Other species, e.g., *G. affinis*, *G. borneënsis*, *G. micranthus*, *G. velutinus*, and *G. xylocarpus* occasionally also occur in *kerangas* forest at altitudes to 500 m. *Gonystylus nervosus* is so far the only species recorded from limestone hill forest, whereas a few species, e.g., *G. brunnescens*, *G. lucidulus*, *G. macrophyllus*, and *G. pendulus* are also known from lower montane forest, at altitudes to 1700 m.

The small but aggregated (in various types of inflorescence) flowers of most species are whitish creamy in colour and often sweet-scented at anthesis. Pollination is most probably affected by insects. The fruits, which are capsules, split into 2–5 valves at maturity exposing the arillate seeds. Frugivorous birds and arboreal small mammals are the most likely agents of seed dispersal.

Uses. Several species of *Gonystylus* occurring in Sabah and Sarawak, e.g., *G. affinis*, *G. bancanus*, *G. borneënsis*, *G. consanguineus*, *G. forbesii*, *G. macrophyllus*, *G. maingayi*, *G. velutinus*, and *G. xylocarpus* reach timber size, i.e., to 50 m tall and 100 cm diameter. The timbers are traded as *ramin*, and that of *G. bancanus* constitute the major source. The whitish, light-weight *ramin* timber is highly prized and popular as a decorative cabinet wood. The timber is also widely used in the manufacture of furniture and various items of interior decoration such as wall-panelling, light flooring, turnery, venetian blind slats, picture frames, drawing boards, and a few others. In construction industry, the timber is commonly used for making planks, door and window frames, mouldings, skirtings, ceilings, partitionings, and others. *Ramin* timber is also highly suitable for veneer, plywood, block-board, and particle-board manufacture. The resin-impregnated heartwood of *G. bancanus* and *G. macrophyllus* is occasionally collected and traded as *gaharu*, similar to that obtained from *Aquilaria malaccensis*. Pounded fruit of *G. keithii* is used as fish poison. (cf. PROSEA 5, 1 (1993) 221, for further information).

Key to *Gonystylus* species

1. Leaves larger, 25–50 × 6–15 cm; lateral veins (15–)25–40(–50) pairs.....2
 Leaves smaller, (5–)8–15(–29) × (2–)4–8(–10) cm; lateral veins (6–)10–20(–30) pairs.....8
2. Leaves bullate.....3
 Leaves not bullate.....4
3. Leaves larger, 40–50 × 7–11 cm; lateral veins 40–50 pairs; base attenuate, margin strongly revolute; petiole 1.7–1.8 cm long.....**2. G. areolatus**
 Leaves smaller, 25–32 × 6–8 cm; lateral veins 25–44 pairs; base cuneate, margin slightly revolute; petiole 1–1.5 cm long.....**19. G. nervosus**
4. Leaves glabrous on both surfaces, stiff thick-coriaceous; midrib deeply, narrowly impressed above; margin strongly revolute; petiole 3–4 cm long. Fruits ellipsoid, c. 6.5 × 5.5 cm, 4-valved, obtusely 4-ridged, verrucose, puberulous.....**20. G. nobilis**
 Not with the above combination of characters.....5
5. Leaves densely, finely golden-brown velutinous below; midrib narrowly channelled above. Petaloid appendages 40–45; stamens c. 55; parastyles absent...**23. G. spectabilis**
 Leaves glabrous on both surfaces or sparsely pilose or tomentose below; midrib flat to prominent above. Petaloid appendages 28–34; stamens 36–51; parastyles 4–6, clavate.6
6. Leaf margin strongly revolute; petiole 0.9–1.5 cm long. Petaloid appendages 34.....
 **10. G. costalis**
 Leaf margin slightly or not revolute; petiole 1.8–3 cm long. Petaloid appendages 28–32
 7

7. Twigs glabrous. Leaf base cordate; margin not revolute; lateral veins 28–30 pairs; petiole 1.8–2.1 cm long. Inflorescences condensed, to 2.5 cm long; petaloid appendages 32, glabrous; stamens *c.* 36 in one whorl.....**7. G. calophylloides**
 Twigs tomentellose. Leaf base narrowly attenuate; margin slightly revolute; lateral veins 20–25 pairs; petiole 2–3 cm long. Inflorescences robust, 15–21 cm long; petaloid appendages *c.* 28, sparsely setulose; stamens *c.* 51 in two whorls.....**12. G. eximius**
8. Leaves thick-coriaceous and often stiff.....9
 Leaves chartaceous to coriaceous.....12
9. Leaf margin slightly revolute. Petaloid appendages 12–16; stamens to 14; parastyles absent. Fruits ellipsoid with a short beak.....**3. G. augescens**
 Leaf margin strongly revolute. Petaloid appendages 20–40; stamens 15–25. Fruit subglobose, globose or ovoid-globose, without a beak.....10
10. Leaves larger, 14–26 × 5–10 cm, glabrous on both surfaces. Petaloid appendages densely setulose. Fruits ovoid-globose, 3.5–5 cm diameter.....**6. G. brunescens**
 Leaves smaller, 4–17 × 2–9 cm, persistently or sparsely hairy at least on the midrib below. Petaloid appendages sparsely setulose or glabrous. Fruits subglobose or globose, 3–7.5 cm diameter.....11
11. Petaloid appendages *c.* 20; stamens *c.* 15; parastyles absent. Fruits 3–3.5 cm diameter...
**4. G. bancanus**
 Petaloid appendages 30–40; stamens *c.* 25; parastyles 4–5. Fruit 5.5–7.5 cm diameter...
**26. G. xylocarpus**
12. Twigs variously hairy.....13
 Twigs glabrous.....15
13. Leaves larger, 10–21 × 4–10 cm; midrib flat above; petiole 0.7–1.3 cm long. Inflorescences condensed, 1–1.3 cm long; stamens *c.* 37 in 3 whorls...**9. G. consanguineus**
 Leaves smaller, 8–13 × 2–6 cm; midrib narrowly channelled above; petiole 0.5–1 cm long. Inflorescences, 2–4-branched, 3–14 cm long; stamens 8–23 in one or two whorls...14
14. Lower leaf surface tomentose; petiole 0.5–0.6 cm long. Calyx lobes ovate, sericeous outside; petaloid appendages 20–30, sparsely setulose; stamens *c.* 23 in two whorls; parastyles *c.* 3, clavate.....**22. G. pendulus**
 Lower leaf surface velutinous; petiole 0.5–1 cm long. Calyx lobes deltoid, velutinous, strongly recurved at anthesis; petaloid appendages *c.* 8, glabrous; stamens *c.* 8 in one whorl; parastyles absent.....**25. G. velutinus**
15. Leaves sparsely tomentose below.....16
 Leaves glabrous on both surfaces or occasionally sparsely puberulous on the midrib below.....18
16. Petiole 0.8–1 cm long. Inflorescences few-branched, 7–10 cm long; petaloid appendages *c.* 20, densely setulose; stamens *c.* 20 in one whorl.....**21. G. othmanii**
 Petiole 1–1.5 cm long. Inflorescences robust, many-branched, 7–20 cm long; petaloid appendages 24–30, glabrous; stamens 19–38 in one or two whorls.....17

17. Leaves larger, 15–22 × 5–8 cm; lateral veins 19–21 pairs; base acute. Petaloid appendages *c.* 30; stamens *c.* 38, in two whorls; parastyles absent.....**5. *G. borneënsis***
 Leaves smaller, 12–16 × 5–6.5 cm; base cuneate to obtuse; lateral veins 18–19 pairs. Petaloid appendages *c.* 24; stamens 19–21, in one whorl; parastyles 4, globose.....**1. *G. affinis*** (in part)
18. Petiole shorter, 0.7–1 cm long.....19
 Petiole longer, 0.9–2.6 cm long.....20
19. Leaves larger, 16–24 × 5–8 cm; base obtuse; midrib flat above. Inflorescences 4–7 cm long; petaloid appendages *c.* 23, sparsely setulose; stamens *c.* 28; parastyles densely villose.....**8. *G. calophyllus***
 Leaves smaller, 7–15 × 3–6 cm; base cuneate or rounded; midrib narrowly channelled above. Inflorescences 10–15 cm; petaloid appendages *c.* 7, glabrous; stamens *c.* 6; parastyles glabrous.....**18. *G. micranthus***
20. Leaf margin not revolute.....21
 Leaf margin slightly to strongly revolute.....22
21. Leaves smaller, 5–12 × 2–5 cm, chartaceous to thin-coriaceous; petiole 0.9–1.4 cm long. Petaloid appendages *c.* 10; stamens *c.* 10. Fruits ellipsoid-globose, 2.8–4 cm long, glabrous.....**13. *G. forbesii***
 Leaves larger, 10–20 × 4–8 cm, coriaceous; petiole 1.3–1.8 cm long. Petaloid appendages *c.* 16; stamens *c.* 18. Fruits ovoid, *c.* 3.5 × 1.7 cm, stellate pubescent.....**15. *G. lucidulus***
22. Leaf margin strongly revolute; petiole 2–2.6 cm long. Inflorescences 18–30 cm long.....**17. *G. maingayi***
 Leaf margin only slightly revolute; petiole 0.4–2 cm long. Inflorescences 4–20 cm long.....23
23. Midrib raised and prominent above; petiole conspicuously channelled above. Calyx lobes narrowly deltoid-lanceolate, 6–7 × 1.5–2 mm; petaloid appendages to 19.....**24. *G. stenosepalus***
 Midrib narrowly or deeply channelled above; petiole terete, flat or finely channelled above. Calyx lobes ovate, lanceolate, ovate-oblong, ovate-deltoid or deltoid, 4–8 × 2.5–5 mm; petaloid appendages 20–40.....24
24. Midrib deeply channelled above; lateral veins obscure above, prominulous below; petiole finely channelled on the adaxial side. Flower buds 7.5–8 × 5.5–6 mm.....**16. *G. macrophyllus***
 Midrib narrowly channelled above; lateral veins obscure above and prominent below or prominulous on both surfaces or prominent on both surfaces; petiole terete or flat on the adaxial side. Flower buds 3–6 × 3–7 mm.....25
25. Leaves smaller, 12–16 × 5–6.5 cm; lateral veins 18–19 pairs, obscure above, prominent below; petiole tomentose. Petaloid appendages glabrous; parastyles 4, densely velutinous.....**1. *G. affinis*** (in part)
 Leaves larger, 13–24 × 4–9 cm; lateral veins 18–23 pairs, prominulous to prominent on both surfaces; petiole glabrous. Petaloid appendages sparsely setulose; parastyles 6 or absent, glabrous.....26

26. Leaf base cuneate; apex caudate; lateral veins prominulous on both surfaces. Petaloid appendages *c.* 26; parastyles 6, glabrous..... **11. G. decipiens**
 Leaf base broadly cuneate or rounded; lateral veins prominent on both surfaces.
 Petaloid appendages *c.* 20; parastyles absent..... **14. G. keithii**

1. Gonystylus affinis Radlk.

(Latin, *affinis* = allied to; resembling another species)

Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 16 (1887) 329; Merrill, EB (1921) 371; Masamune, EPB (1942) 446; Airy Shaw *op. cit.* (1953) 357; Anderson *op. cit.* 332; Whitmore *op. cit.* 388; Turner, Gard. Bull. Sing. 47 (1995) 485; Coode *et al.* (eds.) *op. cit.* 321; Argent *et al.* (eds.) *op. cit.* 634. **Type:** *Beccari PB 1209*, 'Borneo' (holotype M; isotype L, fragment). **Synonym** (homotypic): *Gonystylus beccarianus* Tiegh., *op. cit.* 245.

Tree 20–50 m tall, 25–80 cm diameter; bole straight, without buttresses, slightly fluted at base. **Bark** reddish brown, laminated, finely fissured. **Twigs** terete, *glabrous*, dark brown. **Leaves** chartaceous to coriaceous, *glabrous on both surfaces or sparsely tomentellous below*, on drying greyish brown above, dull brown or greenish brown below; *blade* oblong to elliptic, sometimes ovate to broadly ovate, 12–16 × 5–6.5 cm, *base cuneate to obtuse, margin slightly revolute*, apex caudate-acuminate; *midrib narrowly channelled above; lateral veins 18–19 pairs*, usually rather straight and parallel, *obscure above, prominent below*; intercostal venation reticulate; *petiole to 1.5 cm long, moderately tomentose, terete, rugose or ribbed*, drying reddish brown. **Inflorescences** *robust panicles*, sparsely to densely tomentose, 7–17 cm long, *many-branched*, side branches nodulose, each bearing 4–6 clusters of flowers, each cluster with 2–5 flowers; bracts absent. **Flowers:** pedicels 0.7–1 cm long, tomentose; buds subglobose, 3–6 × 4–7 mm, at anthesis 6–7 × 6–8 mm; *calyx lobes lanceolate-deltoid, 4–6 × 4–5 mm, tomentose outside; petaloid appendages c. 24, linear-subulate, 2.4–3 × 0.2–0.5 mm, apex acuminate, curled towards the ovary, pustulate, glabrous; stamens 19–21, in a single whorl, 1.5–2.5 mm long, filaments 1–1.5 mm long, anthers 0.5–1 × 5 mm; ovary ovoid, subglobose, densely velutinous, 3-loculed, style elongate, filiform, to 6 mm long, glabrous, stigma clavate; parastyles 4, very small, globose, densely velutinous. **Fruits** (immature) ovoid-globose, 3.5–5 cm across, 3-valved, warty, reddish brown.*

Vernacular name. Sarawak—*ramin bukit* (Malay).

Distribution. Peninsular Malaysia and Borneo.

Ecology. Primary lowland mixed dipterocarp and *kerangas* forests on well-drained sandy clay soils, at altitudes to 300 m.

Uses. The wood is an important source of *ramin* timber in Sarawak.

Notes. Two varieties, *viz.* var. *affinis* and var. *elegans*, are recognised.

Key to varieties

Leaves tomentellous below; petiole shorter than 1 cm long, rugose. Inflorescences densely tomentose.....

var. **affinis**

Peninsular Malaysia and Borneo. In Borneo, known in Sabah from Kota Belud, Labuk Sugut and Sandakan districts (e.g., *SAN 15372*, *SAN 21729* and *SAN 99853*) and in Sarawak from Kapit, Limbang and Kuching districts (e.g., *S 23949*, *S 37738*, *S 66099*, and *S 68712*). Also occurring in Brunei (e.g., *BRUN 5653*).

Leaves glabrous below; petiole 1.2–1.5 cm long, ribbed. Inflorescences sparsely tomentose.

var. **elegans** Airy Shaw

(Latin, *elegans* = beautiful)

Kew Bull. 28 (1973) 267. Type: *Galau S 14968*, Borneo, Sarawak, Semengoh FR (holotype K; isotypes L, SAR).

Endemic in Borneo; known in Sabah from Labuk Sugut and Sipitang districts (e.g., *SAN 16794*, *SAN 90477*, *SAN 128881*, and *SAN 132745*) and in Sarawak from Kuching, Lundu and Marudi districts (e.g., *S 14968*, *S 15189* and *S 29461*).

2. **Gonystylus areolatus** Domke ex Airy Shaw

(Latin, *areolatus* = finely net-like; the intercostal venation of the leaves)

Kew Bull. (1952) 73, *op. cit.* (1953) 353. **Type:** *Jaheri (Expedition Nieuwenhuis) 773*, Borneo, Kalimantan, Samarinda (holotype BO; isotype L).

Small tree, *c.* 10 m tall. **Bark** fuscous, rather smooth, dull greyish brown. **Twigs** robust, 5–10 mm diameter. **Leaves** *strongly bullate*, chartaceous to coriaceous, glabrous above, glabrous to sparsely tomentose below, drying greyish brown above, chestnut-brown below; *blade* oblong, rarely oblanceolate-oblong, 40–50 × 7–11 cm, *base attenuate*, *margin strongly revolute*, apex long-caudate or cuspidate; midrib narrowly channelled above, sparsely tomentose below; *lateral veins* 40–50 pairs, impressed above, prominent below; intercostal venation distinctly areolate; *petiole* 1.7–1.8 cm long, rugose, glabrous. **Inflorescences** robust panicle with a few branches, 13–15 cm long, tomentose; rachis to 5 mm diameter; bracts absent. **Flower:** pedicels 2.2–2.8 cm long, tomentose; buds subglobose, 8–8.5 × 7–8 mm; calyx lobes deltoid, 8–9 × 3–6 mm, moderately recurved at anthesis, outer surface tomentose, inner surface densely velutinous; petaloid appendages 35–40, in a single whorl, linear to subulate, 2–3 × 0.2 mm, sparsely setulose; stamens 65–80, 2.5–3.5 mm long, glabrous, filaments 1.8–2.5 mm long, anthers 0.5–1.1 × 0.5 mm; ovary 5–6-loculed, ovoid, densely setulose, style robust, *c.* 5 mm long, villous, stigma capitate; parastyles 4–7, clavate, 1.5–2 mm long, glabrous. **Fruits** unknown.

Vernacular names. Sarawak—*ramin*, *ramin bukit* (Malay).

Distribution. Endemic in Borneo; uncommon and known only from Kuching district in Sarawak (e.g., *S 37175*) and from SE Kalimantan (e.g., the type).

Ecology. In primary and secondary mixed dipterocarp forest, on clay or loam soils, at *c.* 50 m altitude.

3. **Gonystylus augescens** Ridl.

(Latin, *augescens* = increasing, elongating; referring to the inflorescence)

Bull. Misc. Inform. Kew (1946) 43; Airy Shaw *in* Hooker *f.*, *Icon. Pl.* 35 (1947) *t.* 3474, *op. cit.* (1950) 143, *op. cit.* (1953) 353. **Lectotype** (designated here): *Haviland 2078*, Borneo, Sarawak, Kuching (hololectotype K; isolectotypes SAR, SING).

Small tree. **Twigs** terete, dark brown, glabrous. **Leaves** *thick-coriaceous*, chestnut-brown when dry, darker below, glabrous except the midrib below; *blade* broadly elliptic to elliptic oblong, 16–29 × 8–14 cm, base rounded to subcordate, rarely broadly cuneate, *margin slightly revolute*, apex rounded and shortly cuspidate-acuminate; *midrib narrowly channelled above*, raised below; *lateral veins 18–22 pairs*, prominent on both surfaces; intercostal venation reticulate; petiole 1–1.5 cm long, 3–4 mm diameter, rugose, glabrous. **Inflorescences** 9–18 cm long, 2–3-branched, initially densely ochreous-tomentellous, glabrescent; rachis marked with dense, regular, spiral rows of scars of fallen flowers and bracts; bracts ovate-oblong, cucullate, 4–7 × 2–2.5 mm, subsericeous, caducous. **Flowers:** pedicels 0.5–1.3 cm long; buds subglobose, 3–5 × 3.5–4 mm, tomentose; calyx lobes ovate-deltoid, 3–5 × 2–3 mm, densely fulvous-sericeous; *petaloid appendages 12–16*, subulate, 2.5–3 mm long, densely setulose inside, sparsely setulose or subglabrous outside; *stamens c. 14*, 1.6–2 mm long, in a single whorl, filaments *c. 1* mm long, anthers 0.5–1 mm long, glabrous; ovary ovoid, *c. 2.2* mm long, densely velutinous, 3–5-loculed, style filiform, villous, stigma clavate; *parastyles absent*. **Fruits** *ellipsoid with a short beak*, 3–5 × 2–2.5 cm, 3-valved, 6-ribbed, glabrous, dark brown when dry. **Seeds** compressed ellipsoid, *c. 2.5 × 0.8* mm.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo. Rather rare, known in Sarawak only from Kuching and Lundu districts (e.g., *Haviland 488, S 14466* and *S 15524*).

Ecology. In lowland mixed dipterocarp forest, at low altitudes.

Notes. This species is morphologically closely related to *G. lucidulus* in its reproductive characters, *i.e.*, the inflorescence-type and floral parts, but differs by its shorter petioles and the colour of drying leaves.

4. *Gonystylus bancanus* (Miq.) Kurz (of Bangka Is., Sumatra)

Nat. Tijds. Ned. Ind. 27 (1864) 171, 240; Airy Shaw, Kew Bull. (1947) 9, *op. cit.* (1953) 361; Whitmore *op. cit.* 388; Cockburn *op. cit.* 256; Anderson *op. cit.* 332; Turner *op. cit.* 485; Coode *et al.* (eds.) *op. cit.* 321; Argent *et al.* (eds.) *op. cit.* 634. **Basionym:** *Aquilaria ?bancana* Miq., Fl. Ind. Bat., Suppl. (1861) 355. **Type:** *Teijsmann HB 3494*, Sumatra, Bangka Is. (holotype BO; isotype U). **Synonyms:** *Gonystylus miquelianus* Teijsm. & Binn. *op. cit.* 265; *G. hackenbergii* Diels, Bot. Jahrb. 60 (1926) 310.

Tree 25–50 m tall, 30–100 cm diameter; bole straight, without buttresses. **Bark** slightly fissured, dark or greyish brown; inner bark reddish brown, 3–5 cm thick, fibrous. **Sapwood** white to pale yellowish cream. **Twigs** glabrous, dark greyish brown. **Leaves** *thick-coriaceous*, glabrous above, *persistently hairy on the midrib below*, drying characteristically reddish brown below, often folded; *blade* elliptic, oblong-oblancoolate or obovate, 4–15 × 2–7 cm, base broadly rounded to obtuse, *margin strongly revolute*, apex rounded-acuminate, acumen to 2 cm long; midrib narrowly channelled above, rounded and prominent below; *lateral veins 10–18 pairs*, closely arranged, distinct above, less so below; intercostal venation visible above, faint below; petiole 0.7–1.8 cm long, channelled above, glabrous, rugose. **Inflorescences** 8–15 cm long, densely tomentose; bracts absent. **Flowers** in clusters of 2–5; pedicels 1–1.8 cm long, tomentose; buds subglobose, 4–5 mm diameter; calyx lobes deltoid, 3–4 mm long, tomentose outside, densely velutinous inside, ciliate at the margin; *petaloid appendages c. 20*, in a single whorl, subulate, 1.5–3 × 0.5–1 mm, *glabrous*; *stamens c. 15*, 1.5–3 mm long, in a single whorl,

filaments 1–2 mm long, anthers 0.5–1 × 0.5 mm, glabrous; ovary ovoid-globose, *c.* 2 × 2 mm, densely setulose, 3-loculed, style filiform, glabrous, stigma clavate; *parastyles absent*. **Fruits** globose or subglobose, 3–3.5 cm diameter, 3–4-valved, *without a beak*; pericarp surface minutely dotted, rough, fibrous, brown. **Seeds** ovoid or ellipsoid, 2–2.8 × 1.6 cm; testa dark brown, glossy, crustaceous; without endosperm.

Vernacular names. Sabah—*bidaru* (Kedayan), *ramin* (Malay). Sarawak—*lunak* (Melanau Oya), *ramin*, *ramin telur* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known in Sabah from Beaufort, Papar, Ranau, Sipitang, and Tawau districts (e.g., *SAN 34692*, *SAN 56672*, *SAN 93904*, *SAN 132120*, and *SAN A 1719*) and in Sarawak from Betong, Bintulu, Kuching, Miri, Mukah, Sibul, Simunjan, and Sri Aman districts (e.g., *S 1733*, *S 8005*, *S 10001*, and *S 77006*). Also occurring in Brunei (e.g., *FMS 28674* and *FMS 36985*) and in Kalimantan (e.g., *bb. 16645* and *bb. 32396*).

Ecology. Locally common in mixed swamp and peat swamp forests (particularly common in the *Gonystylus bancanus-Dactylocladus-Neoscortechinia* association of peat swamp forest in Brunei and Sarawak), at altitudes to 100 m. In water-logged habitat, the species develops specialised knee-roots (pneumatophores).

Uses. The most important source of *ramin* timber. The timber has been extensively exploited in Malaysia (especially in Sarawak), and is highly valued for planks, furniture, panelling, mouldings of all kinds, and veneer.

5. *Gonystylus borneënsis* (Tiegh.) Gilg (of Borneo)

In Engler & Prantl, *Nat. Pflanzenfam. Nachtr.* 1 (1897) 232; Merrill *op. cit.* (1921) 372; Masamune *op. cit.* 447; Airy Shaw, *Kew Bull.* (1947) 9, *op. cit.* (1953) 355; Cockburn *op. cit.* 255; Anderson *op. cit.* 333; Coode *et al.* (eds.) *l.c.* 321; Argent *et al.* (eds.) *op. cit.* 634. **Basionym:** *Asclerum borneense* Tiegh., *op. cit.* 247. **Type:** *Beccari P.B. 1589*, Borneo, Sarawak, Mt. Matang (isotype L, fragment). **Synonym:** *Gonystylus bancanus auct. non* (Miq.) Kurz; Merrill, *PEB* (1929) 184, Masamune *op. cit.* 446.

Tree 24–35 m tall, to 60 cm diameter; bole straight, slightly fluted at base, with low buttresses. **Bark** greyish brown, finely irregularly fissured; inner bark 5 mm thick, orange-yellow to reddish brown. **Sapwood** whitish or cream. **Twigs** rough, *glabrous*, blackish to reddish brown. **Leaves** *chartaceous to coriaceous*, glabrous above, *sparsely tomentose below*, drying greyish brown on both surfaces; *blade* oblong or sometimes narrowly elliptic, 15–22 × 5–8 cm, *base acute*, margin slightly revolute, apex acuminate or sometimes caudate; midrib narrowly channelled above; *lateral veins 19–21 pairs*, prominent on both surfaces; intercostal venation reticulate; *petiole 1–1.2 cm long*, rugose, sparsely tomentose. **Inflorescences** 15–20 cm long, pendulous, *many-branched*, each branch bearing 5 or more clusters of flowers, each cluster with 3–5 flowers, appressed tomentellous; bracts absent. **Flowers:** pedicels 2.6–3 cm long, sericeous; buds subglobose, 7.5–8 × 7–7.5 mm, tomentose; calyx lobes deltoid, 7.5–9 × 2.5–5.5 mm, tomentose outside, densely velutinous inside; *petaloid appendages c. 30*, in a single whorl, linear-subulate, 4.5–5.4 × 5 mm, apex rarely incised, *glabrous*; *stamens c. 38*, *c. 3 mm long*, in two whorls, filaments *c. 1.5 mm long*, anthers *c. 1.5 mm long*, glabrous; ovary obovoid, densely setulose, 5-loculed, style filiform, *c. 9.5 mm long*, glabrous, stigma clavate; *parastyles absent*. **Fruits** round, 5–7 cm diameter, brown, rough.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo. In Sabah, known from Kinabatangan, Ranau, Sipitang, and Tawau districts (e.g., *SAN 16614*, *SAN 36458* and *SAN 94043*) and in Sarawak, from Kapit, Kuching, Lundu, Marudi, Miri, Simunjan, Sri Aman, and Tatau districts (e.g., *S 23092*, *S 35686*, *S 37207*, *S 41855*, and *S 59971*). Also occurring in Brunei (e.g., *BRUN 316*, *Forman LLF 1078* and *Kirkup DK 356*) and in Kalimantan.

Ecology. In mixed dipterocarp and *kerangas* forests on yellow sandy clay and sandy soils, at altitudes to 500 m.

6. *Gonystylus brunnescens* Airy Shaw

(Latin, *brunnescens* = brownish; the drying leaves)

Kew Bull. (1950) 138, *op. cit.* (1953) 138; Whitmore *op. cit.* (1973) 388; Anderson *op. cit.* 333; Kessler & Sidiyasa *op. cit.* 226; Turner *op. cit.* 485; Argent *et al.* (eds.) *op. cit.* 635. **Type:** *Budding bb. 29629*, Borneo, Kalimantan, Melawai (holotype BO). **Synonym:** *Gonystylus bancanus auct. non* (Miq.) Kurz: Heine *in* Fedde, Rep. 54 (1951) 239.

Tree 20–40 m tall, 30–100 cm diameter; buttresses to 0.3 m tall. **Bark** reddish to dark brown, more or less smooth; inner bark pinkish red, fibrous. **Sapwood** yellowish white. **Twigs** dark brown, glabrous. **Leaves** *thick-coriaceous*, *glabrous on both surfaces*, drying dark brown on both surfaces; *blade* elliptic to oblong, $14\text{--}26 \times 5\text{--}10$ cm, base obtuse, *margin strongly revolute*, apex caudate; midrib narrowly channelled above, glabrous; *lateral veins 15–25 pairs*, distinct on both surfaces, intramarginal veins 1–2 mm from the margin; intercostal venation visible on both surfaces; petiole 1–1.5 cm long, glabrous, ribbed, reddish brown. **Inflorescences** 6–22 cm long, sparsely tomentose; bracts absent. **Flowers:** pedicels 1.5–1.8 cm long, tomentose; buds subglobose, $5\text{--}6 \times 4\text{--}6$ mm; calyx lobes deltoid, $5\text{--}5.2 \times 2\text{--}3.5$ mm, densely tomentose outside, densely velutinous inside; *petaloid appendages c. 20*, in a single whorl, linear-subulate, $3\text{--}3.5 \times c. 0.5$ mm, *densely setulose*; *stamens c. 18*, $3\text{--}3.5$ mm long, in a single whorl, filaments 1.5–2 mm long, anthers $c. 1.5 \times 0.5$ mm, glabrous; ovary ovoid, 3-loculed, densely setulose; style filiform, *c. 3* mm long, glabrous, stigma clavate; parastyles 5–6, globose, tomentose. **Fruits** *ovoid-globose*, *without a beak*, $3.5\text{--}5$ cm diameter, 3-valved, verrucose, brown.

Vernacular names. Sabah—*nasi-nasi pakir* (Malay). Sarawak—*ramin* (Malay).

Distribution. Peninsular Malaysia and Borneo. In Borneo, recorded in Sabah from Mt. Kinabalu (e.g., *Clemens 50705* and *SFN 26391*) and in Sarawak from Bau, Belaga, Kapit, and Samarahan districts (e.g., *S 17028*, *S 19099*, *S 29033*, *S 41322*, and *S 43651*). Also occurring in Brunei (e.g., *FMS 34575*) and in Kalimantan (e.g., *bb. 8311*, *bb. 31633* and *Church et al. 166*).

Ecology. In mixed dipterocarp and lower montane forests on clay and sandy soils, at 40–1500 m altitude.

7. *Gonystylus calophylloides* Airy Shaw

(Latin, resembling *G. calophyllus*)

Kew Bull. 17 (1964) 448, *op. cit.* (1972) 979; Anderson *op. cit.* 333; Coode *et al.* (eds.) *op. cit.* 321. **Type:** Anderson S 4266, Borneo, Sarawak, Marudi district, Ulu Sg. Melinau (holotype SAR; isotypes K, L, SING).

Small tree, 6–10 m tall, 10–25 cm diameter. **Twigs** rugose, *glabrous*, dark brown, sometimes lenticellate. **Leaves** *chartaceous to coriaceous*, drying yellowish brown to greyish brown on both surfaces, *glabrous on both surfaces or sparsely tomentose below*; *blade* oblong to oblanceolate-oblong, 30–40 × 8–12 cm, *base cordate, margin not revolute*, apex rounded and abruptly shortly caudate; *midrib flat or slightly prominulous above*, prominent below; *lateral veins 28–30 pairs*; intercostal venation reticulate; *petiole 1.8–2.1 cm long*, *glabrous, rugose, dark brown*. **Inflorescences** *condensed, to 2.5 cm long*, few-flowered, sericeous; bracts absent. **Flowers:** pedicels slender, 2.8–3.2 cm long, yellowish brown sericeous; buds globose, 7–8 mm diameter, tomentose; calyx lobes broadly deltoid to lanceolate, 7–10 × 3–6 mm, sparsely tomentose outside, densely velutinous inside; *petaloid appendages c. 32*, in two whorls, linear-subulate, 4.5–5 × 1 mm, *glabrous*; *stamens 36*, 2.5–3 mm long, *in a single whorl*, filaments 1–1.5 mm long, anthers 1.5 mm long, *glabrous*; ovary ovoid, 2–3 mm long, 5-loculed, densely setulose, styles elongate, filiform, densely villous, stigma clavate; *parastyles 5*, 1–1.5 mm long, *clavate*, rather flat, densely villous. **Fruits** *globose, c. 3.5 cm diameter, 5-valved*, verrucose, puberulous, substended by 5 persistent calyx lobes borne on striate stalks of *c. 2.5 cm long*. **Seeds** solitary, large, glossy, brown, stony when dry.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo. Known in Sarawak from Belaga, Bintulu, Marudi, and Tatau districts (e.g., S 21814, S 43706, S 51410, and the type). Also occurring in Brunei (e.g., Coode MC 7242, Dransfield JD 6651, Forman LLF 927, Wong WKM 1151, and Wong WKM 2082).

Ecology. In mixed dipterocarp forest, on rocky boulder-strewn gorge and basalt hillsides, at altitudes to 200 m.

8. *Gonystylus calophyllus* Gilg

(Greek, *calo-* = beautiful, *phullon* = leaf; with beautiful leaves)

In Engler & Prantl Nat. Pflanzenfam. Nachtr. 1 (1897) 232; Merrill *op. cit.* (1921) 372; Masamune *op. cit.* 447; Airy Shaw *op. cit.* (1953) 354; Anderson *op. cit.* 333. **Type:** Haviland 998, Borneo, Sarawak, Kuching (holotype K).

Small tree. **Twigs** rugose, *glabrous*, dark brown. **Leaves** *chartaceous to coriaceous*, *glabrous*, drying purplish-lead coloured on both surfaces; *blade* elliptic to oblong, 16–24 × 5–8 cm, *base obtuse*, margin slightly revolute, apex caudate; *midrib flat above*, *glabrous*; *lateral veins* 28–35 pairs, very distinct; intercostal venation reticulate; *petiole* 0.7–1 cm long, robust, *glabrous*, rugose, dark brown. **Inflorescences** 4–7 cm long, tomentose; bracts absent. **Flowers:** pedicels 1–1.5 cm long, tomentose; buds subglobose, 7–7.5 × 5.5–6 mm, tomentose; calyx lobes narrowly deltoid, 6.5–7 × 1–1.5 mm, tomentose outside, densely velutinous inside; *petaloid appendages* c. 23, in a single whorl, linear-subulate, 4–5 × 0.5 mm, *sparsely setulose*; *stamens* c. 28, in two whorls, 3.4–4 mm long, filaments c. 1 mm long, anthers 2.5–3 mm long, *glabrous*; ovary ovoid, 3-loculed, densely setulose, style solitary, filiform, c. 7 mm long, villous, stigma clavate; *parastyles* 4–6, geniculate, c. 1 mm long, *densely villose*. **Fruits** unknown.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo. Uncommon; known only in Sarawak from Bintulu, Kuching, Miri, and Serian districts (e.g., *S* 21775, *S* 27583, *S* 68753, and *S* 82579).

Ecology. In lowland mixed dipterocarp forest on clay and loamy soils.

9. *Gonystylus consanguineus* Airy Shaw

(Latin, *con-* = similar, *sanguinis* = blood; closely allied to *G. affinis* and *G. borneënsis*)

Kew Bull. 17 (1964) 454, *op. cit.* (1972) 979; Cockburn *op. cit.* 255; Kessler & Sidiyasa *op. cit.* 227; Argent *et al.* (eds.) *op. cit.* 635. **Type:** *Meijer SAN 21729*, Borneo, Sabah, Sandakan district, Sepilok FR (holotype K; isotype L).

Tree 20–40 m tall, 30–80 cm diameter; buttresses to 2 m tall. **Bark** fissured, dark brown. **Twigs** somewhat slender, *short fulvo-tomentellous*, *glabrescent*, dark brown. **Leaves** *chartaceous to coriaceous*, moderately punctate, sparsely tomentose, drying greyish green above, yellowish brown below; *blade* elliptic to oblong, 10–21 × 4–10 cm, base rounded or obtuse, margin slightly revolute, apex acuminate or sometimes caudate; *midrib flat above*, rounded and prominent below, sparsely puberulous; *lateral veins* 15–25 pairs, prominent on both surfaces, intramarginal veins 1–2 mm from the margins; intercostal venation visible on both surfaces; *petiole* 0.7–1.3 cm long, sparsely tomentose. **Inflorescences** *condensed*, 1–1.3 cm long, sparsely hairy; bracts absent. **Flowers:** pedicels 4–5 mm long, tomentose; buds subglobose, 5–6 × 4–6 mm; calyx lobes deltoid, 4–5 × 4 mm, tomentose; *petaloid appendages* c. 30, c. 2 × 0.5 mm, *glabrous*; *stamens* c. 37, 1.5–2 mm long, *in 3 whorls*, filaments c. 1 mm long, anthers 0.5–1 × 0.5 mm, *glabrous*; ovary ovoid, 1–1.5 mm long, 3-loculed, densely setulose, styles short, contorted, *glabrous*, stigma small, clavate; *parastyles* absent. **Fruits** (immature) ovoid-globose to ellipsoid, 2–3 × 1.5–1.8 cm; stalk c. 2.2 cm long; pericarp verrucose.

Vernacular name. Sabah—*ramin* (Malay).

Distribution. Endemic in Borneo. In Sabah, recorded from Kinabatangan, Kuala Penyu, Labuk Sugut, Penampang, Sandakan, Tawau, and Tenom districts (e.g., *SAN 23578*, *SAN 92055*, *SAN 103042*, and *SAN 121244*) and in Sarawak, from Miri district (e.g., *S* 15827, *S* 37003 and *S* 43162). Also occurring in W and E Kalimantan (e.g., *Kostermans 5286* and *Kostermans 13901*).

Ecology. In primary and secondary mixed dipterocarp forests, at altitudes to 700 m.

10. *Gonystylus costalis* Airy Shaw

(Latin, *costalis* = relating to the midrib)

Kew Bull. 23 (1969) 269, *op. cit.* (1972) 980; Anderson *op. cit.* 333. **Type:** *Wright S 23989*, Borneo, Sarawak, Kapit district, Bt. Raya (holotype K; isotypes L, SAN).

Small tree, 5–10 m tall, 8–10 cm diameter. **Bark** slightly flaky, greyish brown. **Twigs** 5–8 mm diameter, rugulose-sulcate, greyish brown, appressed greyish brown puberulous, glabrescent. **Leaves** coriaceous, glabrous or sparsely hairy at the base of midrib below, drying brownish on both surfaces; *blade* oblong-elliptic, 25–45 × 8–14 cm, base cuneate or sometimes cordate, *margin strongly revolute*, apex subrotundate and shortly apiculate-caudate; *midrib prominent below, broadly but shallowly elevated above; lateral veins 24–26 pairs*, obscure above, prominent below; intercostal venation reticulate; *petiole 0.9–1.5 cm long*, sparsely short-tomentose, rugose, dark brown. **Inflorescences** robust, to 17 cm long, fulvous-tomentellous; bracts ovate, 4–5 × 2.5–3 mm, tomentose. **Flowers:** pedicels 1.5–2.5 cm long, tomentose; buds subglobose, 7–7.5 × 5.5–6 mm, tomentose; calyx lobes deltoid, 5.5–6 × 5–5.5 mm, tomentose outside, densely velutinous inside; *petaloid appendages c. 34*, in a single whorl, linear-subulate, 2–2.5 × 0.5 mm, glabrous; *stamens c. 37*, 1.5–3 mm long, in a single whorl, filaments 1–1.5 mm long, anthers *c. 1 × 0.5 mm*, glabrous; ovary ovoid, densely setulose, 3-loculed, style filiform, glabrous, stigma clavate; *parastyles 4–6*, 0.5–1 mm long, *clavate*, densely villous. **Fruits** unknown.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo; known only from Belaga and Kapit districts in Sarawak (e.g., *S 25748*, *S 29185*, *S 29664*, and *S 53427*).

Ecology. In primary mixed dipterocarp forest on clay soil, at 160–700 m altitude.

11. *Gonystylus decipiens* Airy Shaw

(Latin, *decipiens* = deceiving; a species closely resembling another species)

Kew Bull. 17 (1964) 454, *op. cit.* (1972) 980. **Type:** *Jacobs 5456*, Borneo, Sarawak, Belaga district (holotype K).

Tree 25–30 m tall. **Twigs** terete, 3–4 mm diameter, *glabrous*, dark brown. **Leaves** chartaceous to coriaceous, *glabrous*, drying greyish brown to slightly greenish on both surfaces; *blade* elliptic, oblong or oblanceolate, 16–21 × 6–8 cm, base cuneate, *margin slightly revolute*, apex caudate; *midrib narrowly channelled above*, sparsely puberulous; *lateral veins 19–23 pairs*, *prominulous on both surfaces*; intercostal venation reticulate; *petiole 1.3–1.5 cm long*, terete, *glabrous*, rugose, dark brown. **Inflorescences** with many branches, 8–16 cm long, bearing numerous flowers, tomentose; bracts absent. **Flowers:** pedicels 1–1.5 cm long, tomentose; buds subglobose, 5–6 × 3–4 mm, tomentose; *calyx lobes deltoid*, 5–6 × 2.5–3 mm, tomentose outside, densely velutinous inside; *petaloid appendages c. 26*, in a single whorl, linear-subulate, 2.5–3 × 0.5 mm, *sparsely setulose*; filaments and anthers of equal length, *c. 1 mm*, glabrous; ovary 3-loculed, densely setulose, style *c. 6 mm* long, filiform, glabrous, stigma clavate; *parastyles 6*, *c. 0.5 mm* long, *glabrous*. **Fruits** unknown.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo; known only from the type.

Ecology. In primary dipterocarp forest on sandstone substratum, at c. 500 m altitude.

12. *Gonystylus eximius* Airy Shaw

(Latin, *eximius* = excellent; inference unknown)

Kew Bull. 28 (1973) 267. **Type:** *Ilias S 28777*, Borneo, Sarawak, Kapit district, Ulu Merit, Sg. Sebatong (holotype K; isotypes L, SAR, SING).

Small tree, to 5 m tall, 10 cm diameter. **Twigs** robust, terete, 6–8 mm diameter, *yellowish brown tomentellous*, glabrescent. **Leaves** *coriaceous*, *sparsely pilose or glabrous above*, *sparsely pilose below*, drying greenish above, chestnut-brown below; *blade elliptic-oblong or oblanceolate-oblong*, 33–48 × 9–15 cm, *base narrowed, abruptly attenuate towards the petiole, margin slightly revolute*, apex *rotundate and abruptly caudate; midrib conspicuously raised and glabrous above*, prominent and densely pilose below; *lateral veins 20–25 pairs*, with several shorter parallel veins in between, impressed above, conspicuously raised below, arching and anastomosing near the margin to form intramarginal veins; intercostal venation reticulate, raised; *petiole 2–3 cm long*, 6–8 mm thick, rugose, puberulous. **Inflorescences** terminal, *robust, 15–21 cm long*, densely reddish brown tomentose; bracts absent. **Flowers:** pedicels robust, 1–2 cm long before anthesis, to 6 cm long at anthesis, densely reddish brown velutinous; buds subglobose, 9–10 × 5.5–6 mm, tomentose; calyx lobes narrowly ovate to lanceolate, 11–16 × 4.5–5 mm, tomentose outside, densely velutinous inside; *petaloid appendages c. 28*, in a single whorl, linear-subulate, 8–9 × 0.5–1 mm, sometimes incised at apex, sparsely pustulate, *sparsely setulose*; *stamens c. 51*, 4–5 mm long, *in two whorls*, filaments c. 3 mm long, anthers c. 2.5 × 0.5 mm, bearded; ovary ovoid, 5-loculed, setulose, style elongate, villous, stigma clavate; *parastyles 4–5, clavate*, 1–1.5 mm long. **Fruits** unknown.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo; known by two collections from Sg. Sebatong, Ulu Merit, Kapit district in Sarawak (*S 28773* and the type).

Ecology. In primary lowland mixed dipterocarp forest near streams, on sandy and clay soil, at altitudes to 250 m.

Notes. Very similar to *G. costalis* but differs by its prominently veined and thinly pilose lower leaf-surface, the densely tomentellous inflorescences, and the very large flowers borne on elongated pedicels.

13. *Gonystylus forbesii* Gilg

Plates 6D–E.

(H.O. Forbes, 1851–1932, Scottish botanist/naturalist)

In Engler & Prantl, Nat. Pflanzenfam. Nachtr. 1 (1897) 232; Merrill *op. cit.* (1921) 372; Masamune *op. cit.* 447; Airy Shaw *op. cit.* (1953) 357; Cockburn *op. cit.* 255; Anderson *op. cit.* 333; Argent *et al.* (eds.) *op. cit.* 635. **Type:** *Forbes 3078*, Sumatra (holotype L). **Synonyms:** *Gonystylus warburgianus* Gilg. *ex Domke op. cit.* 5, 8, 33, 146; *G. bancanus auct. non* (Miq.) Kurz: S. Moore, J. Bot. Suppl. 62 (1924) 14.

Tree 30–55 m tall, 40–80 cm diameter; trunk straight, buttresses to 1.7 m tall. **Bark** fissured, flaking off, greyish brown; inner bark pinkish red, fibrous. **Sapwood** pale yellow. **Twigs** *glabrous*, dark brown to blackish. **Leaves** *chartaceous to thin-coriaceous*, shagreen and *glabrous on both surfaces or sparsely puberulous below*, especially on midrib, drying yellowish brown on both surfaces; *blade* elliptic to almost rhomboid, 5–12 × 2–5 cm, base cuneate, *margin flat*, apex acuminate or rounded-caudate; midrib narrowly channelled or rarely almost flat above; *lateral veins 10–20 pairs*, closely arranged, rather steeply ascending, conspicuous below, less so above, intramarginal veins 0.5–1 mm from the margin; intercostal venation faint on both surfaces; *petiole* slender, 0.9–1.4 cm long, sparsely tomentose, rugose. **Inflorescences** with many branches, 5–15 cm long, each branch bearing 4–8 clusters of flowers, each cluster with 4–6 flowers, reddish yellow short-hairy; bracts absent. **Flowers:** pedicels slender, to 1 cm long, tomentellous; buds subglobose, 3–3.5 × 2–2.5 mm; calyx lobes ovate-deltoid, 3–5 × 2–3 mm, tomentellous at the edges, strongly recurved at anthesis; *petaloid appendages c. 10*, in a single whorl, subulate, 0.5–1 × 0.5 mm, densely setulose; *stamens c. 10*, 1.5–2 mm long, in a single whorl, filaments and anthers 0.5–1 mm long, anthers glabrous; ovary 3-loculed, densely setulose, style glabrous, stigma clavate; parastyles absent. **Fruits** *ellipsoid-globose*, 2.8–4 cm long, 3-valved, *glabrous*, verrucose, rugose, dark brown; pericarp fibrous. **Seeds** ellipsoid, *c. 1.3 cm long*, stony; testa smooth, glossy, dark brown, crustaceous.

Vernacular name. Sarawak—*ramin batu* (preferred name).

Distribution. Sumatra and Borneo. In Sabah, known from Beaufort, Keningau, Kinabatangan, Labuk Sugut, Papar, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 15243*, *SAN 30618*, *SAN 65359*, *SAN 79087*, and *SAN 96655*) and in Sarawak, from Kapit, Kuching, Lawas, Lubok Antu, Marudi, Sarikei, Sibul, and Sri Aman districts (e.g., *S 8084*, *S 29075*, *S 33015*, *S 41403*, and *S 68193*). Also occurring in Brunei (e.g., *FMS 34478*) and E Kalimantan (e.g., *bb. 16824*).

Ecology. In primary mixed dipterocarp and lower montane forests, on clay and sandy soils, at altitudes to 1200 m.

Uses. Source of *ramin* timber. However, this species is not as abundant as *G. bancanus*.

14. *Gonystylus keithii* Airy Shaw

(H.G. Keith, former Conservator of Forests at Sandakan, Sabah)

Kew Bull. (1947) 13, *op. cit.* (1953) 356, *op. cit.* (1964) 453; Cockburn *op. cit.* 254; Anderson *op. cit.* 333; Coode *et al.* (eds.) *op. cit.* 321; Argent *et al.* (eds.) *op. cit.* 635. **Lectotype** (designated here): *Puasa BNBFD 1722*, Borneo, Sabah, Sandakan (holotype K). **Synonym:** *Gonystylus bancanus auct. non* (Miq.) Kurz: Merrill *op. cit.* (1929) 184.

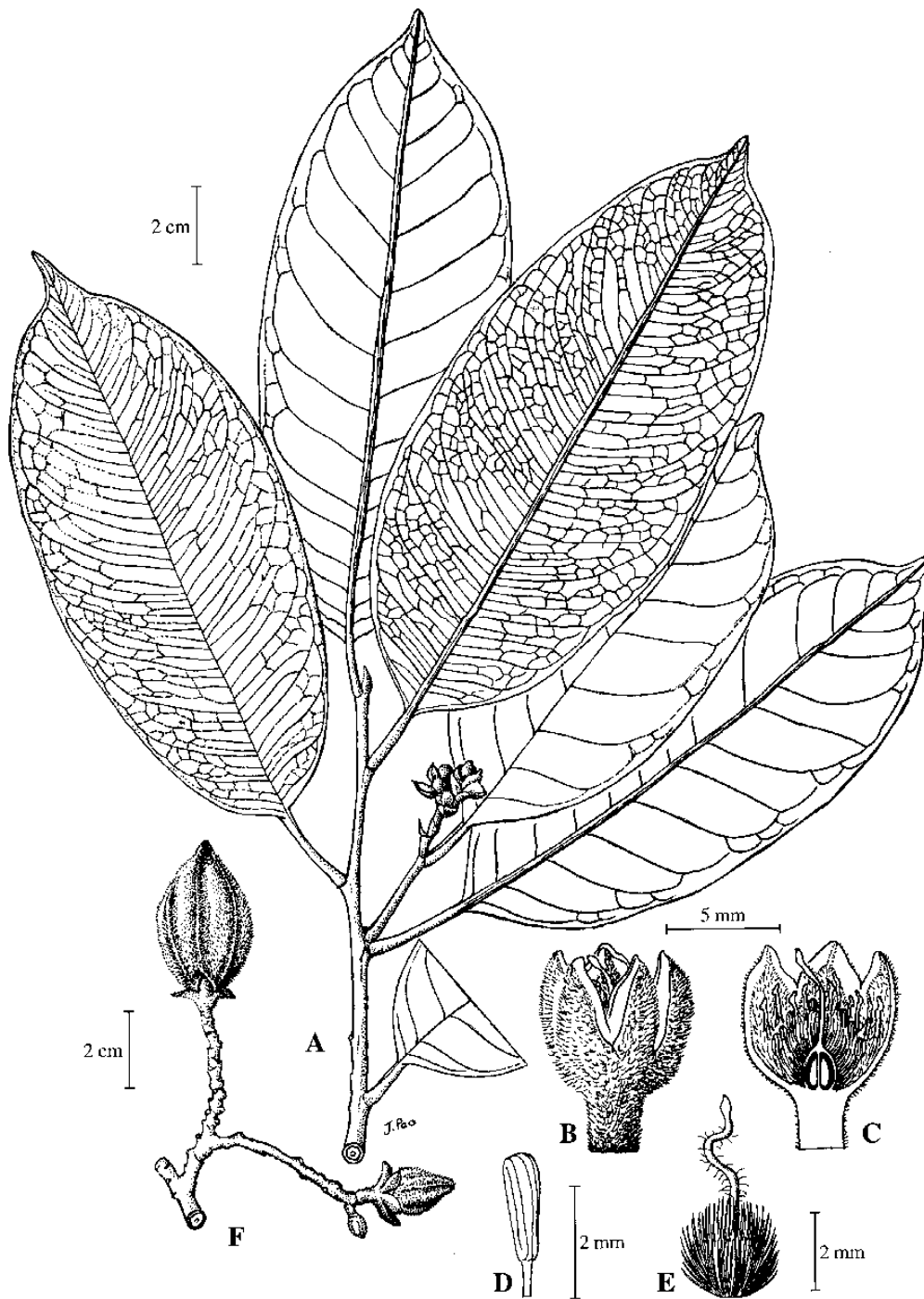


Fig. 4. *Gonystylus lucidulus*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower; D, stamen; E, gynoecium; F, inflorescence. (A–E from *S* 40450, F from *S* 3024.)

Tree to 25 m tall, to 46 cm diameter; trunk straight, without buttresses. **Bark** fissured, smooth to slightly flaky, greyish brown; inner bark pink to dark red. **Sapwood** yellow. **Twigs** blackish grey, *glabrous*. **Leaves** chartaceous, *glabrous on both surfaces*, drying discolourous, greyish green above, pinkish brown below; *blade elliptic-oblong to oblanceolate, 13–24 × 4–9 cm, base broadly cuneate to almost rounded, margin slightly revolute*, apex acuminate to caudate, acumen to 2 cm long; *midrib narrowly channelled above; lateral veins lax, 18–23 pairs*, with 2–3 shorter veins in between, *prominent on both surfaces*; intercostal venation visible on both surfaces; *petiole 1–2 cm long, flat above, glabrous, rugose, dark brown*. **Inflorescences** terminal, short-branched, *9–15 cm long*, sparsely to densely grey tomentose, each branch bearing 5–9 clusters of flowers, each cluster with 5–8 flowers; bracts ovate, *2–3 × 1–1.5 mm*, tomentose. **Flowers:** pedicels 0.8–2 cm long, densely yellowish brown tomentellous; buds subglobose, 4.5–5 mm diameter; *calyx lobes ovate to ovate-oblong, 6–8 × 4–5 mm*, densely subsericeous on both sides, sometimes pustulate outside; *petaloid appendages c. 20*, linear-subulate, *2–4 × 0.5 mm*, sometimes incised at apex, *sparsely setulose*, with numerous spherical creamy pustules, especially on the upper surface; stamens *c. 21*, 1–1.5 mm long, in a single whorl, filaments *c. 1 mm* long, anthers *c. 0.5 mm* long, *glabrous*; ovary ovoid, 2–3 mm long, 3-loculed, densely setulose, style filiform, *c. 4 mm* long, *glabrous*, stigma capitate; *parastyles absent*. **Fruits** rounded or spheroidal, to 6.5 cm diameter, 3–5-valved, brown, verrucate; pericarp fibrous. **Seeds** ellipsoid, stony; testa smooth, glossy, brown, crustaceous; hilum velutinous.

Vernacular names. Sabah—*karai* (Malay), *malindah* (Sungei), *saukau* (Kedayan).

Distribution. Endemic in Borneo. In Sabah, recorded from Beaufort, Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Pensiangan, Pitas, Ranau, Sandakan, and Tawau districts (e.g., *SAN 16900*, *SAN 25774*, *SAN 36908*, *SAN 83421*, and *SAN 121296*). Also occurring in Brunei (e.g., *BRUN 868*) and in Kalimantan (e.g., *bb. 34791* and *Church & Mahyar 1434*).

Ecology. In primary mixed dipterocarp forest, on sandy soil, at 30–350 m altitude.

Uses. In Sabah, pounded fruit mixed with wood ashes is locally used as fish poison.

15. *Gonystylus lucidulus* Airy Shaw

Fig. 4.

(Latin, *lucidulus* = somewhat shining; referring to the upper surface of drying leaves)

Kew Bull. 17 (1964) 447, *op. cit.* (1972) 981; Coode *et al.* (eds.) *op. cit.* 321. **Type:** *Dan S 3024*, Borneo, Sarawak, Miri district, Bt. Lambir (holotype K; isotypes L, SAN).

Tree 27–36 m tall, 30–45 cm diameter; trunk straight, without buttresses. **Bark** finely fissured, flaking to small pieces, soft and fibrous; inner bark soft, pale brown. **Sapwood** hard, pale yellow. **Twigs** terete, 3–5 mm diameter, finely striate, dark brown, *glabrous*. **Leaves** coriaceous, *glabrous on both surfaces*, shining above, sparsely punctulate below, drying greenish above, greyish brown below; *blade oblong, elliptic-oblong or lanceolate-oblong, 10–20 × 4–8 cm*, base rotundate, rarely cuneate or subcordate, *margin not revolute*, apex narrowly rounded, abruptly caudate; *midrib narrowly channelled above, prominent and glabrous below; lateral veins 8–16 pairs*, lax, prominulous on both surfaces; intercostal venation reticulate; *petiole slender, 1.3–1.8 cm long, 2–3 mm thick, sparsely yellowish brown tomentose, rugose, grooved above*. **Inflorescences** 2–4-branched, 3–9 cm long; flowers borne singly and alternately along the branches; rachis thick, knobby, marked with dense, regular, spiral rows of

scars of fallen flowers and bracts; bracts numerous, suborbicular, 7–8 mm broad, dorsally keeled, glabrous. **Flowers:** pedicels 0.3–0.4 cm long, tomentose; buds subglobose, 4–5 × 3.5–4 mm, tomentose; calyx lobes deltoid, 4–4.5 mm long, tomentose outside, densely velutinous inside; *petaloid appendages* *c.* 16, in a single whorl, linear-subulate, 2.5–3 × 0.5 mm, epustulate, densely setulose; *stamens* *c.* 18, 1.5–2 mm long, in a single whorl, filaments 0.5–1 mm long, anthers 1.5–2 × 0.5 mm, glabrous; ovary ovoid, densely setulose, style filiform, densely villous, stigma clavate; parastyles absent. **Fruits** (immature) *asymmetrically ovoid*, *c.* 3.5 × 1.7 cm, 3-valved, *finely stellate pubescent*, dark brown.

Vernacular name. Sarawak—*ramin bukit* (preferred name).

Distribution. Endemic in Borneo, uncommon. Recorded in Sarawak from Kuching and Miri districts (e.g., *S* 38308, *S* 38312, *S* 40450, and *S* 42278). Also occurring in Brunei (e.g., *S* 5928).

Ecology. In mixed dipterocarp forest on clay and sandy soil, at 30–1100 m altitude. The flowers are whitish-creamy, sweet-scented and insect-pollinated.

Notes. The species is morphologically closely allied to *G. augescens* in its floral and fruit characters but differs by its longer petiole (1.3–1.8 cm long), smaller and narrower, smooth and shining leaves without minute appressed hairs on the lower surface, thicker inflorescence rachis, and broader bracts.

16. *Gonystylus macrophyllus* (Miq.) Airy Shaw

Plate 6F.

(Greek, *makro* = large; *phullon* = leaf; large-leaved)

Kew Bull. (1947) 9, *op. cit.* (1953) 354; Backer & Bakhuizen *f. op. cit.* 401; Cockburn *op. cit.* 255; Whitmore *op. cit.* 388; Anderson *op. cit.* 333; Turner *op. cit.* 485; Coode *et al.* (eds.) *op. cit.* 322; Argent *et al.* (eds.) *op. cit.* 636. **Basionym:** *Aquilaria ?macrophylla* Miq., *op. cit.* 356. **Type:** *Diepenhorst HB 2356*, Sumatra, Priaman (holotype U). **Synonyms:** *Gonystylus miquelianus* Teijsm. & Binn., *op. cit.* 265; *G. philippinensis* Elmer, Leaflet. Philip. Bot. 7 (1915) 2674; *G. obovatus* Merr., Philip. J. Sci. 12 (1917) 283.

Tree to 45 m tall, to 100 cm diameter; buttresses to 3 m tall. **Bark** thick, shallowly fissured, dark brown, densely lenticellate; inner bark pale brown, fibrous. **Twigs** *glabrous*, dark brown. **Leaves** *chartaceous to coriaceous*, *glabrous on both surfaces*, drying yellowish brown on both surfaces; *blade* oblong, elliptic, obovate or sub lanceolate, (3–)13–28(–40) × (2–)5–9(–15) cm, base cuneate to rounded, *margin slightly revolute*, apex acuminate, rounded or caudate, acumen to 1 cm long; *midrib deeply channelled above*; *lateral veins 6–19 pairs*, with 1–2 shorter veins in between, *obscure above, prominulous below*; intercostal venation obscure above, visible below, irregularly areolate; *petiole 1.2–2 cm long*, sparsely tomentose or glabrous, rugose, *finely channelled above*, dark brown when dry. **Inflorescences** 14–20 cm long, unbranched or branched, each branch bearing 4–8 clusters of flowers, each cluster with 3–5 flowers, tomentose; bracts ovate, 2–3 × 1.5 mm, tomentose. **Flowers:** pedicels *c.* 1.5 cm long, tomentose; buds subglobose, 7.5–8 × 5.5–6 mm; calyx lobes ovate-deltoid, 4–4.5 mm long, tomentose outside, densely velutinous inside; *petaloid appendages 20–40*, in a single whorl, linear-subulate, 2.5–3 × 0.5 mm, epustulate, sparsely setulose; stamens 16–30, 2–2.5 mm long, in a single or rarely in two whorls, filaments 1–1.5 mm long, anthers *c.* 10 × 0.5 mm, glabrous; ovary ovoid, 2–2.5 mm long, 3-loculed, densely setulose, style filiform, villous, stigma clavate; parastyles absent. **Fruits** globose, 4–7 cm diameter, 3–5-valved; pericarp fibrous, verrucose,

sparsely stellate pubescent, dark brown; testa smooth. **Seeds** ellipsoid, *c.* 4 × 2.4 cm; testa glossy, brown, crustaceous.

Vernacular names. Sarawak—*ramin* (Iban, Malay), *gaharu melitan*, *melawis* (Iban).

Distribution. Nicobar Is. and widespread throughout the Malesian region, except for C and E Java and the Lesser Sunda Is. In Sabah, recorded from Sipitang district (e.g., *SAN 16732*) and in Sarawak, from Bintulu and Kapit districts (e.g., *S 21129* and *S 25455*). Also occurring in Brunei (e.g., *Niga NN 136* and *SAN 17418*) and in Kalimantan (e.g., *Kostermans 5286* and *Veldkamp 8493*).

Ecology. In primary mixed dipterocarp and lower montane forests, on clay and sandy soil, at altitudes to 1700 m.

Uses. The timber is locally used for general light construction purposes, and the infected heartwood for producing incense.

17. *Gonystylus maingayi* Hook.f.

(A.C. Maingay, 1836–1869, British physician and botanist, sometime jail-warden in Malacca, Peninsular Malaysia)

Fl. Brit. Ind. 5 (1890) 200; Gamble *op. cit.* 266; Ridley *op. cit.* (1922) 322; Airy Shaw *op. cit.* (1953) 359, *op. cit.* (1964) 456, *op. cit.* (1972) 978; Cockburn *l.c.* 255; Whitmore *op. cit.* 391; Anderson *op. cit.* 333; Turner *op. cit.* 485; Coode *et al.* (eds.) *op. cit.* 322; Argent *et al.* (eds.) *op. cit.* 636. **Type:** *Maingay s.n.* (= *Kew Distr. No. 1441*), Peninsular Malaysia, Malacca (holotype K).

Tree 27–40 m tall, 50–80 cm diameter. **Bark** pale grey to dark brown, slightly fissured, flaky or cracking; inner bark light red. **Sapwood** pale yellow. **Twigs** dark brown to blackish, *glabrous*. **Leaves** *chartaceous*, *glabrous*, drying dark brown above, purplish brown below; *blade* elliptic-oblong, 8–15 × 4–8 cm, base cuneate to rounded, *margin strongly revolute*, apex acuminate to caudate, acumen to 1.5 cm long; midrib narrowly channelled above, sparsely puberulous; *lateral veins* 24–30 pairs, prominent on both surfaces; intercostal venation reticulate; *petiole* 2–2.6 cm long, sparsely tomentose, rugose, dark brown. **Inflorescences** few-branched, 18–30 cm long, each branch with 3–6 clusters of flowers, each cluster 2–6-flowered, densely tomentose; bracts absent. **Flowers:** pedicels 1–1.5 cm long, tomentose; buds subglobose, 4.5–5 mm diameter, tomentose; calyx lobes deltoid, 3.5–5 × 2–4 mm, tomentose on both surfaces, strongly recurved at anthesis; petaloid appendages *c.* 22, subulate, 2–2.5 × 0.5 mm, epustulate, *glabrous*, fleshy, rigid, reddish brown when dry; stamens *c.* 22, 2–2.5 mm long, in a single whorl, filaments 1–1.5 mm long, anthers *c.* 1 × 0.5 mm, *glabrous*; ovary ovoid-subglobose, *c.* 3 mm long, 3-loculed, densely setulose, style elongate, wiry, *c.* 6 mm long, villous, stigma clavate; parastyles absent. **Fruits** spheroidal, 3–4 × 2.5–4 cm, 2–5-valved; pericarp thick, woody, fibrous, verrucate, sparingly stellate pubescent, dark brown. **Seeds** 1–3 per fruit, ellipsoid; testa smooth, glossy, dark brown, crustaceous.

Vernacular names. Sabah—*mitan* (Iban), *ramin* (Brunei Dusun). Sarawak—*ramin batu air* (preferred name), *ramin hitam*, *ramin paya* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Sabah, recorded from Beaufort and Papar districts (e.g., *SAN 24822* and *SAN A 1703*) and in Sarawak, from Bintulu, Samarahan and Sri Aman districts (e.g., *S 14607*). Also occurring in Brunei (e.g., *BRUN 976* and *FMS 36980*).

Ecology. In primary freshwater swamp and peat swamp forests, at altitudes to 150 m.

Notes. The leaves of *Gonystylus maingayi* resemble those of *G. bancanus* but larger. The calyx lobes are strongly recurved at anthesis, similar to those of *G. forbesii* and *G. velutinus*. It differs, however, from *G. forbesii* and *G. velutinus* by the longer petiole (2–2.6 cm long), number of petaloid appendages (c. 22) and wiry villous style.

Uses. The timber is traded and used as that of *G. bancanus*.

18. *Gonystylus micranthus* Airy Shaw

(Greek, *mikro* = small, *anthos* = flower; small-flowered)

Kew Bull. (1950) 142, *op. cit.* (1953) 361, *op. cit.* (1964) 457; Anderson *op. cit.* 333; Argent *et al.* (eds.) *op. cit.* 636. **Type:** *Garvill S 4*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype KEP; isotype SING).

Tree 18–25 m tall, 30–60 cm diameter. **Bark** dark brown, irregularly flaky; inner bark orange to reddish brown. **Sapwood** yellowish. **Twigs** 3–4 mm diameter, blackish brown, *glabrous*. **Leaves** *chartaceous to coriaceous, glabrous*, drying distinctly dark purplish brown on both surfaces; *blade* elliptic-oblong, 7–15 × 3–6 cm, *base cuneate or rounded*, margin slightly revolute, apex abruptly caudate, acumen 0.6–1.2 cm long; *midrib narrowly channelled above*, puberulous below; *lateral veins 20–23 pairs*, obscure above, prominent below, intramarginal veins 0.5–1 mm from the margins; intercostal venation scalariform, faint on both surfaces; *petiole 0.8–1 cm long*, channelled above, sparsely tomentose, rugose, dark brown. **Inflorescences** few-branched, 10–15 cm long, sparsely tomentose; bracts absent. **Flowers:** pedicels 0.2–0.4 cm long, densely tomentose; buds 2–3.5 × 2–2.5 mm, dark greyish brown tomentose; calyx lobes lanceolate to narrowly deltoid, 2–3 × 1–1.5 mm, sparsely tomentose outside, densely tomentose inside; *petaloid appendages c. 7*, in a single whorl, subulate, 2–2.5 × 0.5–1 mm, epustulate or sometimes sparsely pustulate at apex, *glabrous*; *stamens c. 6*, 1.5–2 mm long, in a single whorl; filaments 0.5–1 mm long, anthers c. 1 × 0.5 mm, bearded; ovary subglobose, 3-loculed, densely setulose, styles filiform, c. 1.5 mm long, *glabrous*, stigma clavate; *parastyles 4–5*, geniculate, *glabrous*. **Fruits** 3.5–4 cm long, elongate with short beaks, dark brown; pericarp fibrous.

Vernacular name. Sarawak—*ramin hitam* (Malay).

Distribution. Endemic in Borneo. Recorded in Sabah from Beaufort and Papar districts (e.g., *SAN 126551*, *SAN 126688* and *SAN 127307*) and in Sarawak from Bintulu, Kuching, Marudi, and Samarahan districts (e.g., *S 34826*, *S 38450*, *S 48929*, and *S 68890*). Also occurring in SE Kalimantan (e.g., *Kostermans 13489* and *Jarvie & Ruskandi 5559*).

Ecology. Primary lowland mixed dipterocarp and *kerangas* forests on undulating lands, on clay or sandy soil, at altitudes to 100 m.

19. *Gonystylus nervosus* Airy Shaw(Latin, *nervosus* = distinctly veined; the leaves)

Kew Bull. 17 (1964) 452, *op. cit.* (1972) 981; Anderson *op. cit.* 333. **Type:** *Anderson S 4644*, Borneo, Sarawak, Baram district, G. Benarat (holotype K; isotypes L, SAN).

Small tree to 5 m tall, 10 cm diameter. **Twigs** terete, 3–5 mm diameter, glabrous, dark brown. **Leaves** chartaceous to thin-coriaceous, glabrous, drying greyish brown on both surfaces, *bullate*; *blade* oblanceolate or rarely oblong, 25–32 × 6–8 cm, *base cuneate*, *margin slightly revolute*, apex narrowed to subrotund, abruptly caudate, acumen 1–4 cm long; midrib slender, flat or impressed above, prominent and sparsely tomentose below; *lateral veins 25–44 pairs*, parallel, impressed above, sharply raised below, conspicuously arcuating and anastomosing toward the margin; intercostal venation reticulate; *petiole 1–1.5 cm long*, sparsely tomentose, rugose, dark brown when dry. **Inflorescences** few-branched, 2–4 cm long, few-flowered, greyish sericeous; bracts absent. **Flowers:** buds subglobose, 4.5–5 mm across; calyx lobes deltoid, 1.8–2.3 mm long, tomentose outside, densely velutinous inside; petaloid appendages *c.* 22, in a single whorl, linear-subulate, 2–2.5 × 0.5 mm, epustulate, glabrous; stamens *c.* 30, 1–1.5 mm long, in 3 whorls, filaments *c.* 5 mm long, anthers *c.* 1 × 0.5 mm, glabrous; ovary ovoid, 3-loculed, densely setulose, style filiform, *c.* 4 mm long, glabrous, stigma capitate; parastyles absent. **Fruits** (immature) ellipsoid, *c.* 3.5 cm long, dark brown, 3-valved, substended by persistent calyx lobes; stalk *c.* 2 cm long. **Seeds** 2 per fruit, flattened subellipsoid, *c.* 2.2 × 1.6 cm; testa shining, pale chestnut brown.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo. Known only in Sarawak from Bintulu, Kuching and Marudi districts (e.g., *BRUN 3227*, *S 4013*, *S 12544*, *S 18189*, and *S 34778*).

Ecology. Confined to limestone hill forest, at altitudes to 450 m.

Notes. The very distinct venation on both surfaces of the bullate leaves is similar to that of *G. costalis*. However, this species differs from *G. costalis* in its glabrous petaloid appendages, glabrous style and the absence of parastyles.

20. *Gonystylus nobilis* Airy Shaw(Latin, *nobilis* = notable or remarkable; referring to the large leaves with long, robust petiole)

Kew Bull. 23 (1969) 271, *op. cit.* (1972) 981; Anderson *op. cit.* 333. **Type:** *Ilias S 15115*, Borneo, Sarawak, Bintulu district, Ulu Segan (holotype K; isotypes L, SAN).

Tree to 25 m tall, without buttresses. **Bark** rather smooth to finely fissured, lenticellate. **Twigs** robust, to 1 cm diameter, finely striate, greyish brown. **Leaves** *stiff thick-coriaceous*, *not bullate*, *glabrous on both surfaces*, drying dull greyish green above, yellowish brown below; *blade* elliptic to suboblong, 30–35 × 9–12 cm, *base broadly cuneate-rotundate*, *margin strongly revolute*, apex abruptly acuminate, acumen acute, *c.* 1 cm long; *midrib* robust, *prominent below*, *deeply narrowly impressed above*; *lateral veins 15–20 pairs*, lax, prominulous above, sharply prominent below, conspicuously anastomosing near the margins; intercostal venation reticulate; *petiole* very robust, terete, 3–4 cm long, *c.* 5 mm thick, sparsely appressed pubescent, rugose, dark brown when dry. **Inflorescences** unbranched, 11–15 cm long, appressed pubescent. **Flowers** unknown; calyx lobes (as seen in immature fruit) 4.5–5.5 × 2.5–3 mm, tomentose

outside, densely velutinous inside; petaloid appendages (as seen in immature fruit) *c.* 5 × 0.5 mm, sparsely setulose, fleshy, rigid, reddish brown when dry. **Fruits** (immature) *ellipsoid*, *c.* 6.5 × 5.5 cm, 4-valved, *conspicuously obtusely 4-ridged, verrucose, puberulous*, greyish brown when dry; pericarp thick, fibrous. **Seeds** ellipsoid; testa glossy, crustaceous, dark reddish brown.

Vernacular name. Sarawak—*ramin bukit* (Malay).

Distribution. Endemic in Borneo; rare and known only by the type.

Ecology. In primary mixed dipterocarp forest on clay sandy and dry soil, at *c.* 300 m altitude.

Notes. The lax venation and long petiole suggest affinity with *G. macrophyllus*, but the twigs of this species are more robust.

21. *Gonystylus othmanii* Tawan

(Othman Ismawi, former research assistant at the Herbarium, Sarawak Forestry Department)

Bot. J. Linn. Soc. 130 (1999) 66. **Type:** *Tawan CST 164*, Borneo, Sarawak, Kuching district, Bako NP (holotype SAR; isotypes HUMS, KEP, SAN).

Tree to 10 m tall, 20 cm diameter; trunk straight; buttresses absent. **Bark** finely fissured, greyish brown. **Twigs** *glabrous*, rugose, dark brown. **Leaves** *chartaceous*, *sparsely tomentose below*, drying greyish brown to brown; *blade* elliptic to narrowly oblong, 9–18 × 3–6 cm, base cuneate, margin slightly revolute, apex acuminate; midrib flat to prominent above, prominent below; *lateral veins 21–25 pairs*, with many shorter veins in between, prominent on both surfaces; intercostals venation reticulate, inconspicuous; *petiole 0.8–1 cm long*, sparsely tomentose, rugose, drying dark brown. **Inflorescences** panicle, *few-branched, 7–10 cm long*, tomentose; bracts ovate, 3–4 × 2.5–3 mm, tomentose. **Flowers:** pedicels 5–7 mm long, tomentose; buds subglobose, 4–5 × 3–3.5 mm; calyx cupular, lobes 5, deltoid, 4.5–5 × 2.5–3.5 mm, tomentose outside, densely setulose inside; *petaloid appendages c. 20*, in a single whorl, linear-subulate, 1–2 × 0.5 mm, epustulate, *densely setulose*; *stamens c. 20*, 2.5–3 mm long, *in a single whorl*, filaments *c.* 1 mm long, anthers *c.* 2 × 1.5 mm, *glabrous*; ovary ovoid, *c.* 2 × 2 mm, 3-loculed, densely setulose, style *c.* 3.5 mm long, filiform, villous, stigma capitate; parastyles *c.* 5, clavate, *c.* 0.5 mm long, densely villous. **Fruits** (immature) ellipsoid, 4.5–5.5 cm long, with short beak, 4-valved, verrucate, sparsely hairy, dull brown when dry.

Distribution. Endemic in Borneo. Known in Sarawak from Kapit, Kuching, Lundu, and Samarahan districts (e.g., *Purseglove P 5044, S 36651, S 43911, S 54409, and S 61744*).

Ecology. In lowland mixed dipterocarp forest on sandy or loamy soil, at low altitude.

Notes. A species closely related to *G. pendulus* but differs by its lateral veins 21–25 pairs (*vs.* 9–12 pairs), petaloid appendages densely setulose (*vs.* sparsely setulose), parastyles 5 and densely villous (*vs.* 3 and *glabrous*), and stamens arranged in a single whorl (*vs.* in two whorls).

22. *Gonystylus pendulus* Airy Shaw(Latin, *pendulus* = drooping; referring to the branches)Kew Bull. (1950) 141, *op. cit.* (1953) 359; Anderson *op. cit.* 333. **Type:** *Clemens 20011*, Borneo, Sarawak, Lundu district, Mt. Pueh (holotype K).

Small tree to 10 m tall, 12.5 cm diameter. **Twigs** elongate, pendulous, *pubescent when young*, dark brown. **Leaves** *chartaceous to thin-coriaceous*, glabrous above, *appressed tomentose below*, drying greyish brown on both surfaces; *blade* oblong-elliptic to almost oblong, 8–12 × 2–4 cm, base rounded-cuneate, margin slightly revolute, apex acuminate to shortly caudate; *midrib* narrowly channelled above, sparsely tomentose below; *lateral veins* 9–12 pairs, steeply ascending, prominent on both surfaces; intercostal venation reticulate; *petiole* 0.5–0.6 cm long, sparsely tomentose, rugose, dark brown. **Inflorescences** 3–4-branched, 3–6 cm long, each branch with 3–4 flowers, sparsely tomentose; bracts absent. **Flowers:** pedicels 1.5–2 cm long, tomentose; buds subglobose, 4.5–5 mm diameter; *calyx lobes* narrowly to broadly ovate, 5–6 × 3.5–4 mm, *appressed sericeous outside*; *petaloid appendages* 20–30, in a single whorl, linear-subulate, 3.5–4.5 × 1.5 mm, epustulate, *sparsely setulose*; *stamens* c. 23, 2–3 mm long, in two whorls, filaments and anthers of more or less equal, 1–1.5 mm long, glabrous; ovary ovoid, densely setulose, style filiform, c. 3 mm long, villous, stigma clavate; *parastyles* c. 3, c. 0.5 mm long, *clavate*. **Fruit** unknown.

Vernacular name. Sarawak—*ramin bukit* (Malay).**Distribution.** Endemic in Borneo; rare and known only by the type.**Ecology.** In lower montane forest, on clay soil, at c. 1200 m altitude.**23. *Gonystylus spectabilis* Airy Shaw**

Fig. 5.

(Latin, *spectabilis* = spectacular; the golden-brown indumentum on the lower leaf surface)Kew Bull. 23 (1969) 269, *op. cit.* (1972) 982; Anderson *op. cit.* 333; Coode *et al.* (eds.) *op. cit.* 636. **Type:** *Jugah S 23816*, Borneo, Sarawak, Kapit district, Bt. Raya (holotype K; isotypes KEP, SAN).

Tree c. 25 m tall, to 50 cm diameter. **Bark** dark brown, regularly flaky; inner bark orange to reddish brown. **Sapwood** yellowish. **Twigs** robust, c. 8 mm diameter, ridged, densely golden-brown tomentellous. **Leaves** *chartaceous to thin-coriaceous*, not bullate, glabrous above except the midrib, *densely finely velutinous with golden-brown short hairs below*, drying slightly shining above; *blade* broadly elliptic-oblong, 25–32 × 8–15 cm, base rounded to slightly cordate, *margin strongly revolute*, apex rounded and abruptly caudate, acumen to 2.5 cm long; *midrib* narrowly channelled above, rounded, prominent, robust, and densely fulvous-tomentellous below; *lateral veins* 20–25 pairs, with up to 5 shorter veins in between, faint above, visible below, intramarginal vein 1–2 mm from the margin; intercostal venation faint above, visible below; *petiole* 1.5–2.5 cm long, densely tomentose, flat above to almost 4-angled. **Inflorescences** robust, 8–22 cm long, many-branched, many-flowered; rachis grooved, densely tawny-tomentellous; bracts absent. **Flowers:** pedicels 1.5–2.5 cm long, tomentose; buds subglobose, 6–8 mm diameter; *calyx lobes* 9.5–10 × 5–7 mm, tomentose outside, densely velutinous inside; *petaloid appendages* 40–45, in a single whorl, linear-subulate, 4–5.5 × 0.5 mm, epustulate, glabrous; *stamens* c. 55, 2.5–4 mm long, in a single whorl, filaments and anthers equal, 1–2 mm long, anthers glabrous; ovary ovoid, c. 2

mm long, 3-loculed, style filiform, *c.* 8 mm long, glabrous, stigma capitate; *parastyles absent*. **Fruits** unknown.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo. Recorded in Sarawak from Kapit and Limbang districts (e.g., *S* 28763, *S* 32371 and the type). Also occurring in Brunei (e.g., *FMS* 35685).

Ecology. In mixed dipterocarp forest on gentle slopes of spur-ridges, at altitudes to 200 m.

Notes. Allied to *G. calophylloides* and *G. calophyllus*, but differing in its dense golden-brown indumentum, its longer petiole (up to 2.5 cm long), larger number (40–45) of petaloid appendages, and its styles without parastyles.

24. *Gonystylus stenosepalus* Airy Shaw

(Latin, *stenos* = narrow, *sepalus* = sepal; having narrow calyx lobes)

Kew. Bull. (1947) 9, *op. cit.* (1953) 355, *op. cit.* (1964) 451; Cockburn *op. cit.* 254; Anderson *op. cit.* 334; Coode *et al.* (eds.) *op. cit.* 322. **Type:** *Haviland* 489, Borneo, Sarawak, Sibuluan district, along Rajang R. (holotype K).

Small tree to 15 m tall, to 20 cm diameter. **Twigs** *glabrous*, ochreous-brown. **Leaves** *chartaceous to coriaceous, glabrous*, drying yellow-ochreous on both surfaces; *blade* elliptic or oblong, 12–20 × 5–9 cm, base rounded, *margin slightly revolute*, apex acuminate; *midrib raised and prominent above*, glabrous; *lateral veins 17–20 pairs*, prominent on both surfaces; intercostal venation reticulate; *petiole 1–1.5 cm long, conspicuously channelled above*, glabrous or sparsely tomentose. **Inflorescences** terminal, 4–5-branched, 4–13 cm long, each branch with 4–6 clusters of flowers, each clusters bearing 3–6 flowers, sparsely appressed tomentose; bracts absent. **Flowers:** pedicels 1.8–2.1 cm long, tomentose; buds subglobose, 3–4 × 2–3 mm; *calyx lobes narrowly deltoid or narrowly lanceolate, 6–7 × 1.5–2 mm*, tomentose outside, densely velutinous inside; *petaloid appendages c. 19*, in a single whorl, linear-subulate, 3.5–4 × 0.5 mm, glabrous, pustulate; stamens *c.* 18, 2.5–3 mm long, in a single whorl, filaments *c.* 1 mm long, anthers *c.* 1.5 × 0.5 mm, glabrous; ovary 3-loculed, densely setulose, styles filiform, sparsely villous, stigma capitate; parastyles 4–5, minute, rounded or geniculate, glabrous. **Fruits** unknown.

Vernacular name. Sarawak—*ramin bukit* (Malay).

Distribution. Endemic in Borneo. In Sabah, recorded from Beaufort, Kota Kinabalu, Kinabatangan, Kuala Penyu, Labuk Sugut, Sandakan, Tawau, and Tenom districts (e.g., *SAN* 20485, *SAN* 21307, *SAN* 32200, *SAN* 79405, and *SAN* 125314) and in Sarawak, from Bintulu, Kapit, Kuching, Lubok Antu, and Miri districts (e.g., *S* 12824, *S* 34061, *S* 36023, *S* 38977, and *S* 43162). Also occurring in Brunei (e.g., *Niga* NN 57).

Ecology. In primary mixed dipterocarp forest, at altitudes to 100 m.

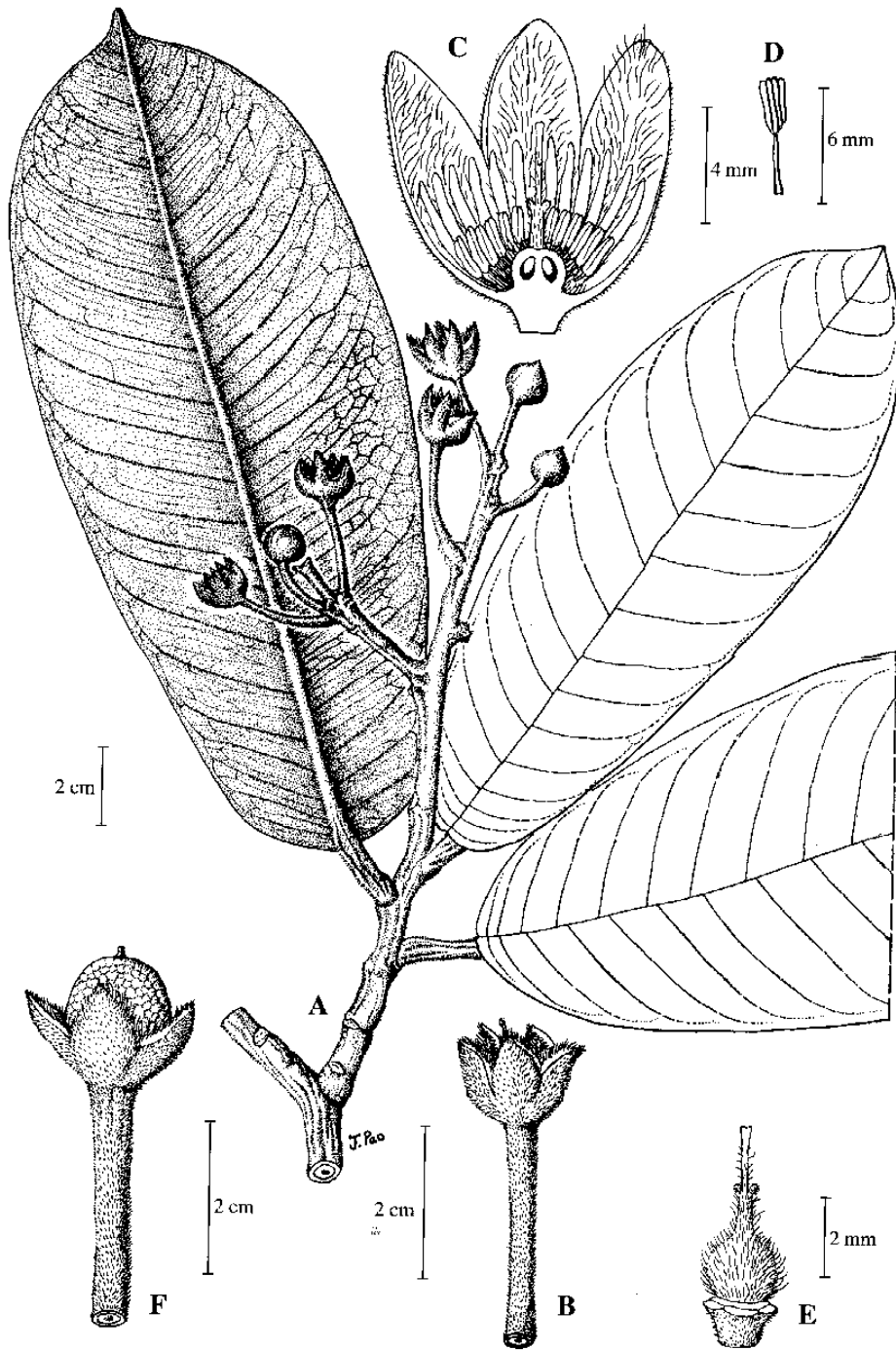


Fig. 5. *Gonystylus spectabilis*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower; D, stamen; E, gynoecium; F, very young fruit. (A from S 28763, B–F from S 32371.)

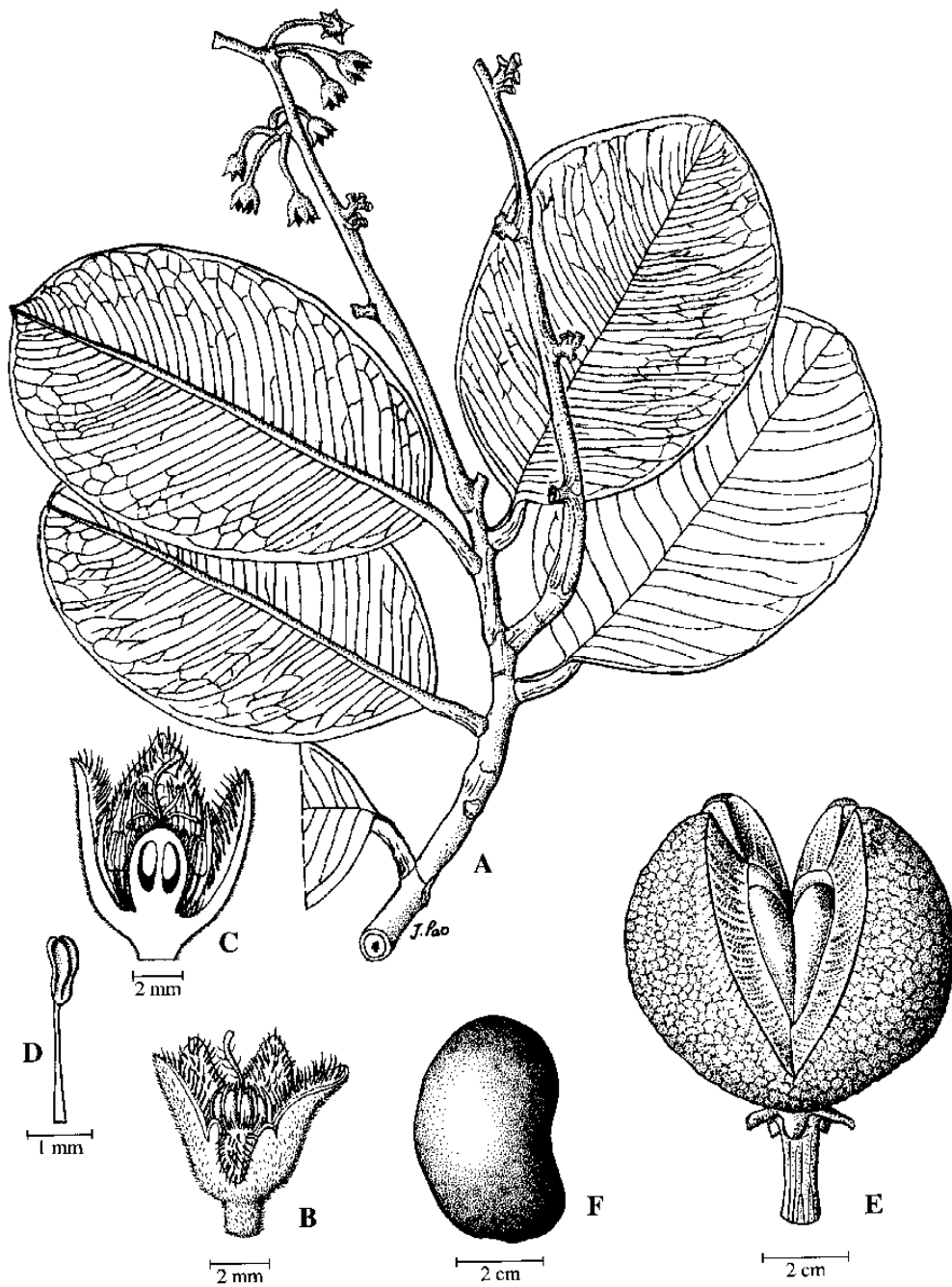


Fig. 6. *Gonystylus xylocarpus*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower; D, stamen; E, mature fruit; F, seed. (A–D from *S* 13457, E–F from *S* 4660.)

25. *Gonystylus velutinus* Airy Shaw

(Latin, *velutinus* = velvety; the indumentum)

Kew Bull. (1950) 140, *op. cit.* (1953) 359; Anderson *op. cit.* 334; Kessler & Sidiyasa *op. cit.* 227; Coode *et al.* (eds.) *op. cit.* 322; Argent *et al.* (eds.) *op. cit.* 638. **Type:** *Dorst 15T/3P/812*, Sumatra, Palembang (holotype K).

Tree 25–35 m tall, 35–70 cm diameter; buttresses to 2.3 m tall. **Bark** pale brown to reddish brown, finely fissured, flaky; inner bark yellowish brown. **Sapwood** yellow. **Twigs** dark brown, *densely reddish brown velvety*, glabrescent. **Leaves** *chartaceous to coriaceous*, glabrous and glossy above, *densely reddish brown velutinous below*, glabrescent, drying pale brown or ochreous on both surfaces; *blade* elliptic, oblong-elliptic or lanceolate-elliptic, 8–13 × 4–6 cm, base cuneate to rotundate, margin slightly revolute, apex acuminate-caudate, acumen to 1 cm long; *midrib narrowly channelled above*, prominent below, densely hairy; *lateral veins 15–25 pairs*, with 6–8 shorter veins in between, prominulous on both surfaces, intramarginal veins 0.5–1 mm from the margin; intercostal venation visible on both surfaces; *petiole 0.5–1 cm long*, channelled above, densely velutinous. **Inflorescences** 7–14 cm long, terminal and axillary, 2–4-branched, each branch bearing 3–7 clusters of flowers, each cluster with 4–6 flowers, densely velutinous; bracts absent. **Flowers:** pedicels 0.6–0.7 cm long, velutinous; buds subglobose, 3–3.5 × 2.5–3.5 mm; *calyx lobes deltoid*, 3.5–4 × 1–2 mm, *velutinous on both surfaces, strongly revolute at anthesis*; *petaloid appendages c. 8*, subulate, 1–1.5 × 0.5 mm, epustulate, *glabrous*; *stamens c. 8*, 0.5–1 mm long, *in a single whorl*, filaments slightly shorter than anthers, bearded; ovary ovoid, 3–5-loculed, densely setulose, style filiform, glabrous, stigma clavate; *parastyles absent*. **Fruits** ellipsoid, 3.5–5.5 × 2.5–3.5 cm, 3–5-valved, woody; pericarp firmly fibrous, thick, verrucate, reddish brown or brown. **Seeds** 1–3 per fruit, ovoid, dorsiventrally compressed, 2.5–3 cm long; testa smooth, glossy, dark brown.

Vernacular name. Sarawak—*ramin batu* (Malay).

Distribution. Sumatra and Borneo. In Sabah, known from Kinabatangan and Sipitang districts (e.g., *SAN 16262* and *SAN 138225*) and in Sarawak, from Kuching, Lundu and Samarahan districts (e.g., *S 16983*, *S 37000* and *S 41126*). Also occurring in Brunei (e.g., *BRUN 147*) and Kalimantan (e.g., *bb. 17012*, *bb. 29341* and *bb. 31632*).

Ecology. In mixed dipterocarp and *kerangas* forests, over clay and sandy clay soils, at altitudes to 100 m.

Notes. A species closely resemble *G. forbesii* and *G. maingayi* in its floral characters but differs from both by its densely velutinous leaves and bearded anthers.

Uses. The timber is used for planks and house construction.

26. *Gonystylus xylocarpus* Airy Shaw

(Greek, *xylos* = wood, *karpos* = fruit; with woody fruit)

Fig. 6.

Kew Bull. (1952) 73, *op. cit.* (1953) 355, *op. cit.* (1964) 450, *op. cit.* (1972) 978; Anderson *op. cit.* 334; Argent *et al.* (eds.) *op. cit.* 638. **Type:** *Omar 58*, Borneo, Sarawak, Simunjan district, G. Ngili FR (holotype SING; isotype KEP).

Tree 30–36 m tall, 40–80 cm diameter; trunk straight, buttresses to 3 m tall. **Bark** deeply fissured, 3–5 mm thick, reddish brown to dark brown; inner bark reddish brown. **Sapwood** cream or yellowish. **Twigs** glabrous, dark brown to blackish. **Leaves** *thick-coriaceous, stiff*, glabrous and brown or dark brown above, *greyish brown or brown and sparsely puberulous on the midrib below*; blade broadly elliptic, 7–17 × 5–9 cm, base rounded or obtuse, *margin strongly revolute*, apex rounded or shortly-apiculate; midrib narrowly channelled above, rounded and prominent below, sparsely tomentose; *lateral veins 15–20 pairs*, rather obscure on both surfaces, intramarginal veins 2–3 mm from the margins; intercostal venation visible on both surfaces; petiole 1–2 cm long, sparsely tomentose, rugose, dark brown. **Inflorescences** robust, 15–20 cm long, 3–5-branched, each branch bearing 6–8 clusters of flowers, each cluster with 4–12 flowers; bracts absent. **Flowers**: pedicels 2–2.5 cm long, greyish sericeous; buds subglobose, 4–5 mm diameter, tomentose; calyx lobes lanceolate or narrowly deltoid, 6–7 × 1.5–3 mm, tomentose outside, densely velutinous on the inner central part; *petaloid appendages 30–40*, narrowly subulate, 3–4 × 0.5 mm, *sparsely setulose to glabrous*, epustulate; *stamens c. 25*, 1.5–2.5 mm long, in a single whorl, filaments 1–1.5 mm long, anthers 0.5–1 × 0.5 mm, glabrous; ovary superior, obovoid, c. 3 mm long, 5-loculed, densely setulose, styles filiform, pilose below, stigma clavate; *parastyles 4–5*, c. 1.5 mm long, flattened-clavate, villous. **Fruits** *globose to ellipsoid-globose*, 5–9 × 4.5–7.5 cm, *without a beak*, woody, thick-walled, 4-valved, warty, puberulous; pericarp fibrous. **Seeds** ellipsoid, to 3.5 × 2 cm, dark brown, stony; testa smooth, glossy, crustaceous.

Vernacular names. Sarawak—*gaharu melitan* (Iban), *ramin bukit* (Malay).

Distribution. Endemic in Borneo. In Sarawak, known from Kuching, Lundu and Simunjan districts (e.g., *S 4660*, *S 13457*, *S 50152*, and *S 56615*). Also occurring in Brunei (e.g., *BRUN 5633*) and in Kalimantan (e.g., *bb. 11350*).

Ecology. Primary mixed dipterocarp and *kerangas* forests on clay and sandy soil, at altitudes to 250 m.

Uses. The wood is an important source of *ramin* timber.

Incompletely known species

Gonystylus sp. 1.

Tree to 9 m tall, to 10 cm diameter. **Bark** smooth, greyish brown; inner bark reddish. **Sapwood** pinkish. **Twigs** terete, glabrous, lenticellate and dark brown to blackish when young, becoming pale cream with the lenticels breaking-up longitudinally when older. Vegetative buds enclosed by a pair of overlapping, ovate stipules. **Leaves** thickly coriaceous, pustulate and glabrous on both surfaces; blade elliptic-oblong, 6–10 × 2–5 cm, base obtuse or rounded, margin slightly wavy, apex acute with short acumen to 5 mm long; midrib glabrous, raised on both surfaces; lateral veins 14–16 pairs, lax, distinctly pustulate-granulate on both surfaces, slightly raised above, distinctly raised below, thinning, looping and forming intramarginal vein loop 5–7 mm from the margins; intercostal venation reticulate, distinctly raised and pustulate-granulate on both surfaces; petiole 0.4–0.5 cm long, distal end furrowed on the adaxial side, flat at the proximal end, glabrous, drying blackish brown. **Inflorescences** terminal or axillary tomentellous panicles, 9–19 cm long; main branches 4–5, each with 9 or more branchlets; each branchlet bearing 1–3 flowers; peduncles 2–3 mm long; bracts ovate, 2–3 × 1–2 mm, tomentellous outside, glabrous inside; bracteoles ovate, 1.8–2 × 1–2 mm, sericeous outside,

glabrous or glabrescent inside. **Flowers:** buds ellipsoid, 2–3 × 1.3–2.5 mm, densely pubescent; sepals 5, aestivation equitans, outer most sepal *c.* 1.5 × 1 mm, innermost one *c.* 1 × 0.3 mm, densely pubescent, thickened at the middle, gradually thinner toward margins; petaloid appendages 5, free, valvate, papery to almost transparent, ovate, *c.* 0.6 × 0.5 mm, glabrescent outside, glabrous inside, sericeous on the distal parts along margins; stamens *c.* 15, filaments 0.2–0.5 mm long, anthers basifixed, 0.5–0.6 mm long; ovary ovoid, 1–2 × 1–1.5 mm, densely pubescent; parastyles 1 or 2, elongate, 1.3–1.8 mm long, villose, blackish brown. **Fruits** (immature) 1-seeded, obovoid to subglobose, slightly compressed, 1.5–2.5 × 1.5 cm, apex slightly cordate, verrucose, sparsely setulose, especially at base; pericarp fibrous, *c.* 2.6 mm thick, inner surface tomentellous. **Seeds** globose; testa smooth, brownish.

Distribution. Known by a single collection (*i.e.*, SAN 83819) from Nabawan, Keningau district, Sabah.

Notes. This species differs from the previously known species of the genus occurring in Sabah and Sarawak by its pustulate-granulate lateral and intercostal veins, overlapping stipules enclosing vegetative buds, equitans aestivation of sepals, and its 5, free, thin-papery petaloid appendages with sericeous apex. More specimens are, however, needed to establish its correct taxonomic status.

5. PHALERIA Jack

(Greek, *phaleros* = glossy white; the flowers)

Mal. Misc. 2 (1822) 59; Hooker *f.*, Fl. Brit. Ind. 5 (1890) 199; Domke, Bibl. Bot. 27, Heft 111 (1934) 123; Merrill, J. Arn. Arb. 33 (1952) 239; Ding Hou, FM 1, 6 (1960) 15; Backer & Bakhuizen *f.*, FJ 1 (1964) 268; Cockburn, TS 1 (1976) 253.

Shrubs or trees. **Leaves** *decussate or opposite, without translucent glandular dots*, pinnately veined; *lateral veins curved; intercostal venation reticulate or scalariform*. **Inflorescences** terminal or axillary, sometimes borne on older branches and/or stems, capitate, fascicled or umbelliform, peduncled, rarely sessile; peduncles usually with decussate, persistent, reddish brown, glabrous bracteoles towards the base. **Flowers** white, sessile, articulated at the base; calyx tube funnel-shaped or cylindrical, glabrous or puberulous on both sides, lobes 5, rarely 4 or 6, slightly unequal; *petaloid appendages obscure and rim-like, or absent, rarely distinct; stamens twice the number of calyx lobes*, in two whorls, usually filamentous and exerted, sometimes included, rarely sessile, anthers oblong, dorsifixed; disk cupular, submembranaceous; *ovary* ovoid or ellipsoid, glabrous or hairy at the apex, *2-loculed or rarely 1-loculed*, style terminal, filiform, sometimes exerted, stigma capitate, papillose. **Fruits** *drupaceous, 1–2-seeded*; exocarp and mesocarp fibrous and fleshy (sometimes hard in dried specimens); endocarp coriaceous and hard. **Seeds** without endosperm; cotyledons thick and hemispherical.

Distribution. A genus comprising about 20 species, distributed from Sri Lanka to SE Asia, throughout Malesia to Australia, Micronesia and the Pacific Is. (as far as Samoa and Tonga). In Sabah and Sarawak, two species are recognised.

Ecology. In mixed dipterocarp and lower montane forests, at altitudes to 1400 m.

Key to *Phaleria* species

Leaves elliptic-oblong, (11–)15–21(–26) × (3–)5–7(–10) cm; lateral veins 8–10 pairs; petiole to 0.5 cm long. Inflorescence usually 8-flowered, sometimes borne on older branches and stems and many-flowered. Ovary glabrous. Fruits subglobose, 1–1.5 cm diameter, usually 2-loculed and 2-seeded.....**1. *P. capitata***

Leaves oblong-lanceolate, oblanceolate, or ovate-oblong, 11–33 × 3–14 cm; lateral veins (8–)13–22 pairs; petiole to 1.5 cm long, slightly winged. Inflorescence 20–many-flowered. Ovary usually hairy at the top. Fruits ovoid, gradually narrowed towards apex, 1.5–3 × 1–2 cm, usually 1-seeded.....**2. *P. perrottetiana***

1. *Phaleria capitata* Jack

Fig. 7.

(Latin, *capitatus* = with a knob-like tip; the stigma)

Mal. Misc. 2 (1822) 59; Backer & Bakhuizen *f.*, *op. cit.* 268; Ding Hou *op. cit.* (1960) 20; Whitmore, TFM 2 (1973) 384; Turner, Gard. Bull. Sing. 47 (1995) 485. **Type:** unknown. **Synonym:** *P. cauliflora* Bedd., For. Man. Bot. (1873) 180.

Shrub or small tree to 10 m tall, to 15 cm diameter. **Twigs** reddish brown. **Leaves** chartaceous, glabrous, drying reddish brown above, pale brown below; *blade elliptic-oblong, 11–26 × 3–10 cm*, base acute to attenuate or sometimes rounded, margin sometimes revolute, apex narrowly acute to acuminate; midrib raised on both surfaces; *lateral veins 8–10 pairs*; intercostal venation laxly reticulate, distinct below, obscure above; *petiole to 0.5 cm long*, glabrous. **Inflorescences** usually 8-flowered, axillary or borne on older branches or stems, subsessile or with short peduncles, with decussate, small bracts at the base; involucre bracts 4, oblong, ovate or obovate, *c. 6 × 3 mm*. **Flowers** 2.5–4.5 cm long; calyx tube cylindrical, gradually enlarged towards the top, glabrous on both surfaces, lobes oblong or elliptic, *6–7 × 2–3.5 mm*, puberulous inside towards the upper part and margin; stamens and style usually exerted, sometimes to 5 mm long; disk cupular; *ovary ellipsoid, glabrous*, apex narrowed into a filiform style, stigma capitate, *c. 1.5 × 1 mm*. **Fruits** subglobose, *1–1.5 cm diameter*, apex sometimes short-acute, usually 2-loculed, 2-seeded; endocarp inside with distinct meshes.

Distribution. Sri Lanka, Carolines Is., Sumatra, Peninsular Malaysia, Borneo, Sulawesi, the Philippines, Maluku, and New Guinea. In Borneo, recorded in Sabah from Lahad Datu, Sandakan and Tawau districts (e.g., *SAN 129460*, *SAN A 3140* and *SAN A 3457*) and in Kalimantan (e.g., *Kostermans 21276*).

Ecology. In primary and secondary forest, at altitudes to 1200 m.

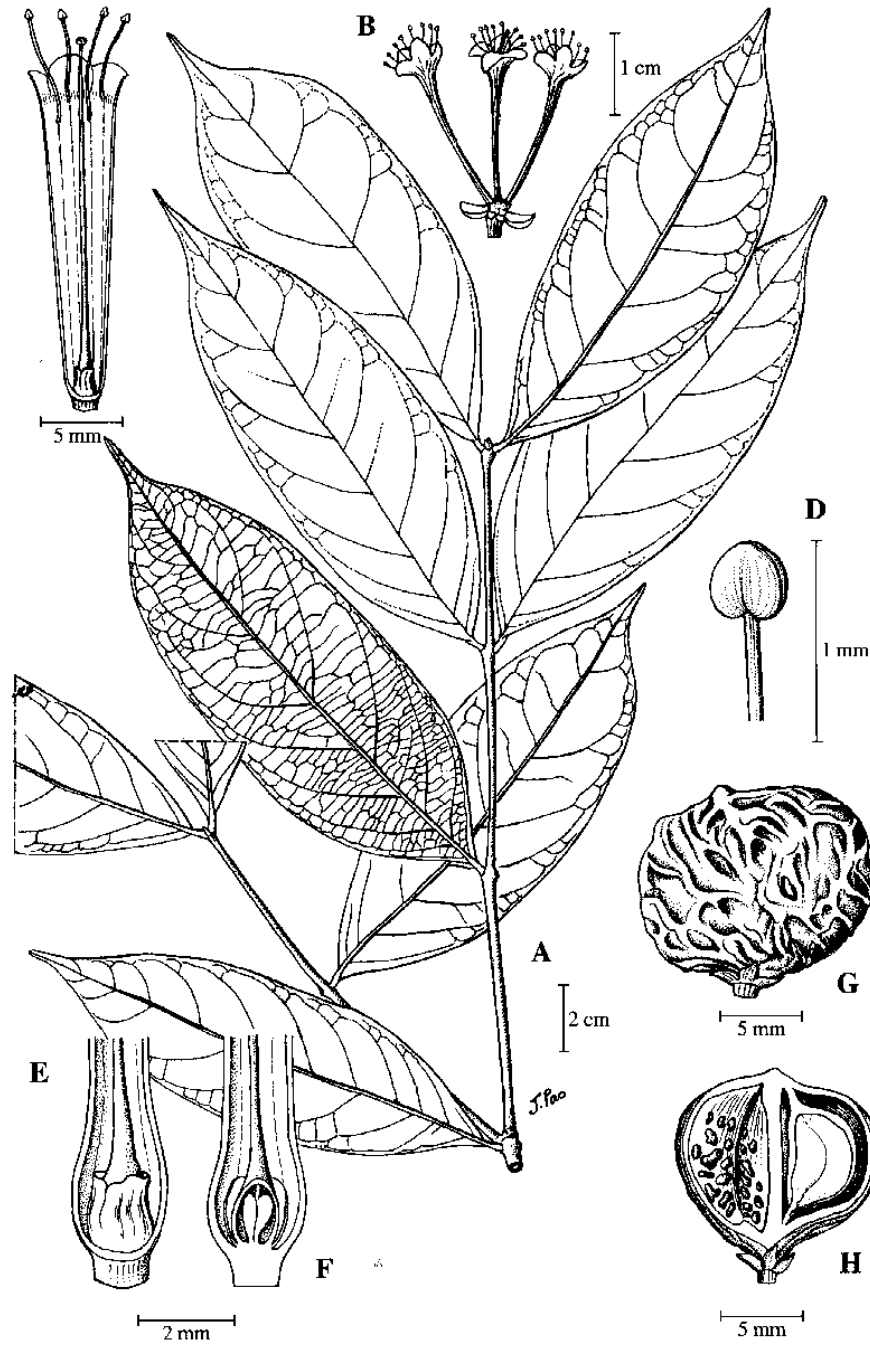


Fig. 7. *Phaleria capitata*. A, leafy twig; B, part of inflorescence; C, longitudinal section of open flower; D, stamen; E, lower portion of gynoecium; F, longitudinal section of gynoecium; G, fruit; H, longitudinal section of fruit. (A and G from *Kostermans 21276*, B–F and H from *SAN 135796*.)

Uses. Often cultivated as an ornamental. Tough fibres of the bark have been used for cordage and tying material. The fruits are sweet and edible. The seeds are used to treat scurfy eruptions in children.

2. *Phaleria perrottetiana* (Decne.) F.-Vill.

(G.S. Perrottet, 1793–1870, Swiss-born French botanist)

Nov. App. (1880) 183; Merrill, Sp. Blancoan. (1918) 378, En. Philip. Pl. 3 (1923) 131; Masamune, EPB 511; Ding Hou *op. cit.* (1960) 18. **Basionym:** *Drimyspermum perrottianum* Decne., Ann. Sci. Nat. Bot. 2, 19 (1843) 40. **Type:** unknown. **Synonym:** *Phaleria splendida* Valetton, Ic. Bog. 4 (1913) 219.

Shrub or small tree, to 8 m tall. **Twigs** glabrous, dark brown. **Leaves** chartaceous; *blades oblong-lanceolate, oblanceolate, or ovate-oblong, 11–33 × 3–15 cm*, base cuneate or rounded, margin slightly revolute, apex acuminate; midrib channelled above, raised below; *lateral veins 8–22 pairs*, distinct and elevated on both surfaces, curving and ascending towards the margin; intercostal venation reticulate; *petiole to 1.5 cm long, slightly winged*. **Inflorescences** 20–many-flowered, terminal or axillary at the terminal node, sometimes in the axil of the two nodes of the branch, solitary, very rarely more than one in the same axil; peduncle to 3.5 cm long; bracts small, lanceolate, *c. 3 mm long*, densely decussate at the basal part of the peduncle, persistent; involucral bracts 4, caducous after anthesis, rarely persistent, oblong, obovate-oblong, *c. 15 × 8 mm*, apex apiculate or obtuse, densely puberulous towards the upper part on both surfaces. **Flowers** 2–4.5 cm long; calyx tube pubescent outside, villous at the lower half or lower 2/3 inside, lobes 5–9 mm long; stamens and style *c. 10 mm long*, exerted beyond the tube; disk cupular, sometimes with 6–7 free lobes; *ovary usually hairy at the apex or on one side*, usually 2-loculed, sometimes 1-loculed. **Fruits** usually 1-seeded, ovoid, *1.5–3 × 1.5–2 cm, gradually narrowed towards the apex*, acute at the base. **Seeds** ellipsoid, *c. 1 × 0.8 cm*.

Distribution. Borneo, the Philippines, New Guinea, Louisiades Archipelago, and Admiralty Is. In Borneo, known from Kudat and Lahat Datu districts in Sabah (e.g., *SAN 16147* and *SAN 31642*).

Ecology. In forest, at altitudes to 1140 m.

6. WIKSTROEMIA Endl., *nom. cons.*

(J.E. Wikström, 1789–1856, former Professor at the Stockholm University, Sweden)

Prod. Fl. Norfolk. (1833) 47 (*Wickstroemia*); Hooker *f.*, Fl. Brit. Ind. 5 (1890) 195; Gamble, J. As. Soc. Beng. 75, 2 (1912) 258; Ridley, FMP 3 (1924) 144; Domke, Bibl. Bot. 27, Heft 111 (1934) 124; Ding Hou, FM 1, 6 (1960) 28; Backer & Bakhuizen *f.*, FJ 1 (1964) 268; Whitmore, TFM 2 (1973) 384; Anderson, CLTS (1980) 334; Coode *et al.* (eds.), CLBD (1996) 322.

Shrubs or trees. Leaves opposite or decussate, very rarely ternate, without translucent glandular dots, pinnately veined; lateral veins curved; intercostal venation reticulate or scalariform. Inflorescences terminal and/or axillary, fascicled or solitary, spicate, racemose, umbelliform or capitate, *often ebracteate. Flowers* subsessile or distinctly pedicelled, 4–5-merous; pedicels articulated; calyx tube cylindrical or tubular, sometimes slightly funnel-shaped, usually caducous after anthesis, rarely persistent, lobes usually in two pairs, imbricate; *petaloid appendages absent*; stamens sessile or filamentous, *twice as many as the calyx lobes*,

included, in two distinct whorls, usually free, anthers oblong, basifixed; disk membranaceous, cupular and slightly crenate or dentate, deeply lobed, or free and scale-like; *ovary* usually ellipsoid, *glabrous or hairy at the top, 1-loculed*, style terminal, short, distinct or obscure, stigma large, capitate or disciform, rarely cylindrical to ovoid. **Fruits** drupaceous, *1-seeded*, sometimes surrounded by dried remains of calyx tube; pericarp fleshy or membranaceous. **Seeds** of the same shape as the fruit; embryo with thickened or flattened cotyledons and short or slightly elongated hypocotyl.

Distribution. About 70 species, distributed from SE Asia, through Malesia to Australia, Fiji and Polynesia. In Sabah and Sarawak, six species are recognised.

Ecology. Common in forested slopes, at low to medium altitudes to 1300 m.

Key to *Wikstroemia* species

1. Lateral veins straight and merging into a distinct intramarginal veins.....2
 - W. brachyantha** Merr.
(Greek, *brachy-* = short, *anthos* = flower; with short flowers)
Philip. J. Sci. 13 (1918) Bot. 313, Enum. Philipp. Pl. (1923) 132; Ding Hou *op. cit.* 31. Type: *Ramos BS 30392*, the Philippines, Luzon, Catanduanes (PNH). Synonym: *Wikstroemia crassifolia* Merr. *ex Domke op. cit.* tab. facing p. 58.
Shrub or small tree, to 3.5 m tall. Young twigs puberulous, light brown, older ones reddish brown, usually fissured. Leaves subcoriaceous to coriaceous, rarely chartaceous, drying olivaceous-brown to brownish on both surfaces, glabrous and shiny; blade elliptic-oblong to ovate-oblong, 5–15 × 2.5–5 cm, base obtuse to cuneate, apex acuminate; midrib channelled above, raised below; *lateral veins 12–15 pairs*, elevated and prominent below, *straight and merging into distinct intramarginal veins*; intercostal venation reticulate; petiole 0.2–0.3 cm long, glabrous. Inflorescences terminal or/and in the leaf axils of terminal nodes, distinctly peduncled; peduncles stout, brownish-pubescent. Flowers yellowish, yellowish green or green, subsessile; calyx tube 10–12 mm long, sparsely puberulous outside, glabrous inside, lobes 4, ovate-oblong, 1.5–3 mm long, obtuse; stamens in two whorls close to each other, filaments short, anthers oblong, obtuse, *c.* 1.5 mm long; disk 2, free, oblong, 2-lobed, scales-like; ovary ellipsoid or slightly obovoid-oblong, *c.* 3 mm long, hairy at the top, style distinct, filiform, *c.* 1 mm long, stigma globose, papilose. Fruits red, broadly ellipsoid, *c.* 12 × 9 mm.
Borneo and the Philippines. In Sabah, known from the Kinabalu NP (e.g., *Wong WKM 2395*). In lowland to montane forests, at altitudes to 2800 m.
Lateral veins curving upwards and not merging into intramarginal veins.....2
2. Low shrubs, to 3 m tall.....3
 - Tall shrubs to small trees, to 10 m tall.....4
3. Leaves ovate, elliptic to lanceolate, 1.5–5.5(–8) × 1–2.5(–4) cm, base acute, apex acute to narrowly acute; intercostal venation distinct below.....

W. androsaemifolia Decne.

(Latin, with leaves resembling those of *Androsaemum* Duhamel = syn. of *Hypericum* L., Guttiferae)

Ann. Sci. Nat. Bot. 2, 20 (1843) 50; Ding Hou *op. cit.* 33; Cockburn, TS 1 (1976) 253; Turner, Gard. Bull. Sing. 47 (1995) 485; Coode *et al.* (eds.) *op. cit.* 322. Type: *Leschenault s.n.*, Java (holotype P; isotype L).

Shrub to 2.5 m tall. Leaves chartaceous, glabrous, rarely sparsely hairy on the veins below; *blade ovate, elliptic to lanceolate, 1.5–5.5(–8) × 1–2.5(–4) cm, base acute, apex acute to narrowly acute;* midrib raised on both surfaces; *lateral veins 8–11 pairs, elevated below, impressed above, curving upwards but not merging into intramarginal veins; intercostal venation reticulate, distinct below;* petiole *c.* 0.2 cm long. Inflorescences umbel-shaped or spicate, 5–10-flowered, terminal or axillary; peduncle to 3.5 cm long. Flowers: pedicels *c.* 1 mm long, articulated at base; calyx tube 9–12 mm long, sparsely hairy outside, lobes oblong or ovate, fleshy, 2–3.5 mm long; stamens filamentous, anthers *c.* 1 mm long; ovary ellipsoid or obovoid, 1.5–2.5 mm long, pilose at the top, style *c.* 1 mm long, stigma globose. Fruits oblong or rounded.

Borneo, Java, Lesser Sunda Is., Sulawesi, and W New Guinea. In Sabah, known from Penampang and Pensiangan districts (e.g., *SAN 111261* and *SAN 127978*) and in Sarawak, from Lubok Antu, Marudi, Sri Aman, and Tatau districts (e.g., *S 19195*, *S 30437*, *SAN 33941*, and *S 45046*). In lowland to lower montane forests, at altitudes to 1800 m.

Leaves obovate-oblong, elliptic-oblong, oblanceolate or elliptic, 1.5–4.5(–7) × 0.5–2(–3) cm, base cuneate to attenuate, apex rounded, obtuse or acute; intercostal venation obscure or invisible on both surfaces.....

W. indica (L.) C.A.Mey.

(of India)

Bull. Acad. Sci. St. Petersb. 1 (1843) 357; Hooker *f. op. cit.* 195; Merrill *op. cit.* (1918) 279, *op. cit.* (1923) 132, 195; Ding Hou *op. cit.* 34; Backer & Bakhuizen *f. op. cit.* 269; Turner *op. cit.* 485. Basionym: *Daphne indica* L., Sp. Pl. (1753) 375. Type: *Herb. Linn. 500/11* (LINN). Synonyms: *Daphne aquilaria* Blanco, Fl. Filip. (1837) 310; *Wikstroemia linearifolia* Elmer, Leaf. Philip. Bot. 2 (1910) 680; *W. pulgarensis* Elmer, Leaf. Philip. Bot. 5 (1913) 1844; *W. pachyphylla* Merr., Philip. J. Sci. 12 (1917) 297, EB (1921) 417, Masamune, EPB (1942) 511, Heine, Pfl. Clemens Kinabalu (1953) 69.

Shrub to 3 m tall. Leaves chartaceous to subcoriaceous, drying brown to reddish brown, shining above, dull and sparsely puberulous below; *blade obovate-oblong, elliptic-oblong, oblanceolate, or elliptic, 1.5–4.5(–7) × 0.5–2(–3.5) cm, base cuneate to attenuate,* margin usually cartilagenous, *apex rounded, obtuse or acute;* midrib channelled above, raised below; *lateral veins 5–12 pairs, irregular, often branched, curving upwards but not merging into intramarginal veins, distinct below obscure above; intercostal venation obscure or invisible on both surfaces;* petiole *c.* 0.2 cm long. Inflorescences terminal, few-flowered, subsessile or sometimes with a very short peduncle. Flowers: pedicels 1.5–2 mm long, articulated at base; calyx tube 10–12 mm long, sparsely puberulous outside, glabrous inside; calyx lobes 2–3 mm long; stamens with short filaments, anthers linear, *c.* 1 mm long; disk 2, free, linear; ovary ovoid or ellipsoid, *c.* 1.5 cm long, style very short or obscure, stigma globose, *c.* 0.3 mm diameter. Fruits broadly ellipsoid, *c.* 6 × 4 mm.

India, SE Asia, Malesia (except Java and Lesser Sunda Is.), Australia, and Melanesia (as far as Fiji). In Sabah, known from Kinabatangan and Lahad Datu districts (e.g., *SAN 133954* and *SAN A 4285*) and in Sarawak, from Kuching and Miri districts (e.g., *Argent & Jeremy 1050*, *S 38546* and *S 44764*). In various types of vegetation from the lowland to 1300 m altitude.

4. Leaves discolourous on drying. Inflorescences 1–5-flowered, usually axillary and occurring in several subsequent leaf axils along the twigs.....**3. W. tenuiramis**
Leaves concolourous on drying. Inflorescences 6–many-flowered, usually terminal and/or in the leaf axils of terminal nodes.....5
5. Leaves ovate or ovate-oblong, 4–14 × 3.5–5 cm, base obtuse or cuneate, rarely subcordate. Flowers articulated at the top of pedicels, in falling leaving short stalks on the rachis.....**1. W. ovata**
.....**1. W. ovata**
Leaves ovate-oblong, elliptic-oblong or lanceolate 6–9(–12) × 1.5–3.5(–4.5) cm, base acute to cuneate, sometimes obtuse or rounded. Flowers articulated at the base of pedicels, in falling leaving prominent scars or short protuberances on the rachis.....**2. W. polyantha**

1. *Wikstroemia ovata* C.A.Mey. ex Meisn.

(Latin, *ovatus* = egg-shaped in outline; the leaves)

In DC., Prod. 14 (1857) 544; Miquel, Fl. Ned. Ind. 1, 1 (1858) 880; Merrill, Philip. J. Sci. 1 (1906) Suppl. 101, *op. cit.* (1923) 133; Masamune *op. cit.* 511; Ding Hou *op. cit.* 31; Anderson *op. cit.* 334. **Type:** *Cuming 458*, the Philippines (isotype L).

Shrub or small tree to 5 m tall. Twigs appressed-hirtellous, glabrescent or glabrous. **Leaves** membranaceous or chartaceous, glabrous, rarely sparsely pubescent on the midrib below, *drying concolourous*, brown; *blade ovate to ovate-oblong, 4–14 × 3.5–5 cm, base obtuse or cuneate, rarely subcordate*, apex acuminate; midrib flat above, raised below; *lateral veins* 8–12 pairs, *curving upwards but not forming intramarginal vein*, slightly elevated below, distinct above; intercostal venation reticulate, distinct below, obscure above; petiole *c.* 0.3 cm long, sparsely appressed-hirtellous. **Inflorescences** *terminal*, short-spicate or umbelliform, peduncled, sparsely puberulous, sometimes with 1 or 2 caducous bracts, *7–20-flowered*. **Flowers** greenish yellow, short-pedicelled, *articulated at the top of pedicels, in falling leaving short stalks on the rachis*; calyx tube cylindrical, 15–20 mm long, sparsely puberulous outside, lobes oblong, obtuse, 2–4 mm long; stamens sessile or on short filaments, anthers 1–1.5 mm long, slightly apiculate; disk 2, free, oblong, scales-like; ovary ellipsoid, 2–3 mm long, hairy at the apex, style distinct, filiform, stigma capitate. **Fruits** subglobose to slightly ellipsoid, 0.8–1 × 0.6–0.8 cm.

Vernacular name. Sabah—*pait-pait* (Bajau).

Distribution. Borneo and the Philippines. In Sabah, recorded from Ranau district (e.g., *SAN 65218*) and in Sarawak, from Lawas and Miri districts (e.g., *Nooteboom & Chai 2319* and *S 50943*).

Ecology. In thickets, primary and secondary forests, at altitudes to 800 m.

2. *Wikstroemia polyantha* Merr.

(Greek, *poly-* = many, *anthos* = flower; with many flowers)

Philip. J. Sci. 10 (1915) Bot. 332, *op. cit.* (1923) 133; Ding Hou *op. cit.* 32; Backer & Bakhuizen *f. op. cit.* 269; Turner *op. cit.* 485. **Type:** *Reillo BS 19243*, the Philippines, Luzon (PNH). **Synonyms:** *Wikstroemia candolleana auct. non Meisn.*; Ridley, Trans. Linn. Soc. Bot. 11 (1893) 341, J. Str. Br. Roy. As. Soc. 35 (1901) 180, *op. cit.* (1924) 145; *W. junghuhnii auct. non Miq.*; Koorders & Valetton, Bijdr. Booms. Java 13

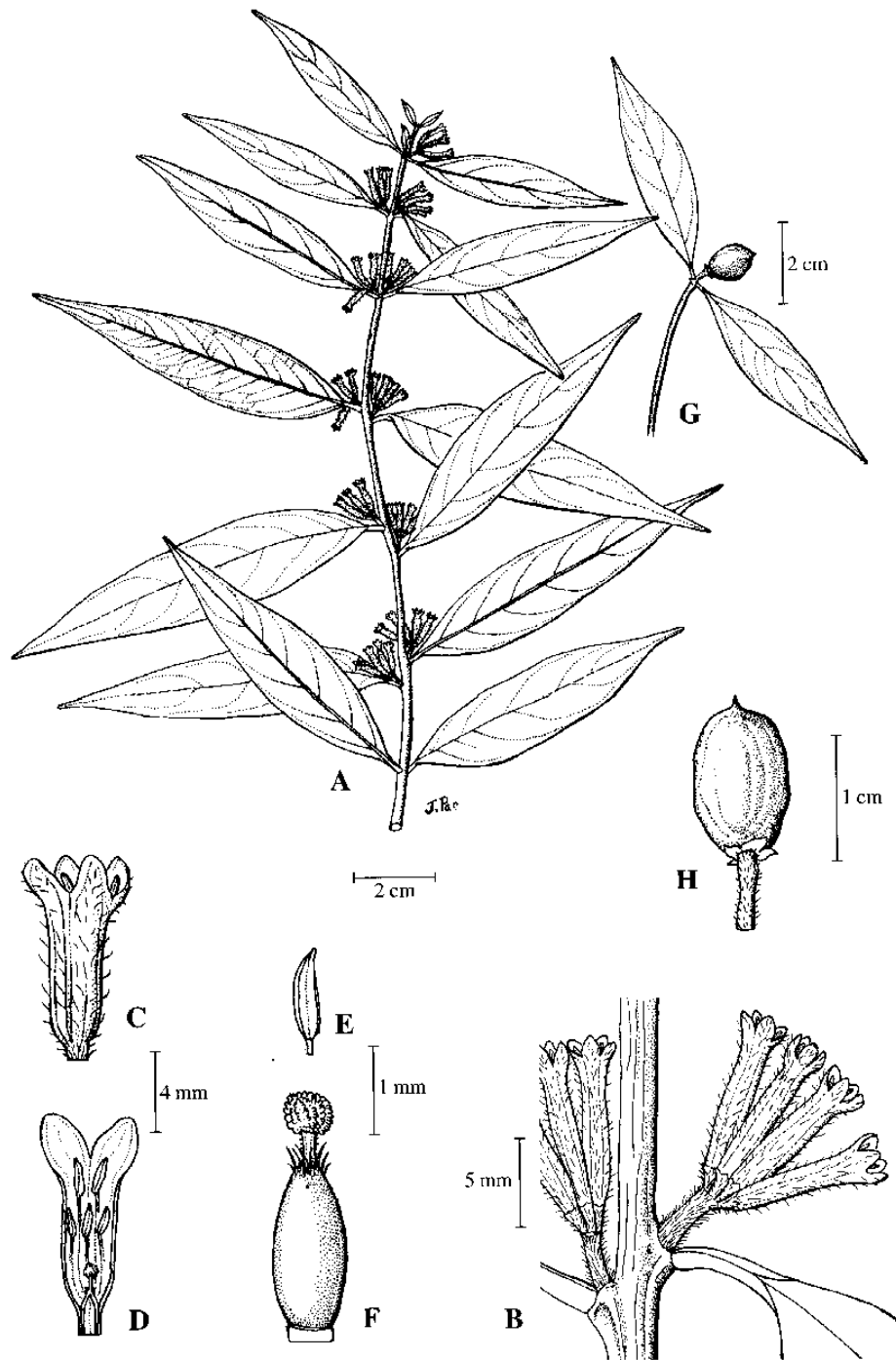


Fig. 8. *Wikstroemia tenuiramis*. A, flowering leafy twig; B, inflorescence; C, open flower; D, longitudinal section of open flower; E, stamen; F, gynoecium; G, fruiting leafy twig; H, fruit. (A–F from S 8444, G–H from S 52466.)

(1914) 58; *W. ridleyi* auct. non Gamble: Gibbs, J. Linn. Soc. Bot. 42 (1914) 132, Merrill *op. cit.* (1921) 417; *W. calva* Backer, Blumea 5 (1945) 494.

Small tree, to 7 m tall, to 8 cm diameter. Twigs reddish to dark brown, sparsely puberulous, glabrescent. **Leaves** membranaceous to chartaceous, rarely subcoriaceous, glabrous on both surfaces, rarely sparsely pubescent on the midrib below, *drying concolourous, light-brown to dark-brown; blade elliptic-oblong or lanceolate, 6–12 × 1.5–3.5 cm, base acute to cuneate, sometimes obtuse or rounded*, margin slightly recurved, apex acuminate; midrib flat above, raised below; *lateral veins* 8–15 pairs, irregular, often branched, *curving upwards but not merging into intramarginal veins*, elevated below, distinct or plane above; intercostal venation reticulate; petiole 0.2–0.4 cm long, sparsely pubescent. **Inflorescences** *terminal or axillary on the terminal nodes*, spicate, up to 4 cm, erect or slightly curved, *6–many-flowered*; peduncle distinct, sparsely hairy. **Flowers** yellow, yellowish green or rarely white, loosely arranged on the rachis; *pedicels*, 0.5–1 mm long, puberulous, *articulated at the base, in falling leaving prominent scars or short protuberances on the rachis*; calyx tube *c.* 10 mm long, sparsely puberulous outside, glabrous inside, lobes oblong or ovate-oblong, 1.5–3.5 mm long; stamens in 3 whorls, anthers linear, *c.* 1 mm long, filament *c.* 0.5 mm long; disk 2, free, linear or obovate-oblong, *c.* 1 mm long, irregularly lobed or dentate; ovary ellipsoid or obovoid, 1.5–2.5 mm long, glabrous or sparsely hairy at the top, style distinct, stigma globose or oblong, *c.* 0.5 mm long, papillose. **Fruits** ovoid, *c.* 0.9 × 0.6 cm, red.

Vernacular name. Sabah—*chandan pelanduk* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Java, Borneo, and the Philippines. In Sabah, recorded from Kuala Penyu, Ranau and Sipitang districts (e.g., *SAN 33594* and *SAN 114892*) and in Sarawak, from Kuching and Lawas districts (e.g., *S 31573* and *S 37129*).

Ecology. In mixed dipterocarp to montane forests, at altitudes to 2200 m.

Uses. The infected heartwood is used for incense.

3. *Wikstroemia tenuiramis* Miq.

Fig. 8.

(Latin, *tenuis* = thin, slender, *ramus* = branch; with thin or slender branches)

Fl. Ned. Ind., Suppl. (1861) 141 & 354; Ding Hou *op. cit.* 31; Anderson *op. cit.* 334; Coode *et al.* (eds.) *op. cit.* 322. **Lectotype** (Ding Hou, 1964): *Teijsmann HB 3387*, Sumatra, Bangka Is. (hololectotype U). **Synonyms:** *Wikstroemia acuminata* Merr. *op. cit.* (1921) 417, PEB (1929) 218; *W. clementis* Merr. *op. cit.* (1917) 99, *op. cit.* (1921) 417; Heine *op. cit.* (1953) 69.

Small tree to 10 m tall. Twigs light-brown to dark-brown, sparsely pubescent or glabrescent when young, smooth, reddish brown and glabrous when older. **Leaves** membranaceous to chartaceous, glabrous, *drying discolourous*, subolivaceous or light brown and rather shiny above, dirty white or light green, rather dull, sometimes light brown below; blade broadly elliptic or lanceolate, rarely ovate, 6–12 × 1.5–4.5 cm, base cuneate, acute or obtuse, apex acuminate, acumen to 1 cm long; midrib raised on both surfaces; *lateral veins* 7–12 pairs, rather irregular, *curving upwards but not merging into intramarginal veins*, slightly elevated, rarely indistinct on both surfaces; intercostal venation loosely anastomosing, reticulations usually obscure on both surfaces; petiole *c.* 0.4 cm long. **Inflorescences** *usually axillary and occurring in several leaf axils along the branchlets*, sometimes also terminal with bract-like reduced leaves, *1–5-flowered*; peduncle to 1.5 cm long, appressed puberulous. **Flowers** yellowish or cream, subsessile; calyx tube 10–13 mm long, sparsely puberulous outside, glabrescent, lobes

ovate-oblong, 2–3 mm long; stamens in 2 whorls, upper whorl sessile or with short filaments, lower whorl short filamentous, anthers linear, 1–1.5 mm long, acute or slightly apiculate; ovary oblong or slightly obovoid-oblong, *c.* 2 mm long, glabrous or sparsely hairy at the top, style very short or sessile, stigma capitate, papillose. **Fruits** ovoid, *c.* 0.8 × 0.5 cm, yellow, green or orange.

Distribution. Sumatra and Borneo. In Sabah, known from Keningau, Kota Kinabalu, Kota Marudu, Pensiangan, Ranau, Sandakan, and Sipitang districts (e.g., *SAN 33737*, *SAN 116514*, *SAN 122192*, *SAN 134388*, and *SAN 139445*) and in Sarawak, from Belaga, Kuching, Lawas, and Miri districts (e.g., *S 39756*, *S 52466*, *S 54115*, and *S 80624*). Also occurring in Brunei (e.g., *van Niel 4299*) and in Kalimantan.

Ecology. In swamp, mixed dipterocarp and lower montane forests, at altitudes to 1600 m.

Uses. The wood is harder than *Aquilaria* and when burn it gives forth fragrance similar to that of aloewood.

APPENDIX

New Dipterocarp Species from Sabah and Sarawak

Hopea obscurinerva P.S.Ashton, *sp. nov.*

Hopea tenuinervula P.S.Ashton *affinis sed lamina coriaceore in sicco roseobrunnescente costis lateralibus utrinsecus 11–14 costis intermediis manifestis costis tertiariis obscuris facile differt. Typus: Mohtar S 51417, Borneo, Sarawak, Bintulu district, Ulu Tubau (holotypus KEP; isotypus SAR).*

Notes. This new species is closely allied to the group in sect. *Hopea* subsect. *Pierrea* which includes *Hopea pachycarpa*, *H. pterygota*, *H. bullatifolia* and *H. tenuinervula*. It differs from *H. pachycarpa* in its aliform fruit sepals. The dry fallen leaf, thickly coriaceous with obscure intercostal venation, the presence of a few intermediate lateral veins, and the striking pink brown colour serve to distinguish it from all others.

The species is endemic in Borneo and known to date from the lower Tubau R. drainage in Sarawak. It occurs in mixed dipterocarp forest on clay soils, at altitude to 300 m.

Specimens examined: BORNEO, SARAWAK—Bintulu district, Ulu Tubau, *Ashton S 18195* (SAR), *Mohtar S 51417* (KEP, SAR).

Shorea calcicola P.S.Ashton, *sp. nov.* (sect. *Shorea*, subsect. *Shorea*)

Shorea scrobiculata Burck *vix discrepens, nihilominus lamina late ovata costis lateralibus utrinsecus 9 distincte laxioribus ample differt. Typus: Murthy & Chai S 24690, Borneo, Sarawak, Kuching district, 21st mile Kuching-Serian Road (holotypus KEP; isotypus SAR).*

Notes. The species is very similar to *Shorea scrobiculata* and *S. atrinervosa* but differs from the former in the broadly ovate leaf blade with *c.* 9 pairs of lax lateral veins and from the latter in its anthers armed with a single apical bristle, non glaucous leaves and lateral veins drying the same tawny-brown as the leaf blade instead of turning black.

The species is endemic in Sarawak and confined to but locally common in forest on organic soils over limestones, at altitude to 400 m.

Specimens examined: BORNEO, SARAWAK—Bau district, Jambusan, *Anderson S 12582* (KEP, SAR), Tai Ton, Bt. Numpang, *Anderson S 22777* (KEP, SAR); Kuching district, 21st mile Kuching-Serian Road, *Murthy & Chai S 24690* (KEP, SAR); Miri district, G. Subis, Sg. Sekaloh, *Sylvester S 27282* (KEP, SAR; tentative record); Serian district, Bt. Selabor, *Ilias S 28041* (KEP, SAR). In addition, there are unconfirmed records comprising sterile specimens collected from limestone hill in the G. Mulu NP, Miri district.

Shorea woodii P.S.Ashton, *sp. nov.* (sect. *Pachycarpae*)

Sect. Pachycarpae affinis lobis calycis longiores in fructu aliformes lamina grandis profunde peltata facile distinguita. Typus: s.c. A56/36, Borneo, Sarawak (holotypus FHO).

Notes. Named after Geoffry Howarth Spencer Wood, who introduced me to the dipterocarps but whose inspiring stay with me in Brunei ended in tragedy. The species is unique among species of the *Shorea* sect. *Pachycarpae* in having long spatulate larger calyx lobes, deeply peltate leaf base and petiole of 4–7 cm long.

The species which is endemic in Sarawak is currently known only by three collections from Belaga and Kapit districts. It is uncommon and occurs as scattered individuals and small groups in mixed dipterocarp forest on damp sandy clay soils, on hillsides at altitude to 200 m.

Specimens examined. BORNEO, SARAWAK—Without locality, *s.c. A56/36* (FHO); Belaga district, Ulu Rajang, Bt. Alet, Nanga Bah, *S 22318* (K, KEP, L, SAR); Kapit district, Btg. Rajang, Pelagus rapids, *S 17801* (K, KEP, SAR).

ABBREVIATIONS OF FREQUENTLY CITED REFERENCES

Anderson, J.A.R. 1980. A Checklist of the Trees of Sarawak. Dewan Bahasa dan Pustaka, Cawangan Sarawak for Forest Department, Sarawak.
CLTS

Argent, G., A. Saridan, E.J.F. Campbell, P. Wilkie, G. Fairweather, J.T. Hadiah, D.J. Middleton, C. Pendry, M. Pinard, M. Warwick & K.S. Yulita (eds.). 1997. Manual of the Larger and More Important Non-dipterocarp Trees of Central Kalimantan, Indonesia. Vols. 1 & 2. Forest Research Institute, Samarinda.
MNDT-CK

Ashton, P.S. 1964. A Manual of the Dipterocarp Trees of Brunei State. Oxford University Press.
MDB

Ashton, P.S. 1968. A Manual of the Dipterocarp Trees of Brunei State and of Sarawak, Supplement. Borneo Literature Bureau for Sarawak Forest Department.
MDBS

Ashton, P.S. 1988. Manual of the Non-Dipterocarp Trees of Sarawak. Dewan Bahasa dan Pustaka, Sarawak Branch for Forest Department, Sarawak.
MNDTS

Backer, C.A. & R.C. Bakhuizen van den Brink, Jr. 1964, 1965 & 1968. Flora of Java. Vols. 1, 2 & 3. N.V. P. Noordhoff, Groningen.
FJ

Beaman, J.H., C. Anderson & R.S. Beaman. 2001. The Plants of Mount Kinabalu 4. Dicotyledon Families: Acanthaceae to Lythraceae. Natural History Publications (Borneo), Kota Kinabalu and Royal Botanic Gardens, Kew.
PMK

Browne, F.G. 1955. Forest Trees of Sarawak and Brunei and Their Products. Government Printing Office, Kuching.
FTSB

Burgess, P.F. 1966. Timbers of Sabah. Forest Department, Sabah.
TBS

Burkill, I.H. 1966. A Dictionary of the Economic Products of the Malay Peninsula. Vols. 1 & 2 Second edition. Ministry of Agriculture and Cooperatives, Kuala Lumpur.
EPMP

Cockburn, P.F. 1976 & 1980. Trees of Sabah. Vols. 1 & 2. Sabah Forest Record No. 10. Forest Department, Sabah. Borneo Literature Bureau, Kuching for Forest Department, Sabah.
TS

- Coode, M.J.E., J. Dransfield, L.L. Forman, D.W. Kirkup & Idris M. Said** (eds.). 1996. A Checklist of the Flowering Plants and Gymnosperms of Brunei Darussalam. Ministry of Industry and Primary Resources, Brunei Darussalam and Royal Botanic Gardens, Kew.
CLBD
- Corner, E.J.H.** 1988. *Wayside Trees of Malaya*. Vols. 1 & 2. Third edition. Malayan Nature Society, Kuala Lumpur.
WSTM
- Flora Malesiana Series I** (Seed Plants). Flora Malesiana Foundation, Leiden (to be listed without editor names, but to include author names, volume and page numbers)
FM
- Kessler, P. & K. Sidiyasa.** 1994. *Trees of the Balikpapan-Samarinda Area, East Kalimantan, Indonesia*. Tropenbos Series 7. The Tropenbos Foundation, Wageningen.
TBSA-EK
- Keith, H.G.** 1947. *The Timbers of North Borneo*. North Borneo Forest Records No. 3. Government of the Colony of North Borneo, Sandakan.
TNB
- Keng, H.** 1969. *Orders and Families of Malayan Seed Plants*. University of Malaya Press, Kuala Lumpur.
OFMSP
- Kochummen, K.M.** 1997. *Tree Flora of Pasoh Forest*. Malayan Forest Records No. 44, Forest Research Institute Malaysia, Kuala Lumpur.
TFPF
- Mabberley, D.J.** 1987 (reprinted with corrections, 1998). *The Plant Book*. Cambridge University Press, Cambridge.
PB
- Masamune, G.** 1942. *Enumeratio Phanerogamarum Bornearum*. Taihoku.
EPB
- Merrill, E.D.** 1921. A Bibliographic Enumeration of Bornean Plants. J. Str. Br. Roy. As. Soc., Special Number.
EB
- Merrill, E.D.** 1929. *Plantae Elmerianae Borneenses*. University of California Publications in Botany. Vol. 15. University of California Press, Berkeley.
PEB
- Newman, M.F., P.F. Burgess & T.C. Whitmore.** 1996. *Manuals of Dipterocarps for Foresters: Borneo Island Light Hardwoods*. Royal Botanic Garden, Edinburgh and Center for International Forestry Research, Bogor.
MDFB-LHW

Newman, M.F., P.F. Burgess & T.C. Whitmore. 1998. Manuals of Dipterocarps for Foresters: Borneo Island Medium and Heavy Hardwoods. Royal Botanic Garden, Edinburgh and Center for International Forestry Research, Bogor.
MDFB-MHHW

Ng, F.S.P. 1991 & 1992. Manual of Forest Fruits, Seeds and Seedlings. Vols. 1 & 2. Malaysian Forest Records No. 34. Forest Research Institute Malaysia, Kuala Lumpur.
MFFSS

Perry, L.M. 1980. Medicinal Plants of East and Southeast Asia. MIT Press, Massachusetts.
MPESA

Plant Resources of South East Asia. 1989–2003. Vols. 1–19. Pudoc Scientific Publishers, Wageningen and Backhuys Publishers, Leiden (to be listed without editor or author names, but to include volume and page numbers).
PROSEA

Ridley, H.N. 1923–1925. The Flora of the Malay Peninsula. Vols. 1–5. L. Reeves & Co., Ltd., London.
FMP

Smythies, B.E. 1965. Common Sarawak Trees. Borneo Literature Bureau, Kuching.
CST

Soepadmo, E. et al. (eds.). 1995, 1996, 2000, 2002 & 2004. Tree Flora of Sabah and Sarawak. Vols. 1, 2, 3, 4 & 5. Forest Research Institute Malaysia, Kuala Lumpur, Forestry Department Sabah, Sandakan and Forestry Department Sarawak, Kuching (to be listed without editor names, but to include author names, volume and page numbers).
TFSS

Stapf, O. 1894. On the Flora of Mount Kinabalu, in North Borneo. Transactions of the Linnean Society, London, Ser. 2, 4. Pp. 69–263.
FMK

Whitmore, T.C. 1972 & 1973 (ed.) and **F.S.P. Ng** 1978 & 1989 (ed.). Tree Flora of Malaya, Vols. 1 & 2 and 3 & 4. Malayan Forest Records No. 26. Forest Research Institute Malaysia. Longman Malaysia Sdn. Bhd., Kuala Lumpur (to be listed without editor names, but to include author names, volume and page numbers).
TFM

Whitmore, T.C. & I.G.M. Tantra. 1986. Tree Flora of Indonesia. Check List for Sumatra. Forest Research and Development Centre, Bogor.
CLS

Whitmore, T.C., I.G.M. Tantra & U. Sutisna. 1990. Tree Flora of Indonesia. Check List for Kalimantan, Part 1 and Parts 2.1–2.2. Forest Research and Development Centre, Bogor.
CLK

Willis, J.C. 1973. A Dictionary of the Flowering Plants & Ferns (revised by H.K. Airy Shaw). Cambridge University Press, Cambridge.
DFPF

Wong, T.M. 1982 (revised by Lim, S.C. & R.C.K. Chung, 2002). A Dictionary of Malaysian Timbers. Malayan Forest Records No. 30. Forest Research Institute Malaysia, Kuala Lumpur.
DMT

COMMONLY USED ABBREVIATIONS FOR LOCALITIES

English		Malay	
Word	Abbreviation	Word	Abbreviation
Central	C	Batang	Btg.
Division	Div.	Bukit	Bt.
East	E	Gunung	G.
Forest Reserve	FR	Kampung	Kg.
Hectare	ha	Sungai	Sg.
Island	Is.	Tanjung	Tg.
Mountain	Mt.		
National Park	NP		
North-East	NE		
North-West	NW		
River	R.		
South	S		
South-East	SE		
South-West	SW		
West	W		

PLATES

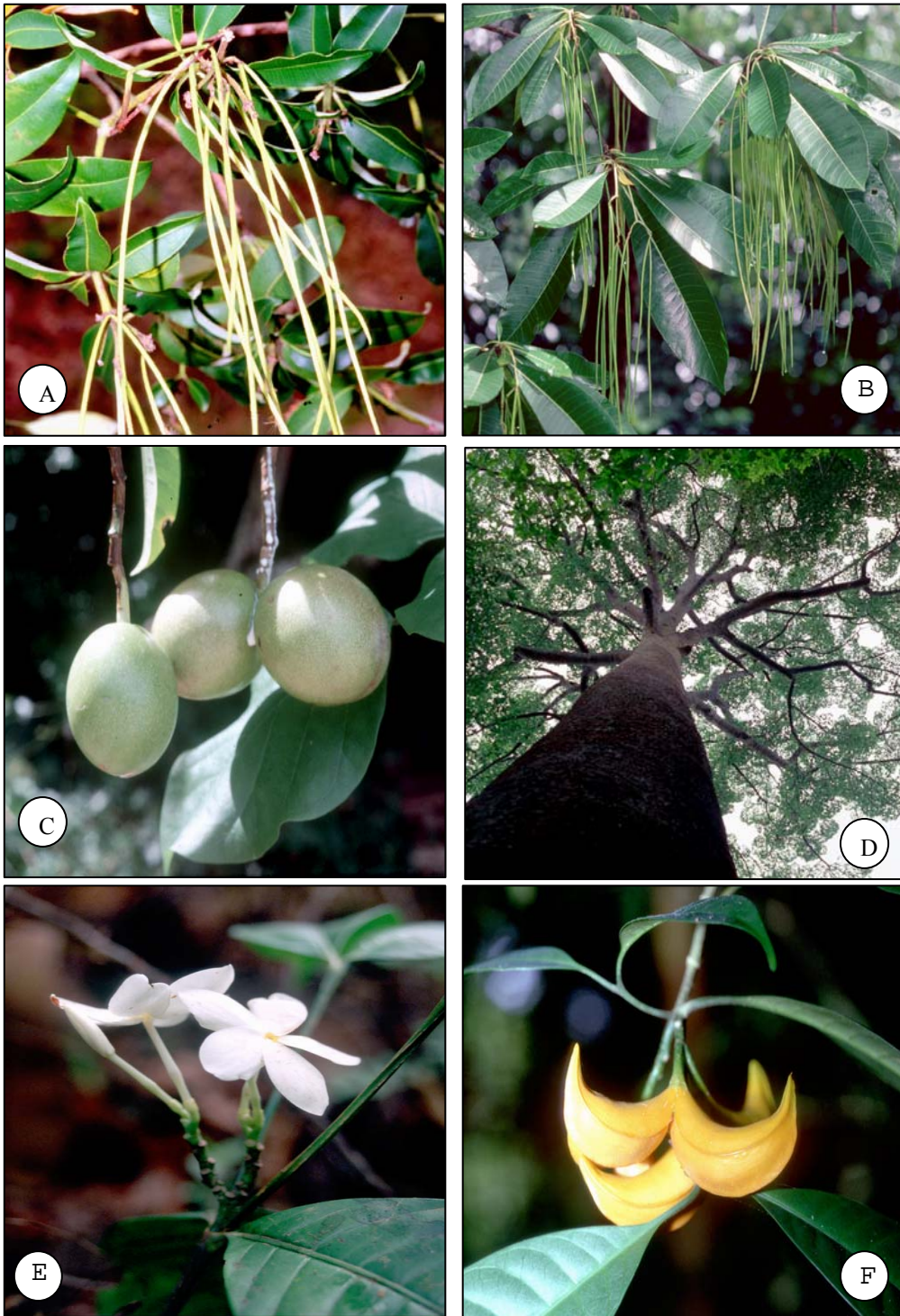


Plate 1. **Apocynaceae:** A, *Alstonia iwahigensis*; B, *Alstonia macrophylla*; C, *Cerbera odollam*; D, *Dyera costulata*; E, *Kopsia pauciflora* var. *mitrephora*; F, *Tabernaemontana pauciflora*.

(Photo credits: A = J.T. Pereira; B–C = E. Soepadmo; D–F = L.G. Saw).

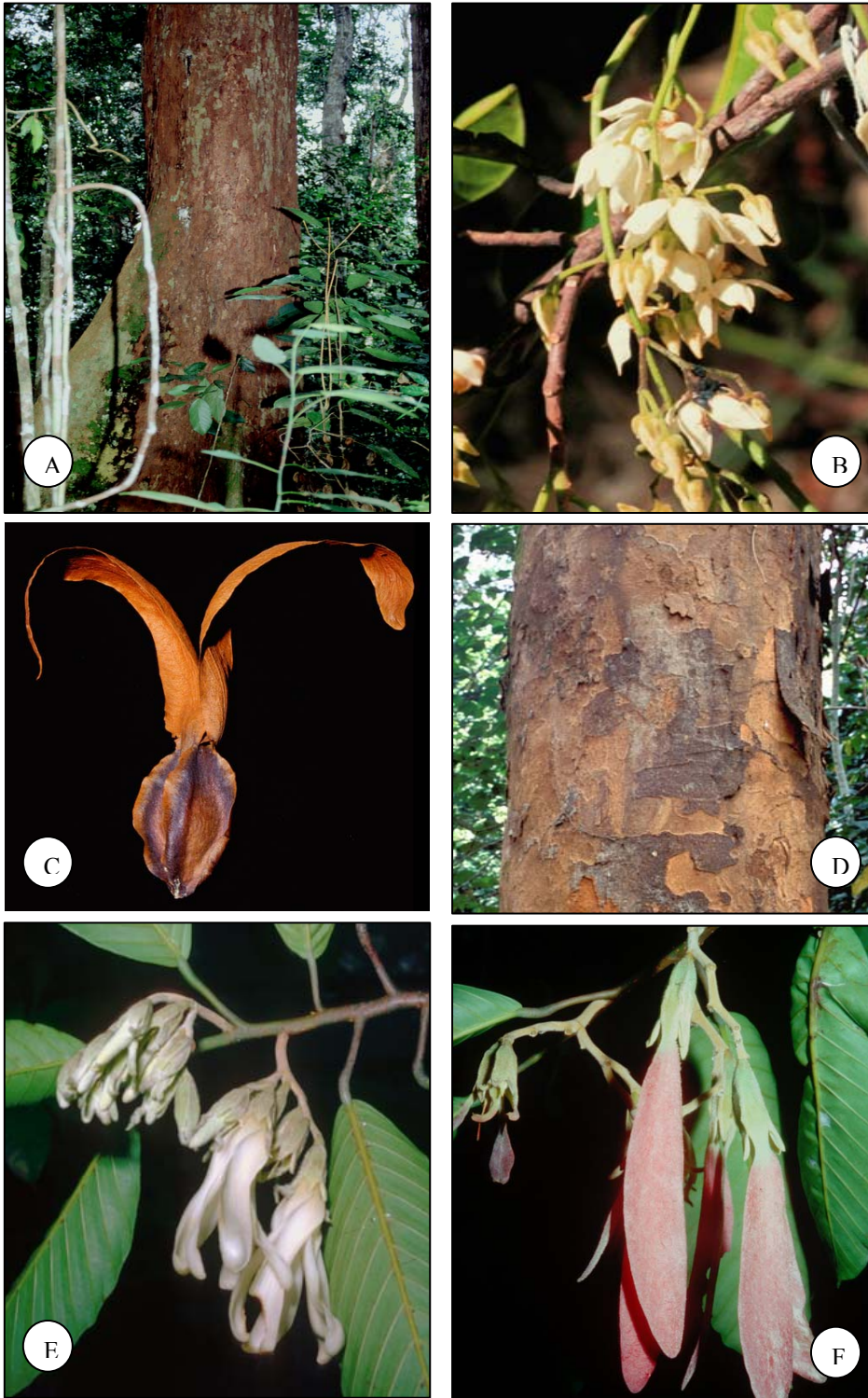


Plate 2. **Dipterocarpaceae:** A–B, *Anisoptera reticulata*; C, *Dipterocarpus grandiflorus*; D–F, *Dipterocarpus oblongifolius*.

(Photo credits: A–B = E. Soepadmo; C = L.S.L. Chua; D = L.G. Saw; E–F = E. Soepadmo).

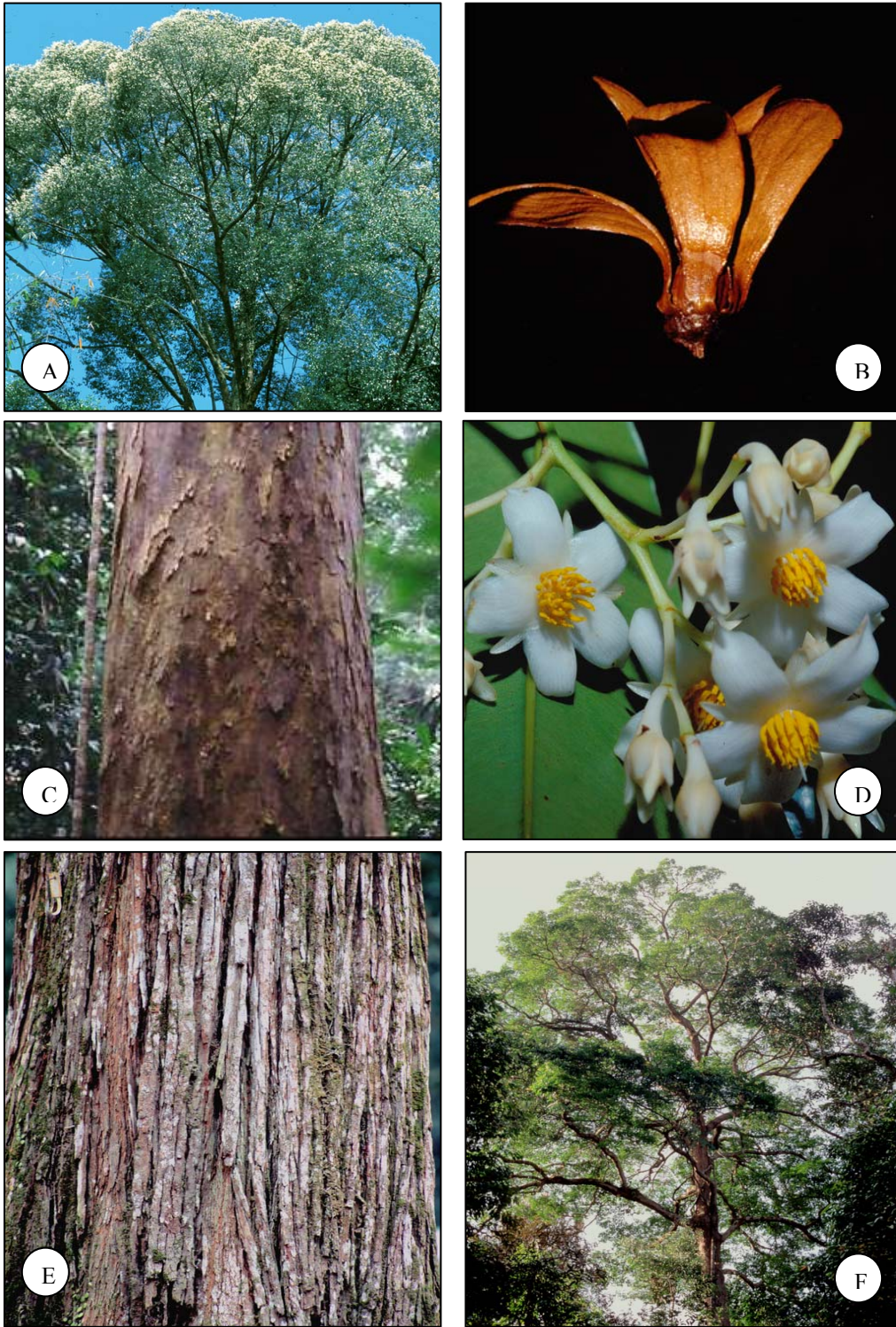


Plate 3. **Dipterocarpaceae:** A–B, *Dryobalanops aromatica*; C, *Dryobalanops beccarii*; D, *Dryobalanops oblongifolia*; E, *Hopea beccariana*; F, *Shorea coriacea*.

(Photo credits: A = H.S. Yong; B = L.S.L. Chua; C = Stephen Teo; D = L.S.L. Chua; E–F = L.G. Saw).

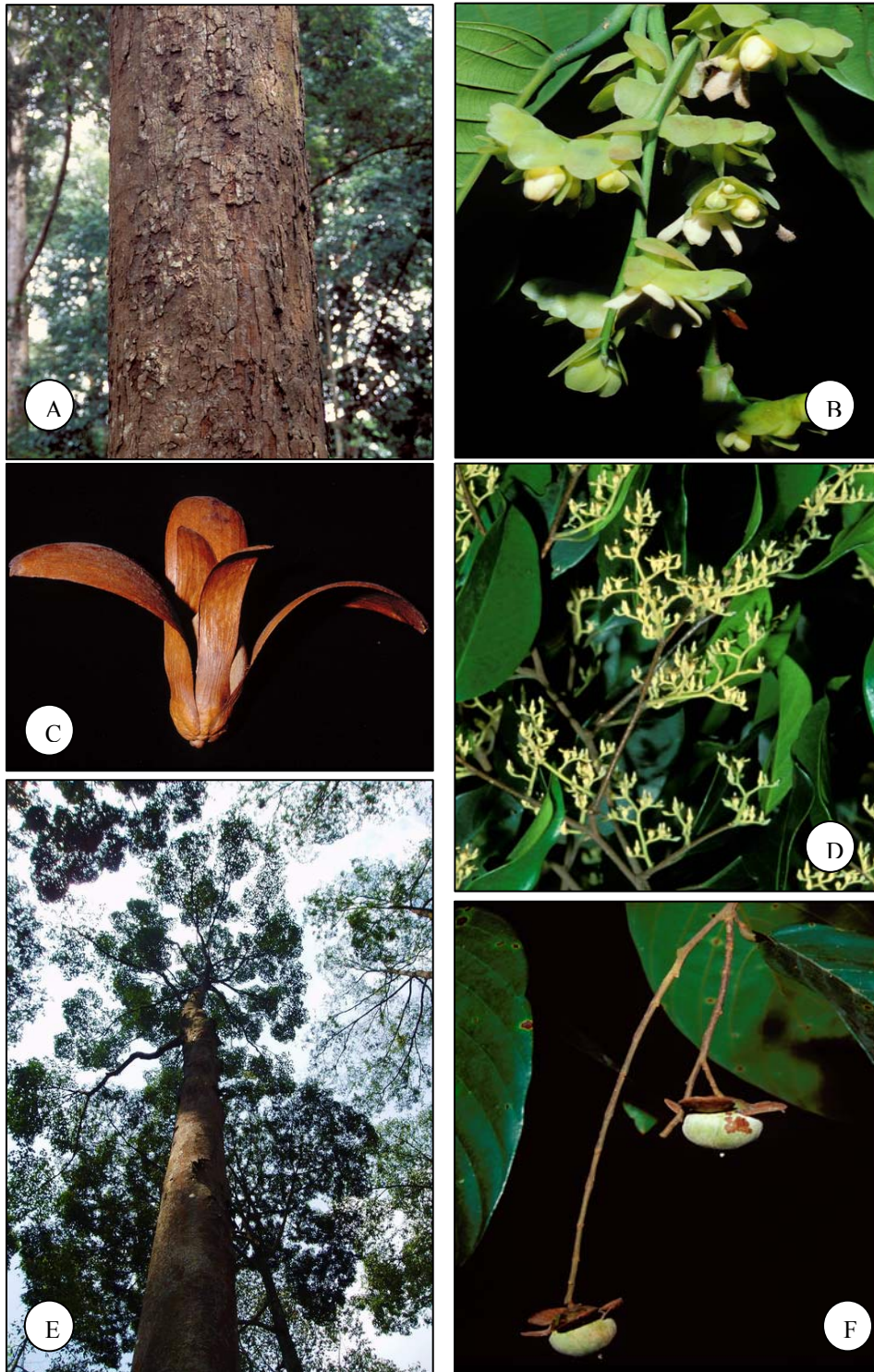


Plate 4. **Dipterocarpaceae:** A, *Shorea exelliptica*; B–C, *Shorea macrophylla*; D, *Shorea multiflora*; E, *Shorea rotundifolia*; F, *Shorea seminis*.

Photo credits: A = L.G. Saw; B–D = L.S.L. Chua; E = W.K. Soh; F = L.S.L. Chua).

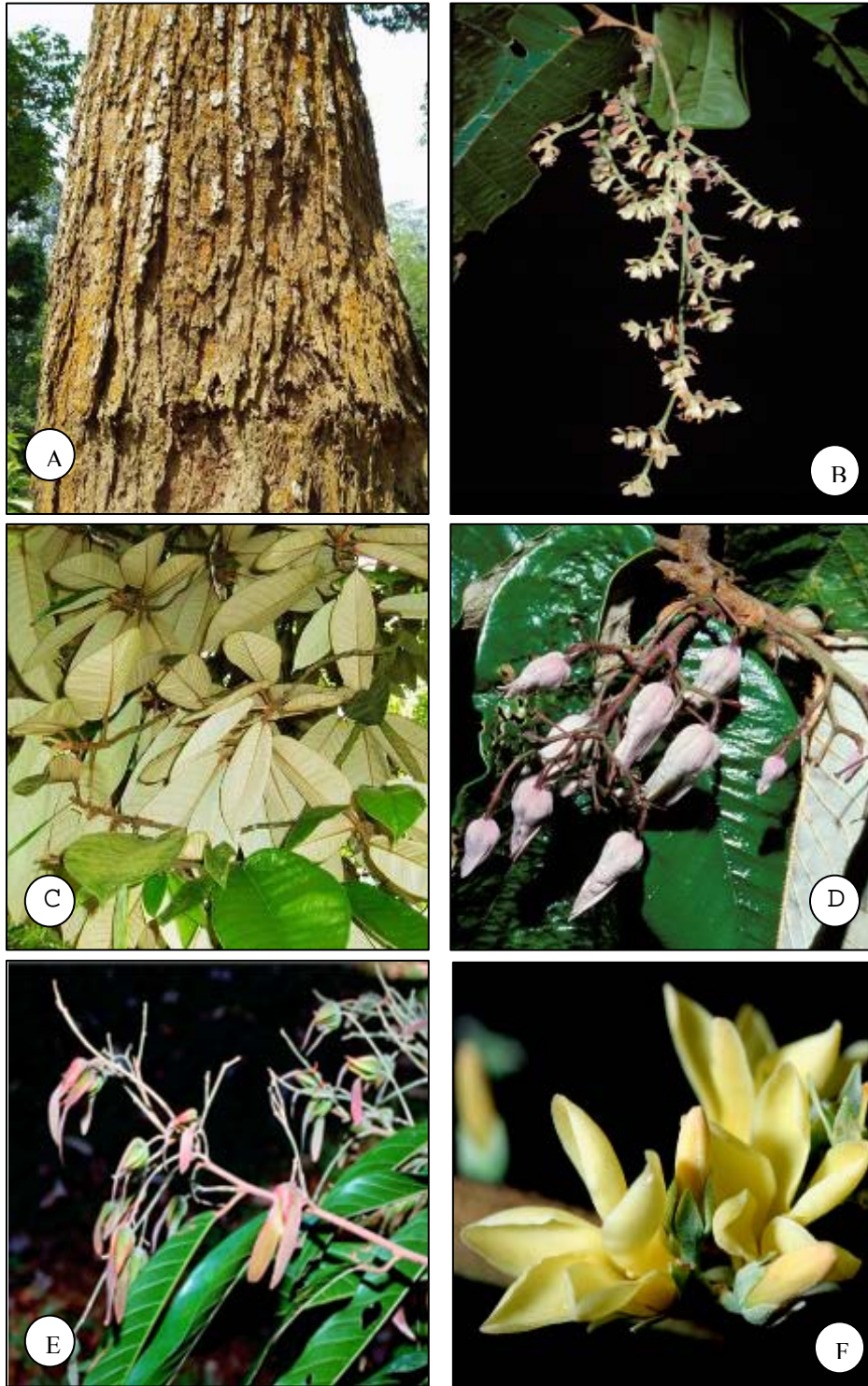


Plate 5. **Dipterocarpaceae:** A–B, *Shorea smithiana*; C–D, *Upuna borneensis*; E, *Vatica nitens*; F, *Vatica odorata*.

(Photo credits: A = W.K. Soh; B = L.S.L. Chua; C = W.K. Soh; D–F = L.S.L. Chua).

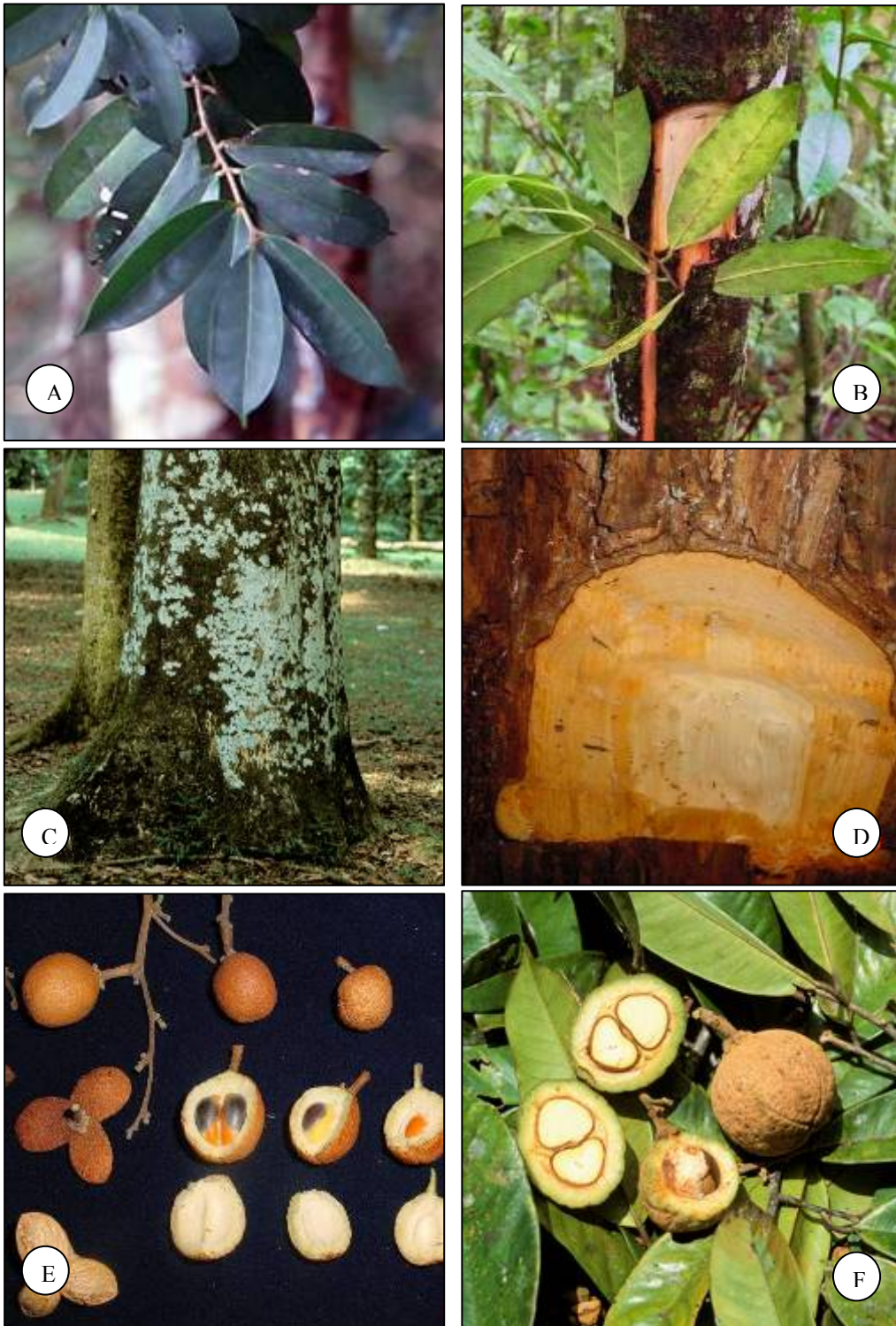


Plate 6. **Thymelaeaceae:** A, *Aëtioxylon sympetalum*; B, *Amyxa pluricornis*; C, *Aquilaria malaccensis*; D–E, *Gonystylus forbesii*; F, *Gonystylus macrophyllus*.

(Photo credits: A = Stephen Teo; B = C.S. Tawan; C = L.G. Saw; D–E = C.S. Tawan; F = E. Soepadmo).

INDEX TO TRADE GROUPS OF *SHOREA* (DIPTEROCARPACEAE)

(compiled by S. Julia & W.K. Soh)

Red meranti

- Shorea acuta* P.S.Ashton 219
Shorea albida Symington 221
Shorea almon Foxw. 223
Shorea amplexicaulis P.S.Ashton 225
Shorea andulensis P.S.Ashton 226
Shorea argentifolia Symington 229
Shorea beccariana Burck 235
Shorea bullata P.S.Ashton 238
Shorea carapae P.S.Ashton 240
Shorea coriacea Burck 243
Shorea curtisii Dyer ex Brandis 245
Shorea dasyphylla Foxw. 247
Shorea dispar P.S.Ashton 249
Shorea elliptica Burck 251
Shorea fallax Meijer 256
Shorea ferruginea Dyer ex Brandis 257
Shorea flaviflora Wood ex P.S.Ashton 258
Shorea flemmichii Symington 259
Shorea foraminifera P.S.Ashton 260
Shorea inaequilateralis Symington 270
Shorea johorensis Foxw. 274
Shorea kunstleri King 276
Shorea leprosula Miq. 282
Shorea macrantha Brandis 285
Shorea macrophylla (de Vriese)
P.S.Ashton 287
Shorea macroptera Dyer 288
Shorea mecistopteryx Ridl. 292
Shorea monticola P.S.Ashton 293
Shorea myrionerva Symington 296
Shorea ovalis (Korth.) Blume 301
Shorea ovata Dyer ex Brandis 303
Shorea pachyphylla Ridl. ex Symington 304
Shorea palembanica Miq. 305
Shorea pallidifolia P.S.Ashton 306
Shorea parvifolia Dyer 306
Shorea parvistipulata F.Heim 308
Shorea pauciflora King 311
Shorea pilosa P.S.Ashton 312
Shorea pinanga Scheff. 313
Shorea platycarpa F.Heim 314
Shorea platyclados Slooten ex Foxw. 315
Shorea praestans P.S.Ashton 317
Shorea pubistyla P.S.Ashton 318
Shorea quadrinervis Slooten 319
Shorea retusa Meijer 321
Shorea revoluta P.S.Ashton 321
Shorea rotundifolia P.S.Ashton 324
Shorea rubella P.S.Ashton 325
Shorea rubra P.S.Ashton 326
Shorea rugosa F.Heim 327
Shorea sagittata P.S.Ashton 328
Shorea scaberrima Burck 328
Shorea scabrida Symington 331
Shorea slootenii Wood ex P.S.Ashton 334
Shorea smithiana Symington 335
Shorea splendida (de Vriese) P.S.Ashton
337
Shorea stenoptera Burck 338
Shorea teysmanniana Dyer ex Brandis 342
Shorea uliginosa Foxw. 343
Shorea venulosa Wood ex Meijer 344
Shorea waltonii Wood ex Meijer 346
Shorea woodii P.S.Ashton 347

Selangan batu

- Shorea asahii* P.S.Ashton 230
Shorea atrinervosa Symington 230
Shorea biawak P.S.Ashton 236
Shorea brunnescens P.S.Ashton 237
Shorea crassa P.S.Ashton 244
Shorea domatiosa P.S.Ashton 249
Shorea excelliptica Meijer 252
Shorea falcifera Dyer ex Brandis 255
Shorea falciferoides Foxw. 255
Shorea foxworthyi Symington 261
Shorea geniculata Symington ex
P.S.Ashton 262
Shorea guiso (Blanco) Blume 264
Shorea havilandii Brandis 265
Shorea hemsleyana (King) King ex Foxw.
266

<i>Shorea hypoleuca</i> Meijer	268	
<i>Shorea inappendiculata</i> Burck	271	
<i>Shorea isoptera</i> P.S.Ashton	273	
<i>Shorea ladiana</i> P.S.Ashton	277	
<i>Shorea laevis</i> Ridl.	278	
<i>Shorea lunduensis</i> P.S.Ashton	284	
<i>Shorea materialis</i> Ridl.	290	
<i>Shorea maxwelliana</i> King	291	
<i>Shorea micans</i> P.S.Ashton	293	
<i>Shorea obscura</i> Meijer	297	
<i>Shorea scrobiculata</i> Burck	332	
<i>Shorea seminis</i> (de Vriese) Slooten	333	
<i>Shorea superba</i> Symington	340	
White meranti		
<i>Shorea agamii</i> P.S.Ashton	220	
<i>Shorea bracteolata</i> Dyer	236	
<i>Shorea confusa</i> P.S.Ashton	242	
<i>Shorea cordata</i> P.S.Ashton	243	
<i>Shorea dealbata</i> Foxw.	248	
<i>Shorea gratissima</i> (Wall. ex Kurz) Dyer	263	
<i>Shorea lamellata</i> Foxw.	280	
<i>Shorea ochracea</i> Symington	298	
<i>Shorea resinosa</i> Foxw.	320	
<i>Shorea symingtonii</i> Wood	341	
<i>Shorea virescens</i> Parijs	345	
Yellow meranti		
<i>Shorea acuminatissima</i> Symington	218	
<i>Shorea alutacea</i> P.S.Ashton	224	
<i>Shorea angustifolia</i> P.S.Ashton	228	
<i>Shorea bakoensis</i> P.S.Ashton	233	
<i>Shorea balanocarpoides</i> Symington	234	
<i>Shorea chaiana</i> P.S.Ashton	240	
<i>Shorea collaris</i> Slooten	241	
<i>Shorea cuspidata</i> P.S.Ashton	246	
<i>Shorea faguetiana</i> F.Heim	253	
<i>Shorea faguetioides</i> P.S.Ashton	254	
<i>Shorea gibbosa</i> Brandis	262	
<i>Shorea hopeifolia</i> (F.Heim) Symington	267	
<i>Shorea iliasii</i> P.S.Ashton	269	
<i>Shorea induplicata</i> Slooten	273	
<i>Shorea kudatensis</i> Wood ex Meijer	275	
<i>Shorea laxa</i> Slooten	281	
<i>Shorea longiflora</i> (Brandis) Symington	283	
<i>Shorea longisperma</i> Roxb.	284	
<i>Shorea macrobalanos</i> P.S.Ashton	286	
<i>Shorea mujongensis</i> P.S.Ashton	294	
<i>Shorea multiflora</i> (Burck) Symington	295	
<i>Shorea obovoidea</i> Slooten	297	
<i>Shorea patoiensis</i> P.S.Ashton	310	
<i>Shorea peltata</i> Symington	312	
<i>Shorea polyandra</i> P.S.Ashton	316	
<i>Shorea richetia</i> Symington	323	
<i>Shorea subcylindrica</i> Slooten	339	
<i>Shorea tenuiramulosa</i> P.S.Ashton	341	
<i>Shorea xanthophylla</i> Symington	347	

INDEX TO SCIENTIFIC NAMES

(compiled by Soh W.K. & S. Julia)

Names in italics here refer to either basionyms or synonyms; family names given in upper case are those of families revised in this volume. Pages where descriptions of families, genera and species are given are printed in bolds, and pages with illustrations are listed in bolds and italics.

A

- Adenium 2, **3**
Adenium obesum 3
Aëtoxyton 434, 435, **437**
Aëtoxyton sympetalum 434, **438, 439, (499)**
Agallochum malaccensis 445
Aganosma **10**
Aganosma marginata 10
Allamanda 1, 2, **4**
Allamanda cathartica 5
Alstonia 1, 2, 5, **14, 15**
Alstonia angustifolia 14, **15, 16**
 var. *elliptica* 17
 var. *latifolia* 17
Alstonia angustiloba 14, 15, **17, 20**
Alstonia calophylla 17
Alstonia costulata 28
Alstonia cuneata 23
Alstonia eximia 28
Alstonia grandifolia 28
Alstonia iwahigensis 14, 15, **18, 19, (494)**
Alstonia latifolia 17
Alstonia macrophylla 14, 15, **20, (494)**
Alstonia macrophylla β *glabra* 20
Alstonia pangkorensis 20
Alstonia pneumatophora 2, 14, 15, **21, 30**
Alstonia polyphylla 30
Alstonia scholaris 15, **21**
Alstonia spatulata 2, 15, **23**
Alyxia 7, 12
Alyxia reinwardtii 12
Amblyocalyx beccarii 17
Amyxa 434, 435, 437, **439**
Amyxa kutcinensis 440
Amyxa pluricornis **440, 441, (499)**
Amyxa taenoicera 440
Androsaemum 480
Anisoptera 69, **71, 72, 73**
 sect. Anisoptera 72
 sect. *Glabrae* 72
Anisoptera cochinchinensis 73
Anisoptera costata 72, **73**
Anisoptera grandiflora 76
Anisoptera grossivenia 72, 73, **74**
Anisoptera guiso 264
Anisoptera laevis 72, 73, **75, 77**
Anisoptera mangachapoi 372
Anisoptera marginata 72, 73, **76, 78**
Anisoptera marginatoides 73
Anisoptera melanoxyton 83
Anisoptera mindanensis 73
Anisoptera oblonga 73
Anisoptera odorata 377
Anisoptera palembanica 108
Anisoptera plagata 173
Anisoptera reticulata 72, 73, **76, 78, (495)**
Anisoptera robusta 73
Anodendron 7, 13 Annonaceae 158
Antherotriche 158
Anthoshorea 193
APOCYNACEAE 1, 2, 10, 494
 subfam. Apocynoideae 2
 subfam. Asclepiadoideae 2
 subfam. Periplocoideae 2
 subfam. Plumerioideae 2
 subfam. Rauvolfioideae 2
 subfam. Secamonoideae 2
Aporosa 352
Aquilaria 434, 435, 437, **442, 443, 484**
 sect. *Agallochum* 442
 sect. *Amphinoman* 442
 sect. *Gyrinopsis* 442
Aquilaria agallocha 445
Aquilaria ?bancana 454
Aquilaria beccariana 434, **443, 444, 447**
Aquilaria crassna 443
Aquilaria cumingiana
 var. *parvifolia* 445
Aquilaria grandifolia 445
Aquilaria ?macrophylla 464

Aquilaria malaccensis 434, 443, **445**
 449, (499)
Aquilaria microcarpa 443, **446**
Aquilaria sinensis 443
Aquilaria sp. 1 **447**
Aquilariella 442
Aquilariella borneensis 446
Aquilariella malaccensis 445
Aquilariella microcarpa 446
Arbor camphorifera 131
 Asclepiadaceae 1, 2
Asclerum 448
Asclerum borneense 455

B

Baharuia **9**
Baharuia gracilis 9
Baillonodendron 127
Baillonodendron malayanum 136
Balanocarpus 139, 234
Balanocarpus acuminatus 295
Balanocarpus bracteatus 150
Balanocarpus curtisii 150
Balanocarpus hemsleyana 266
Balanocarpus latifolius 295
Balanocarpus longiflorus 275
Balanocarpus multiflorus 287
Balanocarpus ovalifolius 145, 283
Balanocarpus pahangensis 227
Balanocarpus penangianus 286
Balanocarpus pubescens 165
Balanocarpus sibogae 287
Balanocarpus sphaerocarpus 175
Bleekeria 41
Bleekeria ackeringae 42
Bleekeria littoralis 42
Bobua anomala 390
Bobua cerasifolia 395
Bobua confusa 417
Brachypodandra 341
 Buxus 391

C

Calophyllum 294
Calpicarpum 41
 Catharanthus **2**
Catharanthus roseus 2
 Celastraceae 393
Celastrus 393
Cerbera 2, 4, **23**, 24

Cerbera dilatata 25
Cerbera lactaria 24, 25
Cerbera manghas 2, 23, **24**
Cerbera odollam 2, 23, 24, **25**, **26**
Cerbera oppositifolia 44
 Chilocarpus **8**
 Chonemorpha 1, **13**
Chonemorpha verrucosa 13
Cordyloblaste 381
Cordyloblaste confusa 417
Cordyloblaste henschelii 405
Cordyloblaste maingayi 405, 408
Cordyloblaste pendula 416
Cordyloblaste scortechinii 405
 Cornaceae 380
Cotylelobium 61, 66, 67, **76**, 77
Cotylelobium beccarianum 80
Cotylelobium burckii 77, **78**, **79**
Cotylelobium flavum 78
Cotylelobium hopeifolium 259
Cotylelobium lanceolatum 77, **78**, **79**
Cotylelobium leucocarpum 80
Cotylelobium malayanum 78
Cotylelobium melanoxyton 7, **80**, **81**
Cotylelobium philippinense 360
Cyrtosiphonia 46
Cyrtosiphonia reflexa 47
Cyrtosiphonia spectabilis 47
Cyrtosiphonia sumatrana 47

D

Dactylocladus 447
Dahpne aquilaria 470
Daphne indica 470
Dicalyx aluminosa 413, 414
Dicalyx aluminosus 414
Dicalyx cochinchinensis 395
Dicalyx odoratissimus 413
Dicalyx tinctorius 403
Dilleniaceae ?nervosa 292
Dioticarpus 135
 DIPTEROCARPACEAE **61**, 62, 66
 subfam. Dipterocarpoideae 62, 63
 tribe Dipterocarpeae 66
 tribe Shoreae 66
 subfam. Monotoideae 62
 subfam. Pakaraimoideae 62
Dipterocarpus 61, 64, 66, 67, **82**, 83
Dipterocarpus acutangulus 85, 87, **89**,
 101

- Dipterocarpus affinis* 122
Dipterocarpus angulatus 102
Dipterocarpus appendiculatus 100
Dipterocarpus applanatus 84, 88, **90, 91**
Dipterocarpus apterus 99
Dipterocarpus balsamiferus 106
Dipterocarpus bancanus 104
Dipterocarpus basilanicus 100
Dipterocarpus blancoi 105
Dipterocarpus borneensis 85, 89, **92, 101**
Dipterocarpus caudatus 84, 89, **92**
 subsp. *caudatus* 93
 subsp. *penangianus* **93**
Dipterocarpus caudiferus 84, 87, 88, **93, 94**
Dipterocarpus concavus 96
Dipterocarpus confertus 85, 86, **95, 96**
Dipterocarpus conformis 85, 87, **96**
 subsp. *borneensis* **96**
 subsp. *conformis* 96
Dipterocarpus coriaceus 86, 87, **97**
Dipterocarpus costulatus 84, 88, **98, 117**
Dipterocarpus crinitus 83, 87, **98**
Dipterocarpus cuneatus 107
Dipterocarpus cuspidatus 86, 87, **99**
Dipterocarpus dryobalanops 116
Dipterocarpus elongatus 84, 86, **99**
Dipterocarpus eurynchoides 100
Dipterocarpus eurynchus 86, **100**
Dipterocarpus exalatus 109
Dipterocarpus fagineus 85, 87, 89, **101**
Dipterocarpus fulvus 104
Dipterocarpus fusiformis 85, 87, **101**
Dipterocarpus geniculatus 85, 87, **102**
 subsp. *geniculatus* **103**
 subsp. *grandis* **103**
Dipterocarpus glabrigemmatus 85, 87, **103**
Dipterocarpus globosus 84, 88, 90, **104, 117**
Dipterocarpus gracilis 84, 87, **104**
Dipterocarpus grandiflorus 85, 88, **105**
Dipterocarpus griffithii 105
Dipterocarpus guiso 257
Dipterocarpus hasseltii 84, 88, **106**
Dipterocarpus helicopteryx 89
Dipterocarpus hirtus 98
Dipterocarpus humeratus 84, 87, **107, 108**
Dipterocarpus kerrii 84, 88, **107**
Dipterocarpus kunstleri 84, 88, **109**
Dipterocarpus kutaianus 93
Dipterocarpus lamellatus 84, 86, **110**
Dipterocarpus lampongus 106
Dipterocarpus lasiopodus 122
Dipterocarpus lowii 84, 88, **110, 111**
Dipterocarpus macrorrhinus 93
Dipterocarpus malaanonan 182
Dipterocarpus mangachapoi 360
Dipterocarpus marginatus 104
Dipterocarpus megacarpus 99
Dipterocarpus motleyanus 105
Dipterocarpus mundus 85, 88, **111, 113**
Dipterocarpus nobilis 119
Dipterocarpus nudus 85, 88, **113**
Dipterocarpus obconicus 107
Dipterocarpus oblongifolius 83, 85, 88, **114**
Dipterocarpus ochraceus 86, 87, 90, **114**
Dipterocarpus pachyphyllus 84, 88, **115**
Dipterocarpus palembanicus 85, 89, **116**
 subsp. *borneensis* **116**
 subsp. *palembanicus* **117**
Dipterocarpus penangianus 93
Dipterocarpus pentapterus 113
Dipterocarpus perturbinatus 107
Dipterocarpus plagatus 168
Dipterocarpus prismaticus 101
Dipterocarpus pseudofagineus 101
Dipterocarpus pterygocalyx 105
Dipterocarpus pulcherrimus 114
Dipterocarpus quinquegonus 106
Dipterocarpus rigidus 84, 87, **117**
Dipterocarpus sarawakensis 86, **117, 118**
Dipterocarpus skinneri 104
 ‘32. *Dipterocarpus* sp.’ 103
Dipterocarpus speciosus 109
Dipterocarpus stellatus 66, 86, 87, **119**
 subsp. *parvus* **120**
 subsp. *stellatus* **121**
Dipterocarpus stenopterus 114
Dipterocarpus subalpinus 106
Dipterocarpus sublamellatus 85, 89, **120**

Dipterocarpus tawaensis 89
Dipterocarpus tempehes 83, 86, 87, 89, **121**
Dipterocarpus teres 126
Dipterocarpus undulatus 110
Dipterocarpus validus 84, 86, 88, **122**
Dipterocarpus vanderhoevenii 104
Dipterocarpus verrucosus 83, 89, **122**
Dipterocarpus warburgii 122
Dipterocarpus woodii 124
Dissolena 46, 49
Dissolena verticillata 49
Doona 186, 187, 188
Doona javanica 173
Doona micrantha 173
Doona multiflora 286
Drapetes **429**, 431
Drapetes ericoides 422, 428
Drimyspermum perrotitianum 468
Dryobalanops 61, 67, **123**, 124
Dryobalanops abnormis 132
Dryobalanops aromatica 64, 124, 125, **126**
Dryobalanops beccarii 125, **126**, **127**
Dryobalanops camphora 126
Dryobalanops fusca 125, **128**
Dryobalanops junghuhnii 126
Dryobalanops kayanensis 131
Dryobalanops keithii 123, 124, 125, **129**, **130**
Dryobalanops lanceolata 125, **131**
Dryobalanops oblongifolia 125, 126, **132**
 subsp. *oblongifolia* **133**, **134**
 subsp. *occidentalis* 134
Dryobalanops oocarpa 128
Dryobalanops rappa 125, **134**
Dryobalanops schefferi 375
Dryobalanops sericea 173
Dryobalanops sumatrensis 126
Dryobalanops vriesii 126
Dyera 2, 5, **25**, 27
Dyera borneensis 29
Dyera costulata **27**, **28**
Dyera laxiflora 27
Dyera lowii 29
Dyera polyphylla 2, 27, **29**
Dyerella 77

E

Ebenales 380
Echites sect. *Aganosma* 10
Echites scholaris 21
Elaeogyne 341
Enkleia 427, **428**, 430
Enkleia malaccensis 427, 428
Epigynum **12**
Epigynum borneense 12
Ervatamia 50
Ervatamia corymbosa 53
 var. *kelsallii* 51
 var. *pubescens* 53
Ervatamia curtisii 51
Ervatamia cylindrocarpa 51
Ervatamia hirta 53
Ervatamia macrocarpa 55
Ervatamia malaccensis 56
Ervatamia pauciflora 53
 var. *minor* 53
Ervatamia rostrata 51
Eucorymbia **11**
Eucorymbia alba 11
Eugeniodes 381
Eugeniodes adenophyllum 389
Eugeniodes cerasifolia 395
Eugeniodes celastrifolius 393
Eugeniodes fasciculatum 403
Eugeniodes henschelii 405
Eugeniodes maingayi 405
Eugeniodes odoratissima 413
Eugeniodes ophirensis 415
Eugeniodes pendula 416
Euphorbia malaanonan 257
Excavatia 41
Excavatia littoralis 42

G

Gonystylus 427, 428, **439**, 440, 441
 sect. *Aetoxylon* 430
Gonystylus affinis 440, 441, 443, **444**, 450
 var. *affinis* **444**
 var. *elegans* **445**
Gonystylus areolatus 441, **445**
Gonystylus augescens 442, **445**, 456
Gonystylus bancanus 440, 441, 442, **446**, 447, 448, 452, 453, 457
Gonystylus beccarianus 444

- Gonystylus borneënsis* 440, 441, **447**, 450
Gonystylus brunnescens 440, 442, **448**
Gonystylus calophylloides 441, **448**, 461
Gonystylus calophyllus 443, 448, **449**, 461
Gonystylus consanguineus 441, 442, **450**
Gonystylus costalis 441, **450**, 452, 479
Gonystylus decipiens 443, **451**
Gonystylus eximius 442, 443, **451**
Gonystylus forbesii 441, 443, **452**, 457, 464
Gonystylus hackenbergii 446
Gonystylus keithii 441, 444, **453**
Gonystylus lucidulus 443, **454**, **455**
Gonystylus macrophyllus 440, 441, 443, **456**, 456
Gonystylus maingayi 440, 441, 443, **457**, 464
Gonystylus micranthus 440, 443, **457**
Gonystylus miquelianus 446, 456
Gonystylus nervosus 440, 441, **458**
Gonystylus nobilis 441, **459**
Gonystylus obovatus 456
Gonystylus othmanii 442, **459**
Gonystylus pendulus 440, 442, **460**
Gonystylus philippinensis 456
Gonystylus pluricornis 433
Gonystylus sp. 1 **465**
Gonystylus spectabilis 441, **461**, **462**
Gonystylus stenosepalus 443, **461**
Gonystylus sympetala 431
Gonystylus velutinus 440, 441, 442, 457, **463**, **465**
Gonystylus warburgianus 452
Gonystylus xylocarpus 440, 441, 442, **464**, **465**
 Goodeniaceae 403
Guettarda polyandra 418
 Guttiferae 62, 470
Gyrinopsis grandifolia 436
- H**
- Hancea* 135
Hancea beccariana 145
Hancea cernua 149
Hancea dryobalanoides 151
Hancea griffithii 156
Hancea mengerawan 160
Hancea micrantha 161
Hasseltia 30
Hasseltia arborea 31
Heurckia 45
Holarrhena daronensis 32
Hopea 61, 67, 68, **134**, 135, 136, 139, 153, 154, 187, 188, 381
 sect. *Dryobalanoides*
 subsect. *Dryobalanoides* 136
 subsect. *Sphaerocarpaceae* 136
 sect. *Hopea*
 subsect. *Hopea* 136
 subsect. *Pierrea* 136, 475
Hopea acuminata 147
Hopea aequalis 137, **142**
Hopea albescens 259
Hopea altocollina 137, 139, **143**
Hopea andersonii 138, 141, **144**
 subsp. *andersonii* **144**
 subsp. *basalticola* **144**
Hopea argentea 149
Hopea aspera 292
Hopea beccariana 136, 137, 139, **145**, 153, 158
Hopea borneensis 151
Hopea bracteata 138, 140, **146**
Hopea bullatifolia 139, 142, **146**, 475
Hopea centipeda 138, 142, **147**, **148**
Hopea cernua 136, 139, 141, **149**
Hopea coriacea 136, 139, 140, **150**
Hopea curtisii 173
Hopea dasyrrhachis 168
Hopea depressinerva 138, 142, **150**
Hopea diversifolia 174
Hopea dryobalanoides 137, 140, 141, 146, **151**, **152**
Hopea dyeri 137, 141, **153**, 155, 178
Hopea enicosanthoides 149, 152, **154**
Hopea fagifolia 173
Hopea ferruginea 137, 141, 154, **155**
Hopea fluvialis 137, 141, **155**
Hopea garangbuaya 150
Hopea globosa 173
Hopea grandiflora 367
Hopea gratissima 256
Hopea griffithii 137, 140, **156**
 var. *pedicellata* 167
Hopea grisea 255
Hopea hasskarliana 173

Hopea heimaniana 259
Hopea hopeifolia 259
Hopea intermedia 145, 153
Hopea javanica 173
Hopea kelantanensis 150
Hopea kerangasensis 137, 140, **157**
Hopea laevifolia 271
Hopea lanceolata 324
Hopea latifolia 137, 141, 146, **158**
Hopea laxa 165
Hopea linggensis 247
Hopea longiflora 275
Hopea longirostrata 136, 140, **158**
Hopea lowii 173
Hopea macrophylla 279
Hopea ?maranti 274
Hopea megacarpa 138, 142, **159**
Hopea mengerawan 136, 137, 139, **159**
Hopea mesuoides 138, 140, **160**
Hopea micrantha 137, 140, 154, **161**
Hopea minima 146
Hopea minutiflora 173
Hopea montana 138, 140, **162**
Hopea multiflora 286
 var. *venosa* 286
Hopea nervosa 137, 142, **162**
Hopea nicholsonii 145
Hopea nutans 138, 141, **163**
Hopea obscurinerva 139, 142, **164**, 479
Hopea ovalifolia 258
Hopea ovoidea 138, 141, 142, **164**
Hopea pachycarpa 138, 142, **165**, **166**,
 475
Hopea pedicellata 137, 139, 140, **167**
Hopea pentanervia 138, 814, **168**
Hopea philippinensis 176
Hopea plagata 138, 141, **168**
Hopea pterygota 139, 142, **169**, **170**,
 475
Hopea resinosa 165
Hopea rudiformis 137, 142, **171**, **172**
Hopea rugifolia 138, 140, **173**
Hopea sangal 68, 138, 141, **173**
Hopea sarawakensis 151
Hopea semicuneata 138, 142, **174**
Hopea seminis 324
Hopea sericea 173
Hopea siamensis 167
Hopea 'sp. nov. aff. H. pachycarpa'
 142

Hopea sphaerocarpa 138, 140, 173, **175**
Hopea splendida 328
Hopea subulata 160
Hopea tenuinervula 139, 141, **176**, 475
Hopea treubii 136, 137, 139, **176**
Hopea vacciniifolia 138, 140, **177**
Hopea vesquei 141, **178**, 154
Hopea wyatt-smithii 138, 140, 142, **179**
Hunteria zeylanica 2
Hydnocarpus 343
Hypericum 470

I

Ichnocarpus **13**
Ichnocarpus frutescens 13
Ichnocarpus serpyllifolius 13
Isauxis 351
Isoptera 186
Isoptera borneensis 324
Isoptera burckii 257
Isoptera seminis 324

K

Kibatalia 2, 6, **30**, 31
Kibatalia arborea **31**,
Kibatalia borneensis 31, **32**
Kibatalia daronensis 32
Kibatalia maingayi 31, **32**, **33**
Kibatalia villosa 31, 32, **34**
Kickxia 30
Kickxia arborea 31
Kickxia borneensis 32
Kopsia 2, 6, **35**
Kopsia alba 38
Kopsia arborea 35, **36**, 40
Kopsia caudata 38
 var. *glabra* 38
Kopsia dasyrachis 36, **37**
Kopsia lancibracteolata 36
Kopsia lancifolia 38
Kopsia larutensis 40
Kopsia laxinervia 36
Kopsia longiflora 36
Kopsia mitrephora 40
Kopsia parvifolia 38
Kopsia pauciflora 36, **38**
 var. *mitrephora* **38**, **39**
 var. *pauciflora* **38**, **40**
Kopsia rajangensis 35, **40**
Kopsia scortechinii 36

Kopsia sleeseniana 35
Kopsia sp. 35
Kopsia tenuis 35, **41**

L

Lactaria 41
Lactaria ackeringae 42
Lactaria glomerata 43
Lactaria oppositifolia 44
Laurus sumatrensis 126
Leuconotis 1, 7
Linostoma 427, **428**, 430
Linostoma longiflorum 429
Linostoma pauciflorum 425, 429
Lodhra rubiginosa 420

M

Malvales 62
Melodinus **11**
Melodinus orientalis 11
Mocanera grandiflora 105
Mocanera guiso 257
Mocanera malaanonan 182
Mocanera mangachapoi 360
Mocanera plagata 168
Myrtus laurinus 398

N

Neisandra 135
Neisosperma 41, 44
Neisosperma glomerata 43
Neisosperma oppositifolia 44
Neobabanocarpus 136, 187, 188, 227
Neoscortechinia 447
Nerium 2, **4**
Nerium divaricatum 51
Nerium oleander 4

O

Ochrosia 2, 5, 6, **41**, 42
Ochrosia ackeringae **42**
var. *angustifolia* 42
Ochrosia glomerata 42, **43**
Ochrosia littoralis 42
Ochrosia oppositifolia 42, **44**, **45**
Ophioxylon 46
Orchipeda foetida 58

P

Pachychlamys 186
Pachychlamys beccarianus 296
Pachychlamys brachypterus 296
Pachychlamys gysbertsiana 279
Pachychlamys hemsleyana 258
Pachynocarpus 341
Pachynocarpus umbonatus 377
Pachynocarpus verrucosus 377
Pagiantha 50
Pagiantha corymbosa 53
Pagiantha macrocarpa 55
Pakaraimaea 77
Paladelpa angustiloba 17
Palura pendula 416
Parahopea 126
Parameria **8**
Parameria laevigata 8
Parameria polyneura 8
Parashorea 67, 68, 136, 187, **179**, 180
Parashorea longisperma 275
Parashorea lucida **181**
Parashorea macrophylla 68, 180, **181**
Parashorea malaanonan 68, 180, **182**
var. *tomentella* 184
Parashorea parvifolia 180, **183**
Parashorea plicata 182
Parashorea smythiesii 181, **183**
Parashorea tomentella 180, 181, **184**,
185
Paravallaris maingayi 32
Parsonsia 1, 2, **11**
Pentacme 186, 187, 188
Perissandra 341
Petalandra 145
Petalandra micrantha 173
Phaleria 427, 430, **466**
Phaleria capitata 425, 426, **466**, **467**
Phaleria cauliflora 466
Phaleria perrottetiana 466, **467**
Phaleria splendida 468
Pierrea 135
Pierrea pachycarpa 165
Plumeria 2, **4**
Plumeria obtusa 4
Plumeria rubra 4
Pseudochrosia 41
Pseudochrosia glomerata 43
Pteranthera 341
Pteranthera mangachapoi 360

Pteranthera sinensis 360
Pterygium 123
Pteridium teres 126
Pygeum grandiflorum 413, 414

R

Rauvolfia 2, 5, 6, **46**
Rauvolfia perakensis 49
Rauvolfia reflexa 47
Rauvolfia samarensis 47
Rauvolfia serpentina 46
 var. *gracilis* 49
Rauvolfia spectabilis 47
Rauvolfia sumatrana 46, **47**, **48**
 var. *longifolia* 47
Rauvolfia verticillata 6, 46, 47, **49**
Retinodendron 341
Retinodendron bancanum 375
Retinodendron kunstleri 375
Retinodendron moluccana 370
Retinodendron rassak 370
Retinodendropsis 341
Retinodendropsis aspera 372
Richetia 186, 313
Richetia acuminata 286
Richetia latifolia 286
Richetia oblongifolia 286
Richetia penangiana 286
Ridleyinda 186
Ridleyinda borneensis 324
Rubroshorea 187

S

Scaphula 69
Shorea 64, 65, 67, 68, 135, 136, 180,
186, 187, 188, 191, 200
 sect. *Anthoshorea* **189**, 201, 214, 230,
 234, 235, 240, 256, 272, 290, 311,
 331, 335,
 sect. *Brachypterae* 65, 188, **190**, 201,
 216, 221, 231, 232, 236, 249, 251,
 252, 262, 266, 267, 285, 295, 296,
 299, 302, 306, 309, 320, 326, 334, 336
 subsect. *Brachypterae* 232, 251,
 252
 sect. *Mutica* 65, **190**, 201, 213, 222,
 238, 239, 250, 252, 258, 273, 274,
 277, 280, 287, 294, 297, 298, 305,
 310, 311, 312, 316, 317, 318, 322,
 325, 332, 333

subsect. *Auriculatae* 190, 213, 250,
 280, 287, 318, 325
 subsect. *Mutica* 190, 222, 239, 252,
 258, 273, 277, 294, 297, 298, 305,
 310, 311, 312, 316, 317, 322, 332,
 333
 sect. *Neohopea* **188**, 201, 264
 sect. *Ovalis* **190**, 201
 sect. *Pachycarpae* 65, 187, **190**, 201,
 219, 228, 278, 283, 303, 304, 308,
 315, 328, 329, 337, 480
 sect. *Richetioides* 64, 187, **189**, 201,
 212, 218, 222, 227, 233, 234, 239,
 245, 246, 255, 259, 261, 264, 267,
 273, 274, 275, 278, 286, 288, 301,
 303, 307, 313, 330, 332, 337
 subsect. *Polyandrae* 189, 307
 subsect. *Richetioides* 189, 218,
 222, 227, 233, 234, 239, 245, 246,
 255, 259, 261, 264, 267, 273, 274,
 275, 278, 286, 288, 301, 303, 313,
 330, 332, 337
 sect. *Rubella* 188, **189**, 190, 191, 201,
 215, 241, 244, 316,
 sect. *Shorea* 64, 187, **188**, 201, 224,
 225, 229, 231, 237, 242, 244, 247,
 248, 253, 254, 257, 258, 260, 263,
 269, 271, 276, 282, 284, 289, 323,
 324, 330
 subsect. *Barbata* 188, 219, 269,
 271, 282, 284
 subsect. *Shorea* 188, 224, 225, 231,
 237, 238, 242, 244, 247, 248, 253,
 254, 257, 258, 260, 263, 276, 282,
 289, 323, 324, 330, 479
Shorea acuminatissima 68, 164, 204,
212
Shorea acuta 199, 207, 210, **213**
Shorea agamii 195, 204, **214**, 235
 subsp. *agamii* **215**
 subsp. *diminuta* **215**
Shorea agsaboensis 294
Shorea alba 282
Shorea albida 187, 190, 196, 208, **215**,
216, 233, 234
Shorea almon 196, **216**
Shorea alutacea 194, 205, **218**
Shorea amplexicaulis 198, 207, **219**,
220, 228, 315
Shorea andulensis 197, 208, **221**

- Shorea angustifolia* 195, 205, **221**
Shorea aptera 296
Shorea argentifolia 199, **222, 223**
Shorea asahii 192, 203, **224**
Shorea assamica 235
Shorea atrinervosa 192, 202, **225, 226**,
289, 475
Shorea baillonii 280, 281
Shorea bakeriana 279
Shorea bakoensis 194, 206, **227**
Shorea balangeroides 333
Shorea balanocarpoides 193, 206, **227**
Shorea barbata 282
Shorea beccariana 198, 207, 221, **228**
Shorea biawak 192, 202, **229**
Shorea borneensis 324
Shorea brachyptera 296
Shorea bracteolata 195, 204, **230**
Shorea brunnescens 191, 203, **231**,
Shorea bullata 197, 208, 210, **231**
Shorea calcicola **232**, 479
Shorea camphorifera 126
Shorea carapae 197, 209, **232**
Shorea chaiana 194, 205, **233**
Shorea chrysophylla 283
Shorea cochinchinensis
var. *oligoneura* 333
Shorea collaris 194, 205, **234**
Shorea compressa 304
Shorea confusa 196, 204, 215, **234**,
235, 272, 336
Shorea cordata 195, 204, **235**
Shorea coriacea 197, 210, **236**
Shorea crassa 192, 202, **237**
Shorea cristata 299
Shorea curtisii 200, 208, **238**
subsp. *curtisii* **238**
subsp. *grandis* 238
Shorea cuspidata 194, 204, 206, **239**
Shorea dasyphylla 200, 208, **239**
Shorea dealbata 195, 204, **240**
Shorea dispar 110, 196, 208, 209, **241**
Shorea doligocarpa 227
Shorea domatiosa 192, 202, **242**
Shorea elliptica 196, 208, **242, 243**
Shorea ?elliptica 244
Shorea exelliptica 191, 203, **247**
Shorea eximia 292
var. *angustifolia* 292
Shorea faguetiana 195, 204, 206, **245**,
246
Shorea faguetioides 194, 205, **246**,
Shorea falcifera 192, 203, **247, 248**
Shorea falciferoides 192, 203, **248**
subsp. *falciferoides* 248
subsp. *glaucescens* **248**
Shorea fallax 197, 212, **249**
Shorea ferruginea 199, 207, 210, **250**
Shorea flava 247
Shorea flaviflora 187, 198, 209, **251**
Shorea flemmichii 196, 212, **251**
Shorea foraminifera 199, 209, **252**
Shorea foxworthyi 191, 203, **253**
Shorea franchetiana 228
Shorea geniculata 191, 201, 202, **254**
Shorea gentiles 298
Shorea gibbosa 194, 205, **255, 260**
Shorea gisok 248
Shorea glaucescens 248
Shorea gratissima 195, 204, **256**
Shorea guiso 187, 191, 201, 203, **256**
Shorea gysbertsiana 281
Shorea havilandii 191, 203, **258**
Shorea hemsleyana 199, 212, **258**
subsp. *grandiflora* **259**
subsp. *hemsleyana* 259
Shorea hopeifolia 194, 206, **259, 287**
Shorea hypoleuca 192, 203, **260**
Shorea iliasii 194, 205, **261**
Shorea inaequilateralis 68, 187, 196,
201, 207, **262**
Shorea inappendiculata 192, 202, **263**
Shorea induplicata 193, 205, **264**
Shorea isoptera 67, 192, 197, 201, 203,
210, **264, 265**
Shorea johorensis 197, **266**
Shorea kalunti 259
Shorea kudatensis 194, 206, **267**
Shorea kunstleri 68, 198, 201, 209, **268**
Shorea ladiana 192, 203, **269, 270**
Shorea laevifolia 271
Shorea laevis 192, 202, **271**
Shorea lamellata 195, 204, **272, 326**
Shorea laxa 193, 205, **272**
Shorea leprosula 200, 209, **273, 299**
Shorea leptocladus 266
Shorea leptoderma 323
Shorea longiflora 193, 205, **274, 278**
Shorea longipetala 257

- Shorea longisperma* 194, 205, **275**
Shorea lucida 181
Shorea lunduensis 192, 203, **276**
Shorea macrantha 187, 199, 207, **277**
Shorea macrobalanos 193, 205, **278**
Shorea macrophylla 198, 207, 210, **278**,
305, 315, 329
Shorea macroptera 199, 207, 210, **280**,
281
 subsp. *baillonii* 280, **281**
 subsp. *macroptera* 280, 281
 subsp. *macropterifolia* 280, **281**
 subsp. *sandakanensis* 280, **281**
Shorea mangachapoi 360
Shorea maranti 274
Shorea martiniana 328
Shorea materialis 192, 203, **282**
Shorea maxwelliana 192, 202, **282**
Shorea meadiana 323
Shorea mecistopteryx 198, 207, **283**
Shorea micans 192, 203, **284**
Shorea mollis 104
Shorea monticola 187, 198, 208, **285**
Shorea mujongensis 195, 206, 256, **286**
Shorea multiflora 193, 206, 260, **286**
Shorea myrionerva 199, 212, **287**
Shorea nebulosa 299, 300
Shorea obovoidea 194, 205, **288**
Shorea obscura 192, 202, **289**
Shorea obtusa
 var. *kohchangensis* 257
Shorea ochracea 195, 204, **290, 291**
Shorea oleosa 249
Shorea ovalis 196, 212, **292, 293**
 subsp. *ovalis* **294**
 subsp. *sarawakensis* 293, **294**
Shorea ovata 200, 209, **294**
Shorea pachyphylla 197, 209, **295**
Shorea palembanica 197, 210, 267, **296**
Shorea pallidifolia 200, 208, **297**
Shorea paludosa 233
Shorea palustris 305
Shorea parvifolia 200, 209, 241, **298**
 subsp. *parvifolia* **299**
 subsp. *velutina* **299**
Shorea parvistipulata 196, 210, 212,
299
 subsp. *albifolia* **300**
 subsp. *nebulosa* **300**
 subsp. *parvistipulata* **301**
Shorea patoiensis 193, 206, **301**
Shorea pauciflora 197, 210, 267, **302**
Shorea peltata 193, 204, 273, **303**
Shorea pierreana 223
Shorea pierrei 317
Shorea pilosa 258, 267, **363**
Shorea pinanga 198, 207, 279, **304**, 315
Shorea plagata 2934
Shorea platycarpa 200, 212, **305**
Shorea platyclados 187, 197, 210, **306**
Shorea polyandra 193, 204, 256, **307**
Shorea praestans 198, 207, **308**, 315
Shorea pubistyla 197, **309**
Shorea quadrinervis 190, 199, 208, **310**
Shorea resina-nigra 275
Shorea resinosa 195, 204, **311**
Shorea retusa 187, 199, 209, **311**
Shorea revoluta 187, 200, 209, **312**
Shorea richetia 193, 206, **313, 314**
Shorea ridleyana 259
Shorea robusta
 var. *schmidtii* 257
Shorea rogersiana 271
Shorea rotundifolia 198, 207, **315**
Shorea rubella 196, 208, **316**
Shorea rubra 200, 209, **316**
Shorea rugosa 200, 208, **317**
 var. *uliginosa* 333
Shorea sagittata **318, 319**
Shorea sandakanensis 280, 281
Shorea scaberrima 187, 197, 212, 249,
320, 321
Shorea scabrida 200, 208, 209, **321**
Shorea schefferiana 324
Shorea scrobiculata 191, 202, 203, **323**,
475
Shorea scutulata 298
Shorea seminis 187, 191, 202, 203, **324**
Shorea slootenii 199, 212, **325**
Shorea smithiana 196, 212, **326, 327**
‘63. *Shorea* sp.’ 312
Shorea splendida 198, 206, **328**
Shorea squamata 249
Shorea stenoptera 187, 198, 206, **329**
Shorea subcylindrica 193, 206, **329**
Shorea sublacunosa 292
Shorea subpeltata 181
Shorea superba 192, 201, 202, **330**
Shorea symingtonii 195, 204, **331**
Shorea tenuiramulosa 194, 206, **332**

- Shorea teysmanniana* 199, **333**
Shorea uliginosa 200, **333**
Shorea utilis 282
Shorea venulosa 197, 210, **334**
Shorea vidaliana 257
Shorea virescens 195, 204, 234, 235, 272, **335**
Shorea vulgaris 257
Shorea waltoni 197, 208, **336**
Shorea woodii 198, 207, **337**, 480
Shorea xanthophylla 194, 205, **337**
Spirolobium cambodianum 2
Strophanthus **9**
Strophanthus caudatus 10
Strophanthus singaporianus 10
Styrax obovatus 416, 417
Sunaptea 341, 342
Sunaptea astrotricha 367
Sunaptea borneensis 348
Sunaptea bureavi 360
Sunaptea dyeri 367
Sunaptea faginea 367
Sunaptea odorata 367
Sunaptea urbanii 348
SYMPLOCACEAE **379**
Symplocos 379, **380**, 381, 390, 404
 subgen. *Hopea* 380
 subgen. *Symplocos* 380
Symplocos adenophylla 379, 382, **387**, **388**
 var. *atrata* 389
 var. *merrittii* 389
 var. *montana* 389
 var. *virgata* 389
Symplocos albifrons 416, 417
Symplocos aluminosa 413, 414
Symplocos anomala 384, **390**
Symplocos bancana 389
Symplocos beccarii 389
Symplocos borneensis 383, **391**
Symplocos brachybotrys 380, **382**
Symplocos brandiana 400
Symplocos brandii 389
Symplocos buxifolia 382, **391**, 392
Symplocos buxifolioides 383, **392**
Symplocos candicans 393
Symplocos capitellata 416, 417
Symplocos caudata 415
Symplocos celastrifolia 379, 384, **392**, **394**
Symplocos cerasifolia 385, **395**
 var. *cerasifolia* 396
 var. *grandifolia* 396
Symplocos clementis 423
Symplocos cochinchinensis 379, 386, **396**
 subsp. *cochinchinensis* 397
 var. *cochinchinensis* **397**
 subsp. *laurina* 397
 var. *laurina* 384, **397**
 subsp. *leptophylla* 397
 subsp. *thwaitesii* 397
Symplocos colombonensis 379, 387, **398**
Symplocos concolor 390
Symplocos confusa 416, 417
Symplocos constricta 389
Symplocos costatifructa 386, **397**, **399**
Symplocos crassipes 379, 385, **400**
 var. *ernae* **401**
 var. *havilandii* **401**
 var. *penangiana* 401, **402**
 var. *rufomarginata* 401, **402**
Symplocos crenulata 416, 417
Symplocos cumingiana 415, 416
Symplocos curtisii 400
Symplocos deflexa 379, 386, **402**
Symplocos dolichantha 405, 407
Symplocos ernae 400, 401
Symplocos fasciculata 379, 385, **403**, 404
 var. *blumeana* 402
 var. *genuina* 403
Symplocos ferruginea 396, 397
Symplocos forbesii 409, 411
Symplocos foxworthyii 416
Symplocos fulvosa 389
Symplocos gambliana 379, **383**
Symplocos goodeniaceae 385, **404**
Symplocos havilandii 383, 400, 401
Symplocos henschelii 380, 384, **405**, 417
 subsp. *henschelii* 407
 var. *henschelii* **406**, **407**
 var. *maingayi* **406**, **408**
 subsp. *magnifica* 407
 var. *hirtistylis* 419
Symplocos hutchinsonii 393
Symplocos illiaspaiensis 386, **408**
 var. *iliaspaiensis* **409**

- var. pedunculata **409**
Symplocos iteophylla 389
Symplocos johniana **386**
Symplocos kinabaluensis 410, 412
Symplocos laeteviridis 379, 386, **409**
 var. alabensis **410**
 var. alternifolia **410**
 var. basirotunda **412**
 var. kinabaluensis **412**
 var. laeteviridis **411**
 var. mjobergii **411**, 412
 var. pauciflora **412**
 var. velutinosa **411**
Symplocos laurina 396, 398
Symplocos leochaii **384**
Symplocos maingayi 405, 408
Symplocos mjobergii 410, 412
Symplocos mollis 396, 397
Symplocos monticola 400
Symplocos nagelii 405, 406
Symplocos nigricans 393
Symplocos odoratissima 380, 383, **413**
 var. *aluminosa* 413
 var. *divaricata* 413, 414
 var. *odoratissima* **414**
 var. *wenzelii* **414**
Symplocos ophirensis 385, **414**
 subsp. *cumingiana* 416
 var. *cumingiana* **416**
 subsp. *perakensis* 416
 var. *perakensis* **416**
Symplocos pahangensis 389
Symplocos palawanensis 389
Symplocos penangiana 400, 402
Symplocos pendula 381, 382, **419**
 var. *hirtistylis* **419**
 var. *pendula* 419
Symplocos peninsularis 393
Symplocos perakensis 415, 416
Symplocos polyandra 379, 384, **418**,
 419
Symplocos pruniflora 389
Symplocos pulcherrima 416
Symplocos pulverulenta 413, 414
Symplocos rubiginosa 386, **420**, **421**
Symplocos scortechinii 405, 407
Symplocos spicata 396, 397
 var. *malasica* 396
Symplocos superba 418
Symplocos trichomarginalis **386**
Symplocos trichophlebia 413, 414
Symplocos tricoccata 385, **422**
Symplocos wenzelii 413, 414
Symplocos zizyphoides 387, **423**
Synaptea 341
Synaptea grandiflora 367
Synapea maingayi 358
Synaptea nitens 364
Synaptea perakensis 370
Synaptea reticulata 360
- T**
- Tabernaemontana* 2, 5, **49**, 50, 52
 sect. *Ervatamia* 50
Tabernaemontana antheonycta 51, **52**
Tabernaemontana corymbosa 52, **53**
Tabernaemontana crispa 51
Tabernaemontana cylindrocarpa 51
Tabernaemontana divaricata **50**
Tabernaemontana floribunda 55
Tabernaemontana hirta 53
Tabernaemontana macrocarpa 50, **53**,
 54
Tabernaemontana malaccensis 56
Tabernaemontana orientalis 55
Tabernaemontana pandacaqui 50, 52,
 55, 58
Tabernaemontana pauciflora 52, **56**, **57**,
 58
Tabernaemontana polysperma 56
Tabernaemontana rostrata **51**, 58
Tabernaemontana sumatrana 53
Tanghinia manghas 24
 Theaceae 62, 379
 Thevetia 2, **3**
 Thevetiana peruviana 3
 THYMELAEACEAE **425**, 426
 subfam. Aquilariodeae 426
 subfam. Gilgiodaphnoideae 426
 subfam. Gonystyloideae 426
 subfam. Thymelaeoideae 426
 Tiliaceae 62
Trachelospermum borneanum 2
- U**
- Upuna* 66, 68, **338**
Upuna borneensis **339**, **340**
Urceola 9, 13

V

- Vallariopsis **10**
Vallariopsis lancifolia 10
Vallaris daronensis 32
Vallaris maingayi 32
Vallaris 10
Vateria rassak 370
Vatica 66, 68, 83, **341**, 342, 345, 363
sect. Sunapteia 342
sect. Vatica 342
Vatica acrocarpa 375
Vatica aerea 368
Vatica albiramis 333, 345, **348**
Vatica aperta 358
Vatica apterantha 360
Vatica astrotricha 367
Vatica badiifolia 344, 347, **348**
Vatica bancana 375
Vatica bantamensis 348
Vatica beccariana 80
Vatica blancoana 373
Vatica borneensis 344, 346, **349**
Vatica brevipes 344, 347, **350**
Vatica brunigii 344, 347, **350**
Vatica bureavi 360
Vatica celebensis 370
Vatica celebica 370
Vatica chartacea 43, 345, **351**
Vatica compressa 343, 345, **351**
Vatica congesta 343, 347, **352**, **353**
Vatica coriacea 344, 345, 346, **354**
Vatica cupularis 373
Vatica curtisii 367
Vatica dulitensis 343, 345, 346, **354**
Vatica endertii 354, 357, **355**
Vatica eximia 292
Vatica faginea 367
Vatica glabrata 344, 345, **355**
Vatica globosa 343, 347, **356**
Vatica grandiflora 367
Vatica granulata 343, 347, 348, **357**
subsp. granulata **357**
subsp. sabaensis **357**
Vatica harmandii 80
Vatica havilandii 346, 350, **361**, **362**
Vatica kunstleri 385
Vatica leucocarpa 80
Vatica lowii 358
Vatica lutea 375
Vatica macroptera 358
Vatica maingayi 354, 355, 357, **358**
Vatica mangachapoi 344, 345, 346, **360**
subsp. mangachapoi **361**, **362**
subsp. obtusifolia **362**
Vatica maritima 343, 348, **362**
Vatica melanoxylon 80
Vatica micrantha 344, 347, **362**
Vatica mindanensis 368
Vatica moluccana 370
Vatica nitens 344, 347, **364**
Vatica oblongifolia 343, 346, **364**
subsp. crassilobata **365**
subsp. elliptifolia **365**
subsp. multinervosa **366**
subsp. oblongifolius **366**
subsp. selakoensis **366**
Vatica obtusifolia 360, 362
Vatica odorata 343, 348, **367**
subsp. mindanensis **368**
subsp. odorata **367**
Vatica ovalis 292
Vatica papuana 370
Vatica parvifolia 344, 346, **368**
Vatica patentinervia 344, 347, **369**
Vatica patula 360
Vatica pedicellata 343, 345, 346, **369**
Vatica perakensis 344, 347, **370**
Vatica ramiflora 72, 373
Vatica rassak 343, 347, **370**
Vatica reticulata 360
Vatica rotata 343, 346, **371**
Vatica rynchocarpa 344, 345, 346, **372**
Vatica sarawakensis 343, 347, **371**, 373
Vatica schefferi 375
Vatica schouteniana 375
Vatica schumanniana 357
Vatica songa 370
Vatica sorsogonensis 368
Vatica sp. 372
Vatica subcordata 370
Vatica sublacunosa 292
Vatica trigyna 105
Vatica umbonata 342, 345, **373**
subsp. acrocarpa **374**, **375**
subsp. umbonata **374**, **375**
Vatica urbanii 348
Vatica venulosa 343, 346, **375**
subsp. simalurensis 376
subsp. venulosa 376
Vatica verrucosa 373

Vatica vinosa 343, 346, **376**
Voacanga 1, 2, 5, **58**
Voacanga borneensis 59
Voacanga foetida **58**
Voacanga havilandii 58, **59**, **60**

W

Wikstroemia 426, 430, **469**
Wikstroemia acuminata 474
Wikstroemia androsaemifolia **470**
Wikstroemia brachyantha 425, **469**
Wikstroemia calva 472
Wikstroemia candolleana 472
Wikstroemia clementis 474
Wikstroemia crassifolia 469
Wikstroemia indica **470**

Wikstroemia junghuhnii 474
Wikstroemia linearifolia 470
Wikstroemia ovata **471**
Wikstroemia pachyphylla 470
Wikstroemia polyantha 427, 471, **472**
Wikstroemia pulgarensis 470
Wikstroemia ridleyi 472
Wikstroemia tenuiramis 427, 471, **472**,
473
Willughbeia **6**
Wrightia **5**
Wrightia religiosa 5

Z

Zizyphus 423

INDEX TO VERNACULAR NAMES

(compiled by S. Julia & W.K. Soh)

Scientific names in brackets are the correct names corresponding to vernacular names listed below.

A

- alan (*Shorea albida* Symington) 217, 334
atup (*Symplocos tricoccata* Noot.) 422

B

- balet (*Gonystylus* Teijsm. & Binn.) 439
banjutan (*Shorea multiflora* (Burck) Symington) 290
bardal (*Voacanga havilandii* Ridl.) 60
barek (*Shorea balanocarpoides* Symington, *S. faguetioides* P.S.Ashton) 230, 249
berancang asu (*Tabernaemontana pauciflora* Blume) 56
bidaru (*Gonystylus bancanus* (Miq.) Kurz) 447
bilat (*Parashorea macrophylla* Wyatt Smith ex P.S.Ashton) 183
buing (*Symplocos laeteviridis* Stapf) 411
bundu-bundo (*Symplocos polyandra* (Blanco) Brand) 420
burut-burut (*Tabernaemontana macrocarpa* Jack) 55

C

- cengal pasir (*Hopea beccariana* Burck) 146
cengal paya (*Hopea pentanervia* Symington ex Wood) 169
chandan pelanduk (*Wikstroemia polyantha* Merr.) 473

D

- damar hitam (*Shorea* sect. *Richetioides*) 203
dampol (*Symplocos celastriifolia* Griff. ex C.B.Clarke) 395
dukun (*Gonystylus* Teijsm. & Binn.) 439

E

- enadak (*Symplocos celastriifolia* Griff. ex C.B.Clarke) 395
engkabang (*Shorea* sect. *Pachycarpae*) 312
engkabang asu (*Shorea palembanica* Miq.) 300
engkabang bintang (*Shorea splendida* (de Vriese) P.S.Ashton) 332
engkabang bungkus (*Shorea macrantha* Brandis) 280
engkabang burung (*Shorea mecistopteryx* Ridl.) 287
engkabang jantung (*Shorea macrophylla* (de Vriese) P.S.Ashton) 282
engkabang kali (*Shorea ferruginea* Dyer ex Brandis) 253
engkabang lajan (*Shorea woodii* P.S.Ashton) 341
engkabang langgai bukit (*Shorea pinanga* Scheff.) 308
engkabang larai (*Shorea mecistopteryx* Ridl.) 287
engkabang layar (*Shorea fallax* Meijer, *S. splendida* (de Vriese) P.S.Ashton) 252, 332
engkabang melapi (*Shorea macrobalanos* P.S.Ashton) 281
engkabang menalit (*Shorea ferruginea* Dyer ex Brandis) 253
engkabang pinang (*Shorea fallax* Meijer) 252

engkabang pinang licin (*Shorea amplexicaulis* P.S.Ashton) 222
 engkabang rusa (*Shorea stenoptera* Burck) 333
 engkabang terendak (*Shorea seminis* (de Vriese) Slooten) 328
 engkabang tikus (*Shorea acuta* P.S.Ashton) 215
 engkaras (*Aquilaria* Lam., *A. beccariana* Tiegh., *A. malaccensis* Lam.,
A. microcarpa Baill.) 434, 437, 438
 ensurai (*Dipterocarpus oblongifolius* Blume) 83, 114
 entiba (*Cerbera manghas* L.) 24
 entulang jerak (*Symplocos ophirensis* C.B.Clarke) 416
 entuyut (*Symplocos polyandra* (Blanco) Brand) 420

G

gagil (*Hopea sangal* Korth.) 175
 gaharu (*Aëtoxyton* Airy Shaw, *A. sympetalum* (Steenis & Domke) Airy Shaw; *Aquilaria*
 Lam., *A. beccariana* Tiegh., *A. crassna* Pierre ex Lecomte, *A. malaccensis* Lam.,
A. microcarpa Baill., *A. sinensis* (Lour.) Sprengel; *Enkleia malaccensis* Griff.;
Gonystylus bancanus (Miq.) Kurz, *G. macrophyllus* (Miq.) Airy Shaw; *Wikstroemia*
polyantha Merr., *W. tenuiramis* Miq.) 426, 429, 431, 434, 437, 438, 440
 gaharu buaya (*Aëtoxyton* Airy Shaw) 150
 gaharu engkaras (*Aquilaria* sp. 1) 439
 gaharu melitan (*Gonystylus* Teijsm. & Binn., *G. macrophyllus* (Miq.) Airy Shaw,
G. xylocarpus Airy Shaw) 439, 455, 465
 gansurai (*Dipterocarpus oblongifolius* Blume) 114
 garang buaya (*Hopea coriacea* Burck) 151
 gatal (*Gonystylus* Teijsm. & Binn.) 439
 giam (*Hopea nutans* Ridl.) 164
 girak (*Symplocos fasciculata* (Kuntze) Zoll., *S. henschelii* (Moritzi) Benth. ex C.B.Clarke,
S. rubiginosa Wall. ex A.DC.) 404, 408, 422

I

inderatan (*Symplocos celastriifolia* Griff. ex C.B.Clarke) 395
 inderopis (*Symplocos celastriifolia* Griff. ex C.B.Clarke) 395

J

jelutong (*Dyera* Hook.f.) 2, 26, 27
 jelutong bukit (*Dyera costulata* (Miq.) Hook.f.) 29
 jelutong paya (*Dyera polyphylla* (Miq.) Steenis) 30
 jiak (*Symplocos adenophylla* Wall. ex G.Don, *S. fasciculata* (Kuntze) Zoll.) 390, 405
 jirah (*Symplocos* Jacq., *Symplocos adenophylla* Wall. ex G.Don,
S. fasciculata (Kuntze) Zoll., *S. laeteviridis* Stapf) 382, 390, 405, 411
 jirak (*Symplocos adenophylla* Wall. ex G.Don, *S. celastriifolia* Griff. ex C.B.Clarke,
S. cerasifolia Wall. ex A.DC., *S. cochinchinensis* (Lour.) S.Moore, *S. crassipes*
 C.B.Clarke, *S. fasciculata* (Kuntze) Zoll., *S. polyandra* (Blanco) Brand, *S. rubiginosa*
 Wall. ex A.DC.) 390, 395, 396, 397, 402, 404, 420, 422

K

kabang (*Symplocos adenophylla* Wall. ex G.Don) 390
 kacau gitik (*Alstonia scholaris* (L.) R.Br.) 22
 kaka (*Gonystylus* Teijsm. & Binn.) 439

kalasiwai (<i>Symplocos celastrifolia</i> Griff. ex C.B.Clarke)	395
kapur (<i>Dryobalanops</i> Gaertn.f.)	124
kapur baru (<i>Dryobalanops aromatica</i> Gaertn.f.)	127
kapur bukit (<i>Dryobalanops beccarii</i> Dyer)	129
kapur empedu (<i>Dryobalanops fusca</i> Slooten)	129
kapur gumpait (<i>Dryobalanops keithii</i> Symington)	129
kapur kelansau (<i>Dryobalanops oblongifolia</i> Dyer subsp. <i>oblongifolia</i>)	134
kapur merah (<i>Dryobalanops beccarii</i> Dyer)	129
kapur paji (<i>Dryobalanops lanceolata</i> Burck)	132
kapur paya (<i>Dryobalanops rappa</i> Becc.)	135
kapur peringgi (<i>Dryobalanops aromatica</i> Gaertn.f.)	127
kapur ranggi (<i>Dryobalanops aromatica</i> Gaertn.f.)	127
karai (<i>Gonystylus keithii</i> Airy Shaw)	453
karas (<i>Aquilaria</i> Lam., <i>A. beccariana</i> Tiegh., <i>A. crassna</i> Pierre ex Lecomte, <i>A. malaccensis</i> Lam., <i>A. sinensis</i> (Lour.) Sprengel)	426, 434, 435, 437, 438
kawang (<i>Shorea</i> sect. <i>Pachycarpae</i>)	311
kawang bukit (<i>Shorea amplexicaulis</i> P.S.Ashton)	222
kawang bulu (<i>Shorea pilosa</i> P.S.Ashton)	307
kawang burung (<i>Shorea mecistopteryx</i> Ridl.)	287
kawang daun merah (<i>Shorea parvistipulata</i> F.Heim)	303
kawang jantung (<i>Shorea macrophylla</i> (de Vriese) P.S.Ashton)	282
kawang pinang (<i>Shorea pinanga</i> Scheff.)	308
kawang tikus (<i>Shorea acuta</i> P.S.Ashton, <i>S. mecistopteryx</i> Ridl.)	215, 287
kayu ara (<i>Symplocos cochinchinensis</i> (Lour.) S.Moore)	397
kayu buyun (<i>Symplocos cochinchinensis</i> (Lour.) S.Moore)	397
kayu kain (<i>Symplocos adenophylla</i> Wall. ex G.Don)	381, 391
kayu liah (<i>Gonystylus</i> Teijsm. & Binn.)	439
kekaras (<i>Aquilaria beccariana</i> Tiegh.)	437
keladan (<i>Dryobalanops aromatica</i> Gaertn.f., <i>D. beccarii</i> Dyer)	127, 129
kelansau (<i>Dryobalanops oblongifolia</i> Dyer subsp. <i>oblongifolia</i>)	134
kelapok (<i>Anisoptera</i> Korth.)	69
kerimpa patong (<i>Tabernaemontana antheonycta</i> Leeuwenberg)	52
keruing (<i>Dipterocarpus</i> Gaertn.f.)	82
keruing arong (<i>Dipterocarpus applanatus</i> Slooten)	92
keruing asam (<i>Dipterocarpus tempehes</i> Slooten)	122
keruing baran (<i>Dipterocarpus eurynchus</i> Miq.)	101
keruing belimbing (<i>Dipterocarpus grandiflorus</i> (Blanco) Blanco)	106
keruing beludu (<i>Dipterocarpus acutangulus</i> Vesque)	90
keruing beludu kuning (<i>Dipterocarpus conformis</i> Slooten subsp. <i>borneensis</i> P.S.Ashton)	97
keruing buah bulat (<i>Dipterocarpus globosus</i> Vesque)	104
keruing bulu (<i>Dipterocarpus stellatus</i> Vesque)	120
keruing daun besar (<i>Dipterocarpus applanatus</i> Slooten)	92
keruing daun tebal (<i>Dipterocarpus pachyphyllus</i> Meijer)	116
keruing gasing (<i>Dipterocarpus caudatus</i> Foxw. subsp. <i>penangianus</i> (Foxw.) P.S.Ashton)	93
keruing gondol (<i>Dipterocarpus kerrii</i> King)	109
keruing gunung (<i>Dipterocarpus stellatus</i> Vesque)	120
keruing jarang (<i>Dipterocarpus lamellatus</i> Hook.f.)	110
keruing kerubung (<i>Dipterocarpus geniculatus</i> Vesque)	103

keruing kerukup (<i>Dipterocarpus humeratus</i> Slooten)	107
keruing kerukup kecil (<i>Dipterocarpus hasseltii</i> Blume)	107
keruing kerut (<i>Dipterocarpus sublamellatus</i> Foxw.)	121
keruing kesat (<i>Dipterocarpus gracilis</i> Blume)	105
keruing kipas (<i>Dipterocarpus costulatus</i> Slooten)	98
keruing kobis (<i>Dipterocarpus confertus</i> Slooten)	96
keruing kosugoi (<i>Dipterocarpus validus</i> Blume)	123
keruing kuntum putih (<i>Dipterocarpus kunstleri</i> King)	110
keruing latek (<i>Dipterocarpus elongatus</i> Korth.)	100
keruing latek bukit (<i>Dipterocarpus humeratus</i> Slooten)	107
keruing layang (<i>Dipterocarpus sarawakensis</i> F.G. Browne ex Slooten)	118
keruing licin (<i>Dipterocarpus nudus</i> Vesque)	114
keruing matang (<i>Dipterocarpus mundus</i> Slooten)	113
keruing mempelas (<i>Dipterocarpus crinitus</i> Dyer)	99
keruing merah (<i>Dipterocarpus verrucosus</i> Foxw. ex Slooten)	123
keruing merkah (<i>Dipterocarpus acutangulus</i> Vesque)	90
keruing neram (<i>Dipterocarpus oblongifolius</i> Blume)	114
keruing Palembang (<i>Dipterocarpus palembanicus</i> Slooten)	116
keruing paya (<i>Dipterocarpus coriaceus</i> Slooten)	98
keruing pipit (<i>Dipterocarpus fagineus</i> Vesque)	101
keruing putih (<i>Dipterocarpus caudiferus</i> Merr.)	94
keruing ranau (<i>Dipterocarpus ochraceus</i> Meijer)	115
keruing rapak (<i>Dipterocarpus kunstleri</i> King)	110
keruing runcing (<i>Dipterocarpus cuspidatus</i> P.S.Ashton)	99
keruing sindor (<i>Dipterocarpus borneensis</i> Slooten)	93
keruing sol padi (<i>Dipterocarpus pachyphyllus</i> Meijer)	116
keruing sol/shol (<i>Dipterocarpus lowii</i> Hook.f.)	111
keruing tangkai panjang (<i>Dipterocarpus geniculatus</i> Vesque)	103
keruing tempayan (<i>Dipterocarpus tempehes</i> Slooten)	122
keruing utap (<i>Dipterocarpus rigidus</i> Ridl.)	118
kerukup (<i>Shorea pachyphylla</i> Ridl. ex Symington)	299
kesugoi (<i>Dipterocarpus</i> Gaertn.f.)	82
kudan (<i>Dipterocarpus elongatus</i> Korth.)	100
kulim babok (<i>Symplocos celastrifolia</i> Griff. ex C.B.Clarke)	395
kumus (<i>Shorea laevis</i> Ridl.)	274
kumus bukit (<i>Shorea asahii</i> P.S.Ashton)	226
kumus hitam (<i>Shorea maxwelliana</i> King)	286
kusi (<i>Symplocos</i> Jacq.)	382

L

lako (<i>Aquilaria</i> Lam.)	434
lamai-lamai (<i>Symplocos celastrifolia</i> Griff. ex C.B.Clarke)	395
lamin ngalang (<i>Gonystylus</i> Teijsm. & Binn.)	439
lampada (<i>Tabernaemontana macrocarpa</i> Jack, <i>T. pauciflora</i> Blume)	55, 56
langgai (<i>Shorea amplexicaulis</i> P.S.Ashton, <i>S. beccariana</i> Burck, <i>S. rotundifolia</i> P.S.Ashton)	222, 231, 319
langgai sepit udang (<i>Shorea myrionerva</i> Symington ex P.S.Ashton)	291
laran (<i>Dipterocarpus oblongifolius</i> Blume)	114
leboh (<i>Symplocos fasciculata</i> (Kuntze) Zoll.)	405
legai (<i>Symplocos pendula</i> Wight)	418

- lemasok (*Symplocos ophirensis* C.B.Clarke) 416
lisang (*Symplocos odoratissima* (Blume) Choisy ex Zoll.) 414
lobo (*Symplocos laeteviridis* Stapf) 411
loboh (*Symplocos* Jacq., *S. adenophylla* Wall. ex G. Don, *S. fasciculata* (Kuntze) Zoll.,
S. ophirensis C.B.Clarke) 382, 390, 405, 416
lop (*Shorea* sect. *Brachypterae*, sect. *Mutica*, sect. *Ovalis*, sect. *Pachycarpae* and sect.
Rubella) 203
luis (*Hopea* Roxb.) 135
luis air (*Hopea fluvialis* P.S.Ashton) 157
luis daun berbulu (*Hopea centipeda* P.S.Ashton) 148
luis daun bulat (*Hopea latifolia* Symington) 159
luis daun serong (*Hopea tenuinervula* P.S.Ashton) 177
luis daun tebal (*Hopea treubii* F.Heim) 178
luis gunung (*Hopea altocollina* P.S.Ashton) 144
luis jangkang (*Hopea nervosa* King) 164
luis jantan (*Hopea griffithii* Kurz) 157
luis kerangas (*Hopea kerangasensis* P.S.Ashton, *H. micrantha* Hook.f.) 158, 162
luis melencur (*Hopea bullatifolia* P.S.Ashton) 147
luis padi (*Hopea bracteata* Burck) 147
luis palit (*Hopea dyeri* F.Heim) 154
luis putih (*Hopea wyatt-smithii* Wood ex P.S.Ashton) 180
luis ribu (*Hopea vacciniifolia* Ridl. ex P.S.Ashton) 178
luis selukai (*Hopea enicosanthoides* P.S.Ashton) 155
luis somit (*Hopea andersonii* P.S.Ashton) 145
luis tebal (*Hopea vesquei* F.Heim) 179
luis timbul (*Hopea cernua* Teijsm. & Binn.) 150
lun (*Shorea* Roxb. ex Gaertn.f., sect. *Richetioides*) 187, 203
lun barun (*Shorea xanthophylla* Symington) 342
lun bukit (*Shorea angustifolia* P.S.Ashton) 224
lun gajah (*Shorea gibbosa* Brandis) 257
lun gondol (*Shorea balanocarpoides* Symington) 230
lun hitam padi (*Shorea patoensis* P.S.Ashton) 305
lun jantan (*Shorea multiflora* (Burck) Symington) 290
lun kunyit (*Shorea collaris* Slooten) 237
lun melapi (*Shorea richetia* Symington) 318
lun meranti (*Shorea longisperma* Roxb.) 279
lun paya (*Shorea longiflora* (Brandis) Symington) 278
lun putih (*Shorea induplicata* Slooten) 267
lun runcing padi (*Shorea cuspidata* P.S.Ashton) 242
lun runcing (*Shorea acuminatissima* Symington) 214
lun siput (*Shorea faguetiana* F.Heim) 248
lun siput daun besar (*Shorea iliasii* P.S.Ashton) 264
lun siput jantan (*Shorea hopeifolia* (F.Heim) Symington) 263
lun timbul (*Shorea laxa* Slooten) 276
lunak (*Gonystylus bancanus* (Miq.) Kurz) 446
lupau (*Symplocos laeteviridis* Stapf) 411
luroh (*Symplocos laeteviridis* Stapf) 411

M

- maba (*Symplocos celastrifolia* Griff. ex C.B.Clarke) 395

madang (<i>Symplocos cerasifolia</i> Wall. ex A.DC.)	396
makulat (<i>Symplocos celastriifolia</i> Griff. ex C.B.Clarke)	395
malindah (<i>Gonystylus keithii</i> Airy Shaw)	453
mangalang (<i>Alstonia macrophylla</i> Wall. ex G.Don)	20
mata kinai (<i>Symplocos celastriifolia</i> Griff. ex C.B.Clarke)	395
mata kucing (<i>Hopea</i> Roxb.)	64
mata kucing bukit (<i>Hopea pedicellata</i> (Brandis) Symington)	168
mata kucing hitam (<i>Hopea dryobalanoides</i> Miq.)	152
melapi (<i>Shorea</i> sect. <i>Anthoshorea</i>)	202
melapi agama (<i>Shorea agamii</i> P.S.Ashton)	216
melapi daun besar (<i>Shorea ochracea</i> Symington)	295
melapi kuning (<i>Shorea symingtonii</i> Wood)	335
melapi laut (<i>Shorea gratissima</i> (Wall. ex Kurz) Dyer)	259
melapi pa'ang (<i>Shorea bracteolata</i> Dyer)	232
melapi sulang saling (<i>Shorea confusa</i> P.S.Ashton)	237
melawis (<i>Gonystylus macrophyllus</i> (Miq.) Airy Shaw)	456
melitan (<i>Gonystylus</i> Teijsm. & Binn.)	439
merakunyit (<i>Shorea</i> sect. <i>Richetioides</i> ; <i>Shorea collaris</i> Slooten)	203, 236
meranti (<i>Shorea</i> Roxb. ex Gaertn.f.)	187
meranti batu (<i>Shorea dasyphylla</i> Foxw.)	242
meranti belang (<i>Shorea resinosa</i> Foxw.)	315
meranti binatang (<i>Shorea argentifolia</i> Symington)	226
meranti buaya (<i>Shorea uliginosa</i> Foxw.)	338
meranti buaya hantu (<i>Shorea rugosa</i> F.Heim)	321
meranti bukit (<i>Shorea platyclados</i> Slooten ex Foxw.)	310
meranti bulu (<i>Shorea pilosa</i> P.S.Ashton)	307
meranti bulu merah (<i>Shorea pubistyla</i> P.S.Ashton)	313
meranti bumbung (<i>Shorea dealbata</i> Foxw.)	243
meranti daun mata lembing (<i>Shorea sagittata</i> P.S.Ashton)	323
meranti daun putih (<i>Shorea andulensis</i> P.S.Ashton)	223
meranti gunung (<i>Shorea monticola</i> P.S.Ashton)	288
meranti kawang pinang (<i>Shorea parvistipulata</i> F.Heim)	303
meranti kawang tikus (<i>Shorea acuta</i> P.S.Ashton)	215
meranti kepong (<i>Shorea ovalis</i> (Korth.) Blume)	297
meranti kepong kasar (<i>Shorea slootenii</i> Wood ex P.S.Ashton)	329
meranti kerangas (<i>Shorea revoluta</i> P.S.Ashton)	316
meranti kerukup (<i>Shorea pachyphylla</i> Ridl. ex Symington)	299
meranti lang (<i>Shorea elliptica</i> Burck)	247
meranti langgai (<i>Shorea beccariana</i> Burck)	231
meranti langgai bukit (<i>Shorea pinanga</i> Scheff.)	308
meranti lapis (<i>Shorea lamellata</i> Foxw.)	275
meranti laut putih (<i>Shorea rubella</i> P.S.Ashton)	320
meranti lilin (<i>Shorea teysmanniana</i> Dyer ex Brandis)	337
meranti lop (<i>Shorea scabrida</i> Symington)	326
meranti lubang hidung (<i>Shorea foraminifera</i> P.S.Ashton)	256
meranti majau (<i>Shorea johorensis</i> Foxw.)	270
meranti melantai (<i>Shorea macroptera</i> Dyer)	283
meranti melecur (<i>Shorea bullata</i> P.S.Ashton)	234
meranti menalit (<i>Shorea ferruginea</i> Dyer ex Brandis)	253
meranti merah kesumba (<i>Shorea rubra</i> P.S.Ashton)	320

meranti pa'ang (<i>Shorea bracteolata</i> Dyer)	232
meranti paya (<i>Shorea platycarpa</i> F.Heim)	309
meranti paya bersisik (<i>Shorea scaberrima</i> Burck)	325
meranti pitis (<i>Shorea ovata</i> Dyer ex Brandis)	298
meranti putih timbul (<i>Shorea agamii</i> P.S.Ashton)	216
meranti rambai (<i>Shorea smithiana</i> Symington)	331
meranti raya (<i>Shorea flemmichii</i> Symington)	255
meranti sarang punai (<i>Shorea parvifolia</i> Dyer)	302
meranti sepit udang (<i>Shorea myrionerva</i> Symington ex P.S.Ashton)	291
meranti sudu (<i>Shorea quadrinervis</i> Slooten)	314
meranti sulang sulang (<i>Shorea virescens</i> Parijs)	339
meranti tangkai panjang (<i>Shorea coriacea</i> Burck)	239
meranti tangkai panjang padi (<i>Shorea venulosa</i> Wood ex Meijer)	338
meranti telur (<i>Shorea retusa</i> Meijer)	315
meranti tembaga (<i>Shorea leprosula</i> Miq.)	277
mergalang (<i>Alstonia angustifolia</i> Wall. ex A.DC.)	17
merkoyong (<i>Hopea pachycarpa</i> (F.Heim) Symington)	166
mersawa (<i>Anisoptera</i> Korth.)	69
mersawa durian (<i>Anisoptera laevis</i> Ridl.)	74
mersawa kesat (<i>Anisoptera costata</i> Korth.)	71
mersawa kunyit (<i>Anisoptera grossivenia</i> Slooten)	72
mersawa paya (<i>Anisoptera marginata</i> Korth.)	76
meruyun (<i>Parashorea smythiesii</i> Wyatt Smith ex P.S.Ashton)	185
mikai (<i>Shorea laevis</i> Ridl.)	274
minyak garu laka (<i>Aëtoxylon sympetalum</i> (Steenis & Domke) Airy Shaw)	431
mitan (<i>Gonystylus maingayi</i> Hook.f.)	457
mundu-mundu (<i>Symplocos polyandra</i> (Blanco) Brand)	420

N

nasi-nasi pakir (<i>Gonystylus brunnescens</i> Airy Shaw)	448
nemesu (<i>Shorea pauciflora</i> King)	306

O

oba suluk (<i>Shorea pauciflora</i> King)	306
--	-----

P

pait-pait (<i>Wikstroemia ovata</i> C.A.Mey. ex Meisn.)	472
paji (<i>Dryobalanops lanceolata</i> Burck)	132
pelai (<i>Alstonia angustifolia</i> Wall. ex A.DC.)	17
pelai pipit (<i>Alstonia angustifolia</i> Wall. ex A.DC.)	17
pelawan-pelawan (<i>Symplocos adenophylla</i> Wall. ex G.Don)	390
peler kambing (<i>Tabernaemontana macrocarpa</i> Jack)	55
pengiran (<i>Anisoptera</i> Korth.)	69
pengiran durian (<i>Anisoptera laevis</i> Ridl.)	74
pengiran gajah (<i>Anisoptera reticulata</i> P.S.Ashton)	76
pengiran kerangas (<i>Anisoptera marginata</i> Korth.)	76
pengiran kesat (<i>Anisoptera costata</i> Korth.)	71
pengiran kunyit (<i>Anisoptera grossivenia</i> Slooten)	72
penyau (<i>Upuna borneensis</i> Symington)	343
peran (<i>Parashorea macrophylla</i> Wyatt Smith ex P.S.Ashton)	183

perawan (*Shorea* sect. *Brachypterae*, sect. *Mutica*, sect. *Ovalis*, sect. *Pachycarpae* and sect. *Rubella*) 203
perawan samak (*Shorea pauciflora* King) 306
periaboh (*Symplocos* Jacq.) 382
pong-pong (*Cerbera manghas* L.) 24
pulai (*Alstonia* R.Br., *Alstonia scholaris* (L.) R.Br.) 13, 22
pulai apong (*Alstonia spatulata* Blume) 22
pulai basong (*Alstonia spatulata* Blume) 22
pulai bukit (*Alstonia angustiloba* Miq.) 17
pulai daun besar (*Alstonia macrophylla* Wall. ex G.Don) 20
pulai lilin (*Alstonia pneumatophora* Backer ex Den Berger, *A. scholaris* (L.) R.Br.) 21, 22
pulai paya (*Alstonia pneumatophora* Backer ex Den Berger) 21
pulai pipit (*Alstonia spatulata* Blume) 22
pulai ucong (*Kibatalia borneensis* (Stapf) Merr.) 32
puruk (*Symplocos celastrifolia* Griff. ex C.B.Clarke) 395
purup (*Symplocos celastrifolia* Griff. ex C.B.Clarke) 395

R

ramin (*Gonystylus* Teijsm. & Binn., *G. affinis* Radlk., *G. areolatus* Domke ex Airy Shaw, *G. augescens* Ridl., *G. bancanus* (Miq.) Kurz, *G. borneensis* (Tiegh.) Gilg, *G. brunnescens* Airy Shaw, *G. calophylloides* Airy Shaw, *G. calophyllus* Gilg, *G. consanguineus* Airy Shaw, *G. decipiens* Airy Shaw, *G. eximius* Airy Shaw, *G. forbesii* Gilg, *G. macrophyllus* (Miq.) Airy Shaw, *G. maingayi* Hook.f., *G. nervosus* Airy Shaw, *G. spectabilis* Airy Shaw, *G. velutinus* Airy Shaw, *G. xylocarpus* Airy Shaw) 426, 439, 440, 445, 446, 447, 448, 449, 450, 451, 452, 453, 456, 457, 458, 462
ramin batu (*Aëtoxylon* Airy Shaw; *Gonystylus forbesii* Gilg, *G. velutinus* Airy Shaw) 429, 452, 463
ramin batu air (*Gonystylus maingayi* Hook.f.) 457
ramin bukit (*Amyxa* Tiegh. ex Domke; *Gonystylus affinis* Radlk., *G. areolatus* Domke ex Airy Shaw, *G. lucidulus* Airy Shaw, *G. nobilis* Airy Shaw, *G. pendulus* Airy Shaw, *G. stenosepalus* Airy Shaw, *G. xylocarpus* Airy Shaw) 431, 444, 445, 455, 459, 460, 462, 465
ramin hitam (*Gonystylus maingayi* Hook.f., *G. micranthus* Airy Shaw) 457, 458
ramin paya (*Gonystylus maingayi* Hook.f.) 457
ramin telur (*Gonystylus bancanus* (Miq.) Kurz) 446
ran (*Dipterocarpus elongatus* Korth.) 100
raruk (*Shorea* sect. *Anthoshorea*, *Shorea ochracea* Symington) 202, 295
resak (*Cotylelobium* Pierre; *Dipterocarpus* Gaertn.f.; *Vatica* L., *V. rassak* (Korth.) Blume) 77, 82, 345, 374
resak air (*Vatica umbonata* (Hook.f.) Burck) 379
resak bajau (*Vatica mangachapoi* Blanco) 366
resak banka (*Vatica venulosa* Blume subsp. *venulosa*) 380
resak bantam (*Vatica badiifolia* P.S.Ashton) 352
resak batu (*Cotylelobium lanceolatum* Craib) 80
resak biabas (*Vatica odorata* (Griff.) Symington) 371
resak biawak (*Shorea biawak* P.S.Ashton) 231
resak bukit (*Vatica dulitensis* Symington) 358
resak bulu (*Vatica micrantha* Slooten) 367
resak daun besar (*Vatica sarawakensis* F.Heim) 377

resak daun merah (*Vatica maingayi* Dyer) 364
 resak daun panjang (*Vatica nitens* King, *V. oblongifolia* Hook.f.) 368, 369
 resak daun tebal (*Vatica coriacea* P.S.Ashton) 358
 resak degong (*Vatica havilandii* Brandis) 363
 resak durian (*Cotylelobium burckii* (F.Heim) F.Heim) 78
 resak hijau (*Vatica micrantha* Slooten) 367
 resak hitam (*Cotylelobium melanoxyton* (Hook.f.) Pierre) 82
 resak julong (*Vatica mangachapoi* Blanco) 366
 resak kelabu (*Cotylelobium lanceolatum* Craib) 80
 resak kemudi (*Vatica borneensis* Burck) 353
 resak kerangas (*Dipterocarpus borneensis* Slooten) 93
 resak kerangas padi (*Vatica parvifolia* P.S.Ashton) 372
 resak laut (*Vatica maritima* Slooten) 367
 resak letup (*Vatica venulosa* Blume subsp. *venulosa*) 380
 resak lidi (*Vatica maingayi* Dyer) 364
 resak membangan (*Vatica oblongifolia* Hook.f.) 369
 resak paya (*Vatica mangachapoi* Blanco) 366
 resak putih (*Vatica albiramis* Slooten) 352
 resak ranting bersisik (*Vatica granulata* Slooten) 361
 resak ranting kesat (*Vatica odorata* (Griff.) Symington) 371
 resak ranting putih (*Vatica albiramis* Slooten) 352
 resak tangkai ungu (*Vatica vinosa* P.S.Ashton) 381
 resak tempurung (*Cotylelobium melanoxyton* (Hook.f.) Pierre) 82
 resak tiong (*Vatica dulitensis* Symington) 358
 rinda-rinda (*Symplocos celastrifolia* Griff. ex C.B.Clarke) 395

S

salambuno (*Symplocos polyandra* (Blanco) Brand) 420
 saukau (*Gonystylus keithii* Airy Shaw) 453
 sayongan (*Alstonia macrophylla* Wall. ex G.Don) 20
 selangan (*Hopea* Roxb., *H. andersonii* P.S.Ashton, *H. bracteata* Burck, *H. vacciniifolia* Ridl. ex P.S.Ashton; *Shorea* Roxb. ex Gaertn.f., sect. *Neohopea*, sect. *Shorea*) 135, 145, 146, 178, 202
 selangan batu (*Shorea* Roxb. ex Gaertn.f., sect. *Mutica* subsect. *Mutica*; sect. *Neohopea*; sect. *Shorea* subsect. *Barbata*, subsect. *Shorea*; *S. guiso* (Blanco) Blume) 68, 187, 188, 189, 202, 226, 227, 231, 233, 239, 244, 247, 250, 256, 257, 259, 260, 261, 263, 267, 272, 279, 284, 285, 287, 292, 326, 327, 334
 selangan batu asah (*Shorea asahii* P.S.Ashton) 226
 selangan batu asam (*Shorea maxwelliana* King) 286
 selangan batu bersisik (*Shorea foxworthyi* Symington) 256
 selangan batu biawak (*Shorea biawak* P.S.Ashton) 231
 selangan batu bukit (*Shorea foxworthyi* Symington) 256
 selangan batu bulu ayam (*Shorea isoptera* P.S.Ashton) 269
 selangan batu daun halus (*Shorea superba* Symington) 334
 selangan batu daun nipis (*Shorea falciferoides* Foxw. subsp. *glaucescens* (Meijer) P.S.Ashton) 251
 selangan batu daun tebal (*Shorea crassa* P.S.Ashton) 240
 selangan batu gelombang (*Shorea isoptera* P.S.Ashton) 269
 selangan batu hitam (*Shorea atrinervosa* Symington) 227
 selangan batu jantan (*Hopea semicuneata* Symington) 175

selangan batu kelabu (<i>Shorea hypoleuca</i> Meijer)	264
selangan batu kilat (<i>Shorea ladiana</i> P.S.Ashton)	272
selangan batu kumus (<i>Shorea laevis</i> Ridl.)	274
selangan batu kurap (<i>Shorea scrobiculata</i> Burck)	324
selangan batu laut (<i>Shorea falciferoides</i> Foxw. subsp. <i>glaucescens</i> (Meijer) P.S.Ashton)	251
selangan batu lubang hidung (<i>Shorea domatiosa</i> P.S.Ashton)	245
selangan batu mata-mata (<i>Shorea domatiosa</i> P.S.Ashton)	245
selangan batu merah (<i>Shorea guiso</i> (Blanco) Blume)	260
selangan batu padi (<i>Shorea obscura</i> Meijer)	293
selangan batu pasir (<i>Shorea materialis</i> Ridl.)	285
selangan batu pinang (<i>Shorea havilandii</i> Brandis)	261
selangan batu tanduk (<i>Shorea obscura</i> Meijer)	293
selangan batu tembaga (<i>Shorea exelliptica</i> Meijer)	247
selangan batu terendak (<i>Shorea seminis</i> (de Vriese) Slooten)	328
selangan batu tinteng (<i>Shorea brunnescens</i> P.S.Ashton)	233
selangan batu tulang ikan (<i>Shorea superba</i> Symington)	334
selangan batu zang (<i>Shorea scrobiculata</i> Burck)	327
selangan bukit (<i>Hopea montana</i> Symington)	163
selangan daun bulat (<i>Hopea wyatt-smithii</i> Wood ex P.S.Ashton)	180
selangan daun halus (<i>Hopea dyeri</i> F.Heim)	154
selangan daun kapur (<i>Hopea dryobalanoides</i> Miq.)	152
selangan daun serong (<i>Hopea tenuinervula</i> P.S.Ashton)	177
selangan jangkang (<i>Hopea nervosa</i> King, <i>H. rudiformis</i> P.S.Ashton)	164, 172
selangan lima urat (<i>Hopea pentanervia</i> Symington ex Wood)	169
selangan lunas (<i>Hopea micrantha</i> Hook.f.)	162
selangan mata kucing (<i>Hopea ferruginea</i> Parijs)	156
selangan merah (<i>Shorea kunstleri</i> King)	271
selangan merah bukit (<i>Shorea flaviflora</i> Wood ex P.S.Ashton)	254
selangan penak (<i>Hopea beccariana</i> Burck)	146
selangan sama (<i>Hopea aequalis</i> P.S.Ashton)	143
selangan urat (<i>Hopea cernua</i> Teijsm. & Binn.)	150
semayur (<i>Shorea inaequilateralis</i> Symington)	265
seraya (<i>Shorea</i> Roxb. ex Gaertn.f., sect. <i>Brachypterae</i> , sect. <i>Mutica</i> , sect. <i>Ovalis</i> , sect. <i>Pachycarpae</i> , sect. <i>Rubella</i> ; <i>S. curtisii</i> Dyer ex Brandis subsp. <i>curtisii</i>)	187, 203, 240
seraya bingkai (<i>Shorea rubra</i> P.S.Ashton)	320
seraya buaya hantu (<i>Shorea rugosa</i> F.Heim)	318
seraya bukit (<i>Shorea platyclados</i> Slooten ex Foxw.)	310
seraya bunga (<i>Shorea teysmanniana</i> Dyer ex Brandis)	337
seraya burung (<i>Shorea monticola</i> P.S.Ashton)	288
seraya daun besar (<i>Shorea flaviflora</i> Wood ex P.S.Ashton)	254
seraya daun kasar (<i>Shorea fallax</i> Meijer)	252
seraya daun merah (<i>Shorea andulensis</i> P.S.Ashton)	223
seraya daun perak (<i>Shorea argentifolia</i> Symington)	226
seraya daun tajam (<i>Shorea revoluta</i> P.S.Ashton)	316
seraya daun tumpul (<i>Shorea retusa</i> Meijer)	315
seraya kelabu (<i>Shorea waltonii</i> Wood ex Meijer)	340
seraya kepong (<i>Shorea ovalis</i> (Korth.) Blume)	297
seraya kepong kasar (<i>Shorea slootenii</i> Wood ex P.S.Ashton)	329
seraya kerangas (<i>Shorea venulosa</i> Wood ex Meijer)	338

seraya kerukup (*Shorea almon* Foxw.) 219
 seraya kuning (*Shorea* sect. *Richetioides*; *S. faguetooides* P.S.Ashton, *S. kudatensis* Wood ex Meijer) 203, 249, 270
 seraya kuning baru (*Shorea xanthophylla* Symington) 342
 seraya kuning bukit (*Shorea angustifolia* P.S.Ashton) 224
 seraya kuning gajah (*Shorea gibbosa* Brandis) 258
 seraya kuning jantan (*Shorea hopeifolia* (F.Heim) Symington) 263
 seraya kuning keladi (*Shorea laxa* Slooten, *S. peltata* Symington) 276, 306
 seraya kuning Quoin (*Shorea polyandra* P.S.Ashton) 311
 seraya kuning runcing (*Shorea acuminatissima* Symington) 214
 seraya kuning siput (*Shorea fagueticana* F.Heim) 248
 seraya langgai (*Shorea beccariana* Burck) 231
 seraya lop (*Shorea scabrida* Symington) 326
 seraya lupa (*Shorea parvistipulata* F.Heim) 303
 seraya majau (*Shorea johorensis* Foxw.) 270
 seraya melantai (*Shorea macroptera* Dyer) 283
 seraya melantai kecil (*Shorea ferruginea* Dyer ex Brandis) 253
 seraya mempelas (*Shorea scaberrima* Burck) 325
 seraya punai (*Shorea parvifolia* Dyer) 302
 seraya punai bukit (*Shorea ovata* Dyer ex Brandis) 298
 seraya sirap (*Shorea kunstleri* King) 271
 seraya sudu (*Shorea quadrinervis* Slooten) 314
 seraya tangkai panjang (*Shorea coriacea* Burck) 239
 seraya tembaga (*Shorea leprosula* Miq.) 277
 seraya timbau (*Shorea smithiana* Symington) 331
 seraya urat banyak (*Shorea myrionerva* Symington ex P.S.Ashton) 291
 sesuan (*Dryobalanops lanceolata* Burck) 132
 smuak (*Symplocos rubiginosa* Wall. ex A.DC.) 422
 sugoi (*Dipterocarpus Gaertn.f.*) 82

T

tangala (*Aquilaria* Lam.) 434
 tara manang (*Tabernaemontana macrocarpa* Jack) 55
 tekam (*Shorea* sect. *Neohopea* and sect. *Shorea*) 203
 tempehes (*Dipterocarpus tempehes* Slooten) 121
 tengkawang (*Shorea* sect. *Pachycarpae*) 312
 tombalik (*Alstonia iwahigensis* Elmer) 18
 tomboilik (*Alstonia iwahigensis* Elmer) 18
 tukil-tukil (*Symplocos celastriifolia* Griff. ex C.B.Clarke) 395

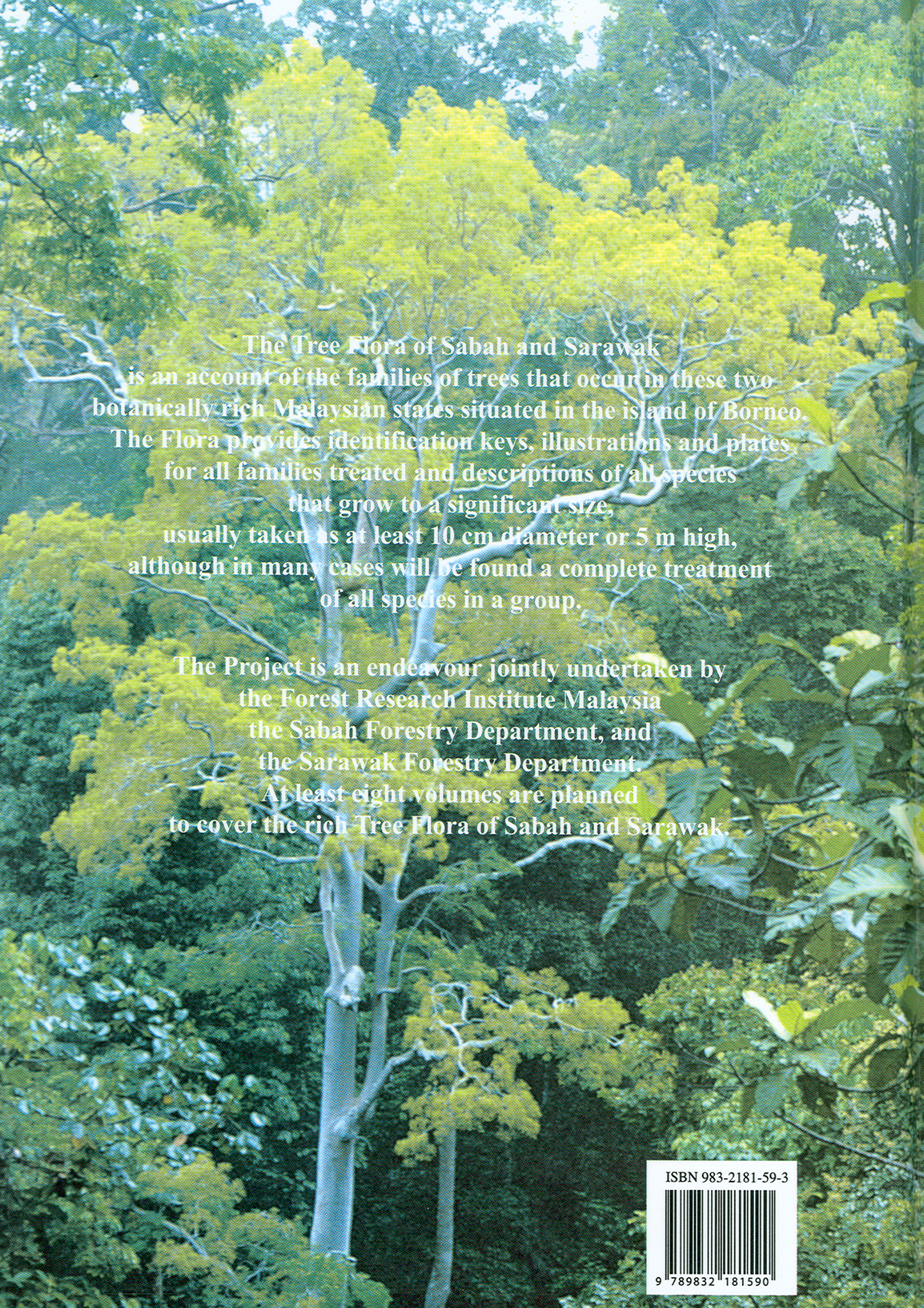
U

upun (*Upuna* Symington; *U. borneensis* Symington) 342, 343
 upun batu (*Upuna borneensis* Symington) 343
 upun penyau (*Shorea geniculata* Symington ex P.S.Ashton) 257
 urat mata (*Parashorea* Kurz; *P. malaanonan* (Blanco) Merr.) 180, 183
 urat mata batu (*Parashorea smythiesii* Wyatt Smith ex P.S.Ashton) 185
 urat mata beludu (*Parashorea tomentella* (Symington) Meijer) 185
 urat mata bukit (*Parashorea parvifolia* Wyatt Smith ex P.S.Ashton) 184
 urat mata daun kecil (*Parashorea parvifolia* Wyatt Smith ex P.S.Ashton) 184
 urat mata daun licin (*Parashorea malaanonan* (Blanco) Merr.) 183

urat mata daun putih (*Parashorea smythiesii* Wyatt Smith ex P.S.Ashton) 185

Y

yum (*Symplocos henschelii* (Moritzi) Benth. ex C.B.Clarke) 408



The Tree Flora of Sabah and Sarawak
is an account of the families of trees that occur in these two
botanically rich Malaysian states situated in the island of Borneo.
The Flora provides identification keys, illustrations and plates
for all families treated and descriptions of all species
that grow to a significant size,
usually taken as at least 10 cm diameter or 5 m high,
although in many cases will be found a complete treatment
of all species in a group.

The Project is an endeavour jointly undertaken by
the Forest Research Institute Malaysia
the Sabah Forestry Department, and
the Sarawak Forestry Department.
At least eight volumes are planned
to cover the rich Tree Flora of Sabah and Sarawak.

ISBN 983-2181-59-3



9 789832 181590



TREE FLORA of SABAH AND SARAWAK

Volume Six

edited by
E. Soepadmo, L.G. Saw, R.C.K. Chung
and Ruth Kiew

TREE FLORA
of
SABAH AND SARAWAK

Produced with the financial support of

**MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION
GOVERNMENT OF MALAYSIA**

Tree Flora of Sabah and Sarawak Editorial Committee — Chairman: *E. Soepadmo* (Forest Research Institute Malaysia). Members: *A. Latiff* (Universiti Kebangsaan Malaysia), *Ruth Kiew* (Forest Research Institute Malaysia), *L.G. Saw* (Forest Research Institute Malaysia), *R.C.K. Chung* (Forest Research Institute Malaysia). Editorial assistant: *S. Julia* (Forest Research Centre, Kuching). ***Advisors:*** *P.S. Ashton* (Harvard University, U.S.A.), *J. Dransfield* (Royal Botanic Gardens, Kew, U.K.), *W.J.J.O. de Wilde* (National Herbarium of the Netherlands, Leiden Branch, the Netherlands).

TREE FLORA of SABAH AND SARAWAK

Volume Six

edited by

E. Soepadmo, L.G. Saw, R.C.K. Chung
and Ruth Kiew

A joint publication of



Sabah Forestry
Department, Malaysia



Forest Research
Institute Malaysia



Sarawak Forestry
Department, Malaysia

2007

**Electronic version prepared by
L.G. Saw & B. Aslina (2008)**

Copyright © Forest Research Institute Malaysia (FRIM)
Sabah Forestry Department, Malaysia
Sarawak Forestry Department, Malaysia

Correspondence:

Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor, Malaysia

First published March 2007

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Tree Flora of Sabah and Sarawak / edited by E. Soepadmo, L.G. Saw,
R.C.K. Chung and Ruth Kiew
ISBN 983-9592- - (v. 6)

1. Botany–Sabah. 2. Botany–Sarawak. 3. Botany–Classification.
4. Plant–Identification. I. Soepadmo, E., II. Saw, L.G., III. Chung, R.C.K.,
IV Kiew, Ruth
581.095952

Front cover: Lowland and hill forests on ultramafic soil, Bt. Tawai FR, Sabah. (Photograph by E. Soepadmo.)

Back cover: *Koompassia excelsa* (Becc.) Taub. with new growth. (Photograph by E. Soepadmo.)

CONTENTS

	<i>Page</i>
Foreword	vii
Acknowledgements	ix
FAMILIES:	
1. Cunoniaceae (<i>R.C.K. Chung</i>)	1
2. Hernandiaceae (<i>L.G. Saw</i>)	11
3. Meliaceae (<i>David J. Mabberley et al.</i>)	17
<i>Aglaia</i> (<i>Caroline M. Pannell</i>)	24
<i>Toona</i> (<i>Jennifer M. Edmonds</i>)	198
4. Polygalaceae (<i>W.J.J.O. de Wilde & Brigitta E.E. Duyffjes</i>)	221
Abbreviations of Frequently Cited References	297
Commonly Used Abbreviations for Localities	301
Plates	303
Index to Scientific Names	313
Index to Vernacular Names	331

FOREWORD

Once again we are delighted to write a few words welcoming the publication of Volume 6 of the Tree Flora of Sabah and Sarawak. We are also pleased that the project continues to be on track by the publication of this volume just about two years after Volume 5. This volume treats four families, namely the Cunoniaceae (R.C.K. Chung), Hernandiaceae (L.G. Saw), Meliaceae (David J. Mabberley, Caroline M. Pannell, Anne M. Sing, and Jennifer M. Edmonds), and Polygalaceae (W.J.J.O. de Wilde and Brigitta E.E. Duyfjes), comprising 180 tree species in 18 genera native to Sabah and Sarawak. Of the 180 species, 72 are endemic in Sabah and Sarawak (or Borneo), 22 taxa (species, subspecies and varieties) are new to science (published elsewhere), 98 species reach timber size (with a dbh of 30 cm or larger), and 10 species produce edible fruits (e.g. species of *Aglaia*, *Lansium* and *Sandoricum*). Ecologically, members of the Meliaceae and Polygalaceae are important constituents of the under storey and main canopy layers of tropical rain forest in Borneo, and play an important role in providing natural habitats and a food source for many species of wildlife. In addition, the timber of many species described in this volume is locally important for house construction, boat-building and handicraft work. The publication of Volume 6 of the Tree Flora of Sabah and Sarawak marks a further milestone for us towards achieving the overall objectives of documenting the tree species richness of Sabah and Sarawak.

For a long-term project, such as the Tree Flora of Sabah and Sarawak, it is difficult to sustain the momentum and progress without adequate funding and full commitment and dedication by all involved in the project. In this context, we would like to acknowledge the full support and financial assistance provided by the Ministry of Science, Technology and Innovation (MOSTI) of Malaysia.

We are also very much obliged to the Curators, Keepers and Directors of the: Herbarium of the Arnold Arboretum, Harvard University, U.S.A.; Herbarium Bogoriense, Bogor, Indonesia; Herbarium of the Royal Botanic Gardens, Edinburgh, U.K.; Herbarium of the Royal Botanic Gardens, Kew, U.K.; National Herbarium of the Netherlands, University of Leiden Branch, Netherlands; Herbarium of the Missouri Botanic Gardens, U.S.A.; Herbarium of the New York Botanic Gardens, U.S.A.; Daubeny Herbarium of the University of Oxford, U.K.; Herbarium of the Singapore Botanic Gardens, Singapore; Herbarium of the Botany Department, Smithsonian Institution,

Washington D.C., U.S.A.; and Herbarium of the Sabah Parks, Sabah, Malaysia. Their collaboration and continual support has been instrumental to the success of the project.

Finally, we would like to congratulate and record our sincere appreciation to the botanists, members of the editorial committee, botanical artists and supporting staff of the three leading Malaysian forestry institutions directly involved in the project for their dedication and hard work in producing Volume 6 of the Tree Flora of Sabah and Sarawak.

Dato' Dr. Hj. Abdul Razak Mohd. Ali

*Director-General
Forest Research Institute Malaysia*

Datuk Sam Mannan

*Director
Sabah Forestry Department
Malaysia*

Datu Cheong Ek Choon

*Director
Sarawak Forestry Department
Malaysia*

October 2006

ACKNOWLEDGEMENTS

In preparing and publishing Volume 6 of the Tree Flora of Sabah and Sarawak, we have received tremendous support and encouragement from various local and international institutions as well as from fellow botanists.

In particular, we are extremely grateful to the Ministry of Science, Technology and Innovation (MOSTI) of Malaysia for providing an adequate research grant and to Dato' Dr. Hj. Abdul Razak Mohd. Ali, the Director-General of the Forest Research Institute of Malaysia (FRIM), Datuk Sam Mannan, the Director of Sabah Forestry Department and Datu Cheong Ek Choon, the Director of Sarawak Forestry Department for their continual guidance and leadership. We are also greatly indebted to the Directors/Keepers/Curators of the following herbaria: A, BO, E, K, KEP, L, NY, SAN, SAR, SING, SNP and US for the loans of specimens and for providing access to their libraries as well as their specimen and reference databases to botanists involved in the Tree Flora of Sabah and Sarawak Project. We would also like to acknowledge our deepest appreciation to the many fellow botanists and other professionals who in various ways have contributed towards the progress and achievements of the project: Prof. P.S. Ashton (Harvard University, U.S.A.); Dr. John Dransfield and Dr. Rogier de Kok (Herbarium of the Royal Botanic Gardens, Kew, U.K.); Dr. Caroline M. Pannell (Daubeny Herbarium, University of Oxford, U.K.); Prof. Pieter Baas, Dr. J.F. Veldkamp, Dr. W.J.J.O. de Wilde, Dr. Brigitta E.E. Duyfjes, Dr. P.H. Hovenkamp, Mr. C.W.J. Lut and Mrs. Ludmila Frankova (National Herbarium of the Netherlands, University of Leiden Branch, Netherlands); Prof. David J. Mabberley (University of Washington Botanic Gardens, U.S.A.); Dr. Chin See Chung, Ms. Serena Lee, and Mr. Hassan Ibrahim (Herbarium of the Singapore Botanic Gardens, Singapore); and Mr. Peter Wilkie (Herbarium of the Royal Botanic Gardens, Edinburgh, U.K.).

For their support and collaboration, we would like to express our sincere thanks to: Dato' Dr. Hj. Wan Razali Wan Mohd, Dato' Dr. Abd. Latif Mohmod, Dr. Che Abdul Rahim Nik, Dr. Chan Hung Tuck, Mr. Mohd. Zamshari Abd. Rahman, and Mr. Nor Azman Hussein (FRIM); Dr. Lee Ying Fah, Mr. John B. Sugau, and Mrs. J.T. Pereira (Forest Research Centre, Sabah Forestry Department); Ms. Lucy Chong (Sarawak Forestry Corporation); Prof. Dato' Abdul Latiff Mohamad (Universiti Kebangsaan Malaysia); Dr. Paul P.K. Chai (ITTO Project, Sarawak Forestry Department); and Dr. Jamili Nais and Mrs. Rimi Repin (Sabah Parks, Sabah, Malaysia).

Finally, we are also deeply indebted to Mr. Joseph Pao (Sarawak Forestry Corporation), Ms. Rosemary Wise (Department of Plant Sciences, University of Oxford, U.K.) and Mr. Ubaldus Majawal (Forest Research Centre, Sabah Forestry Department, Sabah, Malaysia) who illustrated the line-drawings and to Mrs. Zainun Othman for meticulously typing the manuscripts; and to Ms. Julia Sang, Mrs. Suzana Sabran, Ms. Fazilah Ahmad and Mrs. Shahani Saad for their editorial and administrative assistance.

E. Soepadmo
L.G. Saw
R.C.K. Chung
Ruth Kiew

October 2006

CUNONIACEAE

R. C. K. Chung

Forest Research Institute Malaysia,
Kepong, Malaysia

R. Br. *in* Flinders, Voy. Terra Austral. 2 (1814) 548; Miquel, Fl. Ned. Ind. 1, 1 (1856) 717; Merrill, EB (1921) 287; Masamune, EPB (1942) 324; Hutchinson, Fam. Fl. Pl. 2nd. edition 1 (1959) 158, Gen. Fl. Pl. 2 (1967) 4; Backer & Bakhuizen *f.*, FJ 1 (1964) 506; Keng, OFMSP rev. edition (1978) 56; Whitmore, TFM 1 (1972) 179; Cockburn, TS 2 (1980) 26; Corner, WSTM 3rd. edition 1 (1988) 224; Whitmore, Tantra & Sutisna, CLK 1 (1990) 52; Turner, Gard. Bull. Sing. 47 (1995) 182; Coode *et al.* (eds.), CLBD (1996) 64; Beaman *et al.*, PMK 4 (2001) 213; Bradford & Barnes, Syst. Bot. 26, 2 (2001) 354; Hopkins & Hoogland, FM 1, 16 (2002) 53; Bradford *et al. in* Kubitzki (ed.), Fam. Gen. Vasc. Pl. 6 (2004) 91.

Trees or shrubs. **Twigs** almost flat or angular when young, becoming terete with lenticels and longitudinal fissures when older. **Indumentum** of simple hairs. **Stipules** *interpetiolar*, one pair per node between petiole bases, triangular to ovate or almost orbicular, sometimes bifurcate to deeply divided at apex. **Leaves** *opposite and decussate, imparipinnate, trifoliolate* or *unifoliolate*, usually petiolate. **Leaflets** *pinnately veined, margin crenate to serrate or entire*. **Inflorescences** axillary or terminal, paniculate, thrysoid or racemose with a straight peduncle, or capitate. **Flowers** radially symmetrical, occasionally protandrous, bisexual or unisexual (plants dioecious or polygamo-dioecious); sepals 3–6(–9), usually 4 or 5, imbricate, free or basally connate; petals as many as sepals, alternate with them; stamens usually twice as many as sepals, alternipetalous ones often slightly longer than alternisepalous stamens, *filaments usually slender and longer than petals*, anthers dorsifixed, versatile, opening longitudinally; disc free, annular or composed of segments, rarely adnate to the ovary, or absent; ovary superior, (2–)3–5(–14)-carpellate, syncarpous, each carpel with its own free style, styles often diverging and ending in a small inconspicuous stigma, or rarely with decurrent stigmas, ovules (1–)2–many in each locule, often in two rows, placentation axile to pendulous. **Fruits** dehiscent, *capsular*, usually small. **Seeds** small, glabrous or hairy; endosperm starchy.

Distribution. About 27 genera, with *c.* 300 species. Mostly native to the southern hemisphere (especially in Australia, New Guinea, and New Caledonia), but extending into the tropics in C America, W Indies, S Pacific, and throughout Malesia (absent in N America, Europe, mainland Asia north of Peninsular Malaysia and continental Africa except South Africa). About 40 species in 10 genera in Malesia, only three species in one genus (*Weinmannia*) in Sabah and Sarawak.

Ecology. In Sabah and Sarawak, species of Cunoniaceae are found in mixed dipterocarp forest to upper montane forest between (500–)1000 and 2600 m. In Sabah, *Weinmannia fraxinea* can be found in habitats on poor sandy soils at altitude as low as 500 m. In Sulawesi, flowers of *W. furfuracea* H.C.Hopkins are visited by bees, while in Borneo (Mt. Kinabalu) beetles and flies were observed visiting flowers of *W. fraxinea*.

Uses. The timber of *Weinmannia* species (mostly *W. fraxinea*) is used for construction purposes or for utility furniture and house interiors but on a local scale only. In Ambon (Maluku), the bark of *W. fraxinea* is dried and stored in bundles and used to colour sago-porridge during cooking or to improve the flavour of old sago (Heyne, Nuttige Pl. Indonesia 3rd. edition (1950)).

Taxonomy. Bentham & Hooker (Gen. Pl. 1 (1865) 653), King (J. As. Soc. Beng. 66, 1 (1897) 297) and Ridley (FMP 1 (1922) 681) included Cunoniaceae (*Weinmannia*) in Saxifragaceae but most subsequent authors (e.g., Backer & Bakhuizen *f. op. cit.*, Keng *op. cit.*, Whitmore *op. cit.*, Turner *op. cit.*, Beaman *et al. op. cit.*, and Hopkins & Hoogland *op. cit.*) accepted this family as distinct. The recent classification of the angiosperms based on molecular sequence data places Cunoniaceae in the order Oxalidales (Eurosids I), together with Brunelliaceae, Cephalotaceae, Connaraceae, Elaeocarpaceae (including Tremandraceae) and Oxalidaceae (APG, Ann. Missouri Bot. Gard. 85 (1998) 531, Bot. J. Linn. Soc. 141 (2003) 399; APG website, 20 September 2006).

Bradford & Barnes (Syst. Bot. (2001) 354), based on their phylogenetic analyses of Cunoniaceae, recognised six tribes (*Caldcluviae*, *Codieae*, *Cunonieae*, *Geissoieae*, *Schizomerieae* and *Spiraeanthemeae*). This new tribal classification shows that *Weinmannia* together with *Cunonia*, *Pancheria* and *Vesselowskyia* (all in tribe *Cunonieae*) are parts of a derived clade, characterised by the racemose/capitate inflorescence, capsular fruit with a single vertical column bearing the seeds and the tricolporate pollen.

WEINMANNIA L., *nom. cons.*

(Johann Wilhelm Weinmann, 1683–1741; German pharmacist and botanist)

tekarau (Kelabit)

Syst. Nat. 10th. edition 2 (1759) 997, 1005, 1367; Bentham & Hooker *f.*, Gen. Pl. 1 (1865) 653; King, J. As. Soc. Beng. 66, 1 (1897) 298 (under Saxifragaceae); Ridley, FMP 1 (1922) 682 (under Saxifragaceae); Masamune, EPB (1942) 324; Bernardi, Candollea 17 (1961) 123, Candollea 18 (1963) 285, Adansonia 2, 3 (1963) 404, Bot. Jahrb. Syst. 83 (1964) 126; Backer & Bakhuizen *f.*, FJ 1 (1964) 506; Hutchinson, Gen. Fl. Pl. 2 (1967) 9; Whitmore, TFM 1 (1972) 179; Anderson, CLTS (1980) 165; Cockburn, TS 2 (1980) 26; Corner, WSTM 3rd. edition 1 (1988) 224; Whitmore, Tantra & Sutisna, CLK 1 (1990) 52; Turner, Gard. Bull. Sing. 47 (1995) 182; Corner *in* Wong & Phillipps (eds.), Kinabalu Summit Borneo (1996) 129; Coode *et al.* (eds.), CLBD (1996) 64; Bradford, Ann. Missouri Bot. Gard. 85 (1998) 565; PROSEA 5, 3 (1998) 580; Hopkins, Adansonia 3, 20 (1998) 18; Beaman *et al.*, PMK 4 (2001) 213; Hopkins & Hoogland, FM 1, 16 (2002) 141; Bradford *et al. in* Kubitzki (ed.), Fam. Gen. Vasc. Pl. 6 (2004) 108. **Synonym:** *Pterophylla* D. Don, Edinburgh New Philos. J. 9 (1830) 93.

Trees or shrubs. Branching not dichotomous. **Twigs** sometimes slightly thickened or flattened at nodes, often with prominent pale lenticels. **Stipules** elliptic, ovate, orbicular to subreniform, often caducous and leaving a prominent annular scar at the node; in young shoots, a pair of opposite stipules often salverform and amplexicaul. Terminal and lateral vegetative buds enclosed by a pair of bud scales (stipules). **Leaves** with 1–13 pairs of sessile or subsessile, opposite lateral leaflets or rarely unifoliate; petiole and rachis sometimes winged; leaflets chartaceous to coriaceous, glabrous or sparsely to densely pubescent, lateral ones often with an unequal base, frequently smaller than the terminal leaflets; domatia absent; blades with or without multicellular trichome bases, *margin toothed or crenulate*. **Inflorescences** composed of *racemes arranged in groups of two*

(*diads*) or four (*tetrads*) born on a sterile axis (= *peduncle*), which is either axillary and often inserted in series at distal node(s), or terminal, or a combination of these; individual racemes with up to 100 or more flowers. **Flowers** unisexual or bisexual, pedicellate, 4-merous; *buds inserted singly or in small fascicles*, each bud or fascicle subtended by a carinate, often caducous bract; calyx lobes 4, aestivation imbricate; petals 4, usually elliptic, ovate or obovate, base constricted, apex rounded or irregularly emarginate, membranous, often ciliolate; stamens twice as many as calyx lobes, filaments filiform, anthers broadly cordate, deeply incised at base and apiculate at apex; disc divided into 8 free lobes alternating with the filaments, each lobe oblong to obcuneate, sometimes broadly oblong with flanges on either side, usually glabrous; gynoecium 2-carpellate, with the carpels fused at the level of ovary; ovary ovoid, 2-locular, styles 2, free, subulate, glabrous, furrowed on adaxial side, stigmas terminal, small or sometimes capitate and papillose, ovules 8–16 per locule. **Fruits** *septifragal capsules* dehiscing from the apex; free central column often present; valves coriaceous, boat-shaped, with a dark exocarp and smooth, yellow endocarp with extended margins; styles usually persistent; calyx lobes persistent or not. **Seeds** elliptic in outline and circular in transverse section, minutely sculptured, *usually with a tuft of hairs at each end* or sometimes hairy all over (outside Borneo).

Distribution. About 150–160 species in Latin America, W Indies, S Pacific and throughout Malasia. Seventeen species in Malasia; three species in Sabah and Sarawak, of which one species, *Weinmannia clemensiae*, is endemic in Borneo.

Ecology. In mixed peat swamp, *kerangas*, mixed dipterocarp to upper montane forests at about (0–)500–2600 m altitude.

Uses. The wood is reported to be suitable for house-building (poles and beams), utility furniture and interior construction. The bark contains high levels of tannin and it was used medicinally in Java (Burkill, EPMP 2 (1966) 2295; PROSEA *op. cit.*).

Taxonomy. Bernardi (*op. cit.* 1961, *op. cit.* 1963, *op. cit.* 1964) divided *Weinmannia* into six sections, *viz.* sect. *Fasciculatae* Bernardi, sect. *Inspersae* Bernardi, sect. *racemosa* Bernardi, sect. *Simplicifoliae* Bernardi, sect. *Spicatae* Bernardi, and sect. *Weinmannia*. However, Bradford (*op. cit.*) and Bradford *et al.* (*op. cit.*), using a cladistic analysis based on morphology and inflorescence architecture, concluded that the genus is best segregated into five sections, *viz.* sect. *Fasciculatae* Bernardi *ex* Hoogland & H.C.Hopkins, sect. *Inspersae* Bernardi *ex* J.C.Bradford, sect. *Leiospermum* (D.Don) Engl., sect. *Spicatae* Bernardi *ex* J.C.Bradford, and sect. *Weinmannia* (incl. sect. *Simplicifoliae* Bernardi). In Sabah and Sarawak, all three species belong to sect. *Fasciculatae*.

Key to *Weinmannia* species

1. Lateral leaflets elliptic or almost oblong, largest ones 1.4–2.7 × 0.5–1 cm, bullate, margins strongly recurved; young shoots tomentose-velutinous.....**2. W. clemensiae**
Lateral leaflets lanceolate, narrowly elliptic, narrowly obovate to ovate, largest ones (2.2–)4.2–8.5(–12) × (0.8–)1.2–3.5(–4.5) cm, margins flat or slightly recurved; young shoots almost glabrous, puberulent or tomentose.....2
2. Leaves with (0–)1–4(–5) pairs of lateral leaflets; rachis semiterete, sometimes narrowly winged; lateral leaflets coriaceous, narrowly elliptic to narrowly obovate, base cuneate,

apex acute to obtuse, drying chesnut-brown. Inflorescence of 1–2 pairs of opposite dyads.....**1. W. aphanoneura**
 Leaves with 1–8 pairs of lateral leaflets; rachis terete, not winged; lateral leaflets chartaceous to subcoriaceous, lanceolate to ovate, or narrowly elliptic, base usually unequal and varying from cuneate to rounded, apex narrowly acute to acuminate, usually drying greenish brown. Inflorescence of 1–3 pairs of opposite dyads or tetrads.
**3. W. fraxinea**

1. Weinmannia aphanoneura Airy Shaw

Fig. 1

(Greek, *aphanes* = inconspicuous, *neuron* = nerve; leaflets with inconspicuous lateral and intercostal veins)

Bull. Misc. Inform., Kew (1940) 260; Bernardi *op. cit.* (1964) 160; Anderson *op. cit.* 165; Whitmore, Tantra & Sutisna *op. cit.* 52; Hopkins *op. cit.* 35; Beaman *et al. op. cit.* 213; Hopkins & Hoogland *op. cit.* 145. **Type:** Richards 1716, Borneo, Sarawak, Miri Division, Marudi District, Dulit Ridge (holotype K [photo at KEP])

Tree or shrub, 2–20 m tall, to 35 cm diameter. **Bark** dark brown, scaly; inner bark brownish. **Sapwood** pale yellow. **Twigs** adpressed puberulent or glabrescent when young, becoming glabrous with numerous lenticels and prominent leaf scars when older. **Stipules** often persistent at distal nodes, suborbicular, usually flat, to 1.7 × 1.9 cm (rarely spatulate, *c.* 0.6 × 0.4 cm), abaxial surface glabrous or strigose towards the base, adaxial surface glabrous. **Leaves** with (0–)1–4(–5) pairs of lateral leaflets, to 16 cm long; petiole and rachis semiterete, flat, slightly ridged or channelled above, sometimes narrowly winged, wings extending to 1 mm on either side of midline, glabrous or tomentose; petioles 0.7–2.8 cm long; rachis segments between pairs of leaflets 0.5–1.9 cm long; leaflets coriaceous, not bullate, margin flat or slightly recurved, crenate, with 6–11 notches on each side of the largest lateral leaflets, glabrous except for some hairs on midrib below, sometimes shiny above, drying chestnut below, grey or dark chestnut above; lateral leaflets almost sessile, drying chesnut-brown, narrowly elliptic or narrowly obovate, largest 2.4–7 × 0.6–1.9 cm, base cuneate, unequal, apex acute to obtuse; terminal leaflets narrowly elliptic to obovate, 3–9.4 × 0.7–2.7 cm, base narrowly cuneate to attenuate, apex acute to obtuse; midrib prominent below, slightly sunken above; lateral and intercostal veins flat on both surfaces; petiolules of 0.3–1.2 cm long. **Inflorescences** usually of 1 or 2 pairs of opposite dyads; peduncles 0.3–1.9 cm long, glabrous or adpressed puberulent; individual racemes 7–8(–14) cm long, axes puberulent, rarely tomentose. **Flowers** unisexual; pedicels 1.8–3.6 mm long, puberulous; calyx lobes 0.5–0.8 × 0.4–0.9 mm, glabrous; petals oblong or irregularly obovate, 1.2–1.5 × 0.7–0.8 mm, apex rounded or emarginate; disc lobes 0.3–0.5 mm long, oblong and discrete or with thin flanges forming an almost continuous disc. **Male flowers:** filaments 2.1–2.6 mm long, pistillodes 0.5–0.7 mm long, pubescent, styles 0.1–0.2 mm long, incurved. **Female flowers:** staminodes to 1.7 mm long; ovary *c.* 1 mm long, densely pubescent, styles *c.* 1.8 mm long, straight. **Fruit** valves 2.5–3.5 × 1.3–1.5 mm at dehiscence; exocarp pubescent; calyx lobes persistent. **Seeds** *c.* 0.9 mm long, with a tuft of hairs at both ends.

Distribution. Sumatra (one record; Nagamasu 3641, *n.v.*) and Borneo (Sabah, Sarawak and Kalimantan). In Sabah, rare and known only from Mt. Kinabalu (e.g., Clemens 29476 and SAN 76507). In Sarawak, common and recorded from Bintulu (e.g., S 8785), Marudi (e.g., Chew CWL 380, CWL 388 and S 4507) and Limbang districts (e.g., Burt & Martin B 5487, S 26481 and S 26531). Also occurs in Kalimantan (e.g., Endert 4125).

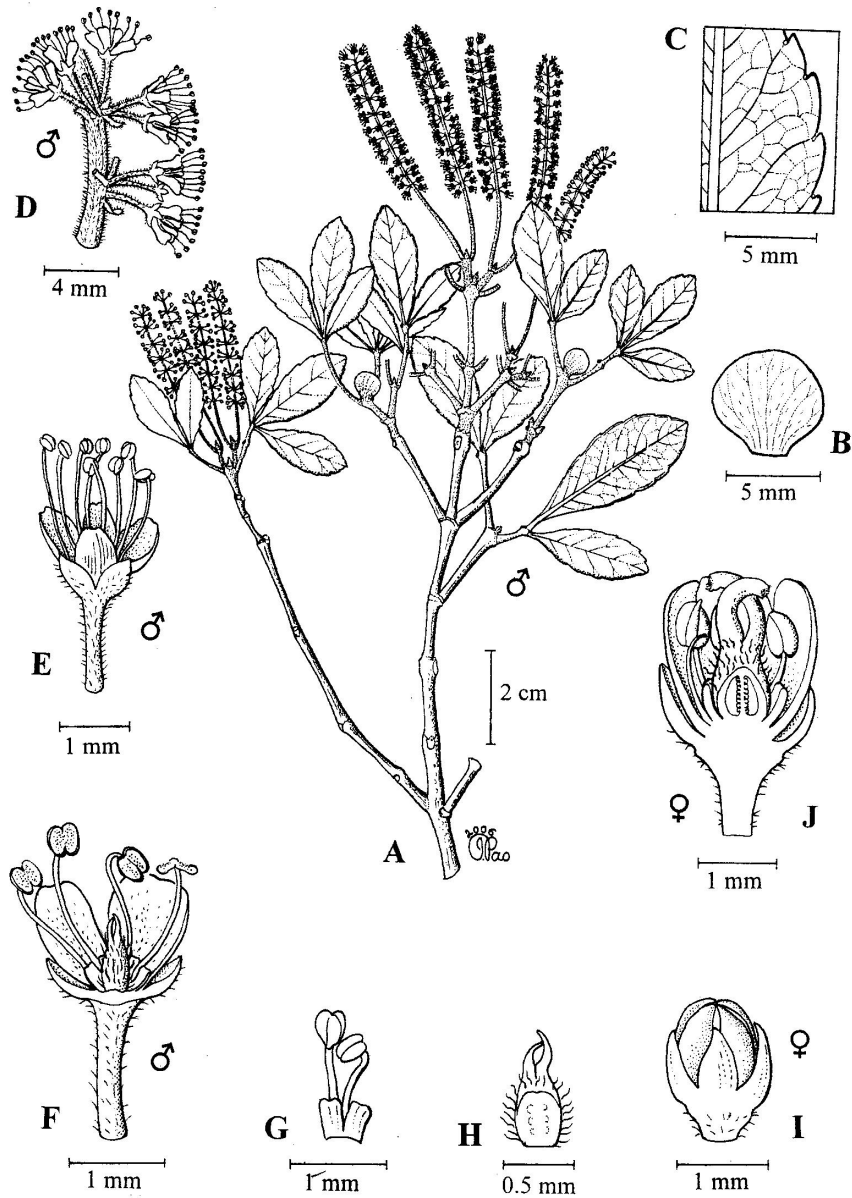


Fig. 1. *Weinmannia aphanoneura*. A, flowering (male) leafy twigs; B, stipule; C, detail venation on lower leaf surface; D, section of rachis of raceme showing male flowers inserted in fascicles; E, open male flower; F, open male flower with two sepals and two petals removed; G, two disk lobes and two stamens; H, longitudinal section of pistillode in staminate flower; I, female flower bud; J, longitudinal section of female flower. (A–H from S 8785, I–J from Burt & Martin B 5487.)

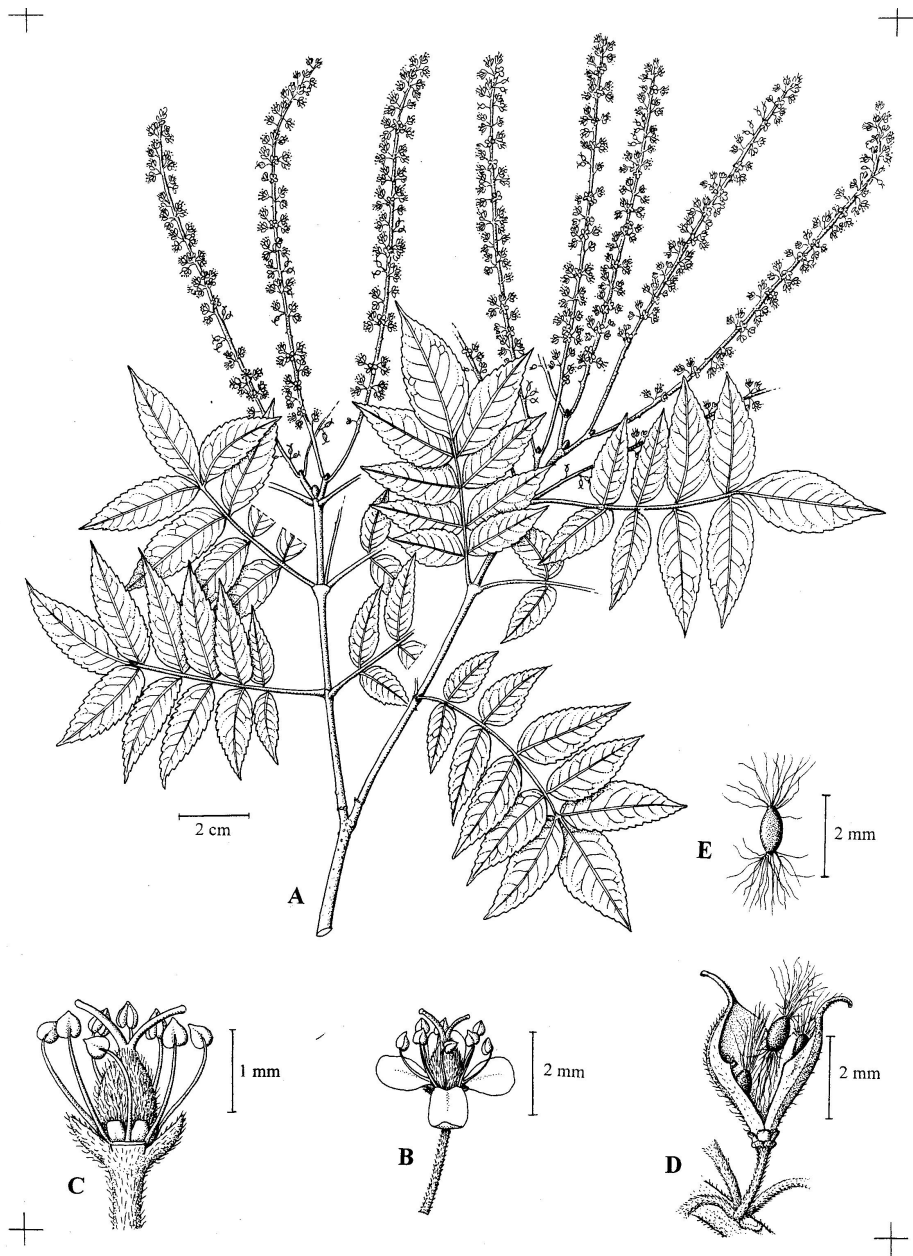


Fig. 2. *Weinmannia fraxinea*. A, flowering (female) leafy twigs; B, female flower; C, female flower with one sepal and four petals removed; D, dehiscent capsule; E, seed. (A and C from *Nooteboom & Chai 1696*, B from *SAN 56254*, D–E from *SAN 84928*.)

Ecology. Lower to upper montane forest and *kerangas* forest, at 1175–2560 m altitude.

2. *Weinmannia clemensiae* Steenis

(Mary Strong Clemens, 1873–1968, prolific plant collector in W Java, Borneo, the Philippines and Papua New Guinea)

J. Bot. 72 (1934) 3; Masamune *op. cit.* 324; Bernardi *op. cit.* (1964) 166; Cockburn *in* Luping *et al.* (eds.), Kinabalu Summit Borneo (1978) 185, *op. cit.* (1980) 28; Whitmore, Tantra & Sutisna *op. cit.* 52; Hopkins *op. cit.* 32; Beaman *et al. op. cit.* 213; Hopkins & Hoogland *op. cit.* 146. **Type:** *Clemens 27880*, Borneo, Sabah, Mt. Kinabalu, near Kamborangah (holotype BO; isotypes K [photo at KEP], L).

Treelet or small tree, 1.5–10 m tall. **Twigs** (young) *densely tomentose-velutinous*. **Stipules** usually caducous, almost orbicular, to 1×1.2 cm, abaxial surface densely sericeous towards the base, adaxial surface velutinous. **Leaves** with 6–13 pairs of lateral leaflets, to 13 cm; long; petiole and rachis terete, not winged, densely tomentose-velutinous; petioles 0.5–1 cm long; rachis segments between pairs of leaflets 0.4–0.9 cm long; *leaflets* coriaceous, *bullate*, *margin strongly recurved and often rolled*, usually obscurely crenate with 5–7 notches on each side of the largest lateral leaflets, sparsely to densely pubescent below, puberulent above or glabrous; midrib sericeous; lateral leaflets sessile, inserted almost at 90° to the rachis, *elliptic or almost oblong*, *largest $1.4\text{--}2.7 \times 0.6\text{--}1$ cm*, proximal leaflets smaller, base rounded to cordate, symmetrical, apex broadly acute; terminal leaflet elliptic, $1.9\text{--}3.3 \times 0.7\text{--}1$ cm, base rounded to rarely cordate, apex acute; midrib prominent below, sunken above; lateral veins almost at 90° angle to midrib, prominent below; intercostal venation obscure; petiolules of 0.3–0.5 cm long. **Inflorescence** of 1 pair of opposite dyads; peduncles 0.3–0.7 cm long, densely tomentose-velutinous; individual racemes to 10.5 cm long, axes densely tomentose-velutinous. **Flowers** unisexual (or sometimes ?bisexual); pedicels 1–1.5 mm long, with short erect hairs; calyx lobes $0.8\text{--}0.9 \times 0.6\text{--}0.8$ mm, hirsute; petals obovate to almost orbicular, $1.1\text{--}1.5 \times 1\text{--}1.1$ mm, apex rounded; disc lobes oblong or broadly oblong, 0.4–0.5 mm long. **Male flowers:** filaments *c.* 2.5 mm long, pistillodes *c.* 0.6 mm long, densely pubescent, styles 0.1 mm long, incurved. **Female flowers:** staminodes to 1.9 mm long; ovary 1.5–2 mm long, densely pubescent, styles *c.* 1 mm long, straight, pubescent at base. **Fruit** valves $3.7\text{--}4.5 \times 1.8\text{--}2.2$ mm at dehiscence; exocarp densely pubescent; calyx lobes persistent. **Seeds** (immature) *c.* 0.9 mm long, with tuft of hairs at both ends.

Distribution. Endemic in Borneo and confined to Mt. Kinabalu and Mt. Tambuyukon in Sabah (e.g., *Barkman & Buin 141*, *Chew & Corner RSNB 4364*, *RSNB 4508*, *RSNB 4755*, *SAN 28737*, *SAN 34617*, *SAN 47041*, *SAN 48098*, *SNP 2318*, *SNP 3675*, *SNP 4896*, and *SNP 12066*). Probably all populations occur within the boundary of Kinabalu Park, whose protection is therefore crucial to the continued survival of this species.

Ecology. Restricted to dwarf upper montane forest with a rather open canopy on ultramafic soils, at (1640–)1900–2600 m altitude.

Notes. This species has characteristically elliptic or almost oblong and bullate leaflets with the margins recurved so that they cannot be flattened and dense tomentose-velutinous twigs.

3. Weinmannia fraxinea (D. Don) Miq.

Fig. 2

(Latin, *fraxinus* = ash tree (*Fraxinus* L. of the family Oleaceae); with leaflets resembling those of the ash tree)

Fl. Ned. Ind. 1, 1 (1856) 718; Bernardi *op. cit.* (1964) 167; Hopkins *op. cit.* 23; Beaman *et al. op. cit.* 214; Hopkins & Hoogland *op. cit.* 151. **Basionym:** *Pterophylla fraxinea* D. Don, Edinb. New Philos. J. 9 (1830) 93. **Type:** *Smith s.n.*, Maluku, Honimoa (holotype LINN-SM). **Synonyms:** *Weinmannia blumei* Planch., Lond. J. Bot. 6 (1847) 470, King, J. As. Soc. Beng. 66, 1 (1897) 299, Merrill, EB (1921) 287, Ridley, FMP 1 (1922) 682, Masamune *op. cit.* 324, Backer & Bakhuizen *f. op. cit.* 506, Bernardi *op. cit.* (1964) 161, Anderson *op. cit.* 165, Whitmore *op. cit.* 179, Cockburn *op. cit.* 26, Corner *op. cit.* 224, Whitmore, Tantra & Sutisna *op. cit.* 52, Turner *op. cit.* 182, PROSEA 5, 3 (1998) 580; *W. blumei* Planch. var. *major* Ridl., FMP 5 (1925) 307; *W. borneensis* Engl., Nat. Pflanzenfam., ed. 2, 18a (1930) 256, Airy Shaw *op. cit.* 260, Bernardi *op. cit.* (1964) 164, Whitmore, Tantra & Sutisna *op. cit.* 52, Coode *et al. (eds.) op. cit.* 64; *W. dulitensis* Airy Shaw *op. cit.* 259, Anderson *op. cit.* 165.

Tree to 25(–40) m tall with small thick buttresses. **Bark** grey to dark brown, smooth and lenticellate to fissured and scaly; inner bark red-brown, fibrous with cream wedges outwards. **Sapwood** white. **Twigs** puberulent to tomentose, rarely glabrous when young, glabrescent and with numerous lenticels when older. **Stipules** often caducous, almost orbicular, subreniform or broadly spathulate, 0.8–1.5 × 0.8–1.8 cm, abaxial surface strigose towards the base, adaxial surface glabrous. **Leaves** with (0–)1–8 pairs of lateral leaflets, 5.5–15.5 cm long; petiole and rachis terete, not winged, glabrous to tomentose-velutinous; petioles 1–3 cm long; rachis segments between pairs of leaflets 1–2.5 cm long; leaflets chartaceous to subcoriaceous, not bullate, margin flat or slightly recurved, rounded or triangular crenate, with 8–14 notches on each side in the largest lateral leaflets, glabrous except for hirsute hairs on midrib below and sometimes also above towards base, sometimes almost shiny above, drying greenish brown; lateral leaflets almost sessile, lanceolate to narrowly elliptic or narrowly ovate to ovate, largest (2.2–)4.2–8.5(–12) × (0.8–)1.2–3.5(–4.5) cm (proximal leaflets usually smaller than distal ones), base rounded to cuneate, unequal, apex narrowly acute to acuminate; terminal leaflets narrowly elliptic to narrowly ovate, 2.5–10 × 1–3.3 cm, base attenuate, apex acuminate; midrib prominent below, sunken above; lateral and intercostal veins slightly prominent below, almost flat above; petiolules of 0.3–1.5 cm long. **Inflorescences** 1–3 of opposite pairs of lateral dyads or tetrads; peduncles 0.3–1.8 cm long, minutely puberulent to tomentose; individual racemes 7.5–15 cm long, axes minutely puberulent to tomentose. **Flowers** unisexual or bisexual; pedicels (1.1–)1.5–3 mm long, minutely hairy; calyx lobes triangular, 0.6–0.9 mm long, hirsute at base; petals oblong to obovate, 1.1–1.8 × 0.7–1.2 mm, apex rounded or rarely emarginate; disc lobes free and oblong, 0.2–0.5 mm long, or rarely forming an almost complete ring. **Male flowers:** filaments *c.* 2.9 mm long, pistillodes *c.* 0.5 mm long, densely pubescent, styles *c.* 0.1 mm, incurved. **Female flowers:** staminodes 0.6–1.2 mm long; ovary 0.6–1.2 mm long, densely pubescent, styles 1–1.3 mm long, straight. **Bisexual flowers:** filaments 3–3.5 mm long; ovary 0.6–0.8 mm long, pubescent, styles 1.5–2 mm long, straight. **Fruit** valves 2.5–4(–6) × 1.5–2(–3.1) mm at dehiscence; exocarp pubescent; calyx lobes usually persistent. **Seeds** 0.8–1.1 mm long, with a tuft of hairs at both ends, hairs to 2 mm long.

Vernacular names. Sabah—*sumu silan* (preferred name); *kayu-papan* (Murut). Sarawak—*tekaran* (Kelabit); *tansang lang* (Iban); *uban* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Singapore, Java, Borneo, Maluku, Lesser Sunda Islands, New Guinea and Solomon Islands. In Sabah, known from Kota Belud, Labuk Sugut, Lahad Datu, Penampang, Ranau, Sandakan, Tambunan, and Tuaran districts (e.g.,

Ahmad Zainudin AZ 4953, Ali AI 412, FRI 41324, SAN 37765, SAN 60638, SAN 62024, SAN 95210, SAN 140143, SFN 27845, SNP 15569, and Sugau JBS 64). In Sarawak, reported from Belaga, Kapit, Kuching, Lawas, Limbang, Marudi, and Miri districts (e.g., *Sarawak Museum Series 40, S 3777, S 10609, S 18535, S 20036, S 21116, S 26012, S 37053, S 51142, and S 52496*). Also occurs in Brunei (e.g., *BRUN 1044, BRUN 1873 and Coode MC 7566*) and Kalimantan (e.g., *Kostermans 12903*).

Ecology. In Malesia, *Weinmannia fraxinea* is the most widely distributed and morphologically the most variable species. The species also has a wide ecological amplitude, occurring in various habitats on different soil types. In Borneo, it occurs in mixed peat swamp (*Agathis* forest) at sea level, mixed dipterocarp, *kerangas*, lower and upper montane forests at (0–)500–1970 m altitude. On Mt. Kinabalu in Sabah, the species has been recorded from dwarf, open montane forest on ultramafic soils.

Uses. In Sarawak, the leaves are boiled in water and then mixed with clay to make a blackish dye (*Chai S 35503*) and the wood is used as firewood.

Notes. The leaflets of this species are variable in number, size, shape, texture and indumentum, but usually they are broader towards the unequal base and the apex is acuminate.

HERNANDIACEAE

L.G. Saw

Forest Research Institute Malaysia,
52109 Kepong, Malaysia

Blume, Bijdr. Fl. Ned. Ind. (1826) 550; Gamble, J. As. Soc. Beng. 75, 1 (1912) 203; Ridley, FMP 3 (1924) 138; Backer & Bakhuizen *f.*, FJ 1 (1964) 135; Hutchinson, Gen. Fl. Pl. 1 (1964) 143; Kubitzki, Bot. Jahrb. Syst. 89 (1969) 78; Ng, TFM 2 (1973) 244; Keng, OFMSP rev. ed. (1978) 37; Corner, WSTM 3rd. ed., 2 (1988) 363; Kubitzki in Kubitzki *et al.* (eds.), Fam. Gen. Vasc. Pl. 2 (1993) 334; Duyfjes, FM 1, 12 (1996) 737; Beaman *et al.*, PMK 4 (2001) 379.

Trees, shrubs, or woody climbers. **Leaves** alternate or spirally arranged, petiolate, without stipules, simple (lobed or unlobed) and palmately or pedately veined, or palmately compound with 3(–5) pinnately veined leaflets, margin entire. **Inflorescences** axillary or terminal, much-branched, compound cymes or corymbose thyrses, with or without bracts. **Flowers** bisexual or unisexual (plants polygamous or monoecious, rarely dioecious); perianth sepaloid with 3–8 imbricate or valvate segments (tepals) in 1 or 2 whorls; stamens 3–7 in a single whorl opposite the tepals, or if the tepals in two whorls, inserted opposite the outer tepals, filaments with two basal glands, or with one dorsal gland, or without glands, anthers 2-locular, dehiscent through 2 lateral or apical valves; interstaminal staminodes present or absent; ovary inferior, 1-locular, with 1 pendulous ovule, style simple, in male flowers absent or reduced, stigma discoid and oblique or capitate. **Fruits** indehiscent, drupe-like and enclosed by inflated, fleshy, expanded cupule (*Hernandia*) or dry and nut-like with 2–4 lateral wings (*Illigera*). **Seed** 1, without endosperm; embryo straight; cotyledons large, fused and ruminant (*Hernandia*) or free and more or less planoconvex or slightly unequal (*Illigera*).

Distribution. Four genera (*Gyrocarpus* Jacq., *Hernandia* L., *Illigera* Blume and *Sparattanthelium* Mart.) with about 60 species; in tropical regions of Asia, Africa, C America and Mexico. Three species in 2 genera (*Hernandia* and *Illigera*) are recorded for Sabah and Sarawak.

Taxonomy and classification. In the past, genera currently included in the Hernandiaceae have been placed in different families (Combretaceae, Hernandiaceae and Lauraceae) but Kubitzki (*op. cit.* 1969) in publishing the monograph of the family comprehensively dealt with the perceived differences. Most authors (e.g., Hutchinson *op. cit.*, Keng *op. cit.*, Cronquist (1981), Int. Syst. Class. Fl. Pl.: 78, Kubitzki *et al. op. cit.*, Bremer *et al.* (2003), APG II, Bot. J. Linn. Soc. 141: 399) agree that Hernandiaceae is closely related to Lauraceae. The family can be divided into two subfamilies, viz. Hernandioideae and Gyrocarpoideae. The two genera occurring in Sabah and Sarawak belong to the subfam. Hernandioideae.

Key to genera

Trees with simple leaves. Fruits a drupe enclosed in a cupule.....**Hernandia**

Woody climbers with palmately compound leaves. Fruits with wings.....

Illigera Blume

(Latin, *illigare* = to entangle)

Bijdr. Fl. Ned. Ind. (1826) 1153; Clarke *in* Hooker *f.*, Fl. Brit. Ind. 2 (1879) 460 (under Combretaceae); King, J. As. Soc. Beng. 66, 1 (1897) 342 (under Combretaceae); Gamble, J. As. Soc. Beng. 75, 1 (1912) 203; Ridley, FMP 3 (1924) 139; Merrill, PEB (1929) 91; Backer & Bakhuizen *f.*, FJ 1 (1964) 136; Ng, TFM 2 (1973) 247; Kubitzki, Bot. Jahrb. Syst. 89 (1969) 157, *in* Kubitzki *et al.* (eds.), Fam. Gen. Vasc. Pl. 2 (1993) 337; Duyfjes, FM 1, 12 (1996) 751; Beaman *et al.*, PMK 4 (2001) 380.

About 20 species mainly in the Sino-Himalayan region; in the Flora region, two species, *I. celebica* Miq. and *I. megaptera* Merr., were recorded for Sabah only.

Woody climbers, climbing with the aid of twining petioles. Leaves palmately 3(–5)-foliolate, leaflets pinnately veined. Inflorescences terminal and axillary, many- or few-flowered. Flowers bisexual, 5-merous, tepals in two rows, valvate in bud, caducous; ovary ovoid, 4-angled, in fruit the angles develop into 2 or 4 wings, style filiform; stamens 5. Fruit a samara; the nut with 2 longer and 2 shorter lateral wings (or wings sometimes absent). In forests or forest edges, at altitudes to 1660 m.

HERNANDIA L.

(F. Hernandez, 16th century Spanish naturalist and explorer)

Sp. Pl. (1753) 981; Blume, Bijdr. Fl. Ned. Ind. (1826) 550; Hooker *f.*, Fl. Brit. Ind. 5 (1890) 188 (under Lauraceae); Gamble, J. As. Soc. Beng. 75, 1 (1912) 203; Ridley, FMP 3 (1924) 138; Masamune, EPB (1942) 318; Backer & Bakhuizen *f.*, FJ 1 (1964) 136; Kubitzki, Bot. Jahrb. Syst. 89 (1969) 122; Ng, TFM 2 (1973) 244; Corner, WSTM 3rd. ed., 2 (1988) 363; Kubitzki *in* Kubitzki *et al.* (eds.), Fam. Gen. Vasc. Pl. 2 (1993) 337; Duyfjes, FM 1, 12 (1996) 737; PROSEA 5, 3 (1998) 287. **Synonym:** *Biosolettia* C.Presl, Reliq. Haenk. 2 (1835) 141.

Monoecious trees or shrubs. **Leaves** spirally arranged, *simple, peltate or not, palmately 3–9-veined, veins arching towards apex*. **Inflorescence** usually at and towards the tips of branchlets; all parts finely pubescent, rarely glabrous; *peduncles distinct; ultimate (distal) partial inflorescences (cymules) comprising 2 lateral pedicelled male flowers and 1 central subsessile female (rarely bisexual) flower, subtended by an involucre of 4 bracts*. **Flowers:** bracteoles of male flowers more or less equal, *those of female flowers united into a cupule partly or wholly surrounding the ovary, accrescent at maturity*; outer tepals quincuncial or imbricate, inner ones valvate. **Male flowers** 3–5(–6)-merous; *pistillode absent or style rudimentary; stamens 3–5(–6), filaments free or partly connate, each with 2, free or connate basal glands*. **Female flowers** 4–6-merous; staminodes absent; ovary somewhat compressed laterally, style sigmoid or straight, at base often thickened and surrounded by 4–5(–10–12) free or connate glands, stigma dilated or irregularly lobed. **Fruits** *drupe-like*, ovoid to ellipsoid, often inconspicuously longitudinally ribbed, with or without an umbo (wart) at apex, *at maturity enclosed by the inflated, fleshy cupule*. **Seeds** with a hard, sometimes spongy testa; *cotyledons fused, ruminant*.

Distribution. Pantropical genus of 24 species; 3 in Malesia. Only 1 species in Sabah and Sarawak.

Hernandia nymphaeifolia (C.Presl) Kubitzki
(Latin, leaves like that of the water lily, *Nymphaea*)

Fig. 1.

Bot. Jahrb. Syst. 90 (1970) 272; Ng *op. cit.* 245; Corner *op. cit.* 363; Turner, Gard. Bull. Sing. 47 (1995) 266; Duyfjes *op. cit.* 747; PROSEA *op. cit.* 287. **Basionym:** *Biasolettia nymphaeaeifolia* C.Presl *op. cit.* 142. **Type:** *Haenke s.n.*, Guam (PR). **Synonyms:** *Hernandia peltata* Meisn. in A. DC., Prodr. 15 (1864) 263, Hooker *f. op. cit.* 188, Gamble *op. cit.* 204, Merrill, EB (1921) 280, Ridley *op. cit.* 138, Backer & Bakhuizen *f. op. cit.* 137, Kubitzki *op. cit.* (1969) 153; *Hernandia ovigera auct. non L.*: Masamune *op. cit.* 318.

Tree, 20–35 m tall, 50–100 cm diameter; bole short, low branching. **Bark** grey-brown, smooth to rough, lenticellate; inner bark thick, fibrous, soft, yellow to dirty brown. **Sapwood** white to yellow to pale orange. **Twigs** 0.5–1 cm diameter apically, smooth, with a broad pith. **Leaves** *palmately 5–9-veined*; petioles 10–20 cm long; blades chartaceous to thinly coriaceous, shiny above, dull below, glabrous on both surfaces, *peltate (rarely non-peltate or barely peltate), attached to the petiole at (0–)0.5–3 cm from margin*, broadly ovate, 10–33 × 6–29 cm, *base rounded to slightly cordate*, apex acute to slightly acuminate; midrib and veins flat to slightly raised above, raised below; *midrib with 2–4 pairs of lateral veins*. **Inflorescences** 3–5 crowded towards apex of twig, 10–30 cm long; *main axes 6–20 cm long*; involucre bracts elliptic to obovate 2–6 × 1–3.5 mm. **Flowers** greenish or white, fragrant. **Male flowers** 3-merous; pedicels 4–4.5 mm long; tepals *c.* 5 mm long; filaments *c.* 3 mm long, each basally with two subspathulate glands *c.* 1 mm long, the glands free or pair-wise fused between stamens, anthers yellow. **Female flowers** 4-merous, more or less sessile, 8–10 mm long; tepals 5–6 mm long; glands 4 (sometimes more), ellipsoid; *ovary enveloped up to halfway by the cupule*, style 3–4 mm long, papillose, stigma pink; cupule at anthesis *c.* 2 × 3 mm, *margin entire of slightly undulate*. **Cupule** (in fruit) loosely enclosing the drupe, inflated, bell-shaped, fleshy, waxy, white or reddish, *margin of the orifice entire and slightly revolute*. **Fruits** *as long as cupules or somewhat exserted*, ellipsoid, 2.5–3 × 1.5–2.3 cm, faintly longitudinally 8-ribbed, short-stalked or sessile, *apex with an umbo, 8–10 mm wide, 2–3 mm high*.

Vernacular names. Sarawak—*kementing laut* (Malay); Peninsular Malaysia—*buah keras laut* (Malay).

Distribution. E Africa, Madagascar, Sri Lanka, Andaman and Nicobar Islands, Thailand, Cambodia, Vietnam, Taiwan, Malesia (Sumatra, Peninsular Malaysia, Borneo, Java, Nusa Tenggara, Sulawesi, the Philippines, Maluku and New Guinea), Micronesia, Melanesia and Polynesia. In Sabah, known from Pulau Tiga, Kuala Penyu district (e.g., *SAN 84739*, *SAN 126793* and *SAN 126972*), Pulau Gaya, Kota Kinabalu district (e.g., *SAN 31355*, *SAN 56123* and *SAN 67178*), Pulau Banggi, Kudat district (e.g., *SAN 16418*), Pulau Timbun Mata and Pulau Sipadan, Semporna district (e.g., *FD FMS 48713* and *Wong WKM 2467*), and in Sarawak from Kuala Sg. Sematan and Pulau Talang Talang Besar, Lundu district (e.g., *Igon 452*, *S 20898* and *S 41812*), Buntal and Bako NP, Kuching district (e.g., *Hewitt 1031* and *S 43898*).

Ecology. Occurs exclusively in coastal areas, along sea-shores, in primary and secondary littoral forest (*Barringtonia asiatica* association), also behind the beach in swampy places; on sand, coral beach, or pebbles; at low altitude.

Uses. Timber is soft and light weight, not durable and of no major economic importance but

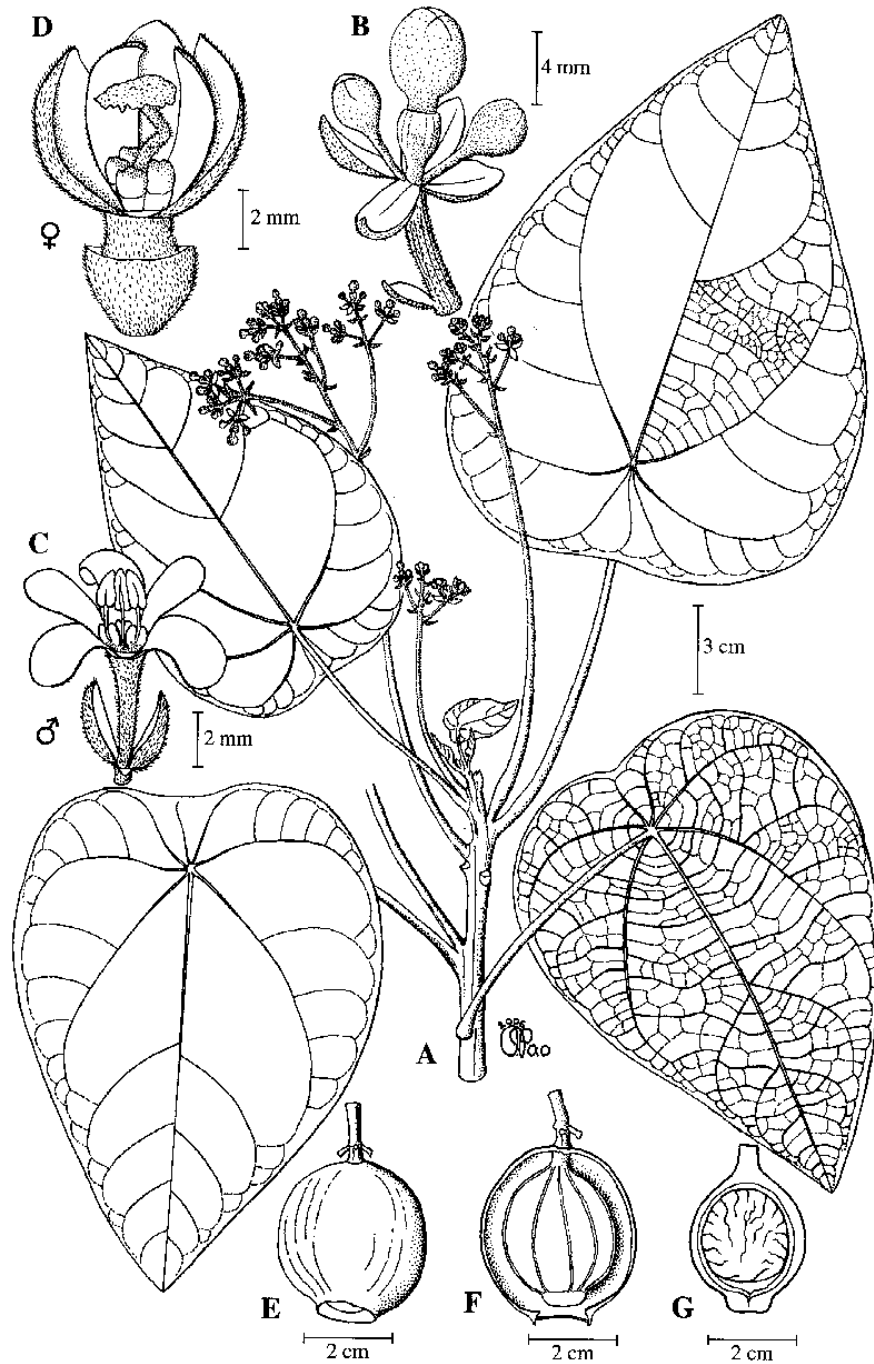


Fig. 1. *Hernandia nymphaeifolia*. A, flowering leafy twig; B, ultimate (distal) cymules with 1 female (centre) and 2 male (lateral) flowers; C, male flower; D, female flower; E, cupule and fruit; F, longitudinal section of cupule exposing the fruit; G, longitudinal section of fruit and seed showing the ruminant endosperm. (A–D from Wong WKM 2467, E–G from S 43898.)

is suitable for furniture, fish-net floats, wooden sandals and drawing boards. (*cf.* PROSEA *op. cit.*)

Notes. Most examined specimens have distinctly peltate leaves; however some specimens collected from islands off the coast of Sabah, e.g., *SAN 126972* from Pulau Tiga and *SAN 56123* from Pulau Gaya, have non-peltate and/or barely peltate leaves. Another specimen (*SAN 126793*, also from Pulau Tiga) has both peltate and non-peltate leaves on the same specimen sheet. These specimens, however, represent true *H. nymphaeifolia* and not *H. ovigera* L. as their fruit apices have the typical umbo found in *H. nymphaeifolia*. *Hernandia ovigera* typically have fruits without umbo.

MELIACEAE

David J. Mabberley

University of Washington Botanic Gardens, Seattle, USA
National Herbarium of the Netherlands, University of Leiden Branch, The Netherlands
and

Caroline M. Pannell (*Aglaia*)

Daubeny Herbarium, University of Oxford, United Kingdom

With contributions by

Jennifer M. Edmonds (*Toona*)

School of Biology, University of Leeds, United Kingdom
and

Anne M. Sing

Daubeny Herbarium, University of Oxford, United Kingdom

Miquel, Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 1; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 540; King, J. As. Soc. Beng. 64, 1 (1895) 16; Merrill, EB (1921) 318; Ridley, FMP 1 (1922) 382; Harms *in* Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 1; Masamune, EPB (1942) 370; Backer & Bakhuizen *f.*, FJ 2 (1965) 116; Pennington & Styles, Blumea 22 (1975) 419; Anderson, CLTS (1980) 246; Mabberley & Pannell, TFM 4 (1989) 199; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 219; Kessler & Sidiyasa, TBSA-EK (1994) 166; Mabberley *et al.*, FM 1, 12 (1995) 1; Turner, Gard. Bull. Sing. 47 (1995) 336; Coode *et al.* (eds.), CLBD (1996) 200; Argent *et al.* (eds.), MNDT-CK (1997) 406; Beaman & Anderson, PMK 5 (2004) 118.

Trees, treelets, often pachycaul* or, more rarely, shrubs or suckering shrublets, monopodial or sympodial, rarely with *Terminalia*-branching (*Vavaea*), dioecious (though sometimes, at least, 'male' trees occasionally producing bisexual flowers), polygamous, monoecious or with all flowers bisexual. **Indumentum** of simple, bifid or stellate hairs or stellate or peltate scales or sometimes mixtures of these. **Buds scales** absent or present. **Leaves** exstipulate (occasionally pseudostipules present), spirally arranged, rarely decussate, pinnate (sometimes with a terminal 'bud', *i.e.* pseudogemmula), trifoliolate, with a single blade (simple or unifoliolate) or rarely bipinnate (*Melia*; introduced); rachis very rarely winged; leaflets usually entire, rarely lobed or serrate, sometimes with minute black glandular dots. **Inflorescences** thyrsoid, racemose, paniculate or spicate, sometimes reduced to fascicles or solitary flowers, axillary, supra-axillary, on branches or bole to ground level. **Flowers** bisexual and/or more usually, unisexual with well developed rudiments of opposite sex present, radially symmetrical; calyx usually more or less lobed, sometimes with discrete sepals, sometimes truncate; petals 3–7(–14) in 1 whorl or rarely in a spiral (some

*As used in FM and Flora North America, etc. = sparsely or not branched, of massive primary construction with wide pith and terminal heads of leaves arising from massive buds; the opposite being leptocaul.

Chisocheton) to give up to 2 apparent whorls, when fresh green, white, cream, pink to claret and violet or yellow (*Aglaiia*); stamens usually partially or completely united by a tube with or without lobes, anthers 3–10(–30) in 1 or, rarely, 2 or more whorls, sometimes locellate (= divided into secondary, smaller compartments), inserted at tips of filaments or at the margin of the tube or within its throat; nectary disc around ovary cushion-like, tubular or absent; ovary superior (or in *Sandoricum* slightly sunk in receptacle), (1 or)2–6(–20)-locular, each locule with 1–many ovules, stigma or stylehead** discoid to capitate. **Fruit** a capsule, berry or drupe. **Seeds** with fleshy aril or sarcotesta or a combination of these or winged and then attached to a woody columella, or with corky outer layers, or very rarely without any of them; endosperm usually absent; cotyledons collateral, superposed or, rarely, oblique, emergent or not at germination, when scale leaves (eophylls) are sometimes produced before first foliage leaves, which may be opposite or spirally arranged, simple or pinnate with later ones simple to bipinnate.

Distribution. Throughout the tropics and subtropics, with poor representation in temperate zones, the family comprises two subfamilies (Meliodeae and Swietenioideae [older name Cedreloideae]) of 49 or 50 genera with about 620 species. It is best represented in the Malesian region for, although Africa is almost as diversified in terms of the number of genera, Sabah and Sarawak alone have far more species (130 in 15 genera) than the whole of Africa (84 species) and exactly matches the specific richness of the whole neotropical region, where only eight genera are found. It is notable that by comparison with the thousands upon thousands of specimens in herbaria of the easily collected smaller trees, notably species of *Aglaiia*, *Chisocheton* and smaller species of *Dysoxylum*, there is only a handful of specimens of the tall timber species of *Toona* and *Dysoxylum* (e.g., *D. acutangulum*, *D. carolinae*, *D. crassum* and *D. flavescens*), for example, so that their distributions noted below may not be as accurate records as are those of the lesser species.

Ecology. Meliaceae are very common trees of the canopy and understorey of lowland primary forest throughout Malesia, making up to 17% of all trees over 10 cm bole diameter (Whitten *et al.*, Sumatra (1984) 262) in the forests of Sumatra for example, and being absent from only the driest zones. They are represented by species of *Xylocarpus* on rocky shores and in mangrove swamps, into the upper reaches of which penetrates *Aglaiia rubiginosa*. The family is represented in freshwater swamp forest by *Sandoricum borneense* and *Chisocheton amabilis* and includes some species restricted to limestone habitat, like *C. ruber* and *Walsura grandifolia* of Sarawak. Along rivers in west Malesia, are a number of rheophytic species including, in Borneo, *Sandoricum borneense*. A few species are tolerant of more open conditions and will colonize large gaps in forest or are frequently encountered in secondary forest e.g., *Aglaiia argentea*, *Toona* spp. and *Chukrasia tabularis*, which even colonizes bare ground along road cuttings and is weedy where introduced, as in Australia.

Uses. The timbers of certain Meliaceae are some of the most sought after in the world, such that natural stands have been much depleted and serious conservation measures have been proposed for wild mahoganies (*Swietenia* spp.) in tropical America. Most ‘mahogany’ (if Meliaceae at all) seen today is derived from *S. macrophylla* introduced to the Old World, probably from Honduras, in 1876 and described from material cultivated in India. It is grown in Sabah and Sarawak. The other important timbers are also generally Swietenioideae, notably *toon*, *Toona ciliata* from India to Australia (‘red cedar’), where most of it has been long cut out, having been the most desirable timber in that continent.

**As distinct from the stigmatic organs themselves (*cf. Sandoricum* for example).

Others include the neotropical *Cedrela odorata* tried in Borneo and species of the African genera *Entandrophragma* (e.g., *E. utile* Sprague), *Khaya* (African mahogany; *K. senegalensis* (Desr.) A.Juss. are common avenue trees in Kuching while *K. ivorensis* A.Chev. has been tried in plantation in Sabah) and *Lovoa* (Nigerian golden walnut). Besides the *Toona* spp. and *Chukrasia tabularis*, the chickrassy wood of commerce, indigenous species are not of world significance in the timber market, despite their large boles, though locally, some species of *Aglaia*, *Dysoxylum* and *Walsura*, and *Azadirachta excelsa*, have been used for construction and furniture, while *Xylocarpus* wood is hard and used for boat-building.

The major problem besetting plantation forestry of Meliaceae is the attacks by moths of the genus *Hypsipyla* (Lepidoptera, Pyralidae), the larvae of which burrow into young plants and seedlings, causing their collapse and death, though Melioideae seem to be rarely attacked — a good argument for their promotion as plantation trees. The shoot-borer is perhaps one of the most economically important insect pests in tropical forestry. There have been many attempts at biological control of the moths, for externally applied insecticides have little effect and systemic ones are expensive. Mixed and enrichment planting with non-susceptible species has been shown to reduce damage and there are possible advances to be made in breeding resistance to attack (see Newton *et al.*, For. Ecol. Manag. 57 (1993) 301 for further details).

The locally very important fruit trees, *Lansium domesticum* (*langsat* and *duku langsat*) and *Sandoricum koetjape* (*sentul*) exist in a number of forms, wild, cultivated and naturalized, though they are not grown on a commercial plantation scale, those reaching markets being largely those selected from kampung trees. A good *langsat* and/or *duku langsat* may be worth more as a proposition than a good durian tree. Seeds of a number of species of *Aphanamixis* and *Chisocheton* yield an oil which has been used as an illuminant, while those of *Lansium domesticum* are used in arrow poisons, as is the bark.

The bitterness (due to the triterpenoids) of the barks of Meliaceae has long been known and they have been used in medicine, some being those eagerly sought by Europeans in the eighteenth century, notably species of *Aphanamixis*, *Chukrasia*, *Heynea*, *Lansium*, *Sandoricum*, *Toona*, and *Xylocarpus*. The bark and indeed, the leaves of the exotic *Azadirachta indica*, the *neem*, are powerful insecticides and this tree (q.v.) has a host of uses including planting in the reclamation of derelict land: it is perhaps one of the most all-round useful trees of Asia. The triterpenoids, which are responsible for the insecticidal properties, have aroused considerable commercial interest and have been examined in a number of genera for their use as biological pesticides. The biological activities of these compounds including insect antifeedant and growth-regulating properties, medicinal effects in humans and other animals, antifungal, bacteriocidal and antiviral activity, are reviewed by Champagne *et al.* (Phytochemistry 31 (1992) 377). Similar bioactivity is attributed to cyclo[b]benzofurans in *Aglaia* (see under account of *Aglaia*).

A number of exotics, notably the Indian cultivars of *Melia azedarach* are planted (e.g., in Sabah) for their elegant foliage and fruits.

Key to subfamilies

Bud scales absent. Fruits capsules, berries or drupes. Seeds neither corky nor winged.....
subfam. **Melioideae** (genera occurring in Sabah and Sarawak: *Aglaia*, *Aphanamixis*,

Azadirachta, Chisocheton, Dysoxylum, Heynea, Lansium, Melia, Pseudoclausena, Reinwardtiodendron, Sandoricum, Vavaea and Walsura).

Bud scales present. Fruits woody septifragal capsules with central columella. Seeds winged or corky.....
 subfam. **Swietenioideae** (genera occurring in Sabah and Sarawak: *Cedrela, Chukrasia, Swietenia, Toona* and *Xylocarpus*).

Key to genera

1. Leaves bipinnate (planted).....
Melia L.
 (Greek name for the European ash trees, *Fraxinus*; alluding to the leaf shape)
 Sp. Pl. 1 (1753) 384; King, J. As. Soc. Beng. 64, 1 (1895) 17; Ridley, FMP 1 (1922) 384; Harms in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 99; Pennington & Styles, Blumea 22 (1975) 463; Mabberley, Gard. Bull. Sing. 37 (1984) 463; Corner, WSTM 3rd. ed., 2 (1988) 502; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 219; Mabberley *et al.*, FM 1, 12 (1995) 329.
 Trees, occasionally flowering precociously as shrublets. Indumentum of simple and stellate-tufted hairs. *Bud scales absent. Leaves bipinnate.* Inflorescences thyrsoid, axillary. Flowers bisexual and male on same tree; calyx 5(or 6)-lobed to near base, lobes somewhat imbricate; petals 5 (or 6), free, imbricate; staminal tube narrowly cylindrical, slightly expanded at mouth, 10(-12)-ribbed, with 10 or 12 truncate, bifid or 4-fid filiform lobes, anthers 10 (or 12), inserted at margin or just within tube, alternating with or opposite lobes; disc small, surrounding the base of ovary; ovary 4-8-locular, each locule with 2 superposed ovules, stylehead capitate to coroniform (= shaped like a crown) with 4-8 short, erect or incurved stigmatic lobes. Fruit a drupe, 3-8-locular, each locule with 1 or 2 seeds; endocarp thick, bony, deeply dimpled at base and apex. Seeds oblong, laterally compressed; testa leathery, sometimes slightly swollen and fleshy around hilum; embryo embedded in oily endosperm; cotyledons flat, collateral; radicle superior, short, projecting from the cotyledons. Germination phanerocotylar; eophylls opposite, pinnatisect or trifoliolate.
 Two or possibly 3 species growing wild in tropical Africa and from India, Nepal, Sri Lanka and tropical China south and east through Sumatra, Java, the Philippines, Nusa Tenggara (Lesser Sunda Islands), New Guinea to tropical Australia and the Solomon Islands. One species, *M. azedarach* L., is planted and naturalised throughout the tropics, including Sabah and Sarawak.
 A glycopeptide, meliacin, isolated from the leaves and roots is responsible for inhibition of in-vitro replication of various DNA and RNA viruses. The seeds yield an oil and the trunk a gum but these have been little utilised, though the first is suitable for soap and hair oil.
 Leaves pinnate to simple (native and planted).....2
2. Leaves all simple (or unifoliolate).....3
 Leaves pinnate to trifoliolate.....4
3. Hairs simple. Trees with *Terminalia*-branching.....**13. Vavaea**
 Indumentum of at least some stellate hairs and/or stellate or peltate scales. Tree branching otherwise.....**1. Aglaia** (in part)

4. Leaves all trifoliolate.....5
 Leaves pinnate (imparipinnate or paripinnate).....6
5. Hairs simple.....**11. Sandoricum**
 Indumentum of stellate hairs and/or stellate or peltate scales.....**1. Aglaia** (in part)
6. Leaves with pseudogemmula (apical buds).....**4. Chisocheton** (in part)
 Leaves without pseudogemmula.....7
7. Leaves/leaflets with scales and/or stellate hairs (sometimes very sparse).....**1. Aglaia** (in part)
 Leaves/leaflets with simple hairs or glabrous.....8
8. Bud scales present.....9
 Bud scales absent.....14
9. Leaves with (1 or)2–4(or 5) leaflets on each side of rachis. Mangrove trees with spherical fruits.....**15. Xylocarpus**
 Leaves with more leaflets. Rainforest trees.....10
10. Leaves with 3–8 leaflets on each side of rachis. Fruits to 15 cm long (planted).....
Swietenia Jacq.
 (Gerard van Swieten, 1700–1772; a Dutch physician)
 Enum. Syst. Pl. Carib. 4 (1760) 20; Harms *in* Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 70; Backer & Bakhuizen *f.*, FJ 2 (1965) 117; Pennington & Styles, Blumea 22 (1975) 521; Corner, WSTM 3rd. ed. 2 (1988) 507; PROSEA 5, 1 (1993) 442.
 Deciduous trees. *Bud scales present. Leaves paripinnate*, very rarely imparipinnate, *without pseudogemmula*, with (2 or)3–6(–8) leaflets on each side of rachis; *leaflets* entire, *glabrous*. Inflorescences thyrsoid, axillary, little-branched. Flowers unisexual, 4- or 5-merous; calyx 5-lobed to about the middle, the lobes obtuse, imbricate; petals (4 or) 5, much longer than the calyx in bud, contorted, reflexed in open flowers; staminal tube cup-shaped or urceolate (= urn-shaped), 8–10-lobed, anthers 8–10, opposite the lobes; disc in males patelliform (= kneecap-shaped), united with the base of staminal tube, forming a ring around pistillode, in females reduced to a swelling at the base of ovary; ovary 5-locular, each locule with 12–16 ovules, stylehead discoid. Fruit an erect, strongly woody, oblong, ovoid or obovoid, septifragal capsule, *to 15 cm long*, opening by 5 valves from the base or base and apex simultaneously, the valves separating into an outer thickly woody and inner thinner layer. Seeds 9–16 per locule, attached by the wing-end to the distal part of columella; endosperm present as a thin layer; embryo with thin cotyledons; radicle slightly exerted. Germination cryptocotylar; eophylls opposite, simple, entire.
 Two (or 3) species in tropical America (from Mexico to Brazil) and the Caribbean. One species, *S. macrophylla* King, was introduced to Java in 1872 and to Singapore in 1876 and since grown in Peninsular Malaysia, Borneo (Sabah and Sarawak) and the Philippines for plantation and/or roadside trees.
 Leaves with more leaflets (native and planted).....11
11. Leaflets strongly asymmetrical. Petals 12–16 mm long.....**5. Chukrasia**
 Leaflets not so. Petals much smaller.....12

12. Staminal tube urceolate or cupular, anthers 8 or 10. Fruits (sub)globose. Seeds winged all round (planted).....

Khaya A.Juss.

Bull. Sci. Nat. Géol. 23 (1830) 238; Harms *in* Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 49; Pennington & Styles, Blumea 22 (1975) 515; PROSEA 5, 3 (1998) 310.

Deciduous, monoecious trees. *Bud scales present. Leaves paripinnate, without pseudogemmula; leaflets entire, glabrous.* Inflorescences thyrsoid, axillary, much-branched. Flowers unisexual, 4- or 5-merous; calyx 4- or 5-lobed almost to base, the lobes subcircular, imbricate; petals 4 or 5, free, *less than 12 mm long*, much longer than the calyx in bud, contorted, erect in open flowers, somewhat hooded; *staminal tube urn-shaped or cup-shaped, bearing 8–10 included anthers* or antherodes (= sterile anthers) toward the apex; disc in males cushion-shaped, united with the base of pistillode, but free from staminal tube, in females more or less reduced to an indistinct swelling at the base of ovary; ovary 4- or 5-locular, each locule with 12–16(–18) ovules, stylehead thick discoid with crenulate margin. Fruit an erect, (sub)globose woody, septifragal capsule, opening by 4 or 5 (or 6) valves from the apex, the valves remaining joined at the base. Seeds 8–18 per locule, broadly transversely ellipsoid to suborbicular, *narrowly winged all around margin*; residual endosperm present; embryo with flat collateral cotyledons; radicle lateral, slightly exserted. Germination cryptocotylar; eophylls opposite, simple, entire, apex often long-acuminate.

About 6 or 7 species in tropical Africa, Madagascar and the Comores. Two species, *Khaya ivorensis* A.Chev. and *K. senegalensis* (Desr.) A.Juss., have been introduced to Sabah and Sarawak for plantation and/or roadside trees.

Stamens 5, free. Fruits ellipsoid, obovoid or club-shaped. Seeds winged at end(s) only (native and planted).....13

13. Androgynophore cushion-shaped not exceeding ovary. Seeds winged at both ends or if at one end then attached at base of columella (native and planted).....**12. Toona**
Androgynophore columnar, longer than ovary. Seeds winged at one end and attached towards apex of columella (planted).....

Cedrela P.Browne

(Latin, *cedrus*, the cedar tree; referring to the strong-smelling wood)

Civ. Nat. Hist. Jamaica (1756) 158; King, J. As. Soc. Beng. 64, 1 (1895) 89; Ridley, FMP 1 (1922) 415; Harms *in* Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 40; Earle Smith, Fieldiana, Botany 29 (1960) 295; Pennington & Styles, Blumea 22 (1975) 512; Corner, WSTM 3rd. ed. 2 (1988) 498; PROSEA 5, 2 (1995) 122.

Deciduous trees. *Bud scales present. Leaves paripinnate, very rarely imparipinnate, without pseudogemmula, usually with (5 or)6–12(–15) leaflets on each side of rachis; leaflets entire, glabrous or simple-hairy.* Inflorescences thyrsoid, axillary, much-branched. Flowers 5-merous, unisexual; calyx lobed more or less to the base, shallowly dentate, or cup-shaped and split down one side; *petals 5, free, less than 12 mm long*, longer than the calyx in bud, aestivation imbricate; *stamens 5, free*, adnate to the *columnar androgynophore* below; ovary 5-locular, each locule with 6–12 ovules, style short, stylehead discoid with glandular stigmatic papillae. *Fruit* a thinly or thickly woody, *obovoid or club-shaped*, septifragal capsule, opening from the apex by 5 valves; columella woody, sharply 3-angled, extending to the apex of the capsule. *Seeds with a terminal wing* attached by the seed-end to the distal part of the columella and winged towards the base of the capsule; residual endosperm present; embryo with collateral, flat and

leaf-like cotyledons; radicle laterally exerted. Germination phanerocotylar; eophylls opposite, trifoliolate, the leaflets sinuate, entire.

About 5–8 species all native to tropical America, from Mexico to Argentina and in the Caribbean. One species, *Cedrela odorata* L., a valuable source of cedar timber, is planted throughout the tropics, including Malaysia (Peninsular Malaysia and Sabah), Indonesia, the Philippines and New Guinea.

14. Leaves paripinnate (see also note under *Chisocheton patens*).....15
 Leaves imparipinnate (sometimes terminal leaflet represented by a scar).....18
15. Stigma with conspicuous lobes. Fruit a drupe (native & planted)..... **3. Azadirachta** (in part)
 Stigma unlobed. Fruit a capsule or berry.....16
16. Disc present. Fruit a capsule..... **6. Dysoxylum** (in part)
 Disc absent. Fruit a berry.....17
17. Anthers in 1 whorl of 10. Fruits on branches and trunk..... **8. Lansium**
 Anthers in 2 whorls of 5. Fruits on axillary infructescences.... **10. Reinwardtiidendron**
18. Leaf rachis swollen at insertion of leaflets..... **14. Walsura**
 Leaf rachis not swollen thus.....19
19. Petals 3; disc absent..... **2. Aphanamixis**
 Petals 4 or more; disc present or absent.....20
20. Staminal tube deeply lobed..... **7. Heynea**
 Staminal tube not deeply lobed.....21
21. Disc absent. Fruit a berry..... **9. Pseudoclausena**
 Disc present. Fruit a capsule or drupe.....22
22. Stigma with conspicuous lobes. Fruit a 1- or 2-seeded drupe (native & planted)..... **3. Azadirachta** (in part)
 Stigma without such lobes. Fruit a capsule.....23
23. Inflorescences bell-rope-shaped. Disc 1 mm tall or less..... **4. Chisocheton** (in part)
 Inflorescences not so. Disc bigger..... **6. Dysoxylum** (in part)

Spot characters for genera

Unbranched or sparsely branched pachycaul treelets: *Aglaiia*, *Aphanamixis*, *Chisocheton*,
Dysoxylum

Rheophytes: *Aglaiia* (*A. lancifolia* and *A. rivularis*), *Sandoricum* (*S. borneense*)

Halophytes: *Xylocarpus*

Bark with white latex: *Aglaiia*, *Chisocheton*

Slash strongly garlic- or *Scorodocarpus*-scented: *Dysoxylum* (*D. alliaceum*, *D. magnificum*,
D. mollissimum, *D. rigidum* and the seeds of *Azadirachta excelsa*)

- Indumentum of or with stellate hairs: *Aglaia*, *Chisocheton* (*C. koordersii*), *Melia* (*M. azedarach*)
- Indumentum of stellate or peltate scales: *Aglaia*
- Leaves opposite: *Dysoxylum*
- Leaves simple or unifoliolate: *Aglaia*, *Vavaea*
- Leaves trifoliolate: *Aglaia*, *Reinwardtiodendron*, *Sandoricum*
- Leaves imparipinnate: *Aglaia*, *Aphanamixis*, *Azadirachta*, *Chisocheton*, *Dysoxylum*, *Heynea*, *Pseudoclausena*, *Walsura*
- Leaves paripinnate (sometimes a lateral leaflet pseudoterminal): *Azadirachta*, *Chisocheton*, *Cedrela*, *Chukrasia*, *Dysoxylum*, *Khaya*, *Reinwardtiodendron*, *Swietenia*, *Toona*, *Xylocarpus*
- Leaves bipinnate: *Melia* (*M. azedarach*)
- Leaves with terminal bud (= pseudogemma): *Chisocheton*
- Inflorescences on bole: *Chisocheton*, *Dysoxylum*, *Lansium*
- Inflorescences on branches: *Aglaia*, *Chisocheton*, *Dysoxylum*, *Lansium*
- Inflorescences like bell-ropes: *Aphanamixis*, *Chisocheton*
- Flowers yellow: *Aglaia*
- Calyx deeply lobed with almost free orbicular sepal lobes: *Aphanamixis*, *Lansium*, *Reinwardtiodendron*
- Calyx valvate: *Xylocarpus*
- Petals in a spiral, sometimes appearing as 2 whorls: *Chisocheton*
- Corolla valvate: *Chisocheton*, *Dysoxylum*, *Walsura*
- Petals 3: *Aglaia*, *Aphanamixis*, *Vavaea*
- Filaments free: *Cedrela*, *Toona*
- Staminal tube globose: *Aglaia*, *Aphanamixis*, *Lansium*, *Reinwardtiodendron*
- Anthers in 2 or more whorls: *Aglaia* (rare), *Reinwardtiodendron*, *Sandoricum*, *Walsura*
- Anthers locellate: *Chisocheton*
- Disc absent: *Aglaia*, *Aphanamixis*, *Lansium*, *Pseudoclausena*, *Reinwardtiodendron*, *Vavaea*
- Disc tubular: *Dysoxylum*, *Sandoricum*
- Fruit a loculicidal capsule: *Aglaia*, *Aphanamixis*, *Chisocheton*, *Dysoxylum*, *Heynea*
- Fruit a septifragal capsule: *Walsura* (*W. dehiscens*)
- Fruit a berry: *Aglaia* (?), *Lansium*, *Pseudoclausena*, *Reinwardtiodendron*, *Vavaea*, *Walsura*
- Fruit a drupe: *Azadirachta*, *Sandoricum*
- Seeds winged: *Cedrela*, *Chukrasia*, *Khaya*, *Swietenia*, *Toona*
- Seeds corky: *Xylocarpus*

1. AGLAIA Lour., *nom. cons.*

(Greek, *Aglaia* = one of the Graces who presided over the original Olympic Games; beauty, lustre)

bekak (Malay), *langsar-langsar* (Malay), *lantupak* (Dusun), *segera* (Iban)

Caroline M. Pannell

Fl. Cochinch. (1790) 173; Miquel, Ann. Mus. Bot. Lugd. Bat. 4 (1868) 38; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 554; King, J. As. Soc. Beng. 64, 1 (1895) 58; Harms *in* Engler & Prantl, Nat.

Pflanzenfam. 3, 4 (1896) 298; Merrill, EB (1921) 321, PEB (1929) 124; Ridley, FMP 1 (1922) 401; Masamune, EPB (1942) 370; Backer & Bakhuizen *f.*, FJ 2 (1965) 126; Pennington & Styles, Blumea 22 (1975) 481; Anderson, CLTS (1980) 246; Corner, WSTM 3rd ed. 2 (1988) 494; Pannell *in* Mabberley & Pannell, TFM 4 (1989) 207, Kew Bull. Add. Ser. 16 (1992) 379, *p.p.*, *in* Mabberley *et al.*, FM 1, 12 (1995) 194; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 219; Kessler & Sidiyasa, TBSA-EK (1994) 167; PROSEA 5, 2 (1995) 38; Coode *et al.* (eds.), CLBD (1996) 200; Argent *et al.* (eds.), MNDT-CK 2 (1997) 407; Beaman & Anderson, PMK 5 (2004) 118. **Synonyms:** *Amoora* Roxb., Pl. Corom. 3 (1820) 54, Miquel *op. cit.* (1868) 34, King *op. cit.* 51, Merrill *op. cit.* (1921) 321, Ridley *op. cit.* (1922) 398, Masamune *op. cit.* 373, Backer & Bakhuizen *f. op. cit.* 125, Anderson *op. cit.* (1980) 250; *Milnea* Roxb., Fl. Ind. 2 (1824) 430; *Nemadra* A.Juss., Bull. Sci. Nat. Géol. 23 (1830) 239; *Beddomea* Hook. *f.* *in* Bentham & Hooker *f.*, Gen. Pl. 1 (1862) 336; *Hearnia* F.Muell., Fragm. Phyt. Austr. 5 (1865) 55; *Aglaioopsis* Miquel *op. cit.* (1868) 58.

Small to large trees, *branched or rarely unbranched*, rarely much-branched shrubs, dioecious; *bark with white latex*. **Indumentum** of various types of hairs and/or scales. **Bud scales absent**. **Leaves** spirally arranged, either widely spaced on the apical shoots or close together with the petiole bases overlapping, *imparipinnate (very rarely paripinnate) or simple (unifoliolate)*, *without pseudogemma*; petiole usually terete, sometimes flat or deeply channelled on the adaxial side; leaflets usually asymmetrical, *glabrous or sparsely to densely covered with hairs and/or scales*, lateral ones alternate, subopposite or opposite, 2–17 on each side of rachis. **Inflorescences** *paniculate or spicate*, axillary, supra-axillary, or occasionally ramiflorous or cauliflorous, often several on an apical shoots; *males* much-branched, bearing up to 10,000 flowers; females less-branched and bearing fewer flowers. **Flowers** usually with fragrance of citronella; *males* terminal on short branchlets of rachis to 2.5 mm long, solitary or in sessile clusters; *females* solitary along rachis, sessile or nearly so, often larger than males; *calyx* cup-shaped, often thickened at the base, shallowly to deeply 3–5 (or rarely 6)-lobed, aestivation open or imbricate, the lobes unequal and sometimes patent at anthesis; *corolla* aestivation quincuncial or imbricate, petals 3–5 (or rarely 6), free or united at base, free from the staminal tube or partially united to it, unequal, concave and usually thickened in the centre, often hooded at the apex when in bud; *staminal tube* more or less truncate at base, apex incurved, without appendages, aperture small to large with entire, wavy or shallowly lobed margin, *anthers* (3–)5–9, in a single whorl, dehiscing by two longitudinal slits, inserted on the inner surface of the staminal tube either just below the margin or rarely on the margin; *antherodes* (= sterile anthers) in female flowers similar but not dehiscing and without pollen; *disc absent*; *ovary* 1–3 (rarely 4)-locular, each locule with 1 or 2 collateral or superposed ovules, placentation axial; *style* a very short constriction between the ovary and stylehead or absent, *stylehead* small, capitate, conical or clavate, *stigma* entire or with 2, 3 or rarely 4 small lobes. **Fruit** a 1–2 (rarely 3–6)-seeded berry (?) or a 2–4-valved, loculicidal capsule containing 2–4 seeds. **Seeds** usually with an aril or sarcotesta nearly or completely covering the seed; *endosperm absent*; *embryo* with thick planoconvex, superposed or rarely oblique cotyledons; *radicle* included. **Germination** subcryptocotylar; eophylls usually opposite, sometimes spirally arranged, simple or trifoliolate, margin entire.

Distribution. At least 115 species, occurring in tropical and subtropical India, Bangladesh, Sri Lanka, Bhutan, China, Andaman Islands, Great Cocos Islands, Myanmar, Laos, Vietnam, Thailand, Cambodia, Taiwan, Sumatra, Peninsular Malaysia, Singapore, Java, Nusa Tenggara (Lesser Sunda Islands), Borneo, the Philippines, Sulawesi (Celebes), Maluku (Moluccas), New Guinea, Australia, Guam, Ponape, Palau, Solomon Islands, Fiji, Samoa and New Caledonia. Sixty species occur in Sabah and Sarawak.

Ecology. Most species occur in lowland and hill forests, at altitudes to 1800 m. The seeds are dispersed by vertebrates. Birds swallow the arillate seeds from dehiscent fruits. Primates break open and take the seeds from indehiscent fruits. The bird-dispersed fruits have an opaque, usually red aril which contrasts with the white inner pericarp and pink or red outer surface of the pericarp. The aril is rich in lipids and can be peeled off the testa; it may therefore be removed in the bird's gizzard and the seed either regurgitated or passed rapidly through the gut. The primate-dispersed fruits have a gelatinous, sweet, often translucent aril which adheres so firmly to the testa that the primate tends to swallow the seed as well as the surrounding flesh; the seed is defaecated cleaned of its flesh. The indehiscent fruits of some species have a longitudinal line or lines of weakness in the pericarp along which the fruit breaks open if pressure is applied. (*cf.* Pannell & Koziol, *Phil. Trans. Roy. Soc. London B* 316 (1987) 303).

Phytochemistry. The genus *Aglaia* is the source of a unique group of natural products featuring a cyclopenta[b]tetrahydrobenzofuran skeleton. The first of these to be described was rocaglamide (King, M. *et al. in J. Chem. Soc., Chem. Commun.* 20 (1982) 1150–1). Since then, more than 50 naturally occurring derivatives of these compounds have been isolated from species in the genus. Most of these compounds have potent insecticidal properties, antifungal, antiviral, antibacterial or antihelminthic bioactivity. Several of them exhibit pronounced cytotoxic activity against a range of human cancers (see the review by Proksch *et al.*, *Current Organic Chemistry* 5 (2001) 923–938 and the website of Professor Harald Greger and Dr. Brigitte Brem at <http://www.phytochemie.botanik.univie.ac.at/herbarium/aglaia.htm>).

Taxonomy. Three sections, viz. sect. **Aglaia**, sect. **Amoora** and sect. **Neoaglaia** are recognised, which can be distinguished as follows:

Sect. **Aglaia:** *Calyx* with 5 (or rarely 6) obtuse or acute lobes; *petals* 5 (or rarely 6), aestivation quincuncial or imbricate (when petals 6); *anthers* (3–)5(–10). *Fruits* indehiscent, sometimes with one or more longitudinal ridges along which the pericarp splits open under pressure. *Seeds* with translucent, yellow, orange or white aril, flesh gelatinous. Species occurring in Sabah and Sarawak included in this section are: 1. *A. angustifolia*, 2. *A. argentea*, 4. *A. bullata*, 5. *A. coriacea*, 6. *A. crassinervia*, 8. *A. cumingiana*, 9. *A. densisquama*, 10. *A. edulis*, 11. *A. elaeagnoidea*, 12. *A. elliptica*, 14. *A. exstipulata*, 15. *A. forbesii*, 16. *A. foveolata*, 17. *A. glabrata*, 18. *A. glabriflora*, 19. *A. grandis*, 20. *A. hiernii*, 21. *A. korthalsii*, 22. *A. lancifolia*, 23. *A. lancilimba*, 25. *A. laxiflora*, 26. *A. leptantha*, 27. *A. leucophylla*, 28. *A. luzoniensis*, 31. *A. meliosmoides*, 32. *A. monozyga*, 34. *A. neotenica*, 35. *A. odoratissima*, 36. *A. oligophylla*, 37. *A. pachyphylla*, 38. *A. palembanica*, 39. *A. ramotricha*, 40. *A. rivularis*, 42. *A. rufibarbis*, 43. *A. rufinervis*, 45. *A. scortechinii*, 46. *A. sessilifolia*, 47. *A. sexipetala*, 48. *A. silvestris*, 49. *A. simplicifolia*, 50. *A. soepadmoi*, 51. *A. speciosa*, 53. *A. squamulosa*, 54. *A. stellatopilosa*, 55. *A. sterculioides*, 56. *A. subsessilis*, 57. *A. tenuicaulis*, 59. *A. tomentosa* and 60. *A. variisquama*.

Sect. **Amoora:** *Calyx* with 3 broadly obtuse lobes; *petals* 3, aestivation imbricate; *anthers* 6–21. *Fruits* more than 6 cm long, dehiscent. *Seeds* with opaque aril, which when fresh has red, white or yellow outer skin. This section is, in Sabah and Sarawak, represented by: 7. *A. cucullata*, 13. *A. erythrosperma*, 29. *A. macrocarpa*, 30. *A. malaccensis*, 33. *A. multinervis*, 41. *A. rubiginosa*, 44. *A. rugulosa* and 52. *A. spectabilis*.

Sect. **Neoaglaia**: (*cf.* Muellner *et al.*, *American Journal of Botany* 92 (2005) 534–543). Intermediate between the other two sections. Calyx with 3 (or rarely 4) broadly obtuse lobes; petals 3–5 (or rarely 6); *anthers* (*rarely* 4)6–10. Fruits small, 1–2.8(–6) × 1.2–2.3(–3.5) cm, dehiscent; when fresh the pericarp usually pink, sometimes carmine-red or yellow in *Aglaia lawii*. Seeds with opaque aril, which when fresh has a red or orange outer skin and white flesh of soft consistency. Species in Sabah and Sarawak belonging to this section are: 3. *A. beccarii*, 24. *A. lawii* and 58. *A. teysmanniana*.

Uses. The timber of several *Aglaia* species is suitable for a variety of uses. The heavier timber (e.g., *A. cucullata* and *A. edulis*) is used in house- and bridge-building, while the moderately heavy timber (e.g., *A. elliptica* and *A. lawii*) is used for light and interior construction. The attractive figure and good working properties of some species make their wood suitable for furniture, flooring, fine finishing, cabinets, turnery, decorative wall panelling, interior trim and face veneer as a substitute for mahogany. The wood is also locally used for general construction, joinery, boat-building, agricultural implements and tool handles. Small-sized poles are often used for fences or poles in local house construction. The arils surrounding the seeds of species with indehiscent fruits are mostly edible (*cf.* PROSEA 5, 2 (1995) 38–54).

Notes. Species distinction in this genus is problematic and is based to a large extent on the structure and distribution of the indumentum. The indumentum is made up of peltate scales or stellate hairs or scales, or a mixture of these. Scales lie in the same plane as the leaflet surface. Peltate scales are round, plate-like structures with an entire (Fig. 1D, 5C, 5I and 6B) or fimbriate (Fig. 2F and 4F) margin, with the rays are visible radiating from the centre of the scale, where it is attached to the leaflet surface. Stellate scales have separate arms radiating from the central point (Fig. 3S and 4B). Stellate hairs also have arms radiating from the centre, but the arms point in any direction from parallel with the plant surface to patent (Fig. 1C, 3C, 5E, 8C, 9B, 10C, 10J and 10Q). The hairs or scales are usually visible with a 20x hand lens, but if a dissecting microscope is available when identifying herbarium specimens, this facilitates observation of key indumentum characters. If neither flowers nor ripe fruits are available, the key allows most species to be identified from a leafy shoot. Hairs and scales are always present on the shoot apex, even if they are absent from the lower surface of the leaflets. Those species most difficult to identify, as well as variable species, appear more than once in the key.

Key to *Aglaia* species

1. Leaves simple (unifoliolate).....2
 Leaves compound (imparipinnate, very rarely paripinnate).....8
2. Leaves linear-lanceolate, more than 4x longer than wide.....**40. A. rivularis**
 Leaves not linear-lanceolate, less than 4x longer than wide (rarely one leaflet on a specimen is slightly more than 4x longer than wide).....3
3. Indumentum composed of peltate scales only, stellate hairs absent.....**28. A. luzoniensis**
 Indumentum composed of stellate hairs, rarely interspersed with peltate scales.....4
4. Leaves shiny when dry; intercostal venation subprominent on both sides.....**31. A. meliosmoides**
 Leaves not shiny when dry; intercostal venation may be visible, but not subprominent..5

5. Leaf base cordate.....**46. A. sessilifolia**
 Leaf base rounded or cuneate.....6
6. Indumentum of mature leaves persistent along midrib and, to a lesser extent, the lateral veins below. Fruits curved with a short stipe (narrowed region at base of fruit).....**55. A. sterculioides**
 Indumentum absent or sparse on mature leaves. Fruits not curved and without stipe.....7
7. Leaves narrowly elliptical, yellowish green when dry, apex caudate with acumen to 22 mm long; lateral veins 8–15 on each side of midrib. Ripe fruits ovoid, to 6.9 × 3.9 cm, with up to 8 longitudinal ridges or flanges.....**34. A. neotenica**
 Leaves elliptical or obovate, pale green when dry, apex acute to obtuse; lateral veins 14–22 on each side of midrib. Ripe fruits subglobose, c. 2.2 × 1.9 cm, with one longitudinal ridge around it.....**49. A. simplicifolia**
8. Flowers with 3 calyx lobes and 3 petals. Ripe fruits 3- or 4-locular, dehiscent.....9
 Flowers with more than 3 (usually 5) calyx lobes and more than 3 (usually 5) petals. Ripe fruits 1- or 2-(or rarely 3)-locular and indehiscent or 3- or 4-locular and dehiscent (or ripe fruit absent or these characters not easily observed).....19
9. Leaflet lower surface completely covered with a reddish brown indumentum..... **41. A. rubiginosa** (in part)
 Leaflet lower surface not completely covered with such an indumentum.....10
10. Ripe fruits less than 3 cm in diameter.....11
 Ripe fruits more than 3 cm in diameter.....13
11. Indumentum of peltate scales only.....**24. A. lawii** (in part)
 Indumentum either of peltate scales interspersed with stellate hairs or of stellate hairs only.....12
12. Leaflet surface and midrib densely covered with pale stellate hairs below, peltate scales absent, base asymmetrical, margin plane or slightly recurved; petiolules 1–2 cm long. Staminal tube cup-shaped, c. 1.1 × 1.3 mm. Seeds obovoid.....**58. A. teysmanniana** (in part)
 Leaflet surface and midrib sparsely covered with pale peltate scales below, sometimes interspersed with stellate hairs or scales, base symmetrical, margin recurved and undulate; petiolules 0–1 cm long. Staminal tube obovoid, 1.4–2.5 × 1.3–2.5 mm. Seeds subglobose.....**3. A. beccarii** (in part)
13. Leaves with 10–12 lateral leaflets on each side of rachis; leaflets with 20–25 lateral veins on each side of midrib.....**33. A. multinervis** (in part)
 Leaves with up to 10 lateral leaflets on each side of rachis; leaflets with up to 19 lateral veins on each side of the midrib.....14
14. Leaflet margins recurved, upper surface often shiny when dry.....**13. A. erythrosperma** (in part)
 Leaflet margins not recurved, upper surface dull when dry.....15

15. One or both leaflet surfaces rugulose.....16
 Leaflet surfaces not rugulose.....18
16. Small tree (to 12 m tall). Leaflets usually attenuate at base (occasionally rounded)...
**44. A. rugulosa** (in part)
 Mature tree usually more than 12 m tall. Leaflets rounded or cuneate at base.....17
17. Intercostal venation not subprominent on lower leaflet surface. Flowers obovoid, 2–3.5
 × 1.6 mm; staminal tube subglobose, *c.* 1.5 mm diameter, anthers 6. Fruits obovoid, to
 7.5 × 7.3 cm; when dry the pericarp longitudinally wrinkled and moulded around the
 seeds.....**29. A. macrocarpa** (in part)
 Intercostal venation subprominent on lower leaflet surface. Flowers ellipsoid, 5–7 × 3–6
 mm; staminal tube cup-shaped, *c.* 2.5 mm diameter, anthers 6–9. Fruits ellipsoid, 8–10
 × 6–8 cm; pericarp not so.....**52. A. spectabilis** (in part)
18. Midrib sparsely to densely covered with minute pale brown or almost white stellate hairs
 or scales.....**30. A. malaccensis** (in part)
 Midrib sparsely to densely covered with minute dark reddish brown peltate scales (which
 sometimes resemble minute pits), sometimes interspersed with pale grey peltate
 scales.....**29. A. macrocarpa** (in part)
19. Leaflet lower surface without or with few hairs or scales; reticulation of intercostal veins
 continuous and subprominent on one or both surfaces.....20
 Leaflet lower surface sparsely to densely covered with scales or stellate hairs; if without
 hairs and/or scales then reticulation of intercostal veins not continuous nor subprominent
 on either surface22
20. Leaflets with the intercostal venation subprominent on the lower
 surface.....**8. A. cumingiana** (in part)
 Leaflets with the intercostal venation subprominent on both surfaces.....21
21. Lateral leaflets 5–7 on each side of rachis, dull when dry.....**25. A. laxiflora** (in part)
 Lateral leaflets 1–3(–5) on each side of rachis, slightly shiny when
 dry.....**36. A. oligophylla** (in part)
22. Leaflets linear-lanceolate or narrowly elliptical, mostly at least 5x longer than
 wide.....23
 Leaflets ovate, elliptical, oblong, oblong-obovate, obovate, lanceolate or oblanceolate,
 mostly less than 5x longer than wide.....26
23. Leaflets at least 10x longer than wide.....**1. A. angustifolia**
 Leaflets 4 to 5, and occasionally to 10x longer than wide.....24
24. Leaflets with stellate hairs and scales numerous on the lower surface or densely covering
 the midrib and numerous on the lower surface.....**4. A. bullata**
 Leaflets with stellate hairs or scales or peltate scales few on the lower surface or densely
 covering the midrib and few or absent on the lower surface.....25

25. Leaflets below with reddish brown stellate hairs or scales densely covering the midrib; blades 11–25 × 1–4.5 cm; lateral veins 6–19 on each side of midrib. Fruits indehiscent, globose, to 2.5 × 2.4 cm.....**22. A. lancifolia**
 Leaflets below with a few to dense cover of peltate fimbriate scales on the midrib; blades 7–12 × 1.8–2 cm; lateral veins 20–25 on each side of midrib, alternating with less distinct shorter veins. Fruits dehiscent, subglobose or ovoid with a small beak, to 6 × 5 cm.....**33. A. multinervis** (in part)
26. Indumentum dense, composed of white or pale brown hairs or scales which nearly or totally conceal leaflet lower surface.....27
 Indumentum reddish brown or, if pale, not totally concealing leaflet lower surface.....32
27. Indumentum composed of hairs which have a central rachis and several whorls of arms radiating from it.....28
 Indumentum composed of stellate hairs or peltate scales.....29
28. Twigs and rachis channelled. Lateral leaflets 9–13 on each side of rachis. Indumentum on lower leaflet surface so dense that the surface is barely visible between the hairs even when using a hand lens. Fruits to 8 × 8.5 cm.....**37. A. pachyphylla** (in part)
 Twigs and rachis terete. Lateral leaflets (4 or) 5–9 on each side of rachis. Indumentum on lower leaflet surface dense but the surface visible between the hairs when using a hand lens. Fruits to 5 × 5.6 cm.....**19. A. grandis**
29. Leaflet upper surface rugose.....**53. A. squamulosa** (in part)
 Leaflet smooth on both surfaces.....30
30. Indumentum dense on lower leaflet surface, consisting of very pale brown peltate scales interspersed with few to numerous brown peltate scales.....**2. A. argentea**
 Indumentum dense on lower leaflet surface, consisting of white stellate scales interspersed with few to numerous brown stellate hairs.....31
31. Lateral leaflets 4 or 5 on each side of rachis; blades ovate, elliptical or obovate; lateral veins 11–17 on each side of midrib; intercostal venation visible above, slightly prominent below; petiolules to 0.5 cm long. Fruits c. 2 × 2 cm, densely covered with dark brown stellate hairs.....**50. A. soepadmoi**
 Lateral leaflets 9–13 on each side of rachis; blades oblong, lanceolate or oblanceolate; lateral veins 24–39 on each side of midrib; intercostal venation subprominent or faint but visible on both surfaces; petiolules 1–2.5 cm long. Fruits to 8 × 8.5 cm, glabrescent.....**37. A. pachyphylla** (in part)
32. Leaflet lower surface densely covered with reddish brown or orange-brown hairs or scales, the surface not or barely visible.....33
 Hairs or scales absent from leaflet lower surface or, when present, the surface readily visible.....35
33. Leaflet lower surface with numerous stellate hairs, interspersed with paler hairs which have one or few ascending arms, the surface barely visible.....**20. A. hiernii** (in part)
 Leaflet lower surface densely covered with stellate or peltate scales, sometimes interspersed with stellate hairs, the surface not visible.....34

34. Twigs densely covered with dark reddish brown peltate scales. Lateral leaflets 4 or 5 on each side of rachis; leaflet lower surface with dark reddish brown entire peltate scales. Flowers pentamerous. Fruits indehiscent, with a long narrow beak to 1.5 cm long and short broad stalk to 5 mm long.....**9. A. densisquama**
Twigs densely covered with reddish brown or dark brown stellate hairs. Lateral leaflets 9–12 on each side of rachis; leaflet lower surface with reddish brown stellate scales. Flowers trimerous. Fruits dehiscent, without such beak and stalk.....**41. A. rubiginosa** (in part)
35. Indumentum mainly consisting of peltate scales, sometimes interspersed with stellate scales.....36
Indumentum mainly consisting of stellate hairs or scales, peltate scales few or absent.....60
36. Indumentum comprising peltate scales only.....37
Indumentum comprising peltate and stellate scales (or with at least some of the scales with a long fimbriate margin).....57
37. Peltate scales densely covering leaflet lower surface.....38
Peltate scales almost absent to numerous on leaflet lower surface.....39
38. Twigs, inflorescence branches and leaflet lower surface covered with yellowish brown or orange-brown peltate scales, all less than 0.25 mm diameter. Fruits 2.5–3.5 × 2–2.5 cm.....**A. crassinervia** (in part)
Twigs, inflorescence branches and leaflet lower surface thickly covered with large, shiny, peltate scales at least some of which are 0.25 mm or more diameter. Fruits 5–5.7 × 3.5–4.7 cm.....**53. A. squamulosa** (in part)
39. Scales few to numerous on leaflet lower surface.....40
Scales absent from leaflet lower surface but sometimes densely covering the midrib below and immediately adjacent to it, occasionally also on the lateral veins.....48
40. Indumentum comprising orange-brown, pale brown or almost white peltate scales....41
Indumentum comprising, at least partly, reddish brown peltate scales.....46
41. Leaflets markedly asymmetrical, terminal ones often folded at the base forming a pocket.....**7. A. cucullata** (in part)
Leaflets only slightly asymmetrical, terminal ones not as above.....42
42. Peltate scales numerous and evenly distributed on leaflet lower surface, sometimes visible to the naked eye as tiny dots.....43
Peltate scales few and not evenly distributed on leaflet lower surface or, if they are, not visible to the naked eye.....44
43. Leaflet lower surface with numerous large dark orange-brown peltate scales and the surface visible to the naked eye as evenly distributed spots. Fruits *c.* 4 × 4 cm.....**60. A. variisquama**
Leaflet lower surface with numerous small yellowish brown or orange-brown peltate scales which have an entire or fimbriate margin or almost stellate scales and the surface visible only with a hand lens. Fruits 2.5–3.5 × 2–2.5 cm.....**6. A. crassinervia** (in part)

44. Fruits dehiscent.....**24. A. lawii** (in part)
 Fruits indehiscent.....45
45. Leaflets below with a few to numerous small, reddish brown, pale brown or orange-brown stellate hairs and scales or peltate scales on the midrib only. Fruits 3.2–5 × 3.1–4.2 cm, usually subglobose with an apical depression, 3-locular but sometimes the seed failing to develop in 1 or 2 of the locules; pericarp thick, woody when dry.....**10. A. edulis** (in part)
 Leaflets below with large pale brown or orange-brown peltate scales with entire or fimbriate margin on the midrib and few to numerous on the surface. Fruits 1.1–2.5 × 1.3–1.5 cm, subglobose, ellipsoid or obovoid without an apical depression, 2-locular; pericarp thin when dry.....**11. A. elaeagnoidea**
46. Staminal tube with a narrow pin-prick aperture *c.* 0.3 mm diameter with an entire margin; anthers included.....**8. A. silvestris**
 Staminal tube with the aperture more than 0.3 mm diameter, margin shallowly lobed; anthers protruding through the aperture of the staminal tube.....47
47. Leaflets narrowly elliptical or narrowly obovate; with numerous scales on the lower surface. Fruits obovoid, without dehiscent lines.....**51. A. speciosa**
 Leaflets ovate or elliptical or sometimes obovate, with few to numerous scales on the lower surface. Fruits ellipsoid, with a longitudinal ridge along which the pericarp splits when pressure is applied.....**21. A. korthalsii**
48. Scales densely covering the midrib on leaflet lower surface and immediately adjacent to the midrib, occasionally also on the lateral veins.....49
 Scales sparse or more or less absent from leaflet lower surface.....52
49. Scales more than 0.2 mm diameter, orange-brown, reddish brown or almost white, with a tendency to flake off.....**23. A. lancilimbia**
 Scales less than 0.2 mm diameter or, if larger, dark reddish brown or purplish brown and adhering closely to the leaflet surface.....50
50. Leaflet lower surface with purplish brown fimbriate peltate scales densely covering the midrib and more or less absent from the rest of the surface.**17. A. glabrata** (in part)
 Leaflet lower surface with dark reddish brown peltate scales numerous on the midrib.....51
51. Lateral leaflets (3 or)4–6(or 7) on each side of rachis; stellate scales absent; petiolules 0.5–1 cm long.....**45. A. scortechinii**
 Lateral leaflets 1 or 2 (or rarely 3) on each side of rachis; some stellate scales interspersed among the peltate scales; petiolules 2–3.5 cm long.....**35. A. odoratissima** (in part)
52. Leaflet veins usually brown or black when dry. Petals 5. Fruit indehiscent.....53
 Leaflet veins rarely black when dry. Petals usually 3 (rarely 4). Fruit dehiscent.....54
53. Leaves to 30 cm long; lateral leaflets opposite; lateral veins of leaflets 6–7 on each side of midrib. Calyx outside without hairs or scales. Fruits without longitudinal ridge.....**18. A. glabriflora**
 Leaves 30–83 cm long; lateral leaflets alternate; lateral veins of leaflets 9–

- 13 on eachside of midrib. Calyx outside densely covered with peltate scales.
Fruits with a longitudinal ridge.....**26. A. leptantha**
54. Leaflets markedly asymmetrical, the terminal ones sometimes folded at the base forming a pocket.....**7. A. cucullata** (in part)
Leaflets only slightly asymmetrical, the terminal ones not as above.....55
55. Ripe fruits to 2.9 cm diameter.....**24. A. lawii** (in part)
Ripe fruits more than 3.5 cm diameter.....56
56. Lateral leaflets 10–12 on each side of rachis, lanceolate; lateral veins 20–25 on each side of midrib, indistinct below; petiolules to 1 cm long. Fruits to 6 × 5 cm.....**33. A. multinervis** (in part)
Lateral leaflets 4–7 on each side of rachis, ovate, obovate, elliptical or oblanceolate; lateral veins 6–15 on each side of midrib, subprominent below; petiolules 1.5–2 cm long. Fruits to 7.5 × 7.3 cm.....**29. A. macrocarpa** (in part)
57. Leaflets not pale yellowish green when dry.....**35. A. odoratissima** (in part)
Leaflets pale yellowish green when dry or with whitish green or orange veins.....58
58. Fruit dehiscent (indicated in unripe fruits by three longitudinal ridges on the pericarp).....**3. A. beccarii** (in part)
Fruit indehiscent (any longitudinal markings on the fruits being slight depressions rather than ridges).....59
59. Leaflets pale brown or yellowish brown when dry. Fruits usually subglobose and 3-locular but sometimes the seed failing to develop in 1 or 2 of the locules.....**10. A. edulis** (in part)
Leaflets yellow or yellowish green when dry. Fruits usually pear-shaped, sometimes subglobose and 2-locular.....**27. A. leucophylla** (in part)
60. Leaflet lower surface with a sparse to dense cover of stellate hairs or scales; when sparse, some hairs or scales occurring evenly distributed between the veins and visible to the naked eye.....61
Leaflet lower surface with or without a few hairs or with a dense cover of hairs on the midrib only and with a few to many stellate scales (visible only with a hand lens) unevenly scattered on the rest of the surface.....75
61. Intercostal venation subprominent on both surfaces when dry. Twigs and sometimes other parts of plant with some hairs which have a central rachis and several whorls of arms radiating from it.....**39. A. ramotricha**
Intercostal venation faint on both surfaces or prominent below. All hairs on plant parts lacking a central rachis.....62
62. Hairs pale yellowish brown or if reddish brown then flower trimerous.....63
Hairs reddish brown or brown, or if pale brown then flower pentamerous.....64
63. Peltate scales absent. Petiolules 1–2 cm long.....**58. A. teysmanniana** (in part)
Peltate scales present, at least on the shoot apex. Petiolules 0–1 cm long.....**A. beccarii** (in part)

64. Hairs on lower leaflet surface numerous and with the arms of adjacent hairs overlapping, but leaving the surface of the leaflet visible.....65
Hairs on leaflet lower surface few or at least with the arms not usually overlapping...
.....69
65. Hairs compact, arms all more or less equal in length *c.* 0.5 mm, brown, densely covering the midrib and densely covering or scattered on the rest of the leaflet lower surface.....66

Hairs large and spreading, arms unequal in length to 1 mm long and in one species (*A. rufibarbis*) more than 1 mm, usually reddish brown and numerous on leaflet lower surface.....67
66. Lower surface of leaflet densely covered with persistent brown stellate hairs and scales. Petiolules to 3.5 cm long. Fruits *c.* 1.7–2.2(–3) × 1.4–2(–2.7) cm; pericarp thin *c.* 2 mm thick, hard and brittle or woody.....**47. A. sexipetala** (in part)
Lower surface of leaflet densely covered with deciduous brown stellate hairs leaving many pits and an uneven indumentum most dense near midrib and veins. Petiolules to 2 cm long. Fruits *c.* 4 × 3.8 cm; pericarp to 4 mm thick, soft.....**15. A. forbesii** (in part)
67. Stellate hairs with long arms, some of which over 1 mm long.....**42. A. rufibarbis**
Stellate hairs with arms up to 1 mm long.....68
68. Lower surface of leaflet with numerous dark reddish brown stellate hairs, the arms of adjacent hairs overlapping, interspersed with some pale brown hairs which have one or few ascending arms. Fruits to 4 × 3 cm, 1-locular, with a hard woody pericarp 2–4 mm thick.....**20. A. hiernii** (in part)
Lower surface of leaflet with numerous reddish brown or orange-brown stellate hairs, the arms of adjacent hairs usually overlapping, interspersed with pale brown stellate hairs, each with several ascending arms. Fruits to 3 × 2.2 cm, 2-locular, with a brittle pericarp less than 2 mm thick.....**59. A. tomentosa** (in part)
69. Leaflet lower surface with indumentum comprising few fimbriate peltate scales and stellate hairs. Fruits to 4 mm diameter, hairs few or absent.....**38. A. palembanica**
Leaflet lower surface without peltate scales. Fruits *c.* 1 cm or more diameter, with dense indumentum.....70
70. Lateral leaflets usually more than 5 on each side of rachis; arms of adjacent hairs on lower surface not overlapping.....71
Lateral leaflets rarely more than 5 on each side of rachis, (if so, the indumentum dense and arms of adjacent hairs on lower surface overlapping).....72
71. Hairs and scales mostly reddish brown. Fruits subglobose, to 1.2 cm diameter, 1-locular.....**43. A. rufinervis**
Hairs and scales mostly orange-brown. Fruits pear-shaped or subglobose, to 2.7 cm diameter, 2-locular.....**27. A. leucophylla** (in part)
72. Leaflets to 6 cm wide, elliptical or oblong; stellate hairs compact, distributed evenly on lower leaflet surface, visible to the naked eye as brown dots, the arms of adjacent hairs and scales not overlapping.....**14. A. exstipulata**

- Leaflets to 11.5 cm wide, mostly obovate, individual hairs not visible as evenly spaced brown dots, the arms of adjacent hairs and scales overlapping.....73
73. Tree usually unbranched.....**57. A. tenuicaulis** (in part)
Tree branching several or many times when mature.....74
74. Leaflets with numerous pale stellate scales on the lower surface, interspersed with reddish brown stellate hairs with arms of different lengths. Fruits 2-locular.....**59. A. tomentosa** (in part)
Leaflets with numerous pale brown or reddish brown stellate hairs, that of the lower surface with arms of similar lengths. Fruits 1-locular.....**57. A. tenuicaulis** (in part)
75. Leaflet lower surface with numerous stellate or peltate scales.....76
Leaflet lower surface with hairs or scales few between the veins when mature, but sometimes densely covering the midrib.....79
76. Stellate scales on lower leaflet surface interspersed with compact stellate hairs.....**47. A. sexipetala** (in part)
Stellate scales on lower leaflet surface sometimes interspersed with peltate scales, stellate hairs absent.....77
77. Fruit dehiscent.....**3. A. beccarii** (in part)
Fruit indehiscent.....78
78. Scales all of one type. Fruits 1(rarely 2)-locular.....**6. A. crassinervia** (in part)
Stellate and peltate scales present together. Fruits 2-locular.....**7. A. leucophylla** (in part)
79. Stellate hairs or scales visible with a hand lens, numerous on or densely covering the midrib, sometimes also on the lateral veins, almost absent elsewhere on the leaflets lower surface.....80
Stellate hairs or scales either minute or almost totally absent from the midrib below and from the rest of the leaflet lower surface.....91
80. Leaflets more or less sessile or with a short petiolules rarely more than 1 cm long; the basal ones much smaller than the rest and subrotund.....**6. A. subsessilis** (in part)
Leaflets not sessile, the basal ones only slightly smaller than the rest and of similar shape.....81
81. Intercostal venation subprominent on lower surface and often on upper surface of leaflet.....82
Intercostal venation inconspicuous or sometimes visible but faint on lower surface.....83
82. Lateral leaflets 5–7 on each side of rachis, with pale brown stellate scales few to numerous on the midrib below; intercostal venation subprominent on both surfaces. Fruits ellipsoid or obovoid, 5–6 × 3.5 cm.....**25. A. laxiflora** (in part)
Lateral leaflets 1–5 on each side of rachis, with pale yellowish brown stellate hairs

- absent to numerous on the midrib below; intercostal venation visible above, subprominent below. Fruits subglobose, to 3.4×3.7 cm.....**36. A. oligophylla** (in part)
83. Tree unbranched or rarely with few branches. Leaflets above shiny when dry.....**5. A. coriacea**
Tree branched. Leaflets above dull (pale yellowish green) when dry.....84
84. Leaflet surfaces with prominent pits.....85
Leaflet surfaces not or faintly so pitted.....87
85. Lateral leaflets 2–4 on each side of rachis.....**17. A. glabrata** (in part)
Lateral leaflets more than 4 on each side of rachis.....86
86. Leaves to 42 cm long; petioles to 8 cm long; leaflets 1.3–2.2(–4.5) cm wide, yellowish green or brown when dry; intercostal venation visible to subprominent; petiolules to 0.8 cm long. Fruits to 2.5 cm long.....**16. A. foveolata**
Leaves to 100 cm long; petioles to 35 cm long; leaflets 3.5–9 cm wide, blackish green when dry; intercostal venation barely visible; petiolules 1.5–2 cm long. Fruits to 4 cm long.....**15. A. forbesii** (in part)
87. Fruit with three longitudinal ridges running from base to apex.....88
Fruit without or with one or two or ten longitudinal ridges from base to apex.....89
88. Fruits dehiscent, $2-2.2 \times 2.1-2.5$ cm.....**2. A. beccarii** (in part)
Fruits indehiscent, $3.2-5 \times 3.1-4.2$ cm.....**10. A. edulis** (in part)
89. Fruits without longitudinal ridges.....**54. A. stellatopilosa** (in part)
Fruits with one longitudinal ridge around it or ten longitudinal ridges from apex to base.....90
90. Lateral leaflets (2 or)3–6 on each side of rachis, subopposite or almost alternate. Fruits obovoid or ellipsoid, with one longitudinal ridge around it.....**12. A. elliptica**
Lateral leaflets 1 or 2 on each side of rachis, opposite. Fruits narrowly ellipsoid, with 10 longitudinal ridges from base to apex.....**56. A. subsessilis** (in part)
91. Petals 5 (or 6). Leaflets yellow or yellowish green; lateral veins black or dark brown when dry.....92
Petals 3. Leaflets brown, greenish brown, purplish brown or orange-brown; lateral veins usually the same colour as the leaflet surface.....96
92. Leaflets greyish brown or blackish green when dry, particularly the veins; scales pale grey or greyish brown.....93
Leaflets yellow or yellowish green when dry; hairs or scales pale brown, reddish brown or golden-brown.....94
93. Leaves to 100 cm long; petioles to 35 cm long; leaflets $8.5-21 \times 3.5-9$ cm, lateral veins 12–24 on each side of midrib. Fruits *c.* 4×3.8 cm.....**15. A. forbesii** (in part)
Leaves 15–25 cm long; petioles 3–5 cm long; leaflets $2-6 \times 1-1.8$ cm, lateral veins 4–6 on each side of midrib. Fruits *c.* 2.3×2 cm.....**54. A. stellatopilosa** (in part)

94. Inflorescences delicate; peduncles, rachis and branches flattened, these and calyces with a very few pale brown stellate scales.....**8. A. cumingiana** (in part)
 Inflorescences robust; peduncles, rachis and branches terete, with numerous to dense cover of orange-brown or reddish brown hairs or scales.....95
95. Lateral leaflets 3–7(–8) on each side of rachis, base rounded or cuneate, margins not recurved when dry; with few to numerous golden-brown scales on the lower surface.....**27. A. leucophylla** (in part)
 Lateral leaflets 1 or 2 on each side of rachis, base cuneate or attenuate, margins recurved when dry; when young, lower surface densely covered with reddish brown stellate hairs, becoming more or less glabrous when older.....**32. A. monozyga**
96. Leaflet surfaces dull and pitted, with tiny stellate hairs sometimes frequent on lower surface; intercostal venation subprominent.....**52. A. spectabilis** (in part)
 Leaflet surfaces smooth or rugulose but not pitted, stellate hairs almost absent from lower surface; reticulation of intercostal veins faint.....97
97. Leaflets 2–4(–6.5) cm wide, lower surface usually purplish brown and smooth when dry.....**30. A. malaccensis** (in part)
 Leaflets (4–)6–12 cm wide, lower surface not purplish brown when dry.....98
98. Lateral leaflet 3–5 on each side of rachis, surfaces smooth or only slightly rugulose, base usually rounded, sometimes cuneate. Fruits subglobose, *c.* 10 cm diameter; pericarp to 1.5 cm thick.....**13. A. erythroperma** (in part)
 Lateral leaflet 6–7 on each side of rachis, surfaces rugulose, base usually attenuate, sometimes cuneate. Fruits ellipsoid or obovoid, to 3.6 cm diameter; pericarp 2–5 mm thick.....**44. A. rugulosa** (in part)

1. *Aglaia angustifolia* (Miq.) Miq.

(Latin, *angustus* = narrow, *folium* = leaf; referring to the narrow leaflets)

Sect. *Aglaia*

Ann. Mus. Lugd. Bat. 4 (1868) 55; Merrill *op. cit.* (1921) 321; Masamune *op. cit.* 370; Corner, Gard. Bull. Sing. Suppl. 1 (1978) 131; Anderson *op. cit.* (1980) 247; Pannell *op. cit.* (1989) 211, *op. cit.* (1992) 337, *op. cit.* (1995) 309; Whitmore, Tantra & Sutisna *op. cit.* 220; Turner, Gard. Bull. Sing. 47 (1995) 336; Coode *et al.* (eds.) *op. cit.* 200. **Basionym:** *Hartighsea angustifolia* Miq., Fl. Ind. Bat. Suppl. 1 (1861) 196, 504. **Lectotype** (Pannell, 1992); *Teijsmann HB 689*, Sumatra, Loeboe-Aloeng (U [Acc. No. 39273]; isoelectotype L [Acc. No. 9081321277]). **Synonyms:** *Hearnia beccariana* C.DC. in A.P. de Candolle, Mon. Phan. 1 (1878) 629; *Aglaia beccariana* (C.DC.) Harms *op. cit.* 298, Merrill *op. cit.* (1921) 321, Masamune *op. cit.* 370, Anderson *op. cit.* (1980) 247; *Aglaia stenophylla* Merr., Philipp. J. Sci., Bot. 11 (1916) 185.

Small tree to 7 m tall, 10 cm diameter, *unbranched* or rarely with a few branches. **Bark** smooth, greyish green or greyish brown or pale brown, sometimes with large lenticels or shallow vertical cracks; inner bark yellow-brown, pale orange or brown; latex white. **Sapwood** pale yellowish brown, becoming orange or brown towards the centre. **Twigs** stout, *densely covered with reddish brown or orange-brown stellate hairs with arms to 1 mm long*. **Leaves** *imparipinnate*, to 100 cm long; petioles to 15 cm long; *leaflets below densely*

covered with stellate hairs on the surface and midrib, sometimes interspersed with either smaller paler hairs with fewer arms or stellate scales; lateral leaflets 9–12(–17) on each side of rachis, subopposite; blades linear-lanceolate, 8.5–34 × 0.5–4 cm, base rounded or subcordate, asymmetrical, margin recurved, apex caudate, acumen acute; midrib prominent below; lateral veins 18–31 on each side of midrib, curved upwards, subprominent below; intercostal venation usually faintly visible; petiolules 0–0.5 cm long. **Inflorescences** densely covered with brown stellate hairs; males to 35 cm long, 24 cm wide; females to 10 cm long. **Flowers** 1.1–1.2 × 1.2–1.5 mm; calyx deeply divided into 5 elliptical lobes with numerous stellate hairs outside; corolla c. 1 × 1.5 mm, divided almost to the base into 5 subtund lobes, bright yellow; staminal tube c. 0.8 × 1 mm, pale yellow, anthers 5, ovoid, c. 0.2 × 0.2 mm; ovary depressed globose, c. 0.2 × 0.2 mm, locule 1, containing 1 ovule, stigma c. 0.3 × 0.2 mm. **Fruits** indehiscent, 1-locular, subglobose, c. 1.2 × 1 cm, yellowish brown; pericarp c. 0.5 mm thick, fairly soft. **Seed** 1, c. 1 × 0.8 × 0.6 cm; aril thin, c. 0.2 mm thick, translucent.

Vernacular names. Sarawak—*pasak bumi* (Malay), *segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia (Johor), Anambas and Natuna Islands, Borneo and the Philippines. In Borneo, known only in Sarawak from Kuching, Lundu, Simunjan, Sri Aman and Song districts (e.g., *Mabberley 1605*, *Pennington 7962*, *Pennington 7973*, *S 42274*, *S 42275* and *S 42859*), Brunei (e.g., *S 21583*, *S 21584* and *SAN 17565*) and Kalimantan (e.g., *Nooteboom 4776*).

Ecology. In mixed dipterocarp forest, sometimes occurring along rivers and in *kerangas* forest, at altitudes to 1000 m.

2. *Aglaia argentea* Blume

(Latin, *argenteus* = silvery; the lower surface of leaflets)

Sect. *Aglaia*

Bijdr. Fl. Ned. Ind. (1825) 170; Miquel *op. cit.* (1861) 543, *op. cit.* (1868) 54; King *op. cit.* 70; Koorders & Valeton, Atl. Baum. Java, 1 (1913) t. 151; Merrill *op. cit.* (1921) 321; Ridley *op. cit.* (1922) 405; Masamune *op. cit.* 370; Backer & Bakhuizen *f. op. cit.* 129; Anderson *op. cit.* (1980) 247; Pannell *op. cit.* (1989) 211, *op. cit.* (1992) 125, *op. cit.* (1995) 237; Whitmore, Tantra & Sutisna *op. cit.* 220; PROSEA *op. cit.* (1995) 42; Turner *op. cit.* 336; Coode *et al.* (eds.) *op. cit.* 200; Beaman & Anderson *op. cit.* 119. **Lectotype** (Pannell, 1992): *Blume s.n.*, Java, Mt. Salak (L [Acc. No. 9108162]). **Synonyms:** *Aglaia hypoleuca* Miq. *op. cit.* (1861) 197, 507; *Aglaia argentea* Blume var. *hypoleuca* (Miq.) Miq. *op. cit.* (1868) 55; *Aglaia argentea* Blume var. *borneensis* Miq. *op. cit.* (1868) 55; *Aglaia argentea* Blume var. *curtisii* King *op. cit.* 71; *Aglaia multifoliola* Merr., Philip. J. Sci., Bot. 9 (1915) 534, Masamune *op. cit.* 372; *Aglaia discolor* Merr. *op. cit.* (1929) 130, Masamune *op. cit.* 371, Anderson *op. cit.* (1980) 247.

Tree to 25 m tall, to 60 cm diameter, branched; buttresses to 1 m tall, 1 m out and 4 cm thick. **Bark** brown or grey, smooth; inner bark pale yellow, brown or reddish brown; latex white, when present. **Sapwood** white, pale brown, brown or reddish brown. **Twigs** stout, densely covered with brown peltate scales with a darker centre. **Leaves** imparipinnate, to 112 cm long; petioles to 41 cm long; leaflets below thickly covered with very pale brown

peltate scales interspersed with a few to numerous brown peltate scales; lateral leaflets 4–6 on each side of rachis, subopposite; *blades smooth on both surfaces, elliptical or oblong, 6.5–31 × 2–7 cm*, base rounded or subcorded, asymmetrical, margin planar, apex acuminate, acumen acute, to 10 mm long; midrib impressed above, prominent below; lateral veins 9–20 on each side of midrib; *intercostal venation invisible on both surfaces*; petiolules 0.5–1 cm long on lateral leaflets, 1–1.2 cm long on terminal leaflets. **Inflorescences** to 60 cm long and wide, densely covered with brown peltate scales. **Flowers** ellipsoid, 2.5–3 × 1.6–2 mm, sessile; *calyx* thickly covered with scales like that of the leaves, *deeply divided into 5 rounded lobes*; *petals* 5; staminal tube obovoid, 1.6–1.8 × 1.2–1.3 mm, *anthers* 5, ovoid, 0.7–0.8 × 0.5 mm; ovary depressed globose, 0.3–0.5 × 0.4–0.9 mm, locules 3, each containing one ovule, stigma ovoid with a truncate apex, 0.6–0.8 × 0.5–0.6 mm, longitudinally ridged. **Fruits** *indehiscent, 2(or 3)-locular*, each locule containing 0 or 1 seed, densely covered with scales like that of the twigs, sometimes glabrescent, ovoid or obovoid, 3–3.5 × 2–3 cm; stalk to 0.5 cm long; pericarp yellow or brown; latex white. **Seeds** completely surrounded with a soft, white, sweet or sweet-sour aril.

Vernacular names. Sabah—*koping-koping* (Dusun), *lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Nicobar Islands, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Java, Nusa Tenggara, Sulawesi, Maluku, New Guinea, Solomon Islands and Australia (Cape York Peninsula). In Sabah, known from Beaufort, Kinabatangan, Kudat, Lahad Datu, Labuk Sugut, Sandakan, Tawau and Tenom districts (e.g., *SAN 18392*, *SAN 46251*, *SAN 51320*, *SAN 89989* and *SAN 120654*) and in Sarawak from Bau, Kuching, Lundu, Marudi and Mukah districts (e.g., *S 22855*, *S 22956*, *S 23660*, *S 37990* and *S 42440*). Also occurring in Brunei (e.g., *Argent 9159* and *SAN 17385*) and Kalimantan (e.g., *Church et al. 1908*, *Church & Mahyar 5495*, *Jarvie & Ruskandi 6509*, *Kostermans 21290* and *Wiridinata 803*).

Ecology. In riverine and *kerangas* forests, on sandy or red soils, and limestone. Scattered to locally rather common, at altitudes to 1200 m. The aril is eaten by monkeys, hornbills and children.

3. *Aglaia beccarii* C.DC.

Fig. 1, Plate 1A.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Sect. *Neoaglaia*

Bull. Herb. Boiss. 2 (1894) 579; Merrill *op. cit.* (1921) 321; Masamune *op. cit.* 370; Whitmore, Tantra & Sutisna *op. cit.* 220; Beaman & Anderson *op. cit.* 119. **Type:** *Beccari PB 3297*, Borneo, Sarawak (holotype G; isotype G). **Synonyms:** *Amoora korthalsii* Miq. *op. cit.* (1868) 36; *Aglaia brachybotrys* Merr., Philip. J. Sci., Bot. 7 (1912) 274; *Amoora curtispica* Gibbs, J. Linn. Soc., Bot. (1914) 63.

Tree to 15(–25) m tall, to 30 cm diameter, *branched*; buttresses (if present) upwards to 90 cm and outwards to 45 cm; sometimes flowering at 2.5 m tall. **Bark** smooth or with shallow depressions or horizontal bands, greyish brown, greenish brown, or white; inner bark pale green, pale yellow, pale orange-brown, white, red or brownish grey. **Sapwood** pale brown or white, pink towards the heartwood; latex white. **Twigs** *with dense orange-brown peltate or stellate scales, sometimes interspersed with stellate hairs*, glabrescent. **Leaves** *imparipinnate*, 15–40 cm long; petioles 3–7 cm long; *rachis sometimes ridged or with*

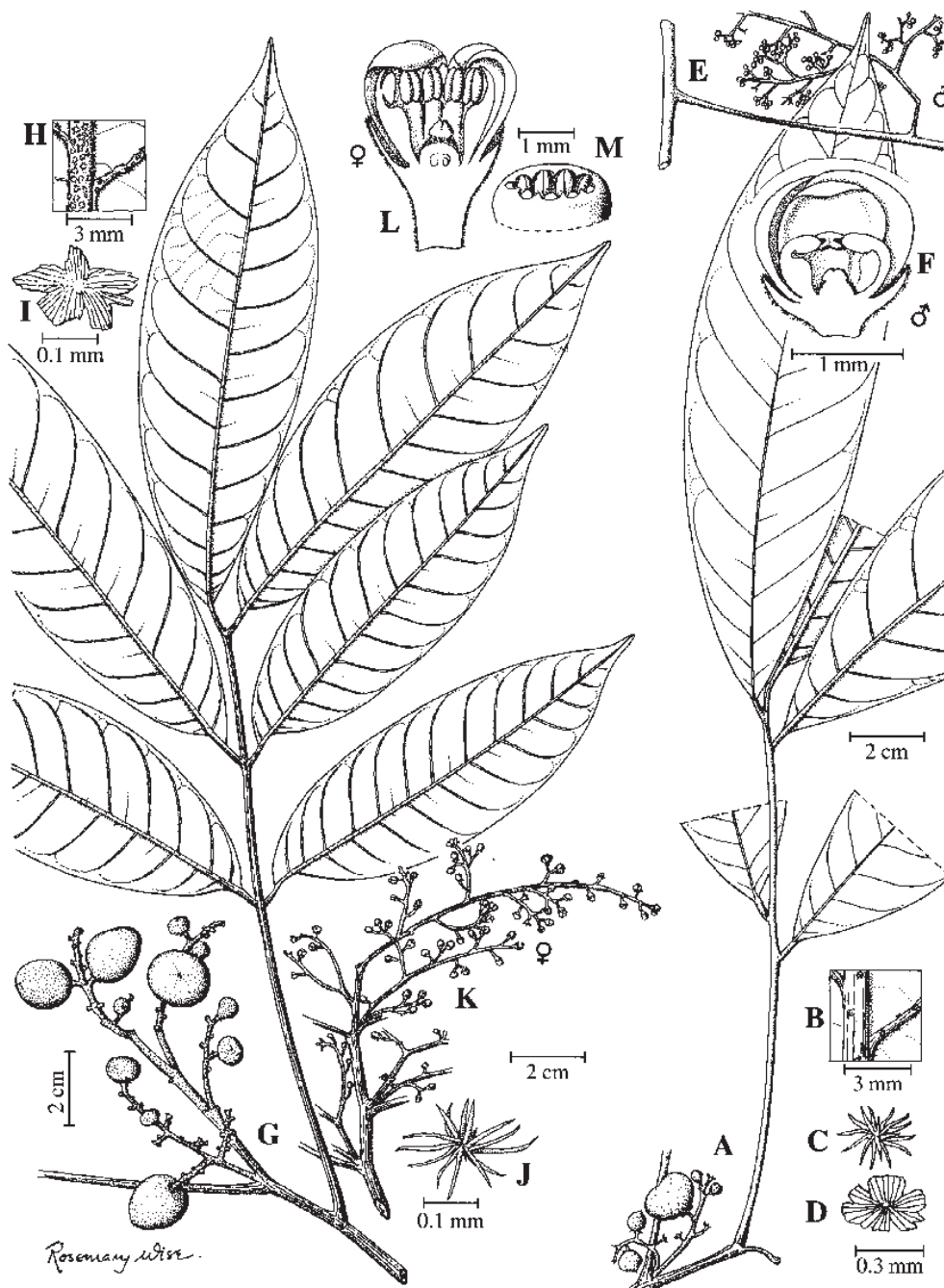


Fig. 1. *Aglaia beccarii*. A, fruiting leafy twig of small tree; B, detail of midrib and lateral vein on the lower leaflet surface showing indumentum; C, stellate hair; D, peltate scale; E, part of male inflorescence; F, longitudinal section of male flower; G, fruiting leafy twig of large tree; H, detail of midrib and lateral vein on the lower leaflet surface showing indumentum; I, peltate scale; J, stellate hair; K, part of female inflorescence; L, longitudinal section of female flower; M, detail of aperture of staminal tube. (A–D from *Beaman* 7262, E–F from *Beaman et al.* 10613, G–J from *Pennington* 7925, K–M from *Pennington* 7943.)

narrow, foliolate wing to 3 mm wide; petioles, rachis and petiolules without or with few scales or hairs like that of the twigs; *leaflets pale green or yellow when dry, surfaces not or only faintly pitted*, above with few peltate or stellate scales or stellate hairs on the midrib, below with few to numerous peltate or stellate scales or stellate hairs on the surface, midrib and lateral veins; lateral leaflets 2–4 on each side of rachis; *blades elliptical, 6.5–32 × 3–11.5(–19.5) cm, base cuneate, symmetrical, margin recurved and undulate*, apex acute, acuminate to caudate, acumen to 15 mm long; midrib and lateral veins prominent below, sometimes pale green when dry; lateral veins 6–21 on each side of midrib; *intercostal venation faint above, faint or subprominent below*; *petiolules 0–1 cm long*. **Inflorescences** 4–17 cm long and 5–18 cm wide. **Flowers** subglobose, (1.5–)1.8–3 × (1.6–)1.7–3.5 mm; pedicels 1–1.5 mm long; *calyx* (0.5–)0.7–1.5 mm tall, *divided into 3 or 4 (or rarely 6) lobes*; *corolla c. 2.5–2.8 × 1.8–3 mm, divided into 3–5 lobes*, joined to the staminal tube at base, *staminal tube obovoid, 1.4–2.5 × 1.3–2.5 mm, anthers 4, 6 or 7, (0.3–)0.5–0.8 × (0.3–)0.4–0.7 mm*; ovary ovoid or subglobose, (0.3–)0.5–0.7 × (0.3–)0.6–1 mm, with dense stellate scales, locules 3, each with 2 ovules, stigma (0.2–)0.3–0.4 × 0.3–0.5 mm, with 3 lobes. Infructescences and fruits with numerous hairs or scales like that of the twigs. **Infructescences** to 15 cm long. **Fruits** with 3 longitudinal ridges running from base to apex, 3-locular, *splitting into 3 lobes when ripe, 2–2.2 × 2.1–2.5 cm*; pericarp *c. 2 mm* thick, pink or reddish purple, with white latex, when dry moulded around the seeds. **Seeds** *subglobose, 1.5–1.6 × 1–1.1 × 0.8–0.85 cm*, with an orange aril.

Vernacular names. Sabah—*langsats* (Dusun Kinabatangan). Sarawak—*segera* (Iban), *langsats* (Malay).

Distribution. Borneo and the Philippines (where it is only known from the type of *A. brachybotrys*). In Sabah, recorded from Keningau, Kinabatangan, Kuala Penyu, Kudat, Ranau, Sandakan, Tambunan and Tawau districts (e.g., *Beaman 7262, Pennington 7925, SAN 55805, SAN 81754 and SAN 108188*) and in Sarawak from Kapit, Kuching, Miri and Mukah districts (e.g., *S 19320, S 23662, S 29169, S 30409 and S 35292*). Also occurring in Brunei (e.g., *Coode 6440*) and Kalimantan (e.g., *Ambriansyah et al. AA 2070 and Kostermans 21768*).

Ecology. In mixed dipterocarp and lower montane forests, on yellow clay soil and limestone, at altitudes to 1500 m.

Notes. Pannell (*op. cit.* 1992 & *op. cit.* 1995) treated *Aglaia beccarii* as a synonym of *Aglaia lawii*. However, the prominent pale green or orange venation on the lower leaflet surface, the orange-brown indumentum, the presence of stellate hairs, and the moulding of the pericarp around the seed in dry fruit, distinguish this species from *Aglaia lawii*. This is the only species of *Aglaia* native to Borneo that sometimes has leaves with a winged rachis.

4. *Aglaia bullata* Pannell

(Latin, *bullatus* = puckered; the leaflets)

Sect. *Aglaia*

Kew Bull. 59 (2004) 87. **Type:** *Ilias S 36269*, Borneo, Sarawak, Kapit district, Bt. Goram, right bank of Ulu Sg. Apah (holotype FHO; isotypes K, KEP, L, MO, SAR).

Tree to 10 m tall, to 12 cm diameter, branched. **Bark** smooth, greyish brown, latex white. **Twigs** slender, greyish brown, densely covered with reddish brown compact stellate hairs and scales. **Leaves** *imparipinnate*, 38–70 cm long; petioles 9–15 cm long; petioles, rachis and petiolules densely covered with hairs and scales like that of the twigs; *leaflets* with numerous pits on both surfaces, *upper surface with compact reddish brown stellate hairs occasionally interspersed with paler stellate scales, lower surface with numerous similar hairs and scales*; lateral leaflets 6–12 on each side of rachis, alternate to subopposite; *blades bullate, narrowly lanceolate, 6.5–19 × 1.2–3 cm*, base cuneate, margin wavy and recurved when dry, apex tapering to a long acute acumen to 15 mm long; midrib and lateral veins impressed above, prominent below; lateral veins 10–16 on each side of midrib, ascending, curved upwards and nearly or quite anastomosing near margin; intercostal venation impressed above, subprominent below; petiolules 0.1–0.5 cm long. **Flowers** unknown. **Infructescences** 15–20 cm long, 4–7 cm wide; peduncles to 11.5 cm long, densely covered with stellate hairs like that of the twigs. **Fruits** *indehiscent, 3-locular*, each locule containing 0 or 1 seed, subglobose, 1.3–1.5 × 1.2–1.5 cm; stalk 4–10 mm long; pericarp brownish yellow, densely covered with reddish brown compact stellate hairs.

Distribution. Endemic in Sarawak and known from Kapit and Mukah districts (e.g., *S* 36221, *S* 48582, *S* 79020 and the type).

Ecology. In mixed dipterocarp forest, on hillsides and ridges on yellow clay loam soil, at altitudes to 420 m.

5. *Aglaia coriacea* Korth. ex Miq.

(Latin, *coriaceus* = leathery; the leaflets)

Sect. *Aglaia*

Ann. Mus. Bot. Lugd. Bat. 4 (1868) 57; Merrill *op. cit.* (1921) 322; Masamune *op. cit.* 371; Pannell *op. cit.* (1989) 213, *op. cit.* (1992) 297, *op. cit.* (1995) 295; Whitmore, Tantra & Sutisna *op. cit.* 221; Turner *op. cit.* 336; Coode *et al.* (eds.) *op. cit.* 200. **Lectotype** (Pannell, 1992): *Korthals s.n.*, Borneo, Kalimantan, G. Bahay (U [*Acc. No.* 39257]; isoelectotype L [*Acc. No.* 9081321382]).

Small tree to 5 m tall, *usually unbranched with up to 10 leaves in a spiral at the apex, but occasionally with 1 or 2 branches in the upper part of the tree*. **Bark** brown with green and grey patches, with longitudinal and transverse cracks; inner bark dark pinkish red. **Sapwood** slightly paler than inner bark; heartwood pale pinkish red or yellowish brown. **Twigs** *densely covered with reddish brown stellate hairs with a dense cluster of short arms and a few long arms to 0.5 mm long at the apices*. **Leaves** *imparipinnate*, to 120 cm long; petioles to 35 cm long; leaflets coriaceous, *above dark glossy-green when dry, below paler and densely covered with reddish brown stellate hairs on the midrib and sometimes on the lateral veins*; lateral leaflets 3–7 on each side of rachis, subopposite, *basal ones only slightly smaller than the rest; blades oblong or obovate-oblong, 13–43 × 4–9 cm*, base cuneate or rounded, sometimes asymmetrical, margin recurved, apex acuminate, acumen obtuse or acute, to 25 mm long; midrib prominent or subprominent below; lateral veins 11–13 on each side of midrib, subprominent below; *intercostal venation inconspicuous; petiolules 0.1–3.5 cm long*. **Inflorescences** to 6 cm long and wide, axillary or sometimes on the upper part of stem below the lowest leaves, densely covered with reddish brown stellate hairs.

Flowers obovoid, *c.* 2.5 × 2 cm; *calyx* outside densely covered with reddish brown stellate hairs, *deeply divided into 5 obtuse lobes*; *petals* 5; staminal tube *c.* 2 mm tall, *anthers* 5, ovoid, *c.* 1 mm long; ovary small, depressed globose, stigma narrowly cylindrical, *c.* 0.6 mm across, with 2 small apical lobes. **Fruits** *indehiscent*, *locules* 1 or 2 (*rarely* 3), septa disintegrating at maturity, ellipsoid, 2.3–4 × 1.8–3.5 cm, yellow or brown; pericarp 0.5–1 mm thick, leathery, inner surface white. **Seeds** 2–3.5 × 1.5–2 cm, with inner surfaces flat; aril 0.5–1 mm thick, translucent, white, sweet and juicy.

Distribution. Peninsular Malaysia and Borneo. In Sabah and Sarawak rare, known only by one collection from Sabah (*Low s.n.*) and one from Sarawak (*S 16972*). Also occurring in Brunei (e.g., *Bernstein 366* and *Simpson 2550*) and C Kalimantan (e.g., *Korthals s.n.*, the type).

Ecology. In mixed dipterocarp forest, at altitudes to 270 m.

6. *Aglaia crassinervia* Kurz *ex* Hiern

Fig. 2.

(Latin, *crassus* = thick, *nervus* = nerve; the lateral veins on the leaflets)

Sect. *Aglaia*

In Hooker *f.*, Fl. Brit. Ind. 1 (1875) 556; Pannell *op. cit.* (1992) 213, *op. cit.* (1995) 267; Turner *op. cit.* 336; Coode *et al.* (eds.) *op. cit.* 200; Beaman & Anderson *op. cit.* 119. **Lectotype** (Pannell, 1992): *Helper 1609* (= *Kew Distr. 1038*), Myanmar, Tenasserim (K; isoelectotypes L, W). **Synonyms:** *Aglaia cinerea* King *op. cit.* (1895) 66, Ridley *op. cit.* (1922) 404; *Aglaia* sp., Merrill *op. cit.* (1929) 131; *Aglaia* sp. 6, Pannell *op. cit.* (1989) 229; *Aglaia* sp. 7/K, Whitmore, Tantra & Sutisna *op. cit.* 226.

Tree to 22 m tall, to 25 cm diameter, branched; flowering at about 5 m tall. **Bark** smooth, pale brown, yellowish brown, greyish brown or greyish green, lenticellate, sometimes with longitudinal cracks; inner bark pale yellow, pale orange, pale brown, reddish brown or pink; latex white. **Sapwood** yellow, white, pinkish brown or brown. **Twigs** fairly stout, *densely covered with yellowish brown or orange-brown or reddish brown, peltate scales with entire or fimbriate margin, less than 0.25 mm diameter*. **Leaves** *imparipinnate*, to 100 cm long; petioles to 20 cm long; leaflets often greyish green when dry, upper surface usually rugulose and with numerous pits, *lower surface usually pitted and covered with numerous scales like that of the twigs*; lateral leaflets (3–)5–7 on each side of rachis, alternate or subopposite, *terminal ones not folded at base*; *blades elliptical or occasionally ovate, 7–35 × 4–12 cm*, base rounded or cuneate, *slightly asymmetrical*, margin recurved, apex acuminate-caudate, acumen acute, to 15 mm long; midrib prominent below; lateral veins 9–17 on each side of midrib, subprominent below; intercostal venation faint on both surfaces; petiolules to 1.5 cm long. **Inflorescences** 30–50 cm long, to 60 cm wide, *densely covered with peltate scales similar to those on the twigs*. **Flowers** subglobose, 1.8–1.9 × 1.3–1.8 mm; *calyx* usually densely covered with scales like that of the twigs, *deeply divided into 5 rounded lobes*; *petals* 5; staminal tube subglobose, 1–1.3 × 1.1–1.3 mm, *anthers* 5, ovoid, 0.4–0.6 × 0.4–0.5 mm; ovary 0.1–0.5 × 0.4 mm, *locules* 1 (or 2), each containing 1 ovule, stigma ovoid or depressed globose with a central depression at the apex, 0.2–0.5 × 0.3–0.5 mm. **Fruits** *indehiscent*, *locules* 1 (or 2), each containing 1 seed, subglobose or pear-shaped, 2.5–3.5 × 2–2.5 cm, yellow or orange; pericarp woody or thin and brittle; stalk *c.* 1 cm long. **Seeds** *c.* 2 × 1.6 × 1.5 cm; aril *c.* 2 mm thick, translucent, green or reddish brown, slightly sour.

Vernacular names. Sabah—*balim* (Kadayan), *langsar-langsar* (Malay), *lantupak* (Dusun-Kinabatangan). Sarawak—*segera* (Iban), *sigirah* (Dyak), *kayu ta'an* (Murut).

Distribution. Nicobar Islands, Myanmar, Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines. Common in Sabah and recorded from Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Tambunan and Tawau districts (e.g., *SAN 30435*, *SAN 40704*, *SAN 70949*, *SAN 88269* and *SAN 90918*) and in Sarawak from Kuching, Lawas, Lundu and Miri districts (e.g., *S 16006*, *S 26596*, *S 31555*, *S 39223* and *S 43995*). Also occurring in Brunei (e.g., *Kirkup DW 639*, *Kirkup DW 912* and *Prance 30694*) and Kalimantan (e.g., *Church et al. 1286*, *Endert 3149*, *Kostermans 8891* and *Lestari & Arifin HL 8*).

Ecology. In forest on sandy, sandy loam or clay soils, at altitudes to 750 m. The aril is eaten by monkeys.

7. *Aglaia cucullata* (Roxb.) Pellegr.

(Latin, *cucullatus* = hooded; the base of terminal leaflet)

Sect. *Amoora*

In Lecomte, Fl. Gén. Indo-Chine, 1 (1911) 771; Anderson *op. cit.* (1980) 250; Whitmore, Tantra & Sutisna *op. cit.* 221; Pannell *op. cit.* (1992) 58, *op. cit.* (1995) 213; PROSEA *op. cit.* (1995) 43; Turner *op. cit.* 336; Coode *et al.* (eds.) *op. cit.* 200; **Basionym:** *Amoora cucullata* Roxb. *op. cit.* (1820) 54, Miquel *op. cit.* (1868) 37, Hiern *op. cit.* 560, King *op. cit.* 55, Merrill *op. cit.* (1921) 321, Ridley *op. cit.* (1922) 399, Masamune *op. cit.* 373, Backer & Bakhuizen *f. op. cit.* 126. **Lectotype** (Pannell, 1992): Roxburgh '1238', India (BM). **Synonyms:** *Amoora aherniana* Merr., Philip. Gov. Lab. Bur. Bull. 17 (1904) 24; *Aglaia tripetala* Merr., J. Str. Br. Roy. As. Soc. 76 (1917) 88, *op. cit.* (1921) 323, Masamune *op. cit.* 373; *Aglaia conduplicifolia* Elmer, Leaflet. Philip. Bot. 9 (1937) 3324.

Tree to 20 m, to 35 cm diameter, branched. **Bark** pinkish grey or pale orange-brown, sometimes flaking in small brittle or papery scales; inner bark pink, fibrous; latex white. **Sapwood** pale yellowish brown, pink or orange-brown. **Twigs** slender, longitudinally wrinkled, *densely covered with pale brown or orange-brown peltate scales which are darker in the centre and have a paler, sometimes fimbriate, margin*. **Leaves** imparipinnate, to 45 cm long; petioles to 15 cm long; *leaflets* subcoriaceous, lower surface rugulose and faintly pitted, *with a few peltate scales on the midrib and lateral veins like that of the twigs and sometimes scattered on the surface in between; lateral leaflets 2 or 3 on each side of rachis*, subopposite; *blades* ovate, 4–12.5 × 2.5–4.5 cm, *that of terminal leaflets sometimes reduced in size to c. 4 × 1.5 cm and folded at the base forming a pocket on the upper surface, base rounded, markedly asymmetrical, margin slightly recurved, apex rounded; midrib impressed above, prominent below; lateral veins 8–13 on each side of midrib, subprominent and longitudinally wrinkled below, rarely black when dry; intercostal venation visible on both surfaces; petiolules to 4 cm long*. **Inflorescences** to 30 cm long, to 35 cm wide, *with a few to numerous scales like that of the twigs*. **Flowers:** males *c. 2.2 × 2.2 mm*; females *c. 4.5 × 3.5 mm*; *calyx divided almost halfway into 3 or 4 obtuse lobes, outside with a few to numerous white stellate scales; petals 3, c. 2–2.5 × 1.4–2.3 mm*; staminal tube obovoid, *c. 2 × 1.7 mm*, *anthers 6, c. 1.3 × 0.4 mm* with a few simple white hairs; ovary 0.3–1 × 0.3–1.2 mm, locules 3, each containing 1 ovule, stigma ovoid, *c. 0.3–0.7 × 0.5 mm*. **Fruits** *dehiscent, locules (2 or) 3, each containing 0 or 1 seed, obovoid, c. 9 × 6 cm, yellow; pericarp leathery, thin, brittle and moulded around the seeds when dry*. **Seeds** *c. 5 × 3 cm, with a shiny, reddish brown aril*.



Fig. 2. *Aglaia crassinervia*. A, leafy twig with male inflorescences; B, longitudinal section of male flower; C, twig with female inflorescence; D, longitudinal section of female flower; E, infructescence; F, peltate scale. (After Pannell, *Kew. Bull. Add. Series 16* (1992) 215, f. 58; A–B from *Pennington 7855*, C–D from *Mabberley 1703*, E–F from *Sangkachand 1602*.)

Distribution. Bangladesh, Thailand, Vietnam, Sumatra, Peninsular Malaysia, Singapore, Borneo, the Philippines, Java and New Guinea. In Sabah, known from Kuala Penyu, Labuk Sugut, Sandakan and Sipitang districts (e.g., *BNB-FD 3042*, *SAN 34351*, *SAN 35479*, *SAN 35780* and *SAN 82466*) and in Sarawak from Bintulu, Lawas and Limbang districts (e.g., *Senada 2013*, *S 26792*, *S 33621*, *S 59069* and *S 59510*). Also occurring in Brunei (e.g., *BRUN 5077* and *BRUN 5125*) and Kalimantan (e.g., *Korthals s.n.* and *Kostermans 9550*).

Ecology. In riverine, tidal estuary, mangrove and nipah swamp and beach forests. Scarce to rather common, at altitudes to 20 m. The pouch at the base of the terminal leaflet is sometimes occupied by ants.

8. *Aglaia cumingiana* Turcz.

(Hugh Cuming, 1791–1865, English traveller, naturalist and plant collector)

Sect. *Aglaia*

Bull. Soc. Nat. Mosc. 31 (1858) 409; Masamune *op. cit.* 371; Pannell *op. cit.* (1992) 291, *op. cit.* (1995) 293; Coode *et al.* (eds.) *op. cit.* 200; Beaman & Anderson *op. cit.* 119. **Lectotype** (Pannell, 1992): *Cuming 1008*, the Philippines, Luzon, Prov. Albay (K; isolectotypes BO, OXF, W). **Synonyms:** *Hearnia cumingiana* (Turcz.) C.DC. *op. cit.* (1878) 629; *Aglaia tarangisi* Elmer *op. cit.* 3314.

Tree to 15 m tall, to 15 cm diameter, branched. **Bark** greenish grey or greyish brown, hoop-marked, with pale lenticels in vertical rows; inner bark pale yellow to pinkish brown; latex white, copious. **Sapwood** white or pale yellow; heartwood reddish brown. **Twigs** greyish green, finely longitudinally wrinkled, with pale lenticels in vertical rows, *densely covered with small delicate pale brown stellate scales*. **Leaves** imparipinnate, 18–43 cm long; petioles 3–12 cm long; *leaflets* shiny dark green above, pale green below when fresh, *pale yellowish green or brownish green below and both surfaces matt when dry, covered with very few pale brown scales like that of the twigs on the midrib below*, often with numerous tiny shiny orange spots below; lateral leaflets 1–4 on each side of rachis, subopposite; *blades usually elliptical, 7–22 × 2–7.5 cm*, base asymmetrical, cuneate, sometimes rounded, margin slightly recurved, apex acuminate, acumen obtuse, to 15 mm long; midrib prominent below; *lateral veins 7–12 on each side of midrib, subprominent below, black or dark brown when dry; intercostal venation subprominent below*; petiolules 0.5–1 cm long. **Inflorescences** *delicate; peduncles, rachis and branches flat, covered with few pale brown stellate scales*; males 11–31 cm long, 11–28 cm wide; females *c.* 19 cm long, *c.* 10 cm wide; peduncles to 7 cm long. **Flowers** subglobose, *c.* 1 × 1–1.7 mm; *calyx divided into 5 subrotund lobes with fimbriate margins; petals 5*; staminal tube dark yellow, cup-shaped, 0.5–0.7 × 1–1.5 mm, *anthers 5, 0.3–0.4 × 0.3–0.4 mm*; ovary 0.1–0.2 × 0.2 mm, locules 2, each containing 1 ovule, stigma ovoid, 0.3–0.4 × 0.2–0.4 mm, with longitudinal ridges. **Fruits** *indehiscent, locules 2*, each containing 0 or 1 seed, ellipsoid, 0.9–1 × 0.9–1 cm, often asymmetrical when only one seed develops, and the stigma displaced to one side during development of the fruit, covered with few stellate scales like that of the twigs or without scales; pericarp orange-brown, papery thin and brittle when dry, orange or red when ripe and fresh.

Vernacular name. Sabah—*lantupak* (Dusun).

Distribution. Borneo and the Philippines. In Borneo, known only in Sabah from Beluran, Kota Belud, Kudat, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tenom districts (e.g., *SAN 23472*, *SAN 63245*, *SAN 86718*, *SAN 93597* and *SAN 118289*), in Sarawak from Kapit and Lundu districts (e.g., *S 4731*) and in Brunei (e.g., *Simpson 2150*).

Ecology. In primary, secondary and gallery forests, and along the seashore, on sandy soil and limestone, at altitudes to 1330 m.

9. *Aglaia densisquama* Pannell

Plate 1B.

(Latin, *densus* = dense, *squama* = scale; the dense indumentum on the leaflet lower surface)

Sect. *Aglaia*

Kew Bull. Add. Ser. 16 (1992) 133, *op. cit.* (1995) 240. **Type:** *Banyeng & Benang S 25209*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype FHO; isotype L, SAR).

Tree to 20 m tall, to 35 cm diameter, branched. **Bark** smooth with longitudinal cracks; without latex. **Sapwood** pink, becoming darker towards the centre. **Twigs** grey, longitudinally wrinkled, *densely covered with dark reddish brown peltate scales 0.3–0.4 mm diameter with a pale margin*. **Leaves** imparipinnate, to 48 cm long; petioles 8–16 cm long; leaflets coriaceous, upper surface pale yellowish green when dry, rugulose and pitted, *midrib and lateral veins on the upper surface and the entire lower leaflet surface densely covered with scales like that of the twigs; lateral leaflets 4 or 5 on each side of rachis*, alternate or subopposite; *blades elliptical or ovate, 7–21 × 4–8 cm*, base rounded or cuneate, markedly asymmetrical, margin recurved, apex caudate-acuminate, acumen obtuse, to 20 mm long; midrib deeply impressed above, subprominent below; lateral veins 7–17 on each side of midrib, distinctly impressed above, subprominent below; intercostal venation faint or invisible on both surfaces; petiolules to 1.5 cm long. **Inflorescences** densely covered with scales like that of the twigs; males *c.* 42 cm long, *c.* 42 cm wide; females *c.* 28 cm long, *c.* 4 cm wide; peduncles 7–11 cm long. **Flowers** *c.* 3 × 3–4 mm; *calyx* thick and fleshy, *divided into 5 subrotund lobes; petals 5*, thick and fleshy, outside with scales like that of the twigs; staminal tube 1.5–1.7 × 2.2–2.5, *anthers 5*, 0.5–0.8 × 0.4–0.5 mm; ovary ovoid, *c.* 0.5–0.8 × 0.6–1 mm, locules 2, each containing 1 ovule, stigma ovoid, 0.2–0.3 × 0.3 mm. **Fruits** *indehiscent, locules 2*, each containing 1 seed, narrowly ellipsoid, ovoid or obovoid, 5–6 × 1.4–2 cm, *with a long narrow beak to 1.5 cm long and a short broad stalk to 5 mm long*. Aril entire, translucent, white.

Vernacular name. Sarawak—*segera* (Iban).

Distribution. Endemic in Borneo, known only in Sabah from Sandakan district (e.g., *SAN 54302* and *SAN 73613*) and in Sarawak from Bintulu, Kapit, Kuching and Limbang districts (e.g., *S 4389*, *S 27951*, *S 32523*, *S 36154*, *S 43962* and *S 46902*).

Ecology. In mixed dipterocarp, mossy lower montane and riverine forests, on alluvial sandy soils with some clay or on clayey loam, at altitudes to 1600 m.

10. *Aglaia edulis* (Roxb.) Wall.

(Latin, *edulis* = edible; the aril surrounding the seed)

Sect. **Aglaia**

Calc. Gard. Rep. (1840) 26; Hiern *op. cit.* 556; Pannell *op. cit.* (1992) 229, *op. cit.* (1995) 272; PROSEA *op. cit.* (1995) 44; Turner *op. cit.* 336; Beaman & Anderson *op. cit.* 120. **Basionym:** *Milnea edulis* Roxb., Hort. Beng. (1814) 18, *nom. nud.*, Fl. Ind., ed. Carey & Wallich 2 (1824) 430. **Lectotype** (Pannell, 1992): *Wall. Cat. 1279 C*, India, Silhet (K-W). **Synonyms:** *Aglaia acida* Koord. & Valetton, Meded 'S Lands Plant. 16 (1896) 143, Backer & Bakhuizen *f. op. cit.* 128; *Aglaia minahassae* Koord., Meded. 'S Lands Plant. 19 (1898) 382, 635; *Aglaia curranii* Merr., Philip. J. Sci., Bot. 7 (1912) 276; *Aglaia diffusa* Merr. *op. cit.* (1912) 277; *Aglaia samarensis* Merr. *op. cit.* (1916) 186; *Aglaia motleyana* Stapf, Bull. Misc. Inform. Kew (1930) 368, Whitmore, Tantra & Sutisna *op. cit.* (1990) 223.

Tree, 10–30 m tall, to 50 cm diameter, *branched*; buttresses to 1.75 m tall, to 50 cm out, to 15 cm thick. **Bark** pale brown, greyish brown, purplish brown, reddish brown or dark green; inner bark brown, reddish grey or yellow; latex white. **Sapwood** white, pink or yellow. **Twigs** greyish brown, longitudinally wrinkled, *densely covered with reddish brown, pale brown or orange-brown stellate hairs and scales or peltate scales with irregular or fimbriate margins*. **Leaves** *imparipinnate*, to 44 cm long; petioles 3.5–9 cm long; *leaflets often pale yellowish brown when dry, covered with few to numerous hairs or scales like that of the twigs on the midrib below and occasionally also on the rest of lower leaflet surface, sometimes with numerous reddish brown pits on both surfaces*; lateral leaflets 2–4 (or rarely 5) on each side of rachis, subopposite or alternate, *terminal ones not folded at the base, basal ones only slightly smaller than the rest, blades usually elliptical, sometimes ovate or obovate, 5.5–25 × 4–11 cm, base slightly asymmetrical, rounded or cuneate, margin planar, apex acuminate, acumen obtuse, to 15 mm long; midrib prominent below; lateral veins 9–15 on each side of midrib, subprominent below, sometimes with shorter veins in between; intercostal venation subprominent or faint but visible below; petiolules 0.5–1.2(–2) cm long*. **Inflorescences** axillary or occasionally borne on older branches, densely covered with hairs and scales like that of the twigs; males to 38 cm long, to 32 cm wide; females *c.* 5 cm long, *c.* 4 cm wide; peduncles 0.5–5 cm long. **Flowers** 1.4–1.8 × 1.4–2.6 mm; *calyx divided into 5 rounded lobes with ciliate margins, outside with few to dense cover of scales like that of the twigs; petals 5; staminal tube 0.7–1.3 × 1.2–2.6 mm, anthers 5, ovoid, to 0.6 × 0.5 mm; ovary c. 0.4 × 0.3–0.7 mm, stigma depressed globose with a central depression or ovoid, 0.2–0.3 × 0.3–0.8 mm*. **Fruits** *indehiscent, locules 3, each containing 0 or 1 seed, subglobose with an apical depression or obovoid, 3.2–5 × 3.1–4.2 cm, with 3 longitudinal ridges running from base to apex, dull orange or brown or yellow when ripe; pericarp 3–6 mm thick, woody or granular, often with numerous warts, outside densely covered with small pale brown or nearly white peltate scales, inside rugulose, sometimes with white latex*. **Seeds** pale brown, 14–20 × 10–19 × 5–9 mm; aril complete, sour, juicy, translucent, white or orange-brown, to 2 mm thick.

Vernacular names. Sabah—*lantupak* (Dusun-Kinabatangan). Sarawak—*segera* (Iban).

Distribution. India, Bhutan, Nicobar Islands, Myanmar, China, Vietnam, Cambodia, Thailand, Sumatra, Peninsular Malaysia, Java, Nusa Tenggara (Bali and Lombok), Borneo, the Philippines, Sulawesi and Maluku. In Borneo, recorded only in Sabah from Keningau, Kinabatangan, Labuk Sugut, Ranau, Sandakan, Tambunan and Tawau districts (e.g., *SAN 33164, SAN 40701, SAN 77775, SAN 82938 and SAN 92160*), in Sarawak from Bau, Kapit, Kuching, Miri and Song districts (e.g., *Haegens et al. 420, Mabberley 1638, S 32672, S 65018 and S 76937*) and in Kalimantan (e.g., *Burley et al. 3138, Endert 2515, Jarvie & Ruskandi 6077, Mahyar et al. 3541 and Sidiyasa PBU 622*).

Ecology. In forests on sandy soils, on banks of streams and ridge-tops, at altitudes to 700 m.

11. *Aglaia elaeagnoidea* (A.Juss.) Benth.

(Greek, *elaeagnoides* = resembling *Elaeagnus*, a genus of shrubs with indumentum comprising shiny scales)

Sect. *Aglaia*

Fl. Austral. 1 (1863) 383; Koorders & Valeton *op. cit.* (1913) *t.* 154; Backer & Bakhuizen *f. op. cit.* 128; Whitmore, Tantra & Sutisna *op. cit.* 221; Pannell *op. cit.* (1992) 143, *op. cit.* (1995) 243; PROSEA *op. cit.* (1995) 44; Turner *op. cit.* 336; **Basionym:** *Nemdra elaeagnoidea* A.Juss. *op. cit.* 239. **Lectotype** (Mabberley in Fl. Nouv.-Calédon. Dépend. 15 (1988) 75): *Baudin s.n.*, Australia (P; isoelectotypes BM, G, K). **Synonyms:** *Aglaia canariifolia* Koord. *op. cit.* 380, 633; *Aglaia parvifolia* Merr., Philip. Gov. Lab. Bur. Bull. 29 (1905) 21; *Aglaia elaeagnoidea* (A. Juss.) Benth. var. *pallens* Merr., Philip. J. Sci. 3 (1908) 413; *Aglaia pallens* (Merr.) Merr., Philip. J. Sci., Bot. 13 (1918) 297; *Aglaia cupreolepidota* Merr., Philip. J. Sci., Bot. 20 (1922) 393.

Small tree or shrub, 5–10(–20) m tall, 15–25 cm diameter, branched; sometimes with small buttresses. **Bark** brown, greyish brown or yellowish grey, with lenticels and narrow vertical fissures, flaking in thin, irregular, stiff scroll-like scales; inner bark pink or reddish brown. **Sapwood** yellow; heartwood red. **Twigs** slender, grey or pale brown, *densely covered with very pale brown or pale orange-brown peltate scales with entire or short-fimbriate margins and dark central spot*. **Leaves** imparipinnate, 6–29 cm long; petioles 2.5–10.5 cm long; leaflets subcoriaceous, reddish brown when dry, upper surface shiny, *lower surface densely covered with scales like that of the twigs on the midrib and sparsely so elsewhere*, with numerous faint or conspicuous pits on both surfaces; lateral leaflets 1–3 on each side of rachis, subopposite, *terminal ones not folded at the base; blades elliptical, sometimes obovate, 2–13(–16) × 1–6.5 cm, base cuneate, slightly asymmetrical*, margin planar, apex rounded or acuminate, acumen obtuse, 2–5(–20) mm long; midrib prominent below; lateral veins 5–11 on each side of midrib, subprominent on both surfaces; intercostal venation subprominent on both surfaces; petiolules 0.5–2 cm long. **Inflorescences** densely covered with peltate scales like that of the twigs or dark reddish brown in colour; males (3–)9–34 cm long, (1–)2.5–25 cm wide; females to 12.5 cm long and to 10 cm wide. **Flowers** subglobose or depressed globose, to 2 × 2 mm; *calyx shallowly divided into 5 broadly ovate obtuse lobes*, outside densely covered with scales like that of the twigs; *petals usually 5*, outside with scales; staminal tube depressed globose or ovoid, *c.* 1 × 1–1.4 mm, *anthers 5*, broadly ovoid, 0.4–0.5 × 0.3–0.4 mm; ovary subglobose, 0.2–0.3 × 0.5 mm, densely covered with stellate scales, locules 2, each containing 1 or 2 ovules, stigma ovoid with two small apical lobes, 0.2–0.3 × 0.3–0.4 mm. **Fruits** indehiscent, *locules 2*, each with 0 or 1 seed, *subglobose, ellipsoid or obovoid, 1.1–2.5 × 1.3–1.5 cm*, orange, brown or red; *pericarp thin*, soft. **Seeds** *c.* 10 × 6 × 3 mm, usually completely covered with a thin, white, gelatinous, sweet aril.

Vernacular name. Sabah—*lengud-lengud* (Dusun and Lumundau).

Distribution. India, Sri Lanka, Taiwan, Vietnam, Cambodia, Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, Bali, Sulawesi, the Philippines, Maluku, New Guinea, Australia, Vanuatu, New Caledonia and Samoa. In Borneo, known only in Sabah from Lahad Datu, Sandakan and Tambunan districts and Sipadan Island (e.g., *Symington FD FMS 35357, SAN*

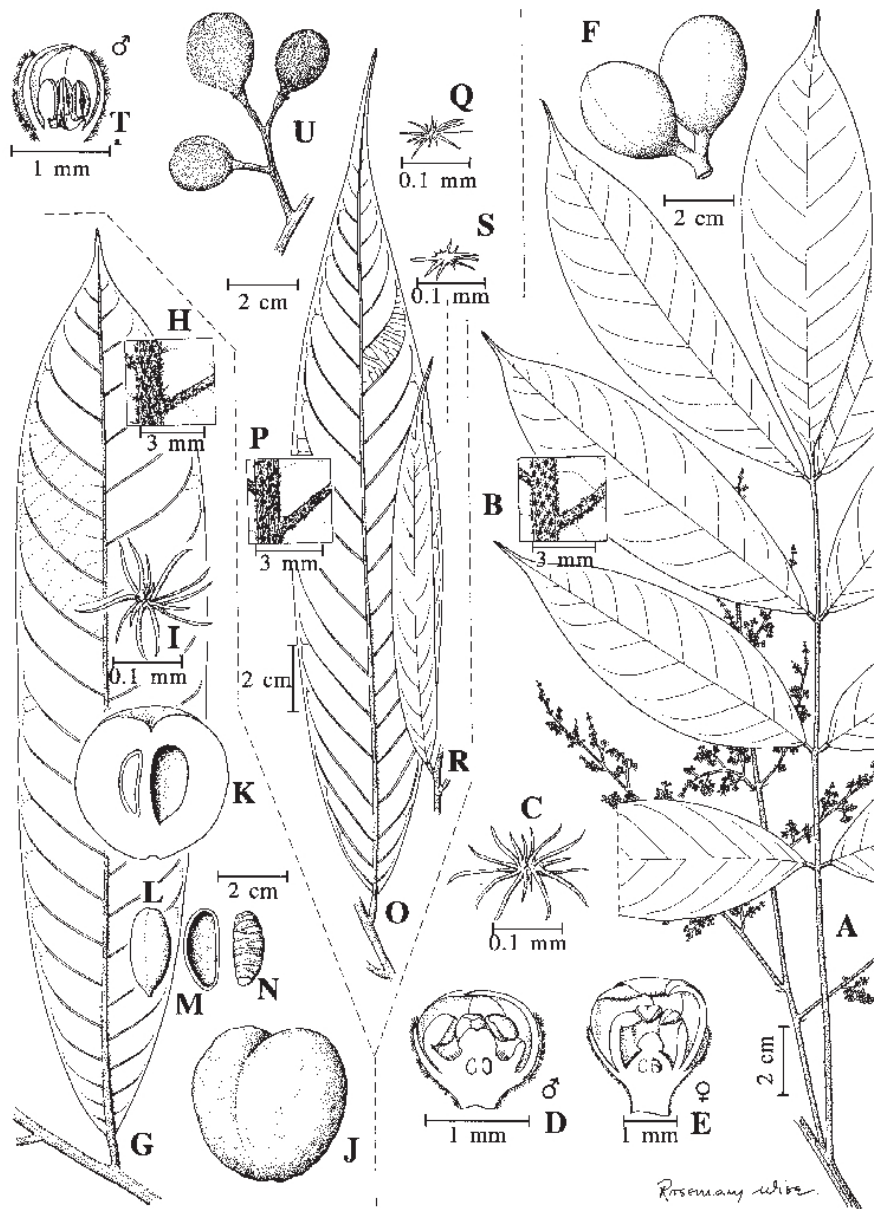


Fig. 3. *Aglaia elliptica*, subsp. *elliptica* (A–F), subsp. *clementis* (G–N); *A. lancifolia* (O–U). A, leafy twig with male inflorescence; B, detail of midrib and lateral vein on the lower leaflet surface showing indumentum; C, stellate hair; D, longitudinal section of male flower; E, longitudinal section of female flower; F, part of infructescence; G, leaflet; H, detail of midrib and lateral vein on the lower leaflet surface showing indumentum; I, stellate hair; J, fruit; K, inside of fruit showing the seeds; L, seed with aril; M, aril; N, seed without aril; O, large leaflet; P, detail of midrib and lateral vein on the lower leaflet surface showing indumentum; Q, stellate hair; R, small leaflet; S, stellate scale; T, longitudinal section of male flower; U, infructescence. (A–D from Pennington 7890, E from Pannell 1242, F from Pennington 8005, G–N from Pennington 7922, O–Q from Pennington 7998, R–S from SAN 78181, T from SAN 78297, U from S 27297.)

40497, SAN 122346 and Wong WKM 2479), in Sarawak from Miri district (e.g., S 16032 and S 31977) and in Kalimantan (e.g., Kessler PK 2283).

Ecology. Mainly found in coastal areas, including on rocky shores and sandy beach forest, sometimes inland including on limestone cliffs, at altitudes to 300 m.

12. *Aglaia elliptica* Blume

Fig. 3A–N.

(Latin, *ellipticus* = elliptical, widest in the middle and tapering at both ends; the shape of leaflets)

Sect. *Aglaia*

Bijdr. Fl. Ned. Ind. (1825) 171; Miquel *op. cit.* (1868) 50; Koorders & Valetton *op. cit.* (1913) t. 15; Backer & Bakhuizen *f. op. cit.* 126; Anderson *op. cit.* (1980) 248; Pannell *op. cit.* (1989) 214, *op. cit.* (1992) 275, *op. cit.* (1995) 288; Whitmore, Tantra & Sutisna *op. cit.* 221; PROSEA *op. cit.* (1995) 45; Turner *op. cit.* 336; Coode *et al.* (eds.) *op. cit.* 200; Beaman & Anderson *op. cit.* 120. **Lectotype** (here designated): *Blume s.n.* (1367), Java, Mt. Parang, Tjianjur (L [Acc. No. 908133141]). **Synonyms:** *Hearnia elliptica* (Blume) C.DC. *op. cit.* (1878) 628; *H. villosa* C.DC. *op. cit.* (1878) 632; ?*Aglaia harmsiana* J.Perkins, Notizbl. König Bot. Gart. & Mus. Berlin 32 (1903) 78; *Aglaia clementis* Merr. *op. cit.* (1918) 76; *Aglaia moultonii* Merr. *op. cit.* (1918) 78; *Aglaia villosa* (C.DC.) Merr. *op. cit.* (1921) 323; *Aglaia baramensis* Merr. *op. cit.* (1922) 317; *Aglaia havilandii* Ridl., Bull. Misc. Inform. Kew (1930) 367; *Aglaia tembelingensis* M.R. Henders., Gard. Bull. Str. Settl. 7 (1933) 94. (For further synonyms cf. Pannell *op. cit.* 1992 & *op. cit.* 1995.)

Tree, 20–40 m tall, to 50 cm diameter, *branched*; bole sometimes fluted throughout; L-shaped buttresses to 60 cm tall. **Bark** greenish brown, greyish green, grey, pale yellow or brown, smooth with shallow pits; inner bark reddish pink or green; latex white. **Sapwood** pale yellow or pale brown; heartwood deep pink. **Twigs** slender, grey, *densely covered with reddish brown, pale orange-brown or yellowish brown stellate hairs or scales, sometimes with pale brown or reddish brown peltate scales with fimbriate margins*. **Leaves** *imparipinnate*, 15–65 cm long; petioles 3–10 cm long; *leaflets dull when dry, lower surface densely covered with hairs or scales like that of the twigs on the midrib and sometimes on the lateral veins, sparsely so on the rest of that surface, not prominently pitted; lateral leaflets (rarely 2) 3–6 on each side of rachis, subopposite or almost alternate, basal ones only slightly smaller than the rest; blades elliptical or oblanceolate-oblong, or sometimes narrowly lanceolate, 5–25(–33) × 1–10.5 cm, base cuneate or rounded, asymmetrical, margin planar or recurved, often undulate, apex acuminate-caudate, acumen obtuse, 2–20 mm long; midrib prominent below; lateral veins 6–19 on each side of midrib, subprominent below; intercostal venation inconspicuous; petiolules 0.4–2.4 cm long*. **Inflorescences** densely covered with hairs or scales like that of the twigs; peduncles 1–10 cm long; males 23–50 cm long, 14–60 cm wide, bearing up to 6,000 flowers; females 13–37 cm long, 5–14 cm wide, bearing fewer flowers than males. **Flowers** depressed globose, 1–2.2 × 1–2.5 mm; *calyx deeply divided into 5 broadly ovate or elliptical, obtuse lobes, outside densely covered with brown stellate scales; petals usually 5; staminal tube shallowly cup-shaped, 0.2–0.6 × 1 mm, anthers 5, 0.3–0.5 × 0.3–0.4 mm; ovary subglobose, densely covered with stellate scales, locules 2, stigma ovoid or depressed globose, 0.2–0.3 × 0.1–0.3 mm, with two small apical lobes or a central depression*. **Fruits** *indehiscent, locules 1 or 2 (or 3), obovoid or ellipsoid, 1.5–3.4(–5) × 1.5–2.7(–4.8) cm, pink or orange when mature; pericarp 1–3(–12) mm thick, with a longitudinal ridge around it, along which the fruit opens under pressure*.

Seeds 1 or 2, to $2.8 \times 1.8 \times 1.1$ cm; aril 1–3 mm thick, sometimes not quite complete on the antiraphe side, pinkish orange, translucent, sweet or acidic tasting.

Vernacular names. Sabah—*lambunau* (Orang Sungei), *langsar gajah* (Malay), *langsar-langsar* (Malay), *langsar munyit* (Malay), *lantupak* (Dusun Kinabatangan), *lantupak jambu* (preferred name). Sarawak—*bunyak* (Iban), *bunyau* (Punan), *buyau* (Punan), *segera* (Iban), *segera ayer* (Iban).

Distribution. Myanmar, Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, Nusa Tenggara (Bali and Flores), Sulawesi and the Philippines.

Uses. In various parts of its range, the wood is used for furniture, general construction and agricultural implements. Bathing in water boiled with the bark is used against tumours, whereas leaves are applied to wounds.

Notes. In Sabah and Sarawak, two subspecies are recognised, viz. subsp. *elliptica* and subsp. *clementis*. *Aglaia lancifolia*, previously treated as a synonym of this species by Pannell (*op. cit.* 1992 & *op. cit.* 1995), is now recognised as a distinct species, endemic in Borneo.

Key to subspecies

Fruits to 3.4×2.7 cm when ripe; pericarp *c.* 3 mm thick.....

subsp. **elliptica** Fig. 3A–F.

Synonyms: *Hearnia elliptica* (Blume) C.DC. *op. cit.* (1878) 628; *H. villosa* C.DC. *op. cit.* (1878) 632, Merrill *op. cit.* (1921) 323, Masamune *op. cit.* 373, Anderson *op. cit.* (1980) 249, Whitmore, Tantra & Sutisna *op. cit.* 225; ?*Aglaia harmsiana* J.Perkins *op. cit.* 78, Anderson *op. cit.* (1980) 248, Whitmore, Tantra & Sutisna *op. cit.* 222, Beaman & Anderson *op. cit.* 120; ?*Aglaia moultonii* Merr. *op. cit.* (1918) 78, *op. cit.* (1921) 322, Masamune *op. cit.* 372; *Aglaia villosa* (C.DC.) Merr. *op. cit.* (1921) 323; *Aglaia baramensis* Merr. *op. cit.* (1922) 317; *Aglaia havilandii* Ridl. *op. cit.* (1930) 367, Anderson *op. cit.* (1980) 248. (For further synonyms, cf. Pannell *op. cit.* 1992 & *op. cit.* 1995.)

Lateral leaflets (2 or) 3–6 on each side of rachis; blades elliptical or oblanceolate-oblong, $5-25(-33) \times 1.5-10.5$ cm, less than 5 times longer than wide. Fruits $1.5-3.4 \times 1.5-2.7$ cm; pericarp *c.* 3 mm thick.

Distribution as the species. Common in Sabah and Sarawak; in Sabah, recorded from Keningau, Kinabatangan, Labuk Sugut, Lahat Datu, Ranau, Sandakan, Semporna, Sipitang, Tawau and Tenom districts (e.g., SAN 24024, SAN 30004, SAN 41639, SAN 64310 and SAN 83280) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Lubok Antu, Lundu, Marudi, Miri, Serian, Simunjan and Tatau districts (e.g., S 33257, S 36761, S 37885, S 40642 and S 44648). Also occurring in Kalimantan (e.g., Burley *et al.* 2497, Church *et al.* 504, Church *et al.* 5497, Kessler B1428 and Mahyar *et al.* 1328) but not yet recorded from Brunei.

Common in riverine forest and periodically flooded lowland and hill forest, at altitudes to 1500 m, on igneous-derived, sandy, clay, loam, and basalt-derived soils. Sometimes rooting below the flood level.

Fruits to 5×4.8 cm when ripe; pericarp to 1.2 cm thick, otherwise indistinguishable from subsp. *elliptica*.....

subsp. **clementis** (Merr.) Pannell

Fig. 3G–N.

(Mary S. Clemens, died in 1968, prolific plant collector in Borneo, Papua New Guinea and the Philippines)

Kew Bull. 59 (2004) 89. Basionym: *Aglaia clementis* Merr. *op. cit.* (1918) 76, *op. cit.* (1921) 322, Masamune *op. cit.* 372, Beaman & Anderson *op. cit.* 120. Lectotype (Pannell, 1992): *M.S. Clemens 10484*, Borneo, Sabah, Mt. Kinabalu, Minitindok Gorge (PNH†; isolectotypes A, BM, UC).

Leaflets to 40×18 cm, either coriaceous and recurved at the margin, or like the typical subspecies, sometimes with numerous reddish brown pits on the lower surface. *Fruits* to 5×4.8 cm, obovoid with an apical depression and longitudinal depressions between the seeds; locules 2 (or 3); *pericarp* to 1.2 cm thick. Seeds 2.

Borneo and Sulawesi. In Sabah, known from Kota Belud, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN 18822*, *SAN 24752*, *SAN 30651*, *SAN 59235* and *SAN 85098*) and in Sarawak from Bau, Simunjan and Serian districts (e.g., *S 28095*, *S 30853*, *S 37550*, *S 45286* and *S 45599*). Also known from Kalimantan (e.g., *Argent et al. 93160* and *Zainal & Arbainsyah AA 1794*) but not yet recorded from Brunei.

In lowland forests, including on limestone, on well-drained sandy soil, at altitudes to 250 m.

13. *Aglaia erythrosperma* Pannell

Fig. 4A–D.

(Greek, *erythros* = red, *sperma* = seed; the seed is completely covered with a red aril)

Sect. *Amoora*

Kew Bull. Add. Ser. 16 (1992) 76, *op. cit.* (1995) 219, PROSEA *op. cit.* (1995) 45; Turner *op. cit.* 336. **Type:** *Pannell 1175*, Peninsular Malaysia, Negri Sembilan, Pasoh FR (holotype FHO). **Synonyms:** *Aglaia* sp. 2, Pannell *op. cit.* (1989) 228; *Aglaia* sp. 2/B, Whitmore, Tantra & Sutisna *op. cit.* 226.

Tree to 20 m tall, to 30 cm diameter, branched; L-shaped buttresses to 70 cm out. **Bark** pale yellow or white, smooth, slightly flaky; inner bark pinkish brown, red or green; latex white. **Sapwood** pink or pinkish brown, with watery greenish brown exudate. **Twigs** stout, *densely covered with brown stellate scales*. **Leaves** *imparipinnate*, to 60 cm long; petioles to 25 cm long; *leaflets* coriaceous, *surface smooth or slightly rugulose, greenish brown, upper surface shiny, lower surface dull, covered with few to numerous pale brown stellate scales like that of the twigs on the midrib and lateral veins and sparsely so on the surface in between; lateral leaflets 3–5 on each side of rachis*, opposite, subopposite, or sometimes alternate; *blades elliptical, 7–18 × 4.5–7.5 cm* (that of immature plant to 40×12 cm), *base rounded, sometimes cuneate*, asymmetrical, *margin slightly recurved*, apex short-acuminate, acumen acute, to 5 mm long; midrib raised and longitudinally ridged and wavy below; *lateral veins 9–14 on each side of midrib*, raised and longitudinally ridged below, *of the same colour as the rest of leaflet; intercostal venation inconspicuous*; petiolules 2–3 cm long. **Inflorescences** to 20 cm long, densely covered with stellate scales like that of the twigs. **Flowers** *c.* $5.5 \times 4–5$ mm; *calyx divided up to halfway into 3 broad, obtuse lobes*, outside densely covered with stellate scales; *corolla* $4.3–5 \times 4$ mm, *divided almost to the base into 3 lobes*, outside covered with a few to dense pale orange-brown stellate scales; staminal tube obovoid, $4–4.2 \times 2.8–3.4$ mm, *anthers* 7, ellipsoid, $2–2.1 \times 0.5–0.7$ mm;

ovary depressed globose with 3 lobes, *c.* 0.3 × 1.1 mm, densely covered with stellate scales, locules 3, each containing 1 ovule, stigma ovoid, 0.6–0.8 × 0.7–1 mm, with 6 longitudinal lobes. **Fruits** *subglobose*, to 10 cm diameter, deep reddish brown, outside densely covered with reddish brown stellate hairs, *locules* 3, each containing 1 seed, *dehiscing into 3 lobes when ripe*; *pericarp to 1.5 cm thick*, inner pericarp white, innermost layer in each locule a detachable membrane surrounding the seed. **Seeds** to 5 × 3.5 × 2 cm, completely surrounded by a bright shiny orange-red aril, which is easily detached from the rest of the seed; testa shiny chestnut-brown.

Vernacular names. Sarawak—*bunya* (Iban), *segera* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia and Borneo. In Sabah, recorded from Sipitang district (e.g., *SAN 16752*) and in Sarawak from Bintulu, Kuching and Miri districts (e.g., *S 2253*, *S 18067*, *S 37168*, *S 38973* and *S 39120*). Also occurring in Kalimantan (e.g., *Kostermans 6116* and *Kostermans 9557*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp and *kerangas* forests, at altitudes to 400 m. The Black Hornbill, *Anthraceros malayanus*, feeds on the seeds and regurgitates them with the aril removed.

14. *Aglaia exstipulata* (Griff.) W.Theob.

(Latin, *exstipulatus* = without stipules; originally placed in the Sapindaceae where most species have stipules)

Sect. *Aglaia*

In F. Mason, *Burmah* 3rd edition, 2 (1883) 583; Pannell *op. cit.* (1989) 215, *op. cit.* (1992) 320, *op. cit.* (1995) 303; Whitmore, Tantra & Sutisna *op. cit.* 222; PROSEA *op. cit.* (1995) 45; Turner *op. cit.* 336; Coode *et al.* (eds.) *op. cit.* 201; Beaman & Anderson *op. cit.* 120. **Basionym:** *Euphoria* ('*Euphora*') *exstipulata* ('*exstipulatis*') Griff., *Not. Pl. As.* 4 (1854) 547. **Lectotype** (Pannell, 1992): *Griffith 985* (= *Kew Distr. 1040*), Myanmar, Mergui (K). **Synonyms:** *Aglaia minutiflora* Bedd. var. *griffithii* Hiern *op. cit.* 557; *Aglaia griffithii* (Hiern) Kurz, *J. As. Soc. Beng.* 44 (1875) 146, King *op. cit.* 75, Ridley *op. cit.* (1922) 409, Anderson *op. cit.* (1980) 248.

Distribution. Myanmar, Thailand, Vietnam, Peninsular Malaysia, Singapore and Borneo.

Notes. Two subspecies are recognised, viz. subsp. *exstipulata* and subsp. *brunneostellata*. The former does not occur in Borneo; the latter is endemic in Borneo and differs from the former in its fewer leaflets which have a smaller length/breadth ratio and are covered with compact stellate hairs distributed evenly on the lower surface so that they are visible to the naked eye as brown dots.

subsp. **brunneostellata** Pannell

(Latin, *brunneus* = brown, *stellatus* = stellate; the indumentum)

Kew Bull. 59 (2004) 89; Beaman & Anderson *op. cit.* 120. **Type:** *E. Wright S 23972*, Borneo, Sarawak, Kapit district, Bt. Raya (holotype FHO; isotypes KEP, SAN, SAR).

Tree to 15 m tall, to 22 cm diameter, branched. **Bark** smooth, brownish yellow or greyish brown; inner bark pale yellowish brown; latex white. **Sapwood** pale yellowish brown. **Twigs** slender, brown, *densely covered with reddish brown stellate hairs*. **Leaves** *imparipinnate*, to 60 cm long; petioles to 11 cm long; *leaflets without or with numerous pits on both surfaces*, upper surface with hairs like that of the twigs on the impressed midrib, *lower surface densely covered with reddish brown stellate hairs (with arms of adjacent hairs not overlapping) on the midrib, numerous on the rest of the surface, interspersed with smaller,*

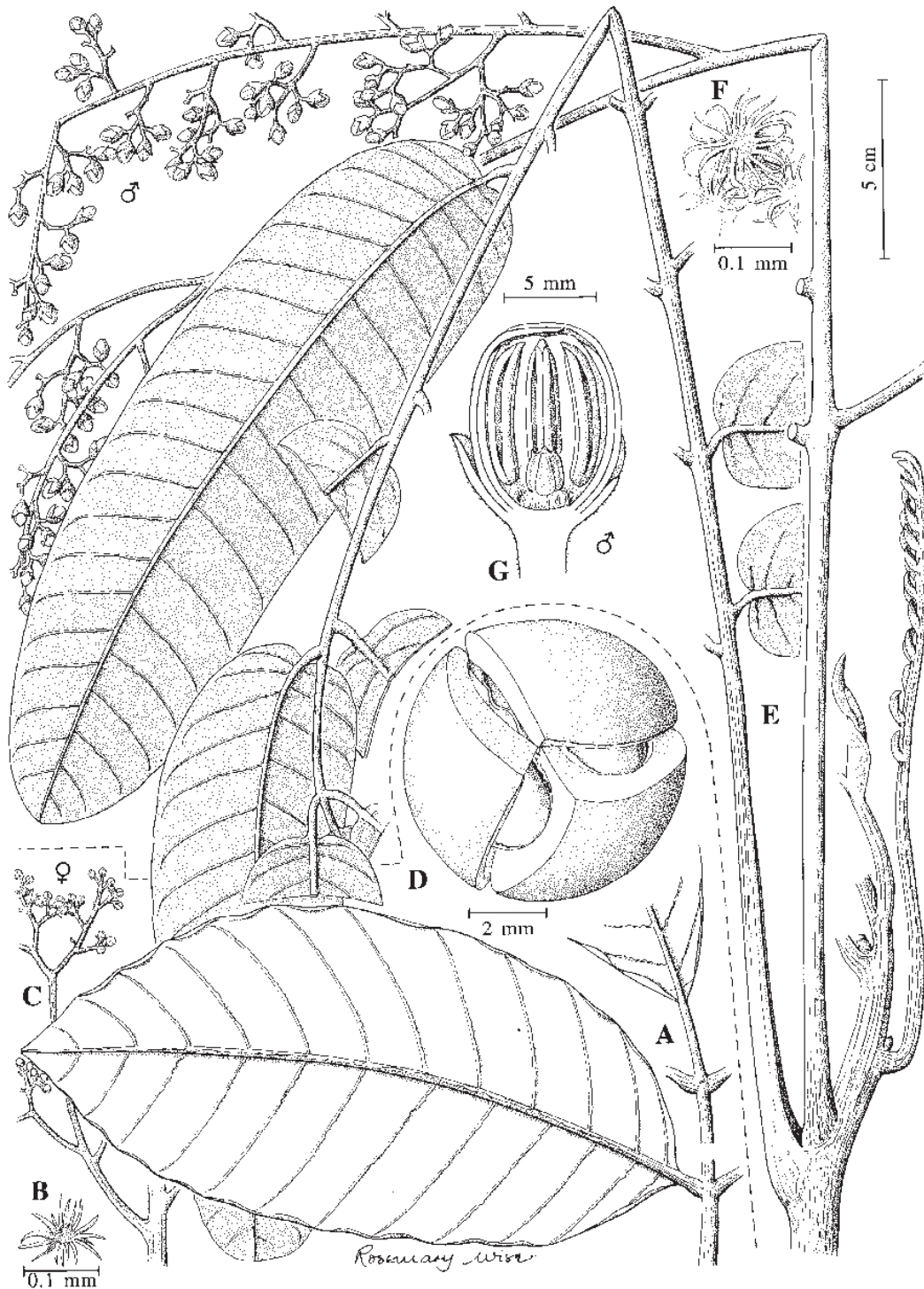


Fig. 4. *Aglaia erythrosperma* (A–D); *A. rubiginosa* (E–G). A, leaf apex and leaflet; B, stellate scale; C, part of female inflorescence; D, fruit; E, leafy twig with male inflorescence; F, stellate scales; G, longitudinal section of male flower. (After Pannell, TFM 4 (1989) 224, f. 3; A–D from Pannell 1175, E–F from KEP 74115, G from SFN 27277.)

paler reddish brown or orange-brown, fewer-rayed stellate hairs; lateral leaflets 3–5 on each side of rachis, subopposite; blades oblong or narrowly elliptical, 4.5–10.5 × 2.5–6 cm, base rounded or cuneate, asymmetrical, margin slightly wavy, apex acuminate or caudate, acumen acute or obtuse, to 15 mm long; midrib impressed above, prominent below; lateral veins 7–12 on each side of midrib, impressed above, subprominent below; intercostal venation prominent below; petiolules 1–2 cm long. Inflorescences densely covered with reddish brown stellate hairs like that of on the twigs; males to 40 cm long and wide; females smaller and less-branched. Flowers c. 0.9 × 0.8 mm (males) or c. 2 × 1.7 mm (females); calyx divided almost to the base into 5 rotund, obtuse lobes, outside with numerous to densely covered with reddish brown stellate hairs; petals 5; staminal tube 0.4–0.9 × 0.7 mm, anthers 5, 0.2–0.3 × 0.2 mm; ovary depressed globose, 0.1–0.2 × 0.3–0.6 mm, stigma depressed globose, 0.1–0.2 × 0.2–0.3 mm. Fruits indehiscent, locules 2, each containing 1 seed, subglobose, 1.2–1.7 × 0.8–1.7 cm, densely hairy. Seeds surrounded by a white edible aril.

Distribution. Borneo and the Philippines (Palawan, known from one collection, *Stone et al.* 282). In Sabah, known from Kota Merudu, Labuk Sugut, Lahad Datu, Ranau, Tambunan and Tenom districts (e.g., *Pennington* 7940, *SAN* 67586, *SAN* 85025, *SAN* 118919 and *SAN* 133699) and in Sarawak from Bau, Kapit, Limbang, Lundu and Marudi districts (e.g., *S* 35481, *S* 36392, *S* 46376, *S* 47696, *S* 47845 and *S* 74113). Also occurring in Brunei (e.g., *Wong WKM* 1529) and Kalimantan (e.g., *Burley et al.* 2400, *Church et al.* 759, *Church et al.* 796, *Mahyar* 3099 and *Tuke* P9 469).

Ecology. In mixed dipterocarp and *kerangas* forests on sandy clay soil, at altitudes to 740 m.

15. *Aglaia forbesii* King

Plate 2C.

(Henry Ogg Forbes, 1851–1932, Scottish botanist and ethnologist)

Sect. *Aglaia*

J. As. Soc. Beng. 64, 1 (1895) 68; *Ridley op. cit.* (1922) 406; *Anderson op. cit.* (1980) 248; *Pannell op. cit.* (1989) 215, *op. cit.* (1992) 207, *op. cit.* (1995) 265; *Whitmore, Tantra & Sutsna op. cit.* 222; *PROSEA op. cit.* (1995) 46 *Turner op. cit.* 337; *Coode et al. (eds.) op. cit.* 201. **Syntypes:** *King's collectors* 10787, Peninsular Malaysia, Perak, Ulu Kali (BM, G, K, L); *King's collector* 4762, Peninsular Malaysia, Perak, Larut (BM, CGE, G); *Curtis* 1631, Perak, Pangkor, Sg. Bruas (SING); *Wray Jr.* 3265, Perak, Larut (SING); *Forbes* 3179, Sumatra, Mt. Napalhitju (BM, K, L). **Synonym:** *Aglaia humilis* King *op. cit.* 69, *Ridley op. cit.* (1922) 407, *Pannell op. cit.* (1989) 218.

Tree to 20 m tall, to 20 cm diameter, *branched*; buttresses (if present) to 1.2 m high. **Bark** brown, pale brown, greenish grey or yellow; inner bark brown, greyish brown, orange-brown or reddish brown; latex white. **Sapwood** pale yellow, pale brown or pale pink. **Twigs** slender, greenish brown or brown, smooth or longitudinally wavy ridged, *densely covered with dark brown, reddish brown or greyish brown stellate scales or hairs*. **Leaves** imparipinnate, to 100 cm long; *petioles* to 35 cm long; *leaflets* subcoriaceous to coriaceous,

blackish green when dry, both surfaces prominently pitted, lower surface with a few to numerous reddish brown or greyish brown stellate hairs (with arms of adjacent hairs overlapping; hairs without central rachis) or scales on the midrib, lateral veins and occasionally on the surface in between; lateral leaflets 5–6(–9) on each side of rachis, alternate or sometimes subopposite, basal ones only slightly smaller than the rest; blades elliptical, oblong or ovate, 8.5–21 × 3.5–9 cm, base rounded or cuneate, asymmetrical, margin strongly recurved, apex acuminate, acumen acute or cuneate, to 12 mm long; midrib slightly impressed above, prominent below, often almost black when dry; lateral veins 12–24 on each side of midrib, slightly impressed above, subprominent below, nearly black when dry; intercostal venation barely visible; petiolules 1.5–2 cm long. **Inflorescences** to 35 cm long and 25 cm wide, densely covered with pale brown or reddish brown stellate scales or hairs. **Flowers** 1.5–3 × 1.5–2.5 mm; calyx lobes 5 or rarely 6, outside densely covered with stellate scales or hairs; petals 5 or rarely 6; staminal tube obovoid, 1–2.2 × 1–1.8 mm, anthers 5, 0.6–0.8 × 0.3–0.5 mm; ovary subglobose, 0.2–0.6 × 0.3–1.2 mm, locules 2, each with 1 ovule, stigma ovoid, 0.2–0.6 × 0.2–0.5 mm, black and shiny, with two small apical lobes. **Fruits** indehiscent, locules 2, each containing 0 or 1 seed, ellipsoid or subglobose, to 4 × 3.8 cm, sometimes with a small beak at the apex and sometimes narrowed at the base into a short stalk to 4 mm long, sometimes with a longitudinal ridge around it; pericarp to 4 mm thick, soft, fibrous and flexible, white, yellow, orange, grey or greenish grey, sometimes longitudinally wrinkled when dry, outside densely covered with white or yellowish grey stellate scales or peltate scales with fimbriate margins, inside shiny, with white latex. **Seeds** 1.5–3 × 2–2.2 × 1.5 cm; aril completely covering the seed, translucent, gelatinous, yellow or pink, to 3 mm thick, sweet-sour or with a flavour like that of langsat.

Vernacular names. Sabah—*langsat burung* (Malay), *lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban), *suloh* (Selakau/Melanau).

Distribution. Myanmar, Thailand, Sumatra, Peninsular Malaysia and Borneo. In Sabah, recorded from Keningau, Kinabatangan, Labuk Sugut, Sandakan, Sipitang and Tenom districts (e.g., *SAN 13266*, *SAN 26893*, *SAN 73181*, *SAN 97645* and *SAN 132941*) and in Sarawak from Belaga, Kapit, Kuching, Lawas and Limbang districts (e.g., *Mabberley 1617*, *S 12288*, *S 27909*, *S 38741* and *S 47590*). Also known from Brunei (e.g., *Dransfield JD 7264* and *KEP 30405*) and Kalimantan (e.g., *Church et al. 1364*, *Kessler et al. B 336*, *Mabberley 1598*, *Wilkie 9514* and *Wilkie 93343*).

Ecology. In forest along rivers, on sandy, clay or sandy loam soils, at altitudes to 950 m.

16. *Aglaia foveolata* Pannell

(Latin, *foveolatus* = minutely pitted; the leaflet surfaces)

Sect. *Aglaia*

Kew Bull. Add. Ser. 16 (1992) 211, *op. cit.* (1995) 266; PROSEA *op. cit.* (1995) 46. Turner *op. cit.* 337; Coode *et al.* (eds.) 201. **Type:** *Kochummen FRI 2112*, Peninsular Malaysia, Terengganu, Jerangau FR (holotype K; isotype KEP). **Synonyms:** *Aglaia* sp. 7, Pannell *op. cit.* (1989) 230; *Aglaia* sp. 8/L, Whitmore, Tantra & Sutisna *op. cit.* 226.

Tree, 20–25 m tall, to 70 cm diameter, branched; buttresses to 75 cm tall, to 30 cm out. **Bark** smooth, reddish brown or greyish brown, with shallow longitudinal fissures; inner

bark pale brown or reddish brown; latex white. **Sapwood** yellowish brown; heartwood brown or reddish brown. **Twigs** slender, *densely covered with reddish brown stellate hairs or scales near the apex*. **Leaves** imparipinnate, to 42 cm long; petioles to 8 cm long; leaflets yellowish green or brown when dry, with numerous pits on both surfaces, upper surface usually dull, lower surface rugulose; scales or hairs like that of twigs few or dense on the midrib on both surfaces and absent to numerous on the rest of the lower surface; lateral leaflets (5–)6–8(–13) on each side of rachis, subopposite, basal ones only slightly smaller than the rest; blades elliptical, oblong or lanceolate, 5–13.5 × 1.3–4.5 cm, base asymmetrical, cuneate or rounded, margin recurved, apex acuminate-caudate, acumen obtuse, to 15 mm long; midrib prominent below; lateral veins 9–15(–24) on each side of midrib, sometimes with shorter veins in between, subprominent below; intercostal venation sometimes subprominent or faint but visible below; petiolules to 0.8 cm long. **Inflorescences** densely covered with reddish brown indumentum like that on the twigs, to 22 cm long and wide. **Flowers** c. 2 × 1.5–2 mm; calyx deeply divided into 5 ovate, obtuse lobes, outside with a few to dense cover of stellate hairs or scales; petals 5; staminal tube 1–1.5 × 1–1.5 mm, anthers 5, ellipsoid, 0.6–0.8 × 0.4 mm; ovary subglobose or depressed globose, c. 0.4 × 0.9 mm, stigma narrowly ovoid or ellipsoid with longitudinal ridges, subglobose or with two lobes at apex, c. 0.5–0.3 mm. **Fruits** indehiscent, *locules 1 or rarely 2*, each containing 1 seed, subglobose or broadly ellipsoid, to 2.5 cm long, purple, brown, orange or yellow, densely covered with stellate hairs or scales. Aril translucent, sweet.

Vernacular name. Sarawak—*segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, known from Labuk Sugut and Sandakan districts (e.g., SAN 27188, SAN 50688, SAN 82053, SAN 83601 and SAN 92188) and in Sarawak from Bintulu, Kapit, Kuching, and Limbang districts (e.g., S 13955, S 25483, S 27979, S 36448 and S 43200). Also occurring in Brunei (e.g., Araffin ARK 103, BRUN 658 and Wong WKM 350) and Kalimantan (e.g., Jarvie & Ruskandi 5406, Jarvie & Ruskandi 5922, Jarvie & Ruskandi 6921 and Sidiyasa 1422).

Ecology. In swamp, riverine and ridge forests, on sandy, silty clay and clay soils, at altitudes to 1000 m.

17. *Aglaia glabrata* Teijsm. & Binn.

Plate 2D.

(Latin, *glabratus* = nearly without hairs or scales; the leaflets)

Sect. *Aglaia*

Nat. Tijdschr. Ned. Ind. 27 (1864) 42; Miquel *op. cit.* (1868) 58; Pannell *op. cit.* (1992) 177, *op. cit.* (1995) 254; Turner *op. cit.* 337. **Type:** *Cult. Hort. Bogor III-B-60*, origin Sumatra, Bangka; vernacular name *bawang* (holotype BO). **Synonym:** *Aglaia chaudiocensis auct. non Pierre* (1896): Anderson *op. cit.* (1980) 247.

Tree to 20 m tall, to 30 cm diameter, *branched*; buttresses steep to 1.2 m high. **Bark** greyish brown or greenish brown; inner bark pale yellow; latex white. **Sapwood** yellowish. **Twigs** *densely covered with dark purplish brown peltate fimbriate scales or with reddish brown or orange-brown stellate scales of less than 0.2 mm diameter*. **Leaves** imparipinnate, to 22 cm long; petioles 3.5–7 cm long; *when dry, leaflets dull and often green above and brown below, both surfaces usually with numerous prominent pits, lower surface without hairs or scales except for the midrib which is densely covered with scales like that of the twigs*;

lateral leaflets 2–4 on each side of rachis, subopposite or sometimes alternate, *basal ones only slightly smaller than the rest*; *blades elliptical or rarely ovate*, 4–10(–13) × 1.5–4(–5) cm, base cuneate, slightly asymmetrical, margin planar, apex acuminate with obtuse acumen; midrib prominent below; lateral veins 6–13 on each side of midrib, subprominent below; *intercostal venation faint but visible on both surfaces*; *petiolules to 0.7 cm long*. **Inflorescences** to 12 cm long and wide, densely covered with peltate scales like that of the twigs or with stellate scales on the peduncles, rachis and branches. **Flowers** subglobose, 1–1.5 × 1–1.5 mm; *calyx shallowly divided into 5 obtuse lobes*, outside densely covered with scales like that of the rest of the inflorescence; *petals 5*; staminal tube obovoid, *c.* 1 × 1 mm, anthers 5, ovoid, 0.5–0.7 × 0.3–0.5 mm; ovary subglobose, 0.3–0.5 × 0.3–0.5 mm, densely covered with reddish brown stellate hairs or scales, locules 2, stigma ovoid with two apical lobes, 0.2–0.5 × 0.2–0.5 mm. **Fruits indehiscent**, *locules 1 or 2*, subglobose, *c.* 1.5 × 1.4 cm, either densely covered with scales like that of the twigs or with orange-brown peltate fimbriate scales.

Vernacular name. Sarawak—*segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Borneo and Maluku. In Sabah, known from Beaufort, Keningau, Kinabatangan, Papar, Sandakan and Sipitang districts (e.g., *Jeprin & Sidkan MB 993*, *SAN 80347*, *SAN 86271*, *SAN 103628* and *SAN 126701*) and in Sarawak from Bau, Bintulu, Kuching, Limbang, Marudi and Sri Aman districts (e.g., *S 4326*, *S 8891*, *S 17133*, *S 29308* and *S 47632*). Also occurring in Brunei (*Muellner et al. ANM 2048* and *BRUN 18707*) and Kalimantan (e.g., *Kostermans 8054*, *Kostermans 9965*, *Kostermans 11206*, *Kostermans & Anta 960* and *Wilkie 93349*).

Ecology. In mixed dipterocarp, peatswamp and *kerangas* forests, on white sand and sandy soil with very thin humus layer, or rocky terrain, at altitudes to 800 m.

18. *Aglaia glabriflora* Hiern

Fig. 5A–F.

(Latin, *glabrus*- = without hairs or scales, *florus* = flower)

Sect. *Aglaia*

In Hooker f., Fl. Brit. Ind. 1 (1875) 555; King *op. cit.* 63; Ridley *op. cit.* (1922) 404; Anderson *op. cit.* (1980) 248; Pannell *op. cit.* (1989) 217; Whitmore, Tantra & Sutisna *op. cit.* 222. **Lectotype** (Pannell, 1992): *Griffith 1042*, Peninsular Malaysia, Johor, Mt. Ophir (K).

Tree to 20 m tall, to 25 cm diameter, branched; sometimes flowering at 3 m tall. **Bark** smooth, dark brown, brownish yellow, yellowish grey or greenish brown, lenticellate; inner bark mid-brown or greenish white, pale red or yellow. **Sapwood** white or orange yellow; latex white or sap clear and watery. **Twigs** with numerous to dense reddish brown peltate scales at the apex, the whole shoot, including leaves, inflorescences and infructescences brown or blackish brown when dry. **Leaves imparipinnate**, to 30 cm long; *leaflets below with occasional stellate scales*; *lateral leaflets 3–5 on each side of rachis, opposite*; *blades elliptical or ovate*, 4–10 × 1.5–4 cm, base cuneate or subrounded, asymmetrical, margin finely recurved, apex acuminate-caudate, acumen obtuse often narrow and parallel-sided, to 15 mm long; midrib flattish above, prominent below; *lateral veins 6–7 on each side of midrib, usually brown or black when dry*; intercostal venation faint; petiolules 0.3–0.8 cm long. **Inflorescences** to 20 cm long. **Flowers** obovoid, 2–2.5 × 1.9–2.1 mm; *calyx without hairs or scales*; *petals 5*; staminal tube 1.7–2.3 × 1.5–2 mm, anthers 0.8–1 × 0.5–0.6 mm; ovary ovoid, 0.5–0.9 × 0.4–0.8 mm, densely covered with orange-brown stellate hairs,

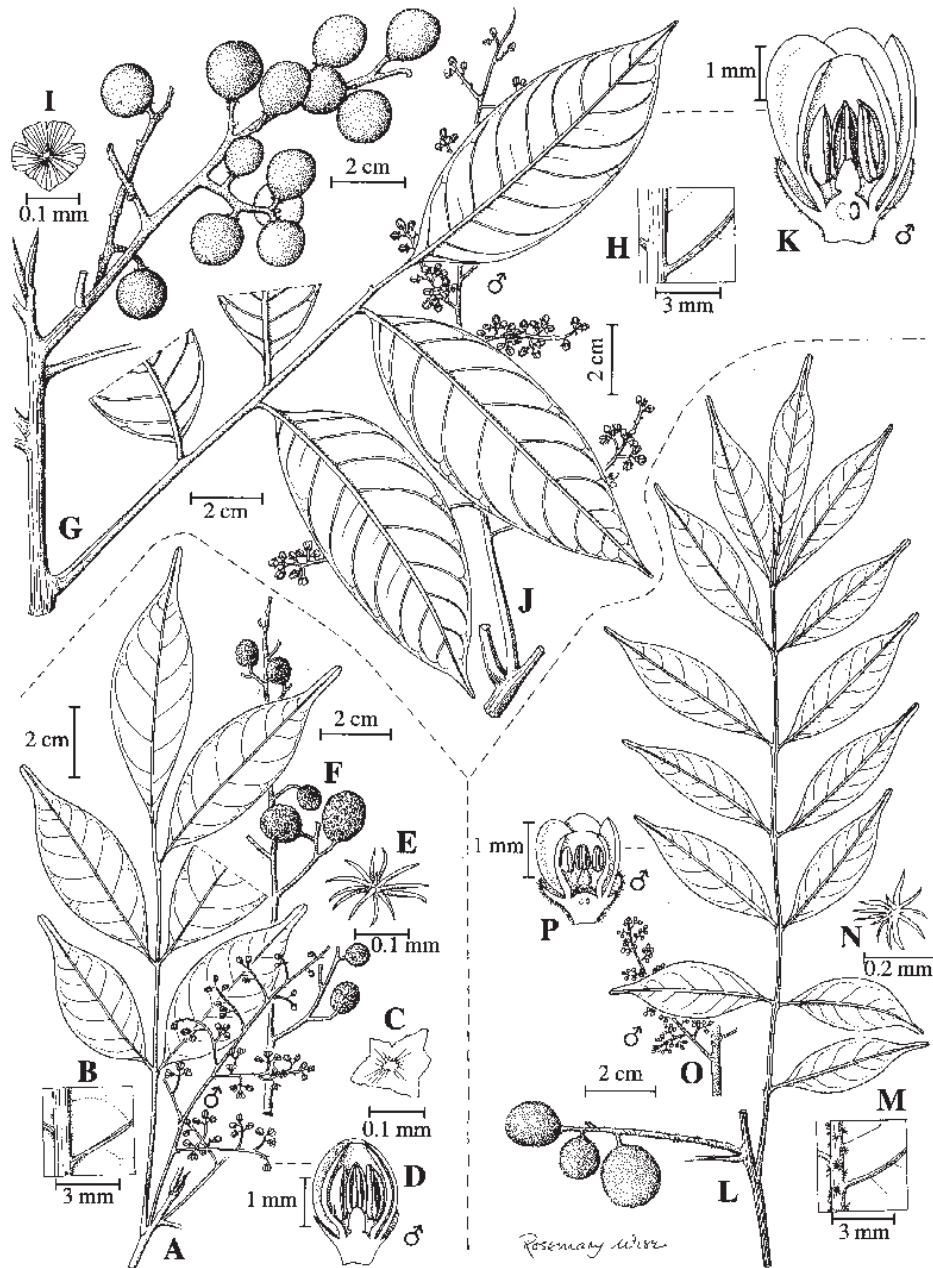


Fig. 5. *Aglaia glabriflora* (A–F), *A. leptantha* (G–K), *A. stellatopilosa* (L–P). A, leafy twig with male inflorescence; B, detail of midrib and lateral vein on the lower leaflet surface showing the indumentum; C, peltate scale; D, longitudinal section of male flower; E, stellate scale; F, infructescence; G, fruiting leafy twig; H, detail of midrib and lateral vein on the leaflet lower surface; I, peltate scale; J, male inflorescence; K, longitudinal section of male flower; L, fruiting leafy twig; M, detail of midrib and lateral vein on the lower surface showing the indumentum; N, stellate hair; O, part of male inflorescence; P, longitudinal section of male flower. (A–D from S 28012, E–F from S 39029, G–I from S 26993, J–K from SAN 76454, L from S 36491, M–N from SAN 537572, O–P from S 47672.)

locules 2, stigma 0.5–0.9 × 0.4–0.5 mm. **Fruits** indehiscent, locules 1 or 2, subglobose to ellipsoid, 1–1.5 × 1–1.5 cm, wrinkled when dry, without longitudinal ridge, densely covered with reddish brown stellate hairs.

Vernacular name. Sabah—*lantupak* (Dusun Kinabatangan).

Distribution. Sumatra, Peninsular Malaysia and Borneo (Sabah and Sarawak). In Sabah, known from Keningau, Labuk Sugut, Lahad Datu, Papar and Sipitang districts (e.g., *SAN 63164*, *SAN 83848*, *SAN 93061*, *SAN 96530* and *SAN 118491*) and in Sarawak from Belaga, Bintulu, Lundu, Miri and Sri Aman districts (e.g., *Pennington 7990*, *S 28012*, *S 39029*, *S 39322* and *S 42779*).

Ecology. In mixed dipterocarp and *kerangas* forests, on sandy clay soil, sometimes in peat swamp forest, at altitudes to 800 m.

Notes. Pannell (*op. cit.* 1992 & 1995) treated *Aglaia glabriflora* as synonym of *A. leptantha*. In the present account, however, *A. glabriflora* is recognised as a distinct species differing from *A. leptantha* in its smaller leaves and glabrous fruits and flowers.

19. *Aglaia grandis* Korth. ex Miq.

(Latin, *grandis* = large; the leaves)

Sect. *Aglaia*

Ann. Mus. Lugd. Bat. 4 (1868) 56; Merrill *op. cit.* (1921) 322; Masamune *op. cit.* 371; Pannell *op. cit.* (1989) 217, *op. cit.* (1992) 111, *op. cit.* (1995) 232; Whitmore, Tantra & Sutisna *op. cit.* 222; Turner *op. cit.* 337; PROSEA *op. cit.* (1995) 46; Beaman & Anderson *op. cit.* 121. **Lectotype** (Pannell, 1992): *Korthals s.n.*, Borneo, Kalimantan, G. Sakoembang (U [*Acc. No. 39243*]; isoelectotypes BO, K, L [*Acc. No. 9081321502* & *9081321533*]). **Synonyms:** *Aglaia lanuginosa* King *op. cit.* 71, Ridley *op. cit.* (1922) 407, Corner *op. cit.* (1978) 131; *Aglaia hemsleyi* [*hemsleyi*] Koord. *op. cit.* 383, 635; ?*Aglaia bernardoi* Merr. *op. cit.* (1915) 302, Anderson *op. cit.* (1980) 247, Whitmore, Tantra & Sutisna *op. cit.* 220; *Aglaia stellatotomentosa* [*stellato-tomentosa*] Merr. *op. cit.* (1915) 535, Anderson *op. cit.* (1980) 247; *Aglaia perfulva* Elmer *op. cit.* 3302.

Tree to 17 m tall, to 25 cm diameter, branched. **Bark** smooth, grey or blackish red, with shallow longitudinal fissures; inner bark brown, reddish brown or pink; latex white. **Sapwood** pinkish brown, reddish brown, yellow or white. **Twigs** stout, *terete*, to 4 cm diameter, with many petiole scars, *densely covered with brown hairs with a central rachis and 2–4 whorls of arms radiating from it*. **Leaves** *imparipinnate*, to 135 cm long; petioles to 20 cm long; leaflets coriaceous, upper surface shiny, *lower surface densely covered with pale brown hairs to 1 mm long like that of the twigs, with the surface visible between the hairs; lateral leaflets (rarely 4) 5–9 on each side of rachis, subopposite; blades elliptical, obovate or oblong, 13–51 × 6.5–14 cm*, base subcordate or cuneate, asymmetrical, margin recurved, apex acuminate, acumen acute, to 15 mm long; midrib impressed above, prominent below; lateral veins 17–45 on each side of midrib, impressed above, prominent below; intercostal venation faint but visible on both surfaces; petiolules to 2 cm long. **Inflorescences** to 30 cm long and to 15 cm wide, densely covered with brown hairs like that of the twigs. **Flowers** sessile, densely packed on the final branches of the inflorescence, 3–4 × 2.5–3 mm; *calyx deeply divided into 5 narrow lobes*, outside with hairs like that of the twigs; corolla 2–3.3 × 2–2.7 mm, glabrous, *petals 5*; staminal tube obovoid, 1.9–3.3 × 1.5–2.3 mm, anthers 5, 0.6–1.1 × 0.5–0.6 mm; ovary depressed globose, 0.3–0.9 × 0.3–1.1

mm, with numerous stellate hairs, locules 3, each containing 1 ovule, stigma 0.5–1.1 × 0.5–0.6 mm, black and shiny, cylindrical, narrowed slightly to the obtuse, 3-lobed apex. **Fruits indehiscent**, brown, 1- or 2-locular, obovoid, to 5 × 5.6 cm, sometimes with a small beak; pericarp with white latex, inner wall reddish brown. **Seeds** to 5.5 × 4.5 cm; aril white.

Distribution. Vietnam, Thailand, Peninsular Malaysia, Borneo, the Philippines and Sulawesi. In Sabah, recorded from Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN 69489*, *SAN 73301*, *SAN 74402*, *SAN 75200* and *SAN 83177*) and in Sarawak from Belaga, Kuching and Marudi districts (e.g., *Chew CWL 1029*, *Mabberley 1606*, *S 30382* and *S 31803*). Also occurring in Kalimantan (e.g., *bb. 11718*) but not yet recorded from Brunei.

Ecology. In forests, including on limestone, at altitudes to 300 m.

20. *Aglaia hiernii* King

(William Philip Hiern, 1839–1925, British botanist)

Sect. *Aglaia*

J. As. Soc. Beng. 64, 1 (1895) 74; Ridley *op. cit.* (1922) 408; Corner *op. cit.* (1978) 131; Pannell *op. cit.* (1989) 218, *op. cit.* (1992) 341, *op. cit.* (1995) 310; PROSEA *op. cit.* (1995) 47; Turner *op. cit.* 337; Beaman & Anderson *op. cit.* 121. **Syntypes:** *Maingay 2493* (= *Kew Distr.* 335), Peninsular Malaysia, Malacca (K); *King's collectors 5976*, Perak, Gopeng (K); *King's collectors 6706*, Perak, Larut (CGE, SING, U); *King's collectors 10877*, Perak, Larut (SING). **Synonyms:** *Aglaia curtisii* King *op. cit.* 71, Anderson *op. cit.* (1980) 247, Whitmore, Tantra & Sutisna *op. cit.* 221; *Aglaia caudatifoliolata* Merr. *op. cit.* (1929) 126, Masamune *op. cit.* 370.

Tree to 30 m tall, to 30 cm diameter, branched. **Bark** greenish brown or grey with fine longitudinal lines of lenticels; inner bark green; latex white. **Sapwood** green, pink, pale yellow or white. **Twigs** fairly stout, *densely covered with dark reddish brown stellate hairs with arms to 1 mm long*. **Leaves** imparipinnate, to 70 cm long; petioles to 18 cm long; leaflets yellowish green when young, *below densely covered with stellate hairs like that of the twigs on the midrib and less so on the surface, with the arms of adjacent hairs overlapping, interspersed with numerous pale brown stellate scales or hairs with few ascending arms*; lateral leaflets (3 or 4) (or 6) on each side of rachis, opposite; *blades obovate, elliptical or oblong, 7–30 × 4–11 cm*, base rounded, margin recurved, apex short-caudate, acumen acute, to 15 mm long; midrib prominent below; lateral veins 12–25 on each side of midrib, subprominent below; *intercostal venation faint*; petiolules 1–2.5 cm long. **Inflorescences** densely covered with stellate hairs like that of the twigs, to 35 cm long and wide. **Flowers** sessile and tightly packed on the terminal branches of the inflorescence, subglobose, *c.* 1 × 1 mm; *calyx divided almost to the base into 4 or 5 subrotund lobes*, outside densely covered with stellate scales; *petals 5*; staminal tube shorter than the corolla, anthers 5, ovoid; ovary *c.* 0.3 mm diameter, stigma glabrous, black when dry. **Fruits indehiscent**, *locule 1*, containing 1 seed, obovoid or ellipsoid, to 4 × 3 cm; stalk to 0.5 cm long; *pericarp 2–4 mm thick, woody and hard when dry*, outside densely covered with stellate hairs or scales. **Seeds** *c.* 2.9 × 1.9 × 1.7 cm; aril *c.* 1.5 mm thick, translucent, pale orange, sweet and edible.

Vernacular names. Sabah—*jalungang sasak* (Malay), *lantupak* (Dusun Kinabatangan and Kadazan). Sarawak—*labonoh* (Kelabit), *pulu* (Kayan), *segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, recorded from Labuk Sugut, Lahad Datu, Ranau, Sandakan, Tambunan and Tawau districts (e.g., *SAN 29563*, *SAN 32323*, *SAN 46793*, *SAN 64990* and *SAN 87647*) and in Sarawak from Belaga, Kapit, Kuching, Marudi, Miri and Song districts (e.g., *Mabberley 1630*, *Pennington 8009*, *S 26220*, *S 35054*, *S 39837* and *S 50568*). Also occurring in Kalimantan (e.g., *Adriansyah & Boestani AA 2194*, *Burley et al. 778* and *Kessler et al. PK 853*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp forests, on sandy, clay, clay-loam soils, at altitudes to 1300 m.

21. *Aglaia korthalsii* Miq.

Fig. 6.

(Pieter Willem Korthals, 1807–1892, Dutch botanist and traveller)

Sect. *Aglaia*

Ann. Mus. Lugd. Bat. 4 (1868) 42; Whitmore, Tantra & Sutisna *op. cit.* 223; Pannell *op. cit.* (1992) 167, *op. cit.* (1995) 251; Turner *op. cit.* 337; Argent *et al.* (eds.) *op. cit.* 410; Beaman & Anderson *op. cit.* 121. **Lectotype** (Pannell, 1992): *Korthals 899a*, Sumatra, Doekoe (L [*Acc. No. 9081321517*]; isoelectotype L [*Acc. 95254125*]). **Synonyms:** *Hearnia sarawakana* C.DC. *op. cit.* (1878) 632; *Aglaia cauliflora* Koord. *op. cit.* 633; *Aglaia dysoxylifolia* Koord. *op. cit.* 634; *Aglaia celebica* Koord. *op. cit.* 634; *Aglaia confertiflora* Merr. *op. cit.* (1929) 125, Whitmore, Tantra & Sutisna *op. cit.* 220; *Aglaia sarawakana* (C.DC.) Merr. *op. cit.* (1921) 323, Masamune *op. cit.* 370; *Aglaia* sp. 4, Pannell *op. cit.* (1989) 228.

Tree to 26 m tall, to 70 cm diameter, branched; buttresses (if present) to 60 cm high. **Bark** pale to dark reddish brown or pinkish brown or grey; inner bark pink, red, purplish yellow, pale grey or brown; latex white. **Sapwood** brownish yellow, yellow or white. **Twigs** longitudinally wrinkled, with pale pink lenticels, *densely covered with shiny reddish brown peltate scales with a dark centre, becoming paler towards the margin or are pale throughout with irregular or shortly fimbriate margins*. **Leaves** imparipinnate, to 40 cm long; petioles 7–12 cm long; *leaflets below sparsely to densely covered with scales like that of the twigs*, sometimes with faint reddish brown pits; lateral leaflets (1 or) 2 (or 3) on each side of rachis, subopposite; *blades ovate or elliptical or sometimes obovate, 3–22 × 1.2–7.5 cm*, base rounded or cuneate, asymmetrical, *margin recurved*, apex acuminate, acumen obtuse or acute, to 15 mm long; midrib prominent below; lateral veins 7–16 on each side of midrib, subprominent below; intercostal venation inconspicuous on both surfaces; petiolules 0.5–1(–3) cm long. **Inflorescences** densely covered with peltate scales like that of the twigs; males to 40 cm long and wide; females smaller, fewer-branched. **Flowers** subglobose or depressed globose, 1.1–1.5 × 1.1–1.6 mm; *calyx divided almost to the base into 5 rounded lobes with fimbriate margins*, outside with few to numerous peltate scales like that of the twigs; *petals 5*; *staminal tube* obovoid or cup-shaped, 0.5–0.9 × 0.7–1 mm, *with an aperture of more than 0.3 mm diameter, margin shallowly lobed*, *anthers 5, protruding through the aperture of staminal tube*, ovoid, *c.* 0.3 × 0.3 mm; ovary depressed globose, 0.2–0.3 × 0.2–0.5 mm, densely covered with peltate scales, stigma ovoid, 0.2–0.3 × 0.2–0.3 mm. **Fruits** indehiscent, *locules 2*, each containing 0 or 1 seed, *with a longitudinal ridge around it along which the pericarp splits when pressure is applied, ellipsoid*, to 3.7 × 3.1 cm, reddish orange or bright red, outside densely covered with orange-brown peltate fimbriate scales.

Vernacular names. Sabah—*langsap munchit* (Sungei), *lantupak* (Dusun Kinabatangan), *lantupak burung* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. NE India (Assam), Bhutan, Nicobar Islands, Myanmar, Vietnam, S Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi and Nusa Tenggara (Sumbawa and Flores). In Sabah, known from Beaufort, Kudat, Lahad Datu, Ranau, Sandakan, Semporna, Sipitang, Tambunan and Tawau districts (e.g., *SAN 46102*, *SAN 66865*, *SAN 72388*, *SAN 90102* and *SAN 114026*) and in Sarawak from Marudi and Miri districts (e.g., *S 24022*, *S 27276*, *S 30422*, *S 35799*, *S 43172* and *S 89435*). Also occurring in Kalimantan (e.g., *bb. 25877*, *Goverse & Adriansyah B 452* and *Leighton 1009*) but not yet recorded from Brunei.

Ecology. In forests, sometimes on limestone, at altitudes to 700 m. Fruits and seeds are eaten and dispersed by Orang-utans.

Taxonomy. In Borneo, *Aglaiakorthalsii* and *A. odoratissima* are difficult to separate when not in fruit, because *A. korthalsii* has leaves with fewer leaflets there than in the rest of its range.

22. *Aglaiakancifolia* (Hook.f.) Harms

Fig. 30–U.

(Latin, *lancea* = light spear, *folium* = leaf; the shape of leaflets)

Sect. *Aglaiak*

In Engler & Prantl, *Nat. Pflanzenfam.* 3, 4 (1896) 298; Masamune *op. cit.* 371; Anderson *op. cit.* (1980) 248; van Steenis, *Rheophytes of the World* (1981) 289; Whitmore, Tantra & Sutisna *op. cit.* 223. **Basionym:** *Milneakancifolia* Hook.f., *Trans. Linn. Soc.* 23 (1860) 165. **Lectotype** (Pannell, 1992): *Lowe s.n.*, Borneo, Sabah (K). **Synonyms:** *Aglaiopsis kancifolia* (Hook.f.) Miq. *op. cit.* (1868) 59; *Hearnia kancifolia* (Hook.f.) C.DC. *op. cit.* (1878) 630, Merrill *op. cit.* (1921) 322; *Aglaiakaramensis* Merr. *op. cit.* (1922) 317, Masamune *op. cit.* 370.

Rheophyte to 6(–9) m tall, branched; flowering at 2 m tall. **Bark** smooth, grey or brown; inner bark pale yellow. **Sapwood** whitish. **Twigs** slender, *densely covered with reddish brown stellate hairs or scales, sometimes interspersed with peltate, fimbriate scales*. **Leaves** imparipinnate, 16–30 cm long; petioles 6–10 cm long; *lateral leaflets (4 or) 5–8 on each side of rachis, alternate or subopposite, below with dense reddish brown stellate hair or scales on the midrib; blades narrowly lanceolate, 11–25 × 1–4.5 cm, mostly 5–11x longer than wide, base cuneate, margin recurved and somewhat wavy, apex acuminate-caudate, acumen to 20 mm long; midrib impressed above, prominent below, with dense indumentum like that of the twigs; lateral veins 9–19 on each side of midrib, faint above, subprominent below; intercostal venation faint on both surfaces; petiolules to 1 cm long*. **Inflorescences and flowers** like those of *A. elliptica* except that the *staminal tube usually divided to the base into 5 lobes*. **Fruits** indehiscent, *locules 2, each with one seed, globose, to 2.5 × 2.4 cm, orange when ripe, with a longitudinal ridge around it, densely covered with indumentum similar to that of the twigs*. **Seeds** to 2.1 × 1.3 × 0.8 cm.

Vernacular names. Sarawak—*buyau* (Punan), *embaloh* (Iban), *paybut* (Punan), *sankuang* (Iban), *segera* (Iban), *segera ayer* (Iban).

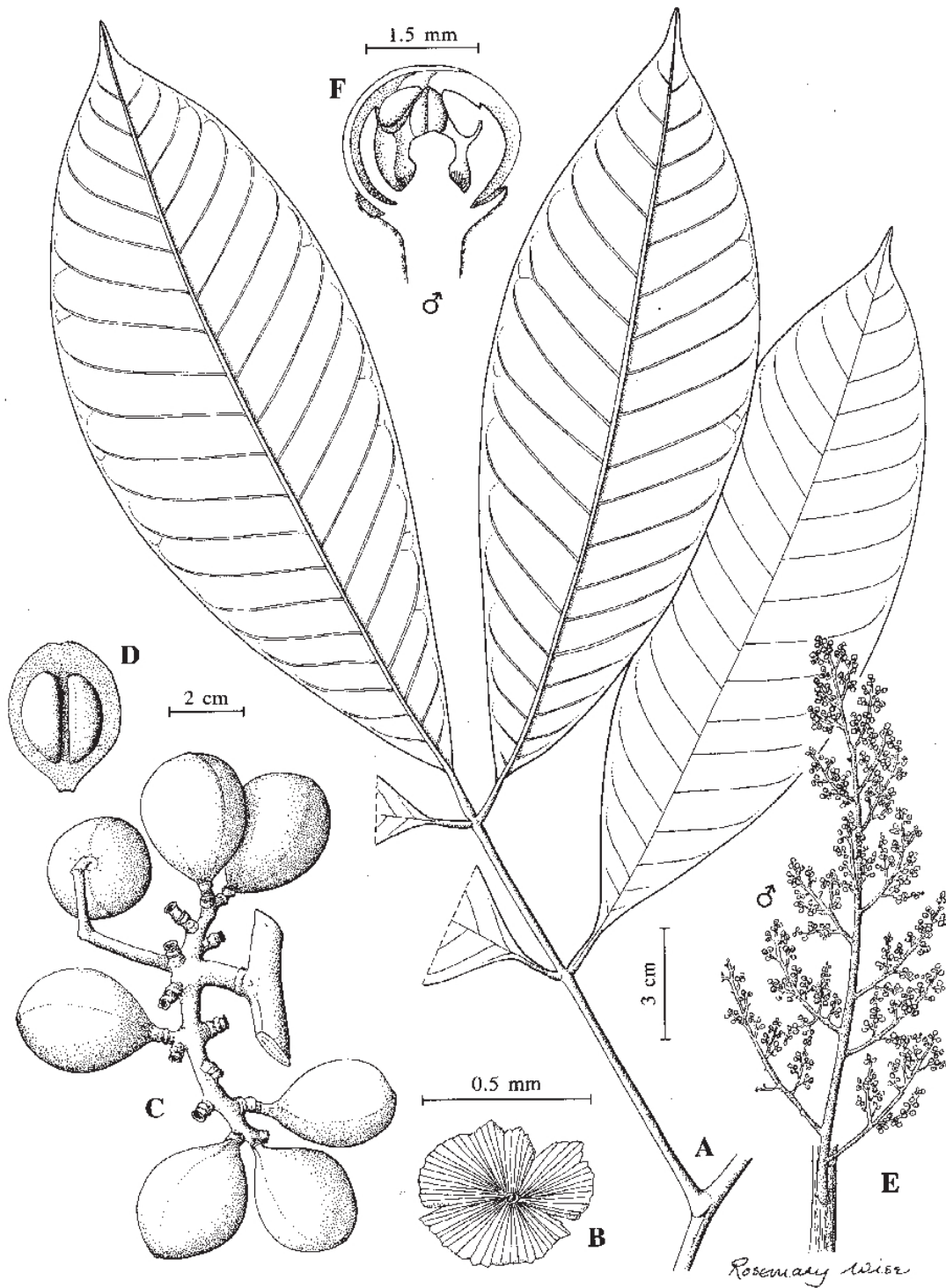


Fig. 6. *Aglaia korthalsii*. A, leaf; B, peltate scale; C, part of infructescence; D, opened fruit showing the seeds; E, male inflorescence; F, longitudinal section of male flower. (After Pannell, Kew Bull. Add. Series 16 (1992) 171, f. 41; A–D from Pannell 1972, E from de Wilde 19198, F from de Wilde 14823.)

Distribution. Endemic in Borneo. In Sabah, recorded from Beaufort, Lahad Datu and Sipitang districts (e.g., *SAN 78181*, *SAN 129531* and *SAN 138405*) and in Sarawak from Kapit, Limbang, Lubok Antu, Miri, Marudi and Sri Aman districts (e.g., *Pennington 7998*, *S 27297*, *S 34079*, *S 41359* and *S 51990*). Also occurring in Brunei (e.g., *Atkin 469*, *Kirkup DK 947*, *Schatz et al. 3282* and *Wong WKM 236*) and in Kalimantan (e.g., *Church et al. 504*, *Church et al. 5494*, *Mogea 3702*, *Ridsdale PBU 358A* and *Sidiyasa et al. BRF 1782*).

Ecology. Frequent on river banks. One specimen (*S 22913*) is reported to be an epiphyte about 16 m up a tree. The orange seed, surrounded by a transparent aril is eaten by fish (*vide* P. S. Ashton on *Pennington 7998*).

Notes. This species was treated as a synonym of *Aglaia elliptica* by Pannell (*op. cit.* 1992 & *op. cit.* 1995). It is here recognized as a distinct, but closely related species differing from *A. elliptica* in its long, narrow leaflets and staminal tube divided almost to the base.

23. *Aglaia lancilimba* Merr.

(Latin, *lancea* = light spear, *limbus* = border; the narrow recurved margin of leaflets)

Sect. *Aglaia*

Philip. J. Sci., Bot. 13 (1918) 294; Pannell *op. cit.* (1992) 137, *op. cit.* (1995) 242. **Lectotype** (Pannell, 1992): *De Mesa & Magistrado FB 26509*, the Philippines, Luzon, Camarines Province (US; isolecotypes K, P, PNH).

Tree to 15 m tall, branched. **Twigs** densely covered with large shiny reddish brown peltate scales which are entire or with a short fimbriate margin and often with a dark centre and a dark ring near the margin, the scales usually 0.2–0.6 mm diameter. **Leaves** imparipinnate, 18–50 cm long; petioles 2.5–12 cm long; leaflets pale yellowish brown when dry, lower surface with numerous pits, the midrib thickly covered with scales like that of the twigs, sometimes interspersed with a few paler and more fimbriate scales, occasionally also on the rest of that surface; lateral leaflets (3–)4–6(–8) on each side of rachis, subopposite or alternate; blades elliptical, 5–18 × 1.5–5.5 cm, base cuneate or rounded, asymmetrical, margin recurved or undulate, apex acuminate, acumen obtuse, 2–25 mm long; midrib prominent below; lateral veins 6–17 on each side of midrib, barely subprominent; intercostals venation faint; petiolules 0.5–2 cm long. **Inflorescences** to 28 cm long, to 23 cm wide, densely covered with scales like that of the twigs or with scales with a longer fimbriate margin or with stellate scales. **Flowers** 1.5–3 × 1.5–3.5 mm; calyx divided into 5 lobes, outside densely covered with scales like that of the twigs; petals 5; staminal tube shallowly cup-shaped, to c. 1 × 1–2 mm, thickened below and between the anthers, anthers 5, 0.4–0.5 × 0.4–0.5 mm, dark blackish brown when dry, with a pale yellow margin; ovary 0.4–1 × 0.6–1 mm, depressed globose, locules 2, each containing 2 ovules, stigma ovoid, 0.2–0.3 × 0.3–0.4 mm, truncate at the apex. **Fruits** indehiscent, locules 2, each containing one seed, subglobose, 2.2–3 × 2.2–3 cm, brown or yellow when ripe; pericarp thin and brittle when dry, outside densely covered with scales like that of the twigs. **Seeds** covered with a white aril.

Distribution. Borneo, the Philippines, Sulawesi and Nusa Tenggara (Bali, Flores and Sumbawa). In Borneo, only known from Bumbun Island, Semporna district, Sabah (e.g., *SAN 146*, *SAN 10128* and *SAN 10279*).

Ecology. In primary forest.

24. **Aglaiia lawii** (Wight) C.J.Saldanha *ex* Ramamoorthy

(John Sutherland Law, 1810–1885, British Civil Servant in Bombay, India)

Sect. **Neoaglaia**

In Saldanha & Nicolson, Flora of Hassan District (1976) 392; Pannell *op. cit.* (1992) 97, *op. cit.* (1995) 228; PROSEA *op. cit.* (1995) 47; Turner *op. cit.* 337; Argent *et al.* (eds.) *op. cit.* 410.

Basionym: *Nimmonia lawii* Wight, Calc. J. Nat. Hist. 7 (1847) 13 (*nom. nov. pro Epicharis exarillata* J.Graham, *non* Arn.). **Neotype** (Pannell, 1992): *Law s.n.*, India, Bombay (K; isoneotype CGE).

Synonyms: *Aglaiia submonophylla* Miq. *op. cit.* (1868) 40, Merrill *op. cit.* (1921) 323, Masamune *op. cit.* 373; *Aglaiia oligocarpa* Miq. *op. cit.* (1868) 45, Pannell *op. cit.* (1989) 221, Whitmore, Tantra & Sutisna *op. cit.* 224; *Lansium pedicellatum* Hiern *op. cit.* 588; *Amoora maingayi* Hiern *op. cit.* 562, Ridley *op. cit.* (1922) 400; *Aglaiia maingayi* (Hiern) King *op. cit.* 79; *Aglaiia eusideroxylon* Koord. & Valetton *op. cit.* (1896) 128, Koorders & Valetton *op. cit.* (1913) t. 97, Backer & Bakhuizen *f. op. cit.* 127, Whitmore, Tantra & Sutisna *op. cit.* 221; *Amoora lepidota* Merr. *op. cit.* (1904) 23; *Aglaiia alternifoliola* Merr. *op. cit.* (1915) 532; *Aglaiia grandifoliola* Merr. *op. cit.* (1918) 293; *Aglaiia trimera* Merr. *op. cit.* (1929) 128; *Aglaiia racemosa* Ridl. *op. cit.* (1930) 367; *Aglaiia pedicellata* (Hiern) Kosterm., Reinwardtia 7, 3 (1966) 226 & 264.

Distribution. India, Bhutan, China, Indo-China, Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines.

Notes. *Aglaiia lawii* is the most variable and widespread species in the genus. Three subspecies, viz. subsp. *lawii*, subsp. *oligocarpa* and subsp. *submonophylla* are recognised. Whereas subsp. *lawii* does not occur in Borneo, and subsp. *oligocarpa*, is known in Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines, subsp. *submonophylla* has been recorded only from Kalimantan.

subsp. **oligocarpa** (Miq.) Pannell

(Greek, *oligo-* = few, *karpos* = fruit)

Kew Bull. 59 (2004) 90. **Basionym:** *Aglaiia oligocarpa* Miq. *op. cit.* (1868) 45, Pannell *op. cit.* (1989) 221, Whitmore, Tantra & Sutisna *op. cit.* 224. **Lectotype** (Pannell, 1992): *Junghuhn 41*, Sumatra, Angkola Province (L [Acc. No. 9081321568]; isolectotype L [Acc. No. 908329629]). **Synonyms:** *Amoora maingayi* Hiern *op. cit.* 562, Ridley *op. cit.* (1922) 400; *Aglaiia maingayi* (Hiern) King *op. cit.* 79; *Aglaiia trimera* Merr. *op. cit.* (1929) 128; *Aglaiia racemosa* Ridl. *op. cit.* (1930) 367.

Tree to 30 m tall, to 40 cm diameter, branched; sometimes flowering when *c.* 2.5 m tall; buttresses (if present) to 90 cm high, to 50 cm out. **Bark** reddish brown, dark brown, grey, greyish brown, greenish brown, pale green, pale yellow or white; inner bark pale green, pale yellow, pale orange-brown, red, pink or white; latex white. **Sapwood** pale brown, yellow or white, sometimes pinker towards the heartwood. **Twigs** slender, longitudinally ridged, sometimes with numerous elliptical brown lenticels, *densely covered with very pale brown to almost white peltate scales with irregular or fimbriate margins and sometimes with a dark brownish black central spot.* **Leaves** *imparipinnate*, to 66 cm long; petioles to 16 cm long; *leaflets below occasionally with peltate scales, not or only faintly pitted, blackish green, pale green, yellowish green or pale yellow when dry; lateral leaflets 1–3 on each side of rachis, alternate or subopposite, terminal ones not folded at the base; blades*

elliptical, ovate or obovate, 5–23(–32) × (2–)2.5–8.5(–11) cm, base broadly cuneate, rounded, attenuate or cordate, slightly asymmetrical, margin recurved and undulate, apex acuminate or acuminate-caudate, acumen obtuse, 5–25 mm long; midrib prominent below; lateral veins (6–)10–14(–20) on each side of midrib, prominent below, not turning black when dry; intercostal venation barely visible or subprominent below; petiolules 0–2 cm long. Inflorescences axillary or ramiflorous, 2.5–22 cm long, 1.5–20 cm wide, densely covered with scales or hairs like that of the twigs. **Flowers** (1.5–)1.8–3 × (1.6–)1.7–3.5 mm; *calyx shallowly divided into 3 or 4 (rarely 6) obtuse lobes; corolla a short tube connate with the base of the staminal tube, divided into 3 or 4 subrotund lobes; staminal tube (0.8–)1.5–2.5 × (0.7–)1.3–3 mm, sometimes thickened below the insertion of the anthers, anthers (4–)6–9, ovoid, (0.3–)0.5–0.8 × (0.3–)0.4–0.7 mm; ovary subglobose or ovoid, (0.3–)0.5–0.7 × (0.3–)0.6–1 mm, locules 3, each containing 2 ovules, stigma ovoid or columnar, 0.2–0.6 × 0.3–0.5 mm, with 3 apical lobes or truncate at the apex. Fruits* subglobose, 2–2.9 cm across, with three longitudinal ridges along which the pericarp dehisces; *locules 3, each containing 0 or 1 seed; outer pericarp pink or yellow, inner pericarp white. Seeds* 1.5–2.3 × 1–1.4 cm, with an orange or orange-red aril.

Vernacular names. Sabah—*lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Borneo, known in Sabah from Keningau, Kinabatangan, Kudat, Papar, Ranau, Sandakan, Sipitang and Tenom districts (e.g., *Pennington 7943, SAN 28984, SAN 41153, SAN 41403* and *SAN 86774*) and in Sarawak from Bau, Betong, Kapit, Kuching, Miri and Serian districts (e.g., *Jacobs 5438, Mabberley 1625, S 22785, S 28106, S 32629* and *S 40267*). Also occurring in Brunei (e.g., *BRUN 5177*) and Kalimantan (e.g., *Laman et al. 1121, Laman et al. 1225, Laman et al. 1402, Veldkamp 8278* and *Veldkamp 8563*).

Ecology. In *kerangas* and mixed dipterocarp forests, sometimes in peat swamp or on limestone forests at altitudes to 600 m. In Peninsular Malaysia, the seeds are eaten and thought to be dispersed by birds ranging in size from bulbuls (Pycnonotidae) to magpies (Corvidae) and hornbills (Bucerotidae).

25. *Aglaia laxiflora* Miq.

(Latin, *laxus* = loose, *florus* = flower; the well-spaced arrangement of the flowers in the inflorescence)

Sect. *Aglaia*

Ann. Mus. Bot. Lugd. Bat. 4 (1868) 52; Ridley, J. Str. Br. Roy. As. Soc. 63 (1912) 59; Merrill *op. cit.* (1921) 322; Pannell *op. cit.* (1992) 294, *op. cit.* (1995) 294; Coode *et al.* (eds.) *op. cit.* 201. **Lectotype** (Pannell, 1992): *Korthals s.n.*, Borneo, Kalimantan, Doesoen (L [Acc. No. 9081321677]; isolectotype BO).

Tree to 10 m tall or more, to 35 cm diameter, branched. **Bark** light grey with numerous orange-brown depressions and scalloped pattern; inner bark reddish pink, laminated. **Sapwood** whitish pink, with tiny rays. **Twigs** with numerous lenticels, *densely covered with small pale brown stellate scales at the apex. Leaves* imparipinnate, to 60 cm long; petioles to 11 cm long; *leaflets pale green above and pale brownish green below when dry, below with few to numerous scales like that of the twigs on the midrib and few on the rest of that*

surface; lateral leaflets 5–7 on each side of rachis, alternate, basal ones only slightly smaller than the rest; blades narrowly elliptical or oblong, 5–24 × 2–8 cm, base cuneate or rounded, margin recurved, apex acuminate, acumen to 15 mm long; midrib prominent below; lateral veins 8–15 on each side of midrib, subprominent below; *intercostal venation subprominent on both surfaces*; petiolules 0.5–2 cm long. **Inflorescences** sparsely covered with stellate scales like those on the twigs; branches slender and widely spaced giving the inflorescence a lax appearance; males to 56 cm long and to 40 cm wide; females not seen. **Male flowers** 1.1–1.2 × 1.2–1.3 mm; *calyx with 5 spreading rounded lobes with a ciliate margin*, without hairs or scales; *petals 5*; staminal tube cup-shaped, 0.5–0.9 × 0.9–1 mm, apical margin incurved, anthers 5, ovoid, 0.3–0.4 × 0.3 mm, dehiscent only in the lower half, darker at the apex; ovary 0.2–0.4 × 0.3 mm, locules 2, each containing 1 ovule, with a dense ring of pale stellate scales at the junction with the stigma, stigma ovoid with two tiny apical lobes, c. 0.2 × 0.2 mm. **Fruits indehiscent, locules 2**, each containing 0 or 1 seed, *ellipsoid or obovoid*, 5–6 × 3.5 cm, orange or orange-yellow when ripe; pericarp 3–5 mm thick; the fruit curved and asymmetrical when a seed fails to develop in one of the locules. **Seeds** c. 3.1 × 1.8 × 1 cm, surrounded by an entire translucent aril 2–3 mm thick.

Vernacular name. Sabah—*lantupak* (Dusun Kinabatangan).

Distribution. Endemic in Borneo. In Sabah, known from Keningau, Lahad Datu and Tawau districts (e.g., *SAN 39965*, *SAN 47759*, *SAN 70926*, *SAN 84862* and *SAN 112145*) and in Sarawak from Belaga and Miri districts (e.g., *Geh & Samsuri 116* and *Stone 13726*). Also occurring in Brunei (e.g., *Forman 1137* and *Sands 5912*) and Kalimantan (e.g., *Leighton 898* and *Nooteboom 4427*).

Ecology. Common in mixed dipterocarp forest, along ridges and river banks, on alluvial or sandy soils, sometimes also on limestone hills or swampy ground, at altitudes to 1650 m.

26. *Aglaia leptantha* Miq.

Fig. 5G–K.

(Greek, *lepto-* = narrow, *anthos* = flower; flower is ellipsoid rather than subglobose as is usually in the genus)

Sect. *Aglaia*

Ann. Mus. Bot. Lugd. Bat. 4 (1868) 51; Merrill *op. cit.* (1921) 322; Masamune *op. cit.* 372; Pannell *op. cit.* (1992) 201, *op. cit.* (1995) 261; PROSEA *op. cit.* (1995) 48; Turner *op. cit.* 337; Coode *et al.* (eds.) *op. cit.* 201; Beaman & Anderson *op. cit.* 121. **Lectotype** (Pannell, 1992): *Korthals s.n.*, Sumatra (L [Acc. No. 9081321697]; isolectotypes BO, K). **Synonyms:** *Aglaia leptantha* [*lepantha*] Miq. var. *borneensis* C.DC. *op. cit.* (1878) 604, Masamune *op. cit.* 372, Anderson *op. cit.* (1980) 247; *Aglaia laevigata* Merr., Philip. Gov. Lab. Bur. Bull. 35 (1906) 31; *Aglaia multiflora* Merr., Philip. J. Sci. 1, Suppl. (1906) 73; *Aglaia glabrifolia* Merr. *op. cit.* (1929) 129, Masamune *op. cit.* 371; *Aglaia gamopetala* Merr. *op. cit.* (1929) 126, Masamune *op. cit.* 371, Anderson *op. cit.* (1980) 248, Pannell *op. cit.* (1989) 216, Whitmore, Tantra & Sutisna *op. cit.* 222.

Tree to 12 m tall, to 25 cm in diameter, branched. **Bark** pale grey, greyish brown or brown; inner bark green, pale orange-brown or reddish brown. **Sapwood** brown, yellowish brown or

pale orange-brown; latex white. **Twigs** densely covered with reddish brown, pale brown or grey peltate scales with fimbriate margins, when pale, the scales sometimes with a dark grey central spot. **Leaves** imparipinnate, 30–83 cm long; petioles 6.5–16 cm long; leaflets below sparsely to densely covered with scales like that of the twigs on the midrib, sparsely so on the lateral veins and rarely on the surface in between, sometimes with numerous pits on both surfaces; lateral leaflets 2–4 on each side of rachis, alternate; blades elliptical, ovate, oblong, oblanceolate, rarely obovate, 4.5–21 × 2.1–7 cm, base broadly cuneate, rounded rarely subcordate, asymmetrical, margin planar to slightly recurved, apex acuminate-caudate, acumen to 20 mm long; midrib prominent below, flat to slightly prominent above; lateral veins 9–13 on each side of midrib, black, blackish brown or reddish brown when dry; intercostal venation faint on both surfaces, visible below; petiolules 0.2–1 cm long on lateral leaflets, to 2.5 cm long on terminal leaflets. **Inflorescences** to 40 cm long and wide; peduncles to 10 cm long, with indumentum like that of the twigs. **Flowers** 1.7–4.5 × 1.3–3 mm; calyx 5-lobed, outside with dense cover of scales; petals 5; staminal tube slightly shorter or longer than the corolla, obovoid, 1–4 × 1–2.6 mm, anthers narrowly ovoid, 0.5–1.6 × 0.3–0.7 mm; ovary depressed globose, 0.3 × 0.1–0.5 mm, densely covered with stellate hairs or scales, locules 1 or 2, stigma ovoid with two small apical lobes, 0.2–0.6 × 0.3 mm. **Infructescences** to 70 cm long. **Fruits** indehiscent, locules 1 or 2, each containing 1 seed, yellow or orange when ripe, ellipsoid or subglobose, 1.2–3.2 × 1.2–3 cm, sometimes laterally compressed, with a longitudinal ridge around it, outside densely covered with pale brown stellate scales; pericarp either thin or hard and woody to 5 mm thick. **Seeds** ovoid with the inner surface flattened, to 2.3 × 1.4 × 1 cm; aril gelatinous translucent, edible.

Vernacular names. Sabah—*langsat-langsat* (Malay), *lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo, the Philippines and Nusa Tenggara (Flores). In Sabah, recorded from Beaufort, Lahad Datu, Labuk Sugut, Papar, Ranau, Sandakan and Tawau districts (e.g., SAN 30585, SAN 61208, SAN 67662, SAN 76454 and SAN 83185) and in Sarawak from Bau, Kuching, Limbang, Lundu, Miri and Simunjan districts (e.g., S 13377, S 26993, S 25689, S 27697 and S 39576). Also occurring in Kalimantan (e.g., *Kostermans 9184* and *Kostermans 10262*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp forest at altitudes to 650 m.

Notes. The complex species *Aglaia leptantha* of Pannell (*op. cit.* 1992) is here resolved for Borneo into three distinct species, viz. *A. leptantha*, *A. glabriflora* and *A. stellatopilosa*, with the latest endemic in Borneo.

27. *Aglaia leucophylla* King

(Greek, *leukos* = white, *phullon* = leaf; leaflets are pale yellow when dry)

Sect. *Aglaia*

J. As. Soc. Beng. 64, 1 (1895) 66; Ridley *op. cit.* (1922) 403; Pannell *op. cit.* (1989) 218, *op. cit.* (1992) 226, *op. cit.* (1995) 271; Whitmore, Tantra & Sutisna *op. cit.* 223; PROSEA *op. cit.* (1995) 48; Turner *op. cit.* 337; Coode *et al.* (eds.) *op. cit.* 201; Beaman & Anderson *op. cit.* 121. **Syntypes:** *King's collectors 1874*, Peninsular Malaysia, Perak, Larut (*n.v.*), *King's collectors 2998*, Perak, Larut

(K), *King's collectors 6494* (K); *Wray Jr. 2935*, Perak, Asam Kumbong (SING, W). **Synonyms:** *Aglaia kunstleri* King *op. cit.* 69; *Aglaia heteroclita* King *op. cit.* 78, Ridley *op. cit.* (1922) 410; *Aglaia elmeri* Merr. *op. cit.* (1929) 127, Masamune *op. cit.* 371; *Aglaia simplex* Merr. *op. cit.* (1929) 128, Masamune *op. cit.* 373.

Tree to 25 m tall, to 26 cm diameter, branched; bole sometimes fluted at base or with low narrow buttresses. **Bark** smooth, grey, brown, reddish brown or greyish brown, sometimes flaking; inner bark pale yellow or pink; latex white. **Sapwood** yellow, reddish brown or white. **Twigs** slender to fairly stout, with shallow longitudinal wavy ridges, *densely covered with golden-brown or brown stellate scales*. **Leaves** *imparipinnate*, to 80 cm long; petioles to 22 cm long; *leaflets often rugulose on both surfaces, pale green or yellowish green when dry, lower surface with numerous reddish brown pits and sparsely to densely covered with tiny golden-brown stellate scales, sometimes interspersed with darker peltate scales or reddish brown stellate hairs (with arms of adjacent hairs not overlapping); lateral leaflets 3–7(or 8) on each side of rachis, alternate or subopposite; blades elliptical-ovate or obovate, 5–28 × 2.5–10 cm, base rounded or cuneate, asymmetrical, margin planar, apex acuminate or caudate, acumen acute or obtuse, to 25 mm long; midrib prominent below; lateral veins (5–)7–16(–22) on each side of midrib, visible above, subprominent below, black or dark brown when dry; intercostal venation visible below; petiolules 0.1–2 cm long, sparsely to densely covered with scales like that of the twigs*. **Inflorescences** *robust, covered with a few to numerous golden-brown stellate scales; males to 60 cm long and to 25 cm wide; females c. 8 cm long and c. 2.5 cm wide*. **Flowers** (0.8–)1.2–3 × 0.9–3 mm; *calyx divided into 5 lobes, outside with a few to a dense cover of golden-brown stellate hairs; petals 5; staminal tube cup-shaped, 0.5–1.3 × 1–1.6 mm, anthers 5 (or rarely 6), ovoid, 0.4–0.7 × 0.2–0.5 mm; ovary depressed globose, 0.2–0.6 × 0.3–0.8 mm, densely covered with orange-brown stellate hairs, locules 2, each containing 1 ovule, stigma ovoid, 0.1–0.6 × 0.2–0.8 mm*. **Fruits** *indehiscent, locules 2, each containing 0 or 1 seed, densely covered with stellate scales, either pear-shaped or subglobose, to 3.7 × 2.7 cm, with white, thin, brittle pericarp or pear-shaped to 3.4 × 2.5 cm, with stalk c. 4 mm long and beak c. 2 mm long; pericarp thick, hard, woody, yellow, brown or reddish brown*. **Seeds** *c. 2.3 × 1 cm; aril white or red, edible, sweet or sour; testa brown*.

Vernacular names. Sabah—*langsap hutan* (Malay), *langsap-langsap* (Malay), *lantupak* (Dusun Kinabatangan). Sarawak—*pangak* (Kenyah), *segera* (Iban).

Distribution. S Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines and Sulawesi. Common in Borneo. In Sabah, known from Keningau, Kinabatangan, Kota Belud, Kota Merudu, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Sipitang and Tawau districts (e.g., *SAN 62443*, *SAN 72649*, *SAN 81379*, *SAN 94398* and *SAN 120738*) and in Sarawak from Bau, Kapit, Kuching, Limbang, Lubok Antu, Miri, Mukah, Serian, Simunjan, Song and Tatau districts (e.g., *S 25175*, *S 34377*, *S 40292*, *S 42375* and *S 43171*). Also occurring in Brunei (e.g., *BRUN 5095*, *BRUN 5663*, *Kirkup DK 923* and *SAN 17092*) and Kalimantan (e.g., *Church et al. 1019*, *Tuke P2 419*, *Wilkie 968*, *Wilkie 93140* and *Wilkie 93364*).

Ecology. In forests on basalt-derived, leached yellow clay, sandy or sandy clay loam soils, at altitudes to 1200 m.

28. *Aglaia luzoniensis* (Vidal) Merr. & Rolfe (of Luzon, the Philippines)

Sect. **Aglaia**

Philip. J. Sci., Bot. 3 (1908) 105; Merrill *op. cit.* (1929) 124; Masamune *op. cit.* 372; Pannell *op. cit.* (1992) 242, *op. cit.* (1995) 277; Whitmore, Tantra & Sutisna *op. cit.* 223; PROSEA *op. cit.* (1995) 48; Beaman & Anderson *op. cit.* (1980) 122. **Basionym:** *Beddomea luzoniensis* Vidal, Rev. Pl. Vasc. Filip. (1886) 84. **Lectotype** (Pannell, 1992): *Vidal 169*, the Philippines, Tayabas, Province Quezon (A; isolectotypes K, L). **Synonyms:** *Aglaia unifoliolata* Koord. *op. cit.* 383, 635; *Aglaia monophylla* J.Perkins, Fragm. Fl. Philip. (1904) 33; *Aglaia brevipetiolata* Merr. *op. cit.* (1916) 14; *Aglaia rizalensis* Merr. *op. cit.* (1918) 289.

Tree to 10 m tall, to 15 cm diameter, branched. **Bark** smooth or lenticellate, brown or red, soft; inner bark red or reddish brown, soft. **Sapwood** pale brown, white or reddish brown. **Twigs** apices densely covered with orange brown or reddish brown peltate scales which sometimes with fimbriate margins. **Leaves** simple, the midrib below densely covered with peltate scales like that of the twigs and sparsely or densely so on the lower surface and sometimes interspersed with paler brown scales; blades elliptical, 5–23 × 2–6.5(–8) cm, base cuneate, margin planar, apex acuminate, acumen obtuse, to 10 mm long; midrib prominent below; lateral veins 5–18 on each side of midrib, curving upwards, not or just anastomosing, subprominent below; intercostal venation faint on both surfaces; petioles 1–3 cm long, thickened at both ends. **Inflorescences** densely covered with scales like that of the twigs; males to 19 cm long, to 9 cm wide; females 2.5–8 cm long, 1–4 cm wide. **Flowers** 1–1.5 × 1–1.5 mm; calyx divided into 5 ovate lobes with fimbriate margins, outside densely covered with scales like that of the twigs; petals 5 (or rarely 6), yellow; staminal tube cup-shaped, 0.5–0.6 × 1 mm, margin incurved, anthers 5, 0.2–0.5 × 0.2–0.5 mm; ovary depressed globose, 0.2 × 0.3–0.4 mm, densely covered with peltate scales, stigma ovoid or depressed globose, 0.2–0.3 × 0.3–0.4 mm, sometimes with a central depression at the apex. **Fruits** indehiscent, locules 1 or 2, each containing one seed, subglobose, 1.8–2 × 1.4–1.5 cm, dark brown, reddish brown, pale orange or yellow, outside densely covered with peltate scales. **Seeds** c. 0.6 × 0.4 cm; aril c. 2 mm thick, translucent.

Vernacular names. Sabah—*langsats-langsats* (Malay), *langsats monyet* (Malay), *lantupak* (Dusun Kinabatangan).

Distribution. Borneo, the Philippines and Sulawesi. In Borneo, known only in Sabah from Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Nabawan, Pitas, Ranau, Sandakan, Tawau and Tenom districts (e.g., *SAN 35382*, *SAN 79944*, *SAN 83068*, *SAN 95549* and *SAN 121241*), in Sarawak from Kapit, Miri and Tatau districts (e.g., *Chew CWL 1034*, *S 28237*, *S 31768* and *S 84309*) and in Kalimantan (e.g., *Nooteboom 4548*).

Ecology. In forests on sandstone-derived, sandy alluvial, sandy, limestone-derived, clay, volcanic clayey soils, at altitudes to 1400 m.

29. **Aglaia macrocarpa** (Miq.) Pannell
(Greek, *makros* = large, *karpos* = fruit)

Plates 3A–C.

Sect. **Amoora**

Kew Bull. Add. Ser. 16 (1992) 65, *op. cit.* (1995) 215; PROSEA *op. cit.* (1995) 49; Turner *op. cit.* 337; Beaman & Anderson *op. cit.* 122. **Basionym:** *Epicharis macrocarpa* Miq. *op. cit.* (1861) 196, 505. **Lectotype** (Pannell, 1992): *Diepenhorst 3090*, Sumatra, Priaman (U; isolectotypes BO, L).

Synonyms: *Amoora rubescens* Hiern *op. cit.* 561, King *op. cit.* 57, Ridley *op. cit.* (1922) 399; *Aglaia trimera auct. non Merrill* (1929): Ridley *op. cit.* (1930) 368; *Aglaia triplex* Ridl., Bull. Misc. Inform. Kew (1938) 215; *Aglaia rubescens* (Hiern) Pannell, Mal. For. 45 (1982) 455, *op. cit.* (1989) 223, Whitmore, Tantra & Sutisna *op. cit.* 224.

Tree to 35 m tall, to 68 cm diameter, branched; buttresses (if present) upwards to 95 cm and outwards to 100 cm. **Bark** brown, pale brown, pinkish orange, greyish brown or white or pale, flaking in large irregular scales up to 10 cm long and 6 cm wide and with numerous orange or reddish brown lenticels, some in longitudinal rows; inner bark pink or pale brown; latex white. **Sapwood** pinkish brown, white or yellow; latex brownish yellow. **Twigs** fairly stout, *apices densely covered with minute reddish brown or grey peltate fimbriate scales which are deciduous and leaving dark reddish brown pits*. **Leaves** imparipinnate, to 70 cm long; petioles to 20 cm long; leaflets coriaceous, both surfaces usually rugulose, sometimes smooth, upper surface pale reddish brown and dull when dry, lower surface with few minute reddish brown scales sometimes interspersed with pale grey peltate scales on the midrib and lateral veins; lateral leaflets 4–5(–7) on each side of rachis, subopposite, terminal ones not folded at the base; blades ovate, obovate, elliptical or oblanceolate, 6–21 × 2–6 cm, base rounded or cuneate, slightly asymmetrical, margin planar, apex acuminate or caudate, acumen obtuse or acute, to 15 mm long; midrib impressed above, slightly prominent below; lateral veins (6–)7–10(–15) on each side of midrib, impressed above, subprominent below; intercostal venation faint below; petiolules 1.5–2 cm long. **Inflorescences** to 30 cm long, to 20 cm wide, densely covered with peltate fimbriate scales like that of the twigs. **Flowers** obovoid, 2–3.5 × 1.6 mm; calyx divided almost halfway into 3 lobes, outside densely covered with dark brown stellate scales; petals 3; staminal tube shorter than the corolla, subglobose, c. 1.5 mm diameter, anthers 6, ellipsoid or narrowly ovoid, c. 0.5 mm long; ovary depressed globose, 0.75–1 mm across, densely covered with stellate scales, stigma ovoid. **Fruits** obovoid, to 7.5 × 7.3 cm, bright red and orange or pinkish yellow, *dehiscing into 3 lobes when ripe, locules 3, each containing 0 or 1 seed; pericarp longitudinally wrinkled and moulded around the seeds when dry*. **Seeds** 4.2–5.4 × 2.3–3 × 2–2.5 cm, with a complete red, orange or white aril 1–3 mm thick; testa brown.

Vernacular names. Sabah—*lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Vietnam, Sumatra, Peninsular Malaysia, Singapore, Borneo, the Philippines (Palawan), Java, Sulawesi and Maluku (Halmahera and Seram). In Sabah, known from Keningau, Lahad Datu, Tawau and Tenom districts (e.g., SAN 61855, SAN 73522, SAN 77020, SAN 79703 and SAN 92178) and in Sarawak from Belaga, Bintulu, Kapit and Miri districts (e.g., S 19078, S 27045, S 39195, S 43133 and S 45445). Also known in Brunei (e.g., Muellner *et al.* ANM 2006) and Kalimantan (e.g., de Vogel 1028, Kostermans 7388 and Kostermans 10623).

Ecology. In mixed dipterocarp forest on hillsides, at altitudes to 400 m.

30. *Aglaia malaccensis* (Ridl.) J.A.R.Anderson (of Malacca, Peninsular Malaysia)

Sect. *Amoora*

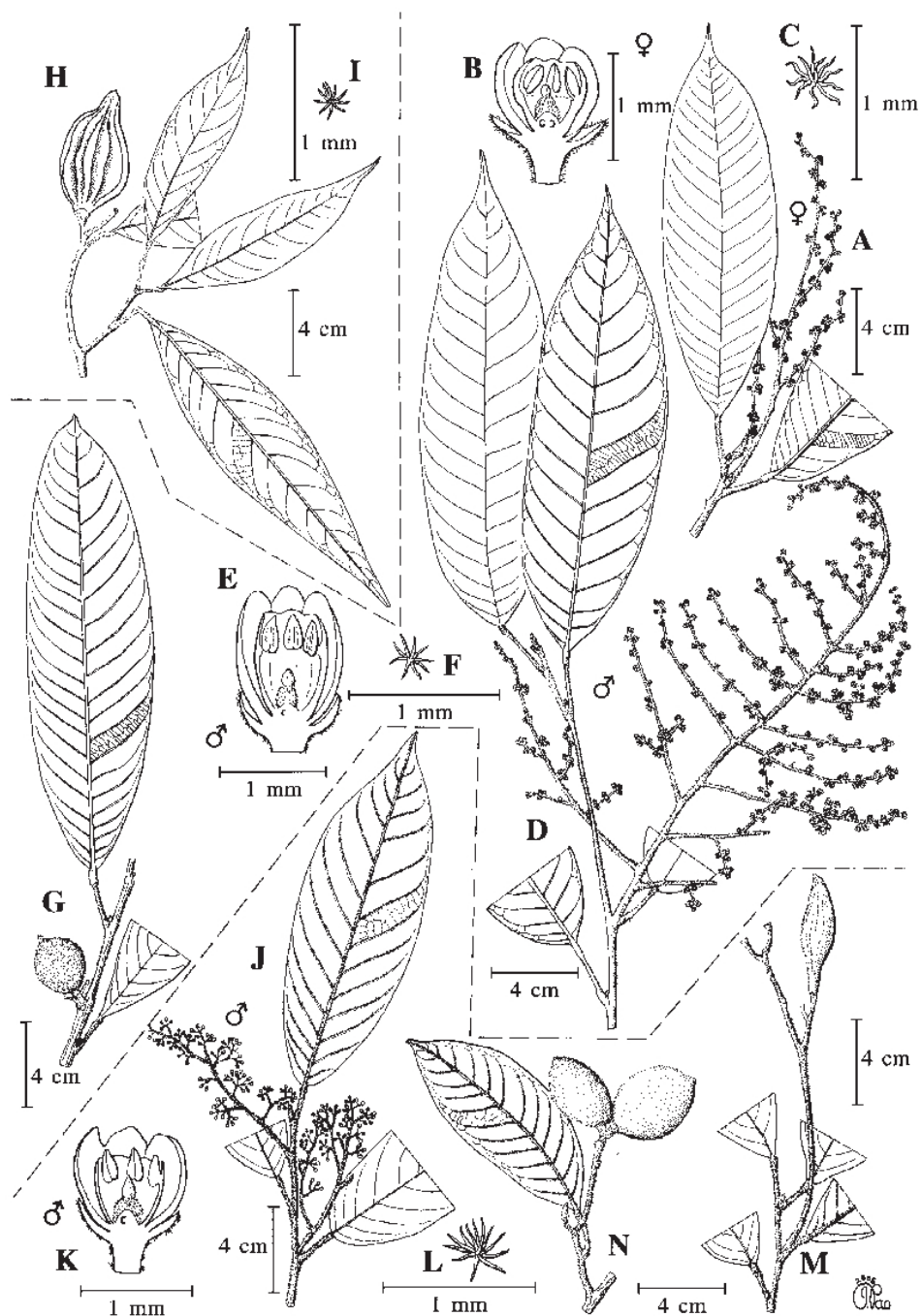


Fig. 7. *Aglaia meliosmoides* (A–G); *A. neotenica* (H–I); *A. sterculioides* (J–N). A, leafy shoot with female inflorescence; B, longitudinal section of female flower; C, stellate hair; D, leafy shoot with male inflorescence; E, longitudinal section of male flower; F, stellate hair; G, leafy shoot with fruit; H, leafy shoot with fruit; I, stellate hair; J, leafy shoot with male inflorescence; K, longitudinal section of male flower; L, stellate hair; M, leafy shoot with mature fruit; N, leafy shoot with young fruit. (A–C from SAN 64604, D–F from SAN 53434, G from SAN 91695, H–I from S 27851, J–L from S 21330, M from S 39858, N from S 51427.)

CLTS (1980) 248; Pannell *op. cit.* (1982) 455, *op. cit.* (1989) 219, *op. cit.* (1992) 70, *op. cit.* (1995) 216; Whitmore, Tantra & Sutisna *op. cit.* 223; PROSEA *op. cit.* (1995) 49; Turner *op. cit.* 337. **Basionym:** *Amoora malaccensis* Ridl., J. Str. Br. Roy. As. Soc. 75 (1917) 16, *op. cit.* (1922) 399. **Lectotype** (Pannell, 1982): *Ridley 1797*, Peninsular Malaysia, Malacca, Ayer Panas (K).

Tree to 25 m tall, to 60 cm diameter, branched; sometimes with a few thick, shallow buttresses to 50 cm tall. **Bark** greyish brown or yellowish brown, with longitudinal rows of lenticels, flaking in large scales of irregular size to 65 × 35 cm; inner bark pink or white; latex white. **Sapwood** pink, yellow or white. **Twigs** fairly stout, *apices densely covered with small pale brown or almost white stellate hairs or scales*. **Leaves** imparipinnate, to 50 cm long; petioles to 20 cm long; *leaflets smooth on both surfaces, (dull) green above and dark purplish brown below when dry, with a few very small pale brown stellate scales on the lower surface; lateral leaflets 4–7 on each side of rachis, subopposite; blades lanceolate, oblong or elliptical, 6.5–19 × 2–6.5 cm, base rounded, asymmetrical, margin planar, apex acuminate, acumen obtuse or acute, to 15 mm long; midrib impressed above, prominent below, sparsely to densely covered with minute dark reddish brown peltate scales; lateral veins 10–14 on each side of midrib, impressed above, slightly or not at all prominent below; intercostal venation faint; petiolules 1.5–2 cm long*. **Inflorescences** to 25 cm long, to 15 cm wide, densely covered with indumentum like that of the twigs. **Flowers** obovoid, to 3 × 2.5 mm; *calyx divided to about halfway into 3 (or rarely 4) acute lobes, outside densely covered with stellate scales; petals 3, white, obovate, outside densely covered with stellate scales; staminal tube obovoid, cup-shaped, c. 2 mm tall, anthers 6 (or rarely 7), as long as the staminal tube, narrowly ellipsoid; ovary depressed globose, densely covered with stellate hairs, stigma ovoid with 3 apical lobes and 6 longitudinal ridges*. **Fruits** depressed globose, 3.8–6 × 5.3–7 cm, reddish brown, *dehiscing into 3 lobes when ripe, locules 3 or 4, each containing 0 or 1 seed; latex white*. **Seeds** 2.7–3.8 × 2–2.1 × 1.5–1.8 cm, completely covered with a red or yellow aril 1–2 mm thick.

Distribution. Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Sabah, recorded from Keningau, Kinabatangan, Labuk Sugut and Sipitang districts (e.g., *SAN 72126*, *SAN 76287*, *SAN 83361*, *SAN 84130* and *SAN 84833*) and in Sarawak from Belaga, Bintulu, Kuching and Lundu districts (e.g., *S 13951*, *S 18303*, *S 57161* and *S 81378*). Also occurring in Kalimantan (e.g., *Arbainsyah et al. AA 1985* and *Leighton 859*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp forests on clay, shale, sandy and loamy soils, at altitudes to 700 m. Rare and scattered to common.

31. *Aglaia meliosmoides* Craib (like *Meliosma*, Sabiaceae; the leaves)

Fig. 7A–G, Plate 3D.

Sect. *Aglaia*

Bull. Misc. Inform. Kew (1913) 68; Corner *op. cit.* (1978) 31; Pannell *op. cit.* (1989) 219; Whitmore, Tantra & Sutisna *op. cit.* 223; Beaman & Anderson *op. cit.* 122. **Lectotype** (Pannell, 1992): *Kerr 2369*, Thailand, Rawng Kwang (K; isolecotypes BM, E, K). **Synonyms:** *Aglaia matthewsii* Merr. *op. cit.* (1918) 79, *op. cit.* (1921) 322, *op. cit.* (1929) 124, Masamune *op. cit.* 372, Anderson *op. cit.* (1980) 248; *Aglaia unifoliolata auct. non* Koord. (1898): Ridley *op. cit.* (1930) 369, Anderson *op. cit.* (1980) 249; *Aglaia triandra* Ridl. *op. cit.* (1938) 215, *nom. nov. pro Aglaia unifoliolata* Ridl.; *Aglaia odoardoii* Merr., Webbia 7 (1950) 312, Anderson *op. cit.* (1980) 249; *Aglaia shawiana* Merr. *op. cit.* (1950) 314, Anderson *op. cit.* (1980) 249.

Tree to 20 m tall, to 30 cm diameter, branched; sometimes flowering when *c.* 1.5 m tall. **Bark** greyish brown, yellowish brown, pale or dark brown, pale yellow, usually smooth, sometimes lenticellate or flaky; inner bark brown, reddish brown, blackish red, pink, pale orange; latex white. **Sapwood** white, pale yellow or pink. **Twig apices densely covered with orange-brown or reddish brown stellate hairs, sometimes interspersed with peltate scales, sparsely so elsewhere.** **Leaves simple**, glossy green above and paler green below, *upper surface shiny when dry; blades elliptical or lanceolate-oblong, 4.8–29 × 1.5–8 cm*, base cuneate, slightly asymmetrical, margin slightly recurved and somewhat wavy, apex acute to acuminate, acumen to 25 mm long; midrib prominent on both surfaces, sometimes with persistent indumentum like that of the twigs; lateral veins 7–20 on each side of midrib, prominent below, subprominent above, with persistent indumentum similar to that of the twigs; *intercostal venation subprominent on both surfaces when dry*; young leaves densely covered with hairs like that of the twigs, glabrescent, sometimes persisting on the midrib near the petiole on both surfaces; petioles to 4 cm long, with swelling to 0.5 cm long adjacent to the lamina. **Inflorescences** to 20 cm long and 15 cm wide, densely covered with hairs like that of the twigs. **Flowers** subglobose, 1.9–2 × 1.7 mm, either sessile or with a pedicel to 2 mm long; *calyx deeply divided into 5 subrotund lobes; petals 5*; staminal tube *c.* 1.5 × 1.1 mm, anthers about half the length of staminal tube; ovary subglobose, stigma *c.* 0.4 × 0.1 mm. **Fruits indehiscent, locules 1 or 2**, each containing 1 seed, *without a longitudinal ridge around it*, obovoid or subglobose, either to 4.4 × 4.1 cm, yellow or white, with a thick woody pericarp to 10 mm thick and densely covered with stellate hairs on the outside, glabrescent, or *c.* 3.5 × 3 cm with pericarp *c.* 1 mm thick.

Vernacular name. Sarawak—*segera* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Singapore and Borneo. Common; in Sabah, known from Beaufort, Keningau, Kinabatangan, Kota Merudu, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Sipitang and Tawau districts (e.g., *SAN 36081, SAN 66283, SAN 68101, SAN 71258* and *SAN 79953*) and in Sarawak from Bintulu, Kapit, Kuching and Miri districts (e.g., *S 16575, S 18348, S 24302, S 37461* and *S 48402*). Also occurring in Brunei (e.g., *BRUN 87, Nielsen & Baslev 1104* and *Simpson 2354*) and Kalimantan (e.g., *Ambriansyah & Arifin B 1496, Burley et al. 2872, Nootboom 4420* and *Wilkie 94176*).

Ecology. In mixed dipterocarp and *kerangas* forests, often on hillsides, on clay-rich soil or yellow sandy soil, sometimes on limestone or granite, at altitudes to 1350 m.

Notes. Pannell (*op. cit.* 1992 & *op. cit.* 1995) treated this species as a synonym of *Aglaia simplicifolia*. In the present treatment, however, the species is recognised as distinct, differing from *A. simplicifolia* in its leaves which are shiny above when dry, subprominent intercostal venation on both surfaces, and fruit without a longitudinal ridge around it.

32. *Aglaia monozyga* Harms

(Greek, *monos* = solitary, *zygos* = yoke; the leaf with one lateral leaflet on each side of rachis)

Sect. *Aglaia*

Notizbl. Bot. Gart. Berlin 15 (1941) 473; Anderson *op. cit.* (1980) 249; Whitmore, Tantra & Sutisna *op. cit.* 223; Pannell *op. cit.* (1992) 311, *op. cit.* (1995) 299; Turner *op. cit.* 337; Beaman & Anderson

op. cit. 122. **Lectotype** (Pannell, 1992): *Clemens 28192*, Borneo, Sabah, Mt. Kinabalu, Tenompok (K; isolecotypes B, BO, G, K, L).

Small tree to 10 m tall, to 16 cm diameter, branched. **Bark** smooth, white; inner bark reddish brown or yellowish brown. **Twigs** longitudinally wrinkled, *apices densely covered with reddish brown stellate hairs which are often deciduous*. **Leaves** imparipinnate, 8–67 cm long; petioles 2.5–10(–14.5) cm long; *leaflets coriaceous, rugulose and minutely pitted on both surfaces, pale green or yellowish green when dry, both surfaces densely covered with hairs like that of the twigs when young, becoming more or less glabrous when older; lateral leaflets 1 or 2 on each side of rachis, opposite; blades lanceolate or obovate, 8–25(–46) × 3–7(–13) cm, base cuneate or attenuate, sometimes asymmetrical and rounded on one side, margin recurved, apex acuminate or caudate, acumen acute or obtuse, to 20 mm long; midrib prominent or subprominent on both surfaces; lateral veins 6–15(–23) on each side of midrib, subprominent or barely prominent on both surfaces, black or dark brown when dry; intercostal venation faint on both surfaces; petiolules 1–3.5(–4) cm long, swollen at the base, flat or channelled on the adaxial side. Inflorescences robust, 11–35 cm long, 7–12 cm wide, densely covered with reddish brown or pale reddish brown stellate hairs. Flowers 1.2–3 × 1.5–2.5 mm; calyx divided into 5 subrotund lobes, outside densely covered with reddish brown stellate hairs; petals 5; staminal tube cup-shaped or broadly cone-shaped, 0.5–1.5 × 1.5 mm, anthers 5, 0.5–0.7 mm long; ovary depressed globose, 0.2–0.3 mm long, densely covered with pale brown stellate hairs with long arms, locules 1 or 2, stigma 0.3–0.4 mm long, ovoid, subglobose or depressed globose with a shallowly lobed margin and central depression. Fruits indehiscent, locules 2, each with 0 or 1 seed, subglobose or ellipsoid, to 4.5 × 4.1 cm, sometimes with a longitudinal ridge around it or with a small beak; pericarp 0.4–0.9 cm thick, orange or orange-red. Seeds c. 3.1 × 2.1 × 1.8 cm; aril pink.*

Vernacular names. Sabah—*beluno-beluno* (Dusun), *langsar-langsar* (Malay).

Distribution. Peninsular Malaysia and Borneo. In Sabah, known from Keningau, Labuk Sugut, Ranau, Sandakan, Tambunan and Tawau districts (e.g., *Clemens 30181*, *SAN 71929*, *SAN 81372*, *SAN 94961* and *SAN 111316*) and in Sarawak from Belaga, Kapit and Sri Aman districts (e.g., *S 25749*, *S 42525*, *S 56588* and *S 82180*). Also occurring in E Kalimantan (e.g., *Burley et al. 324*, *Burley et al. 792* and *Kostermans 10441*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp, riverine, freshwater swamp, and montane forests on sandy, loam, laterite, and clay soils, sometimes on limestone, at altitudes to 2000 m.

33. *Aglaia multinervis* Pannell

(Latin, *multus* = many, *nervus* = nerve; the many-veined leaflets)

Sect. *Amoora*

Kew Bull. Add. Ser. 16 (1992) 84, *op. cit.* (1995) 222; PROSEA *op. cit.* (1995) 49; Turner *op. cit.* 338. **Lectotype** (Pannell, 1992): *Maingay 1610* (= *Kew Distr. 343*), Peninsular Malaysia, Malacca (K). **Synonym:** *Amoora lanceolata* Hiern *op. cit.* 560, King *op. cit.* 55, Ridley *op. cit.* (1922) 399; *Aglaia* sp. 3, Pannell *op. cit.* (1989) 228; *Aglaia* sp. 3/C, Whitmore, Tantra & Sutisna *op. cit.* 226.

Tree to 25 m tall, to 30 cm diameter, branched; buttresses small. **Bark** pale brown or pale; inner bark reddish brown; latex white. **Sapwood** pink, pale yellow. **Twigs** stout, *apices densely covered with peltate scales with a dark reddish brown centre and pale fimbriate margin, sometimes interspersed with reddish brown stellate hairs*. **Leaves** imparipinnate, to 40 cm long; petioles to 10 cm long; *leaflets coriaceous, lower surface rugulose, with a few pale brown stellate scales with a darker centre on the midrib and scattered elsewhere; lateral leaflets 10–12 on each side of rachis, subopposite, terminal ones not folded at the base; blades lanceolate, 7–12 × 1.8–2 cm, base rounded or subcuneate, slightly asymmetrical, margin planar, apex acuminate, acumen obtuse, to 5 mm long; midrib slightly impressed above, prominent and wrinkled below; lateral veins 20–25 on each side of midrib, alternating with less conspicuous veins which sometimes branch before reaching the margin, indistinct below, rarely turning black when dry; intercostal venation sometimes visible; petiolules to 1 cm long, sparsely stellate hairy*. **Inflorescences** c. 20 cm long, c. 10 cm wide, densely covered with peltate fimbriate scales like that of the twigs. **Flowers** 2.3–3 × 1.8–2.8 mm; *calyx* c. half the length of corolla, *divided halfway into 3 acute lobes*, outside densely covered with stellate scales; *corolla tube* 2.2–3 × 1.8 × 2.8 mm, *divided for two thirds of its length into 3 lobes*, outside densely covered with stellate scales; staminal tube obovoid, 1.5–2 × 0.8–2.3 mm, anthers 6 or 7, ellipsoid, 1.2–1.5 × 0.3–0.6 mm, with a few simple hairs; ovary depressed globose, 0.4–0.6 × 0.6–0.8 mm, stigma ovoid with 3 apical lobes and 6 longitudinal ridges, 0.4–0.8 × 0.3–0.5 mm. **Fruits** *subglobose or obovoid with a small beak, to 6 × 5 cm, brown, bright red or yellow, densely covered with minute reddish brown stellate hairs; dehiscing into 3 lobes when ripe, locules 3, each containing one seed.*

Vernacular names. Sabah—*langsats-langsats* (Malay), *lantupak* (Dusun Kinabatangan), *manggi* (Dusun Kinabatangan).

Distribution. Sumatra, Peninsular Malaysia, Singapore and Borneo. In Sabah, known from Keningau, Kinabatangan, Lahad Datu, Sandakan and Tawau districts (e.g., *SAN 16438*, *SAN 19222*, *SAN 42152*, *SAN 85005* and *SAN 88689*) and in Sarawak from Lubok Antu and Marudi districts (e.g., *S 69606*, *S 91409* and *S 91580*). Also occurring in E Kalimantan (e.g., *Kostermans 5067*, *Kostermans 5867*, *Kostermans 6702* and *Kostermans 12635*) but not yet recorded from Brunei.

Ecology. In forest, often on hillsides, at altitudes to 500 m.

Notes. The older epithet *lanceolata* can not be applied to this species because it has been preoccupied by *Aglaia lanceolata* Merr. (Philip. J. Sc., Bot. 5 (1910) 184, which has become a synonym of *A. rimosa* (Blanco) Merr., Spec. Blanc. (1918) 212).

34. *Aglaia neotenica* Kosterm.

Fig. 7H–I.

(Greek, *neos*- = new or young, *teinein* = extend or retain; retaining juvenile form, the fruit)

Sect. *Aglaia*

Reinwardtia 7, 5 (1969) 433. **Type:** *Hallier 2810*, Borneo, Kalimantan, Lianggagang (holotype BO; isotypes K, L).

Small tree to 8 m tall, branched. **Bark** smooth, greyish green. **Twigs** pale greenish brown or greyish brown, *densely covered with deciduous reddish brown stellate hairs*. **Leaves** *simple,*

with dense hairs like that of the twigs when young, glabrous or with few hairs on the midrib below when older, *pale green when dry*; *blades narrowly elliptical*, sometimes elliptical, (5–)10–15(–24) × (1.5–)2–4 cm, *base cuneate*, margin planar, *apex caudate*, *acumen narrow, obtuse, to 22 mm long*; midrib impressed above, prominent below; *lateral veins 8–15 on each side of midrib*, ascending, curved upwards near the margin and nearly or quite anastomosing, impressed above, subprominent below; *intercostal venation slightly prominent below*; petioles 0.5–2 cm long. **Inflorescences** to 3.5 cm long and 2.5 cm wide. **Flowers** 2–2.5 × 2–2.5 mm; calyx cup-shaped, divided almost to the base into 5 ovate lobes *c.* 1.5 × 1 mm; *petals 5, aestivation quincuncial*; staminal tube shallowly cup-shaped, 1.2 × 1.6 mm, anthers 3; ovary 0.2 × 0.3 mm, with dense orange-brown stellate hairs, stigma sessile, *c.* 0.6 × 0.3 mm. **Fruits indehiscent**, borne singly, *ovoid, to 6.9 × 3.9 cm*, green turning bright reddish orange when ripe, *with up to 8 shallow longitudinal ridges or prominent flanges to 3 mm wide*, sometimes with a small apical beak to 3 mm long, densely covered with brown stellate hairs; peduncles to 1.5 cm long. **Seed** 1.

Vernacular name. Sarawak—*segera* (Iban).

Distribution. Endemic in Borneo, known only in Sarawak from Bau, Bintulu, Kapit, Kuching, Marudi and Miri districts (e.g., *S 17632, S 23038, S 25638, S 30758, S 43883 and S 66003*) and in Kalimantan from the type.

Ecology. In mixed dipterocarp forest or forest on slopes, usually on limestone, sometimes on clay loam or rhyodacite-derived soil, at altitudes to 900 m.

Notes. Previously treated by Pannell (*op. cit.* 1992 & *op. cit.* 1995) as a synonym of *Aglaia simplicifolia*, *A. neotenica* is here recognised as distinct, differing from *A. simplicifolia* in its narrowly elliptical leaves and fruit with 8 or more longitudinal ridges or flanges.

35. *Aglaia odoratissima* Blume

(Latin, *odoratissimus* = very sweet-smelling; the flowers)

Sect. *Aglaia*

Bidjr. Fl. Ned. Ind. (1825) 171; Miquel *op. cit.* (1868) 43; King *op. cit.* 67; Koorders & Valetton *op. cit.* (1913) t. 160; Ridley *op. cit.* (1922) 404; Merrill *op. cit.* (1929) 124; Masamune *op. cit.* 372; Backer & Bakhuizen *f. op. cit.* 128; Corner *op. cit.* (1978) 31, *op. cit.* (1988) 496; Anderson *op. cit.* (1980) 249; Pannell *op. cit.* (1989) 221, *op. cit.* (1992) 237, *op. cit.* (1995) 276; Whitmore, Tantra & Sutisna *op. cit.* 224; Turner *op. cit.* 338; Coode *et al.* (eds.) *op. cit.* 201; Beaman & Anderson *op. cit.* 122. **Lectotype** (Pannell, 1992): *Blume s.n.*, Java, Mt. Salak (L [Acc. No. 9081321428]; isolectotypes BO, L [Acc. No. 9081321458, 9081321495 & 9081321499]). **Synonyms:** *Aglaia affinis* Merr. *op. cit.* (1908) 235, Masamune *op. cit.* 370, Anderson *op. cit.* (1980) 247; *Aglaia heterophylla* Merr. *op. cit.* (1918) 77, *op. cit.* (1921) 322, Masamune *op. cit.* 371; *Aglaia cuspidella* Ridl. *op. cit.* (1930) 367, Anderson *op. cit.* (1980) 247. (For further synonyms cf. Pannell *op. cit.* 1992 & *op. cit.* 1995.)

Usually a small tree, sometimes to 18 m tall, to 25 cm diameter, branched. **Bark** smooth, greenish grey, pale brown or brown, with small lenticels in longitudinal rows; inner bark reddish brown, yellow or white; latex white. **Sapwood** pale yellowish brown or pale yellow; heartwood reddish brown. **Twig apices densely covered with dark brown, peltate fimbriate scales (usually less than 0.2 mm diameter) interspersed with pale yellowish brown stellate**

hairs. **Leaves** imparipinnate, to 40 cm long; petioles to 6.5 cm long; *leaflets often bluish green above and pale brown below when dry, the midrib above sparsely covered with scales or hairs like that of the twigs, densely so on the midrib below, and sparsely to densely so on the lower surface; lateral leaflets 1 or 2 (or rarely 3) on each side of rachis, subopposite or opposite; blades elliptical, ovate or obovate, (2.2–)5–18 × (0.7–)1.5–7.5 cm, base rounded or cuneate, asymmetrical, margin slightly recurved, apex acuminate-caudate, acumen obtuse, to 20 mm long; midrib prominent below; lateral veins (rarely 4) 5–11 on each side of midrib, subprominent below; intercostal venation faint on both surfaces; petiolules 2–3.5 cm long*. **Inflorescences** densely covered with reddish brown stellate scales; males 7–35 cm long, 2–25 cm wide, females 3.5–12 cm long. **Flowers** 1.1–1.5 × 1–1.5 mm; *calyx* outside with numerous reddish brown stellate scales, *divided almost to the base into 5 subrotund lobes; petals 5; staminal tube shallowly cup-shaped, 0.8–1 × 0.9–1.4 mm, apical margin incurved and shallowly 5-lobed, anthers ovoid, c. 0.3 × c. 0.2 mm; ovary depressed globose, 0.2–0.3 mm across, densely covered with stellate hairs, locules 1 or 2, each containing 1 ovule, stigma ovoid, c. 0.3 × 0.4 mm*. **Fruits** indehiscent, *locules 1 (rarely 2), each containing 1 seed, ellipsoid or obovoid, 1.5–2 × 1–1.6 cm, yellow, orange or orange-red, densely covered with pinkish orange stellate scales turning brown when dry; pericarp 1–1.5 mm thick, fibrous and flexible*. **Seeds** 1.3–1.4 × 0.9–1.1 × 0.7–0.8 cm; aril 1 mm thick, pale pink, white or yellow, translucent, gelatinous, sweet-tasting.

Vernacular names. Sabah—*langsats* (Malay), *langsats munyit* (Malay), *lantupak* (Dusun Kinabatangan), *tanggal* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Nicobar Islands, Myanmar, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Java, Nusa Tenggara and Sulawesi. Common throughout Sabah and Sarawak. In Sabah, known from Beaufort, Keningau, Kinabatangan, Kota Kinabalu, Kudat, Lahad Datu, Ranau, Sandakan, Semporna and Tawau districts (e.g., *SAN 57190, SAN 67184, SAN 76477, SAN 82258* and *SAN 116612*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Lawas, Lundu, Miri, Serian, Simunjan and Tatau districts (e.g., *S 18454, S 21728, S 34208, S 44684* and *S 55293*). Also occurring in Brunei (e.g., *Argent 9198, Dransfield JD 6811, Kirkup DK 344, Niga NN 360* and *Wong WKM 1396*) and Kalimantan (e.g., *Church et al. 1198, Endert 4945, Kessler et al. PK 1347* and *Sidiyasa 1207*).

Ecology. In mixed dipterocarp and riverine forests, on clay loam, basalt, shale-derived, brown sandy, and yellow or white sandy soils, at altitudes to 1370 m.

36. *Aglaia oligophylla* Miq.

(Greek, *oligos* = few, *phullon* = leaf; with few leaflets)

Sect. *Aglaia*

Fl. Ind. Bat. Suppl. 1 (1861) 507, *op. cit.* (1868) 41; King *op. cit.* 63; Ridley *op. cit.* (1922) 403; Pannell *op. cit.* (1989) 222, *op. cit.* (1992) 302, *op. cit.* (1995) 297; Whitmore, Tantra & Sutisna *op. cit.* 224; Turner *op. cit.* 338; Beaman & Anderson *op. cit.* 123. **Lectotype** (Pannell, 1992): *Diepenhorst s.n.*, Sumatra, Priaman (U [Acc. No. 39229]; isoelectotype U [Acc. No. 39230]). **Synonyms:** *Aglaia oligantha* C.DC. *op. cit.* (1878) 603, Merrill *op. cit.* (1929) 124, Masamune *op. cit.* 372; *Aglaia fusca* King *op. cit.* 62, Pannell *op. cit.* (1989) 216; *Aglaia bordenii* Merr. *op. cit.* (1904) 22; *Aglaia polyantha* Ridl. *op. cit.* (1930) 369, Anderson *op. cit.* (1980) 249; *Aphanamixis reticulosa* Kosterm., *Reinwardtia* 7, 1 (1965) 30.

Tree to 25 m tall, to 25 cm diameter, branched. **Bark** smooth, pale green, pale brown, greenish yellow or pale grey; inner bark pale green, pale grey, pale yellow or yellowish brown; latex white. **Sapwood** white or yellow. **Twig apices densely covered with pale yellowish brown stellate hairs or scales.** **Leaves imparipinnate**, to 40 cm long; petioles to 9 cm long; *leaflets* subcoriaceous, *both surfaces rather shiny when dry, lower surface with a few to dense pale brown stellate hairs on the midrib and occasionally also on the rest of the surface; lateral leaflets 1–5 on each side of rachis*, opposite or subopposite, *basal ones only slightly smaller than the rest; blades obovate or elliptical, 5–22 × 2–8.5 cm*, base cuneate or rounded, asymmetrical, margin recurved, apex acuminate-caudate, acumen obtuse, to 10 mm long; midrib prominent below; lateral veins 5–10 on each side of midrib, subprominent on both surfaces; *intercostal venation visible above, subprominent below; petiolules 1.2–2 cm long*, thickened at base, densely covered with indumentum like that of the twigs. **Inflorescences** 10–20 cm long, 9–15 cm wide, densely covered with indumentum like that of the twigs. **Flowers** depressed globose, to 2 × 2.5 mm; *calyx divided to almost halfway into 5 blunt lobes with ciliate margin*, outside sparsely covered with stellate scales; *petals 5*; staminal tube depressed globose, *c. 1 × 1.3 mm*, anthers 5, obovoid, *c. 0.5 mm*; ovary depressed globose, stigma narrowly ovoid, densely covered with stellate hairs on the lower two thirds, with two small shiny black glabrous apical lobes. **Fruits indehiscent, locules 1 or 2 (rarely 3)**, each containing 1 seed, *subglobose, to 3.4 × 3.7 cm*; pericarp greyish brown or yellow, woody and longitudinally ridged when dry, outside densely covered with pale yellowish brown stellate hairs. **Seeds** with a translucent gelatinous, white or brown, sweet edible aril.

Vernacular names. Sabah—*langsar-langsar* (Malay), *langsar munyit* (Malay), *lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Andaman Islands, Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Sabah, known from Kinabatangan, Lahad Datu, Ranau, Sandakan, Semporna, Tawau and Tenom districts (e.g., *SAN 24030*, *SAN 65875*, *SAN 77941*, *SAN 89501* and *SAN 93137*) and in Sarawak from Kapit, Kuching and Limbang districts (e.g., *Haviland 3200*, *S 42943*, *S 47362*, *S 62005* and *S 85897*). Also occurring in Brunei (e.g., *Simpson 2150*) and Kalimantan (e.g., *Church et al. 2401*, *Kostermans 4847*, *Kostermans 10168* and *Kostermans 21043*).

Ecology. In mixed dipterocarp and *kerangas* forests, at altitudes to 830 m.

37. *Aglaia pachyphylla* Miq.

(Greek, *pachys* = thick, stout, *phullon* = leaf)

Sect. *Aglaia*

Ann. Mus. Bot. Lugd. Bat. 4 (1868) 57; Pannell *op. cit.* (1992) 117, *op. cit.* (1995) 234; PROSEA *op. cit.* (1995) 50; Turner *op. cit.* 338; Argent *et al.* (eds.) *op. cit.* 412; Beaman & Anderson *op. cit.* 123. **Lectotype** (Pannell, 1992); *Korthals s.n.*, W Sumatra (U [Acc. No. 39214]; isoelectotype L [Acc. No. 9081321571 & 9081321650]). **Synonyms:** *Aglaia barbatula* Koord. & Valeton *op. cit.* (1896) 167, *op. cit.* (1913) t. 153, Backer & Bakhuizen *f. op. cit.* 126, Pannell *op. cit.* (1989) 213, Whitmore, Tantra & Sutisna *op. cit.* 220; *Aglaia megistocarpa* Merr. *op. cit.* (1929) 130, Masamune *op. cit.* 372, Anderson *op. cit.* (1980) 248.

Tree to 43 m tall, to 65 cm diameter, branched; sometimes flowering when *c.* 3 m tall; buttresses to 2 m tall, to 1 m out and to 23 cm thick. **Bark** brown, greyish brown, with large corky lenticels or with pits and regular longitudinal narrow fissures; inner bark dark brown or yellow; latex white, when present. **Sapwood** pinkish brown, pale brown. **Twigs** to 3 cm diameter, with large prominent petiole scars, *channelled, densely covered with reddish brown stellate hairs or hairs with a long central rachis and many arms.* **Leaves** imparipinnate, to 135 cm long; petioles to 30 cm long; *leaflets smooth on both surfaces, upper surface usually shiny, with numerous minute pits, lower surface densely covered with pale reddish brown hairs with a central rachis and 2–4 whorls of arms radiating from it or densely covered with pale or dark brown stellate hairs or scales, sometimes interspersed with darker hairs; lateral leaflets 9–13 on each side of rachis, subopposite; blades oblong, lanceolate or oblanceolate, 12–31.5 × 2–9 cm, base rounded, subcordate or cuneate, asymmetrical, margin planar, apex acuminate, acumen acute or obtuse, to 15 mm long; midrib impressed above, prominent below; lateral veins 24–39 on each side of midrib, impressed above, prominent below; intercostal venation subprominent or faint but visible on both surfaces; petiolules 1–2.5 cm long.* **Inflorescences** to 45 cm long, to 60 cm wide, densely covered with hairs like that of the twigs. **Flowers** sessile on the terminal branches of the inflorescence and often clumped together, subglobose, to 2.2 × 2 mm; *calyx almost as long as corolla, outside densely covered with pale brown stellate hairs, with 5 rounded lobes; petals 5, c. 1.3 × 1.7 mm; staminal tube subglobose, c. 1.1 × 1.3 mm, thick and fleshy, anthers 0.8 × 0.5–0.6 mm; ovary depressed globose, c. 0.4 × 0.7 mm, locules 3, each containing 2 ovules, stigma cylindrical, c. 0.6 × 0.3 mm, truncate at the apex.* **Infructescences** with 1–3 fruits each, crowded in axils of leaves at ends of shoots. **Fruits** indehiscent, *locules 2 or 3 (rarely 4), each containing 1 or 2 seeds, obovoid or subglobose, to 8 × 8.5 cm, greyish green when young, brown when mature, glabrescent; pericarp 1.6–2 cm thick, with white latex.* **Seeds** *c. 3.6 × 2.1 × 1.9 cm, completely surrounded by a fleshy, translucent aril.*

Vernacular names. Sabah—*koping-koping* (Malay), *langsar-langsar* (Malay).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Java and Sulawesi. In Sabah, recorded from Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan and Semporna districts (e.g., *SAN 29818, SAN 82351, SAN 92156 and S 94021*) and in Sarawak from Kapit, Kuching, Lawas, Lundu and Miri districts (e.g., *S 13643, S 20892, S 28289, S 31545 and S 41873*). Also occurring in Kalimantan (e.g., *Burley et al. 692 and Burley et al. 2706*) but not yet recorded from Brunei.

Ecology. In forest, on limestone, igneous rocks, clay and sandstone, at altitudes to 600 m.

38. *Aglaia palembanica* Miq. (of Palembang, Sumatra)

Sect. *Aglaia*

Fl. Ind. Bat. Suppl. 1 (1861) 507, *op. cit.* (1868) 52; Hiern *op. cit.* 557; King *op. cit.* 72, *p.p.*; Merrill *op. cit.* (1921) 323, *op. cit.* (1929) 124; Ridley *op. cit.* (1922) 409, *p.p.*; Masamune *op. cit.* 372; Corner *op. cit.* (1978) 131; Anderson *op. cit.* (1980) 249; Pannell *op. cit.* (1989) 223, *op. cit.* (1992) 323, *op. cit.* (1995) 304; Whitmore, Tantra & Sutisna *op. cit.* 224; Turner *op. cit.* 338; Beaman & Anderson *op. cit.* 123. **Lectotype** (Pannell, 1992): *Teysmann HB 3527*, Sumatra, Palembang, Batu

Radja (U [Acc. No. 39222]; isolectotypes K, L [Acc. No. 9081321647]). **Synonym:** *Aglaia pamattonis* Miq. *op. cit.* (1868) 53, Merrill *op. cit.* (1921) 323, Masamune *op. cit.* 372.

Treelet to 5 m tall, branched. **Twig apices densely covered with brown stellate hairs with the arms usually not overlapping.** **Leaves imparipinnate**, to 36 cm long; petioles to 10 cm long; leaflets below with brown stellate hairs like that of the twigs evenly scattered, interspersed with some paler stellate scales or peltate scales with a long fimbriate margin; lateral leaflets 4–6 on each side of rachis, subopposite; blades narrowly elliptical, lanceolate, oblong or oblanceolate, 6–22.5 × 1.3–3.5 cm, base cuneate or rounded, asymmetrical, margin slightly wavy and recurved, apex caudate or acuminate, acumen obtuse or acute, to 15 mm long; midrib prominent below; lateral veins 9–13 on each side of midrib, subprominent below; *intercostal venation faint but visible below*; petiolules to 0.8 cm long. **Inflorescences** to 30 cm long and 30 cm wide, densely covered with brown stellate hairs. **Flowers** tightly packed on the terminal branches of the inflorescence, subglobose or slightly longer than broad, *c.* 1.2 mm long; *calyx c.* 1.2 mm diameter, with 5 rotund or elliptical obtuse lobes, outside sparsely to densely covered with pale brown stellate hairs; *petals* 5; staminal tube *c.* 0.8 mm tall, cup-shaped with the apical margin incurved, anthers ovoid *c.* 0.4 mm long; ovary depressed globose. **Fruits indehiscent**, *locules* 1 or 2, subglobose, to 4 mm diameter, *glabrous or sparsely hairy*, brown or red; pericarp thin and brittle.

Vernacular name. Sabah—*lantupak* (Dusun Kinabatangan).

Distribution. Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Borneo, known only in Sabah from Keningau, Kinabatangan, Kota Belud, Kudat, Labuk Sugut, Lahad Datu, Sandakan, Tawau and Tenom districts (e.g., *SAN 43030*, *SAN 55846*, *SAN 63271*, *SAN 72022* and *SAN 88198*) and in Kalimantan (e.g., *Arifin et al. AA 1141*, *Laman et al. TL 1240* and *Motley s.n.*).

Ecology. In forest, on clay, laterite, sandstone, sand, limestone-derived soils, at altitudes to 450 m.

39. *Aglaia ramotricha* Pannell

(Latin, *ramus* = branch, Greek, *trichos* = hair; with branched hairs)

Sect. **Aglaia**

Kew Bull. Add. Ser. 16 (1992) 115, *op. cit.* (1995) 234; Beaman & Anderson *op. cit.* 123. **Type:** *Beaman 9308*, Borneo, Sabah, Kota Belud district (holotype FHO; isotype K).

Tree, 6–15(–20) m tall, to 20 cm diameter, branched; buttresses to 60 cm tall, to 30 cm out. **Bark** brown; inner bark pale brown or pink. **Sapwood** yellow or brown. **Twigs** 2–4.2 cm diameter, *densely covered with compact reddish brown stellate hairs or brown hairs which have a central rachis and 2–4 whorls of arms radiating from it.* **Leaves imparipinnate**, to 155 cm long; petioles to 46 cm long; leaflets below with numerous hairs like that of the twigs when young, with numerous reddish brown, pale brown or nearly white stellate hairs and scales on the midrib and lateral veins and sparsely so on the rest of that surface when mature; lateral leaflets 7–10 on each side of rachis, subopposite or alternate; blades oblong

or elliptical, 8.5–68 × 3–22 cm, base rounded, subcordate or cuneate, margin recurved, apex broadly acuminate, acumen obtuse or acute, 5–20 mm long; midrib prominent below; lateral veins 16–32 on each side of midrib, subprominent below; *intercostal venation subprominent on both surfaces*; petiolules 1–2.5 cm long. **Inflorescences** to 45 cm long, to 60 cm wide, sparsely branched, densely covered with hairs like that of the twigs or the distal branches densely covered with golden-brown stellate hairs. **Flowers** ellipsoid or subglobose, 1.6–3.5 × 1.6–2.5 mm, sessile and clumped around the terminal branches of the inflorescence; *calyx* almost as long as corolla, with 5 rounded lobes, outside sparsely covered with pale brown stellate scales; *corolla* 1.3–3 × 1.4–2.5 mm, divided to half way or almost to the base into 5 broad ovate lobes; staminal tube ellipsoid or obovoid, 1–2.5 × 1.1–1.8 mm, anthers 5, ellipsoid or ovoid, 0.7–1.2 × 0.5–0.8 mm; ovary depressed globose, 0.1–0.5 × 0.6–0.7 mm, densely covered with pale stellate scales or hairs, locules 2 or 3, stigma 0.5–1.1 × 0.3–0.5 mm, apex expanded to 0.4–0.5 mm wide, columnar, shiny dark brown, with 5–10 longitudinal ribs and 3–5 apical lobes. **Fruits** indehiscent, locules 2 or 3, each containing 1 seed, reddish yellow, subglobose or ellipsoid, c. 3.5 cm diameter, with numerous to densely packed compact reddish brown hairs or pale brown stellate hairs. **Seeds** to 2 × 1.2 cm.

Vernacular name. Sabah—*lantupak* (Dusun Kinabatangan).

Distribution. Endemic in Borneo, known only in Sabah from Kuala Penyu and Ranau districts (e.g., *Beaman 9722*, *Clemens 26870* and *Clemens 31468*), in Sarawak from Bau, Belaga, Marudi, Serian and Tatau districts (e.g., *S 21794*, *S 28091*, *S 30396*, *S 37453* and *S 41066*) and in Kalimantan (e.g., *Amdjah 536* and *Burley et al. 688*).

Ecology. Understorey tree in hill and lower montane forests on limestone and sometime ultrabasic substrate, at altitudes to 1600 m.

40. *Aglaia rivularis* Merr.

(Latin, *rivulus* = brook, rivulet; referring to its natural habitat)

Sect. *Aglaia*

PEB (1929) 125; Masamune *op. cit.* 373; van Steenis *op. cit.* 291; Whitmore, Tantra & Sutisna *op. cit.* 224; Pannell *op. cit.* (1992) 247, *op. cit.* (1995) 279; PROSEA *op. cit.* (1995) 51; Beaman & Anderson *op. cit.* 123. **Lectotype** (Pannell, 1992): *Elmer 21789*, Borneo, Sabah, Tawau (UC; isolectotypes A, BM, G, GH, L, MICH, SING, U).

Small tree to 15 m tall, to 15 cm diameter; some branches projecting horizontally from the river bank over the water. **Bark** smooth, brown or whitish brown; inner bark reddish brown or pale brown. **Sapwood** pink or almost white. **Twig apices** densely covered with reddish brown, orange-brown or pale brown peltate scales often with a short or long fimbriate margin. **Leaves** simple, densely covered with peltate scales like that of the twigs on the midrib below, and sparsely so on the rest of the lower surface (sometimes densely when young); *blades* linear-lanceolate, 6.5–24 × 1–4 cm, base cuneate, margin recurved, apex acuminate, acumen to 20 mm long; midrib prominent below; lateral veins 10–17 on each side of midrib, subprominent below; intercostal venation faint but visible or occasionally subprominent below; petioles 1–2 cm long, densely covered with scales like that of the

twigs. **Inflorescences** 12–23 cm long, 6–12 cm wide, densely covered with scales like that of the twigs. **Flowers** 1–2 × 1.5–2.5 mm; *calyx divided into (rarely 4) 5 rounded lobes*, margins ciliate, outside densely covered with peltate scales; *petals 5 (rarely 6)*; staminal tube 1–1.3 × 0.9–1.5 mm, thickened inside below the bases of the anthers, margin lobed, anthers 5, ovoid, *c.* 0.3 × 0.3 mm; ovary depressed globose, 0.2–0.4 × 0.3–0.4 mm, outside densely covered with peltate or stellate scales, locule 1, containing 1 ovule, stigma ovoid or depressed globose with a central apical depression, 0.2–0.3 × 0.3–0.4 mm. **Fruits indehiscent, locule 1**, ellipsoid, *c.* 1.5 × 0.8–1 cm, brown, reddish brown or yellow; stalks to 0.8 cm long; pericarp reddish brown. **Seed** 1, surrounded by an edible aril.

Vernacular names. Sabah—*lambunan* (Dusun Labuk), *runu* (Sungei Segaliud).

Distribution. Endemic in Borneo, known only in Sabah (widespread) from Kinabatangan, Kota Belud, Kota Merudu, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN 44708*, *SAN 69375*, *SAN 89005*, *SAN 95918* and *SAN 116405*) and in Kalimantan (e.g., *Amdjah 823*, *Arbainsyah AA 1915*, *Kostermans 12728* and *Kostermans 21189*).

Ecology. Rheophyte, found along river banks in forest on sandy soils, at altitudes 500–1000 m.

41. *Aglaia rubiginosa* (Hiern) Pannell
(Latin, *rubiginosus* = rusty red; the indumentum)

Fig. 4E–G.

Sect. **Amoora**

Mal. For. 45 (1982) 455, *op. cit.* (1989) 225, *op. cit.* (1992) 92, *op. cit.* (1995) 225; Whitmore, Tantra & Sutisna *op. cit.* 225; PROSEA *op. cit.* (1995) 51; Turner *op. cit.* 338; Coode *et al.* (eds.) *op. cit.* 201. **Basionym:** *Amoora rubiginosa* Hiern *op. cit.* 561, King *op. cit.* 54, Ridley *op. cit.* (1922) 398, Corner *op. cit.* (1978) 131, 198, Anderson *op. cit.* (1980) 250. **Lectotype** (Pannell, 1982): *Griffith 1050*, Peninsular Malaysia, Malacca (K). **Synonym:** *Aglaia ignea* Valetton in K. Heyne, Nutt. Fl. Ned. Ind. 3 (1917) 59, Anderson *op. cit.* (1980) 248, Whitmore, Tantra & Sutisna *op. cit.* 222.

Tree to 20 m tall, branched. **Bark** greyish brown, flaking into long narrow scales; inner bark pale pinkish brown; latex white. **Sapwood** yellowish brown, reddish brown towards the heartwood. **Twigs** stout, with large petiole scars, *densely covered with reddish brown or dark brown stellate hairs*. **Leaves** *imparipinnate*, to 80 cm long; petioles to 20 cm long; leaflets coriaceous, above dark shiny green and pitted, *below densely covered with reddish brown stellate scales with a darker, depressed centre; lateral leaflets 9–12 on each side of rachis*, subopposite; *blades lanceolate or ovate*, 6.5–16.5 × 2.2–6 cm, base rounded or cordate, asymmetrical, margin strongly recurved, apex acuminate, acumen acute, to 10 mm long; midrib impressed above, prominent below; lateral veins 13–18 on each side of midrib, impressed above, prominent below; intercostal venation faint to invisible on both surfaces; petiolules 1–2 cm long. **Inflorescences** to 70 cm long and wide, with indumentum like that of the twigs. **Flowers** to 9 × 5 mm; *calyx shallowly 3-lobed*, with indumentum like that of the twigs; *petals 3*; staminal tube ellipsoid, shallowly 3-lobed, anthers 6, narrowly ovoid; ovary depressed globose, densely covered with stellate hairs, stigma ellipsoid with 3 apical lobes and 6 longitudinal ridges. **Fruits** ellipsoid or obovoid, *c.* 6 × 5 cm, red, *without a beak or a stalk, locules 3*, each containing 1 seed, *dehiscing into 3 lobes when ripe*. **Seeds** with a complete red aril; testa brown.

Vernacular names. Sabah—*lantupak paya* (preferred name), *lantupak* (Dusun Kinabatangan). Sarawak—*jelungan sasak* (preferred name), *bersangai* (Melanau Rejang), *chenaga gayong* (Iban), *sangai* (Melanau Oya).

Distribution. Sumatra, Peninsular Malaysia, Singapore and Borneo. In Sabah, uncommon and recorded from Beaufort, Labuk Sugut, Papar, Sandakan and Tawau districts (e.g., *SAN* 22879, *SAN* 41549, *SAN* 45052 and *SAN* 63525) and in Sarawak from Betong, Bintulu, Daro, Kuching, Lawas, Lundu, Miri, Mukah, Sarikei, Sibu and Sri Aman districts (e.g., *Pennington* 7980, *S* 9018, *S* 9807, *S* 16521 and *S* 25418). Also occurring in Brunei (e.g., *BRUN* 949 and *BRUN* 1002) and Kalimantan (e.g., *Kostermans* 8009 and *Kostermans* 10353).

Ecology. In freshwater, peatswamp and dry *kerangas* forests, at altitudes to 15 m.

42. *Aglaia rufibarbis* Ridl.

Plates 3A & B.

(Latin, *rufus* = reddish, *barba* = beard; with indumentum comprising reddish brown stellate hairs with long arms)

Sect. *Aglaia*

J. Str. Br. Roy. As. Soc. 75 (1917) 17, *op. cit.* (1922) 409; Pannell *op. cit.* (1992) 344, *op. cit.* (1995) 312; Turner *op. cit.* 338. **Type:** *Cantley* 25, Peninsular Malaysia, Johor, Mt. Ophir (holotype K).

Small tree to 5 m tall, to 5 cm diameter, sparsely branched. **Bark** usually grey and pale brown, sometimes dark brown with dark grey patches, with longitudinal cracks; inner bark green, pale yellowish brown or orange-brown, with longitudinal striations; latex white. **Sapwood** pale yellowish brown or orange-brown. **Twigs** densely covered with reddish brown stellate hairs with arms to 4 mm long, the hairs sometimes deciduous or the longer arms often breaking off leaving a dense cluster of short arms. **Leaves** imparipinnate, to 85 cm long; petioles 10–22 cm long; leaflets with numerous stellate hairs like that of the twigs on both surfaces but more frequent on the lower one, with the arms of adjacent hairs overlapping, interspersed with smaller paler hairs with fewer arms; lateral leaflets 3 on each side of rachis, opposite; blades obovate or elliptical, 14–28 × 6–11 cm, base cuneate or subcordate, asymmetrical, margin recurved, apex acuminate or caudate, acumen obtuse or acute, 5–25 mm long; midrib prominent below; lateral veins 14–21 on each side of midrib, prominent below; intercostal venation faint but visible on both surfaces; petiolules 0.2–4 cm long. **Inflorescences** densely stellate hairy; males to 40 cm long and wide; females to 6 cm long and wide. **Flowers** minute, subglobose, to 1.2 mm diameter; calyx deeply divided into 5 narrow, acute lobes, outside covered with numerous stellate hairs; petals 5 (rarely 6), c. 1 mm long; staminal tube nearly as long as the corolla, anthers broadly ovoid, 0.2–0.25 mm; ovary depressed globose, stigma subglobose with 2 small apical lobes. **Fruits** (young) indehiscent, locule 1, containing 1 seed, subglobose, c. 2 × 2 cm, densely covered with often deciduous stellate hairs like that of the twigs; pericarp brittle, readily torn open, c. 1 mm thick, inner surface smooth, white and shiny.

Distribution. Peninsular Malaysia and Borneo. In Borneo, known only in Sarawak from Belaga, Bintulu, Kapit, Kuching and Miri districts (e.g., *Mabberley* 1582, *Mabberley* 1631, *S* 13663, *S* 49152 and *S* 68534) and in Kalimantan (e.g., *Church et al.* 236 and *Winkler* 637).

Ecology. In mixed dipterocarp forest, at 100–250 m altitude.

43. *Aglaia rufinervis* (Blume) Benty.

(Latin, *rufus* = reddish, *nervus* = nerve; the indumentum on the lateral veins on the lower leaflet surface)

Sect. *Aglaia*

Acta Bot. Neerl. 11 (1962) 19; Backer & Bakhuizen *f. op. cit.* 127; Pannell *op. cit.* (1992) 317, *op. cit.* (1995) 302; PROSEA *op. cit.* (1995) 52; Turner *op. cit.* 338. **Basionym:** *Trichilia rufinervis* Blume *op. cit.* (1825) 164. **Lectotype** (Pannell, 1992): *Sin. coll.*, Java, Mt. Gede and Pangrango (L [Acc. No. 91043340]). **Synonyms:** *Aglaia trichostemon* C.DC. *op. cit.* (1878) 608, King *op. cit.* 77, Merrill *op. cit.* (1921) 323, Ridley *op. cit.* (1922) 407, Masamune *op. cit.* 373, Anderson *op. cit.* (1980) 249, Pannell *op. cit.* (1989) 227, Whitmore, Tantra & Sutisna *op. cit.* 225; *Aglaia borneensis* Merr. *op. cit.* (1917) 87, *op. cit.* (1921) 322, Masamune *op. cit.* 370, Anderson *op. cit.* (1980) 247.

Tree to 15 m tall, to 15 cm diameter, branched. **Bark** smooth, greyish brown or yellowish brown; inner bark pale brown or pale yellow; latex white. **Sapwood** pale brown or pale yellow. **Twigs** stout, *densely covered with dark brown stellate hairs*. **Leaves** imparipinnate, to 100 cm long; petioles to 12 cm long; *leaflets pale yellowish green when dry, upper surface rugulose and pitted, lower surface with numerous reddish brown pits and dense cover of reddish brown stellate scales on the midrib, and with pale brown stellate scales scattered to numerous on that surface, interspersed with a few reddish brown stellate hairs, with the arms of adjacent hairs not overlapping; lateral leaflets (5–)7–9 on each side of rachis, subopposite; blades oblong, ovate or elliptical, 6–25(–32.5) × 3–8.5(–14.5) cm, base rounded or cuneate, asymmetrical, margin slightly recurved, apex shortly caudate, acuminate, to 10 mm long; midrib prominent below; lateral veins 10–13 on each side of midrib, subprominent below; intercostal venation faint but visible below; petiolules 1.5–3 cm long, with indumentum like that of the twigs. Inflorescences to 80 cm long, to 75 cm wide, densely covered with reddish brown stellate scales. Flowers 1.1–1.5 × 1.2–1.5 mm; calyx divided almost to the base into 5 rounded lobes, outside sparsely to densely covered with orange-brown or reddish brown stellate hairs or scales; corolla 1–1.3 × 1–1.4 mm, petals 5; staminal tube 0.7–0.8 × 0.8–1 mm, margin wavy, anthers 5, 0.4–0.5 × 0.3–0.4 mm with pale yellow simple hairs; ovary depressed globose, *c.* 0.2 × 0.2–0.3 mm, locule 1, containing 1 ovule, stigma ovoid, 0.3–0.4 × 0.2–0.3 mm. Fruits indehiscent, locule 1, subglobose, to 1.2 cm diameter, dull orange, outside densely covered with dark brown or orange-brown stellate hairs and scales.*

Vernacular name. Sarawak—*segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Singapore, Borneo and Java. In Sabah, recorded from Keningau, Kinabatangan, Kudat, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Sipitang and Tawau districts (e.g., Pennington 7898, SAN 24881, SAN 32484, SAN 71260 and SAN 82395) and in Sarawak from Belaga, Kapit, Kuching, Lawas, Lubok Antu, Marudi, Miri and Sri Aman districts (e.g., Pennington 7969, S 31891, S 44020, S 45014 and S 46796). Also occurring in Brunei (e.g., Coode 6607, Kirkup 869 and Prance 30542) and Kalimantan (e.g., Kostermans 10680 and Laman *et al.* TL 150).

Ecology. In mixed dipterocarp forest on sandstone-derived, clay and alluvium soils, at altitudes to 860 m.

44. *Aglaia rugulosa* Pannell(Latin, *rugulosus* = somewhat wrinkled; the leaflet surface)Sect. **Amoora**

Kew Bull. Add. Ser. 16 (1992) 73, *op. cit.* (1995) 217; Turner *op. cit.* 338. **Type:** *Whitmore FRI 15226*, Peninsular Malaysia, Pahang, Taman Negara, Ulu Sat (holotype K; isotypes KEP, L). **Synonym:** *Aglaia* sp. 1, Pannell *op. cit.* (1989) 227.

Small tree to 12 m tall, to 10 cm diameter, branched. Bark smooth, brown or greenish brown; inner bark pale brown; latex white. **Sapwood** pale yellow. **Twigs** to 2.8 cm diameter, *covered with a few to dense white or reddish brown stellate hairs or scales. Leaves imparipinnate*, to 130 cm long; petioles to 35 cm long; *leaflets coriaceous, dull pale brown when dry, upper surface rugulose, lower surface more markedly so and with a few stellate hairs on the midrib and lateral veins; lateral leaflets 6–7 on each side of rachis*, opposite or subopposite; *blades obovate or oblanceolate, 16–48 × 6–12 cm, base attenuate or sometimes cuneate or rounded, margin not recurved*, apex acuminate or shortly caudate, acumen acute, to 15 mm long; midrib subprominent above, prominent below; *lateral veins 9–17 on each side of midrib, usually of the same colour with leaflet surface*, subprominent with longitudinal wavy ridges above, prominent and more markedly ridged below; *intercostal venation faint*; petiolules 2.5–4 cm long. **Inflorescences** to 30 cm long, to 15 cm wide, with indumentum like that of the twigs. **Flowers** subglobose, *c.* 3 × 3 cm; *calyx shallowly divided into 3 acute lobes*, with few to numerous stellate scales; corolla depressed globose, *c.* 2 × 2.5 mm, *petals* 3, yellow or pale yellow, subrotund; staminal tube shorter than the corolla, cup-shaped, margin shallowly lobed, anthers 7–9, as long as the staminal tube; ovary depressed globose, *c.* 0.3 × 0.8 mm, densely covered with pale brown stellate hairs, locules 3, each containing 1 ovule, stigma ovoid, *c.* 0.4 × 0.2 mm. **Fruits ellipsoid or obovoid**, 6–9 × 3–6 cm, *locules* 3, each containing 1 seed, *dehiscing into 3 lobes when ripe*, reddish brown or pinkish red, densely covered with compact reddish brown stellate hairs outside; *pericarp 2–5 mm thick*, thickest at the apex, with white latex. **Seeds** 4.5 × 1.5 × 1.8 cm, completely covered with a red aril.

Distribution. Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Sabah, known from Kudat and Sandakan districts (e.g., *SAN 82386*, *SAN 87646* and *SAN 111767*) and in Sarawak from Bintulu, Kapit and Miri district (e.g., *S 18314* and *S 66717*). Also occurring in Kalimantan (e.g., *Kostermans 10441*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp forest on hill sides, at altitudes to 100 m.

45. *Aglaia scortechinii* King

(Reverend Benedetto Scortechini, 1845–1886, Italian Roman Catholic missionary and government botanist at Taiping, Perak)

Sect. **Aglaia**

J. As. Soc. Beng. 64, 1 (1895) 64; Ridley *op. cit.* (1922) 403; Pannell *op. cit.* (1989) 230, *op. cit.* (1992) 175, *op. cit.* (1995) 254; Turner *op. cit.* 338. **Type:** *Scortechini 722*, Peninsular Malaysia, Perak (G, L, SING).

Tree, 22–30 m tall, to 25 cm diameter, branched. **Bark** smooth, green, greyish brown or reddish brown; inner bark yellow, pale brown or pink; latex white. **Sapwood** white. **Twig apices densely covered with dark reddish brown peltate fimbriate scales usually less than 0.2 mm diameter.** **Leaves** imparipinnate, to 45 cm long; petioles to 7 cm long; leaflets yellowish brown when dry, lower surface with numerous reddish brown peltate scales on the midrib and scattered elsewhere; lateral leaflets (3–)4–6(–7) on each side of rachis; blades elliptical or ovate, 5–18.5 × 1.5–4.5 cm, base cuneate, margin recurved, apex acuminate, acumen obtuse, to 20 mm long; midrib prominent below; lateral veins 6–15 on each side of midrib, subprominent below; intercostal venation faint on both surfaces; petiolules 0.5–1 cm long. **Inflorescences** c. 13 cm long, c. 19 cm wide, densely covered with peltate fimbriate scales like that of the twigs. **Flowers** 1.5–1.9 × 1.5–2 mm; calyx divided into 5 lobes, outside densely covered with peltate fimbriate scales; petals 5, yellow or orange; staminal tube obovoid, 0.8–1.3 × 1.1 mm, thickened below and between the anthers, anthers 5, c. 0.5 × 0.3; ovary c. 0.2 × 0.4 mm, densely covered with orange-brown peltate scales with a fimbriate margin, locules 2 (rarely 3), each containing 1 ovule, stigma subglobose or ovoid with two apical lobes, c. 0.4 × 0.5 mm. **Fruits indehiscent, locules 2 (rarely 3),** each containing one seed, subglobose, 1.5–3 × 2–3.5 cm, red when ripe; pericarp thin and brittle when dry. **Seeds** c. 1.3 × 1.1 × 0.9 cm, completely covered with a white or yellow aril.

Vernacular name. Sabah—*lantupak* (Dusun Kinabatangan).

Distribution. Peninsular Malaysia and Borneo. In Sabah, known from Sandakan and Sipitang districts (e.g., *SAN 16569*, *SAN 20814* and *SAN 113471*) and in Sarawak from Bau, Lubok Antu and Sri Aman districts (e.g., *Mabberley 1634*, *S 12558*, *S 33763*, *S 37513* and *S 42478*). Also occurring in Kalimantan (e.g., *Kostermans 21523* and *de Vogel 932*) but not yet recorded from Brunei.

46. *Aglaia sessilifolia* Pannell

(Latin, *sessilis* = stalkless or apparently so, *folium* = leaf)

Sect. *Aglaia*

Kew Bull. 59 (2004) 88. **Type:** *George et al. SAN 117676*, Borneo, Sabah, Kinabatangan district, Bt. Goram (holotype K; isotypes KEP, SAN).

Tree to 12 m tall; bole to 6 m, to 20 cm diameter, branched. **Bark** greyish brown or dark brown, slightly scaly; inner bark reddish brown or whitish brown, fibrous. **Sapwood** pinkish brown or pinkish yellow; latex white. **Twigs densely covered with yellowish brown stellate hairs and scales interspersed with compact reddish brown stellate hairs.** **Leaves** simple, dull pale yellowish green when dry, with few to numerous hairs and scales like that of the twigs on the midrib below and scattered on the rest of that surface; blades obovate, 12–36 × 3–11.5 cm, base cordate or rounded, margin planar, apex acuminate, acumen c. 10 mm long; midrib prominent below, with a 5–10 mm long pulvinus-like swelling at 5–12 mm from the leaf base; lateral veins 17–30 on each side of midrib, ascending and curved upwards near the margin, not or quite anastomosing, subprominent below; intercostal

venation visible but not subprominent below; petioles 0.5–0.7 cm long or leaves sessile. **Inflorescences** to 18 cm long, to 10 cm wide; peduncles, branches and pedicels with numerous to dense yellowish brown stellate hairs and scales. **Flowers** 2–2.7 × 1.7–2.4 mm; pedicels *c.* 1.5 mm long; *calyx* cup-shaped, *divided almost to the base into 5 ovate lobes* about 1 mm long, with a few yellowish brown stellate scales about 0.1 mm in diameter; *petals* 5, obovate, *c.* 1.9 × 1.5 mm, yellow, aestivation quincuncial; staminal tube obovoid, 1–1.9 × 1–1.3 mm, shallowly lobed, anthers 4 or 5; ovary 0.3 × 0.3–0.5 mm, densely covered with scales like that of the calyx, style 0.2–0.5 mm long, stigma subglobose, 0.3–0.6 mm diameter, with four shallow lobes and darker depressed apical lobe *c.* 0.3 mm in diameter; locule 1. **Fruits** *indehiscent*, *locule* 1, ellipsoid, *c.* 2.5 × 1.6 cm, with few yellowish brown stellate hairs and scales.

Distribution. Endemic in Borneo and known only in Sabah from Keningau, Kinabatangan and Sandakan district (e.g., *SAN 30696*, *SAN 90877*, *SAN 117676* and *SAN 135055*).

Ecology. In limestone hill forest, at altitudes to 1000 m.

47. *Aglaia sexipetala* Griff.

(Latin, *sex* = six, *petalum* = petal; flower with 6 petals)

Sect. *Aglaia*

Not. Pl. As. 4 (1854) 505; Pannell *op. cit.* (1995) 268; Turner *op. cit.* 338; Coode *et al.* (eds.) *op. cit.* 201; Beaman & Anderson *op. cit.* 124. **Type:** *Griffith 1036*, Burma (= Myanmar), Ching, Nhinghuk (holotype K). **Synonyms:** *Aglaia aspera* Teijsm. & Binn. *op. cit.* (1864) 42, Miquel *op. cit.* (1868) 52, Koorders & Valetton *op. cit.* (1913) t. 152, Backer & Bakhuizen *f. op. cit.* 127, Pannell *op. cit.* (1989) 211, *op. cit.* (1992) 217, Whitmore, Tantra & Sutisna *op. cit.* 220, PROSEA *op. cit.* (1995) 43; *Aglaia calelanensis* Elmer *op. cit.* 3283; *Aglaia* sp. 5, Pannell *op. cit.* (1989) 229.

Tree to 15 m tall, to 30 cm diameter, branched; buttresses (if present) to 30 cm tall, to 30 cm out. **Bark** brown, dark grey, reddish brown with white brown patches; inner bark reddish brown; latex white. **Sapwood** white. **Twigs** slender, almost smooth, *densely covered with reddish brown stellate scales*. **Leaves** *imparipinnate*, to 72 cm long; petioles to 17 cm long; *leaflets* usually brown when dry, upper surface with a few stellate scales and numerous pits, *lower surface with numerous scales like that of the twigs, interspersed with compact brown stellate hairs with many, overlapping, short arms c. 0.5 mm long*; lateral leaflets 4–8 on each side of rachis, subopposite; *blades elliptical, lanceolate-oblong, oblong, ovate or obovate, 6–17 × 2–6 cm*, base rounded, subcordate or cuneate, asymmetrical, margin recurved and somewhat undulate, apex acuminate, acumen obtuse or acute, 10–15 mm long; midrib below prominent and with numerous to dense cover of scales like that of the twigs or with peltate scales with a long fimbriate margin; lateral veins 12–16 on each side of midrib, subprominent below; *intercostal venation faint on both surfaces; petiolules 1.2–3.5 cm long*. **Inflorescences** (males) to 40 cm long, 40–50 cm wide, with indumentum like that of the twigs. **Flowers** *c.* 1 × 1.1 mm; *calyx divided almost to the base into 5 subrotund lobes*, outside with numerous stellate scales; *petals* 5, elliptical or subrotund, yellow; staminal tube cup-shaped, *c.* 0.5 × 0.7 mm, apical margin incurved and shallowly 5-lobed, anthers 5, *c.* 0.2 × 0.2 mm; ovary subglobose, densely covered with stellate hairs or scales, stigma depressed globose, *c.* 0.2 × 0.3 mm. **Fruits** *indehiscent*, *locules* 2, each containing 1 seed, subglobose, *1.7–2.2(–3) × 1.4–2(–2.7) cm*, yellowish brown, reddish brown or orange-brown; *pericarp to 2 mm thick, hard and brittle or woody when dry*, sometimes with white latex. **Seeds** completely covered with transparent or white aril.

Vernacular names. Sabah—*lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines (type of *A. calelanensis* only) and New Guinea. Fairly common in Sabah and known from Beaufort, Labuk Sugut, Sandakan, Tambunan and Tawau districts (e.g., *SAN* 29631, *SAN* 32255, *SAN* 71188, *SAN* 78218 and *SAN* 97645) and in Sarawak from Belaga, Bintulu, Kapit, Lundu, Marudi, Miri and Simunjan districts (e.g., *S* 23835, *S* 24133, *S* 34273, *S* 39256 and *S* 43370). Also occurring in Brunei (e.g., *Ashton* B1, *Coode* 6955 and *Kirkup* DK 906) and Kalimantan (e.g., *Argent* & *Saridan* 9337, *Burley et al.* 2414, *Jarvie* & *Ruskandi* 6405, *Leighton* 213, *Wilkie* 94191 and *Wilkie* 93403).

Ecology. In mixed dipterocarp and *kerangas* forests on white sandy soil, at altitudes to 860 m.

48. *Aglaia silvestris* (M.Roem.) Merr.

(Latin, *silvestris* = of forest; growing wild)

Sect. *Aglaia*

Interpr. Rumph. Herb. Amboin. (1917) 210; Pannell *op. cit.* (1992) 193, *op. cit.* (1995) 259; PROSEA *op. cit.* 52; Turner *op. cit.* 338; Coode *et al.* (eds.) *op. cit.* 201; Beaman & Anderson *op. cit.* 124. **Basionym:** *Lansium silvestre* M.Roem., Fam. Nat. Syn. Monogr. 1 (1846) 99. **Neotype** (Pannell, 1992): *C.B. Robinson Herbarium Amboinense* 490, Maluku, Ambon (PNH; isoneotypes BM, BO, K, L, NY, P). **Synonyms:** *Aglaia ganggo* Miq. *op. cit.* (1861) 506, *op. cit.* (1868) 47, King *op. cit.* 65, Koorders & Valetton *op. cit.* (1913) t. 156, Backer & Bakhuizen *f. op. cit.* 129, Pannell *op. cit.* (1989) 216, Whitmore, Tantra & Sutisna *op. cit.* 222; *Aglaia acuminata* Merr. *op. cit.* (1915) 531; *Aglaia micropora* Merr. *op. cit.* (1929) 129, Masamune *op. cit.* 372, Anderson *op. cit.* (1980) 249; *Aglaia copelandii* Elmer *op. cit.* 3286.

Tree to 30 m tall, to 35 cm diameter, branched; buttresses (if present) to 3 m tall and 1 m out. **Bark** pale greyish brown, pale yellow, greenish yellow or reddish brown, with longitudinal rows of lenticels, sometimes flaky; inner bark reddish brown, pale brown, orange, pale yellow; latex white or sap red and watery. **Sapwood** paler than inner bark; heartwood pale yellowish brown or almost white. **Twigs** slender, *densely covered with peltate scales with a dark brown centre and pale, sometimes fimbriate margin*. **Leaves** imparipinnate, 19–65 cm long; petioles 10–20 cm long; *leaflets* subcoriaceous, *upper surface sometimes with dense scales like that of the twigs when young but deciduous before maturity, lower surface sparsely to densely covered with similar scales*; lateral leaflets (rarely 2) 6–8 on each side of rachis, alternate; *blades lanceolate or elliptical, 6.5–17 × 1.2–5.5 cm*, base rounded or abruptly cuneate, sometimes asymmetrical, margin recurved, apex acuminate, acumen obtuse, to 18 mm long; midrib prominent below; lateral veins 7–17 on each side of midrib; intercostal venation faint on both surfaces; petiolules 0.5–2 cm long, densely covered with peltate scales like that of the twigs. **Inflorescences** to 30 cm long, to 20 cm wide, densely covered with peltate scales like that of the twigs. **Flowers** obovoid, 2–2.7 × 1.4–2.6 mm; *calyx* to half the length of corolla, *deeply divided into 5 broadly ovate, ciliate lobes*, densely covered with peltate scales like that of the twigs; *petals* 5 or rarely 6, yellow, elliptical or ovate; *staminal tube* obovoid, 1–1.4 × 0.7–1.7 mm, *with a narrow pin-*

prick aperture c. 3 mm diameter with an entire margin, anthers 5, included, ovoid, 0.8–1 × 0.3–0.4 mm; ovary depressed globose, c. 0.4 × 0.4 mm, stigma ovoid, 0.4–0.7 × 0.2–0.4 mm. Fruits indehiscent, locules 1 or 2 (rarely 3), each containing 1 seed, usually obreniform (= inverted kidney-shaped) in outline, longitudinally flat, c. 2.1 × 1.8 × 0.9 cm; pericarp densely covered with peltate scales like that of the twigs, orange, with white latex, wrinkled when dry; stalks to 1 cm long. Aril thin, brown, translucent and sweet.

Vernacular names. Sabah—*langsar-langsar* (Malay), *lantupak* (Dusun Kinabatangan). Sarawak—*buniau* (Iban), *bunya* (Iban), *bunyo* (Kayan), *gayan* (Kayan), *lepuniau* (Kenyah), *segera* (Iban).

Distribution. Andaman Islands, Nicobar Islands, Vietnam, Cambodia, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Java, Sulawesi, Maluku, New Guinea, New Britain and Solomon Islands. In Sabah, recorded from Keningau, Ranau, Sandakan and Tawau districts (e.g., *SAN 40906*, *SAN 50323*, *SAN 74479*, *SAN 84122* and *SAN 89503*) and in Sarawak from Bintulu, Kapit and Kuching districts (e.g., *S 27469*, *S 32063*, *S 37459*, *S 43906* and *S 44185*). Also occurring in Brunei (e.g., *SAN 17450* and *Sands 5530*) and Kalimantan (e.g., *Kostermans 9956*, *Laman et al. TL 295* and *Leighton 772*).

Ecology. In mixed dipterocarp and *kerangas* forests, often on limestone-derived or clay-rich soils, at altitudes to 1650 m.

49. *Aglaia simplicifolia* (Bedd.) Harms

(Latin, *simplex* = simple, *folium* = leaf)

Sect. *Aglaia*

In Engler & Prantl, *Nat. Pflanzenfam.* 3, 4 (1896) 300; Pannell *op. cit.* (1992) 306, *p.p.*, *op. cit.* (1995) 298, *p.p.*; Turner *op. cit.* 338, *p.p.*; Coode *et al.* (eds.) *op. cit.* 202; Beaman & Anderson *op. cit.* 124. **Basionym:** *Beddomea simplicifolia* Bedd., *Fl. Sylv.* 1 (1871) t. 135. **Lectotype** (Pannell, 1992): *Beddome* '1165', India, Tinnevely hills (BM). **Synonym:** ?*Beddomea racemosa* Ridl., *J. Fed. Malay. States* 4 (1909) 10.

Tree, 15–20 m tall, 15–20 cm diameter, branched. **Bark** smooth, greyish brown. **Sapwood** white. **Twigs** pale greyish or yellowish brown, with dense reddish brown stellate hairs at the apex only. **Leaves** simple, surfaces dull (pale green) when dry, below with occasional hairs like that of the twigs on the midrib; blades elliptical or obovate, 7–18 × 2.5–7.5 cm, base cuneate or rounded, margin planar, apex acute or obtuse; midrib prominent below, somewhat impressed above; lateral veins 14–22 on each side midrib, ascending and curved upwards near the margin and not or just anastomosing; intercostal venation inconspicuous on both surfaces; petioles 0.5–1.7 cm long. **Inflorescences** and **flowers** unknown from Borneo. **Infructescences** to 6 cm long and 5 cm wide; peduncles 5–10 mm long. **Fruits** indehiscent, subglobose, c. 2.2 × 1.9 cm, red when ripe, not curved, without stipe, with one longitudinal ridge around it; peduncle, branches, and fruits with dense hairs like that of the twigs.

Vernacular name. Sarawak—*segera* (Iban).

Distribution. India, Laos, Thailand, Sumatra, Peninsular Malaysia and Borneo. In Borneo, known only in Sabah from Keningau district (e.g., *SAN 71980*, *SAN 74450* and *SAN 107406*) and in Sarawak from Marudi district (e.g., *S 22844*).

Ecology. In lowland and lower montane forests at altitudes to 1500 m.

Notes. A large number of specimens collected from Sabah and Sarawak previously identified as *Aglaia simplicifolia* (Pannell *op. cit.* 1992 & *op. cit.* 1995) belong to *A. meliosmoides*.

50. *Aglaia soepadmoi* Pannell

Fig. 8.

(Engkik Soepadmo, 1937–, Coordinator and Chief Editor, Tree Flora of Sabah and Sarawak Project)

Sect. **Aglaia**

Gard. Bull. Sing. 57, 2 (2005) 183. **Type:** *Othman et al. S 59970*, Borneo, Sarawak, Lundu district, Sg. Sebuloh (holotype SAR; isotype KEP).

Small tree to 7 m tall, branched. **Twigs** longitudinally channelled, *densely covered with dark brown or blackish brown stellate hairs, interspersed with pale stellate scales*. Leaves and inflorescences crowded near the apices of the shoots. **Leaves** *imparipinnate (only occasionally paripinnate)*, to 95 cm long; petioles 22–28 cm long; petioles, rachis and petiolules channelled adaxially, with indumentum like that of the twigs; leaflets above shiny-green, *smooth on both surfaces*, below densely covered with white stellate scales interspersed with dark brown, stellate hairs; *lateral leaflets 4 or 5 on each side of rachis, opposite; blades ovate or elliptical, the terminal one often markedly obovate, 15.5–24 × 6–9 cm*, base cordate, apex acuminate (rarely rounded), acumen acute to 16 mm long; midrib impressed above, prominent below; *lateral veins 11–17 on each side of midrib, impressed above, subprominent below, ascending and markedly curved upwards and looped at the margin; intercostal venation reticulate, visible above, slightly prominent below; petiolules c. 0.5 cm long*. **Inflorescences** to 17 cm long, to 9 cm wide, densely covered with indumentum like that of the twigs. **Flowers** sessile, subglobose, *c. 1.3 × 1.3 mm*; *calyx divided into 5 lobes*, outside densely covered with reddish brown stellate hairs and scales; *petals 5*; staminal tube obovoid, with a shallowly lobed aperture *c. 0.2 mm* across, anthers 5, almost as long as the staminal tube, inserted longitudinally and visible through the aperture; ovary subglobose, stigma ovoid with two apical lobes. **Infructescences** *c. 18.5 cm* long. **Fruits** *indehiscent, subglobose, c. 2 × 2 cm, densely covered with dark brown stellate hairs interspersed with a few white hairs*.

Ecology. Lowland mixed dipterocarp forest and beach forest on rocky terrain, at altitudes to 1100 m.

Distribution. Sumatra and Borneo. In Borneo, known only in Sarawak from Kuching and Lundu districts (e.g., *S 41873, S 54426, S 54873, S 63857* and the type).

51. *Aglaia speciosa* Blume

(Latin, *speciosus* = beautiful, showy, splendid)

Sect. **Aglaia**

Bijdr. Fl. Ned. Ind. (1825) 171; Miquel, Fl. Ind. Bat. 1 (1859) 543, *op. cit.* (1868) 46; Koorders & Valetton *op. cit.* (1913) t. 162; Backer & Bakhuizen *f. op. cit.* 127; Whitmore, Tantra & Sutisna *op. cit.* 225; Pannell *op. cit.* (1992) 164, *op. cit.* (1995) 250; PROSEA *op. cit.* (1995) 53; Turner *op. cit.* 338; Beaman & Anderson *op. cit.* 124. **Lectotype** (Pannell, 1992): *Anon.* 627, Java, Mt. Salak (L [Acc. No. 9081321091]).

Tree to 35 m tall, to 60 cm diameter, branched; buttresses to 1.3 m tall, to 1 m out. **Bark** grey or pink; inner bark reddish brown or greyish brown; latex white. **Sapwood** pale yellow or white, pinker towards the heartwood. **Twigs** with pinkish orange lenticels scattered or in longitudinal rows, *densely covered with peltate scales with a dark reddish brown centre and pale, sometimes fimbriate margin*. **Leaves** imparipinnate, 25–30 cm long; petioles 4.5–10 cm long; *leaflets below with numerous scales like that of the twigs*, lateral leaflets 1–2(–6) on each side of rachis, subopposite; *blades narrowly elliptical or narrowly obovate, 3.2–12 × 2–3.5 cm*, base rounded or cuneate, margin planar to slightly recurved, apex acuminate, acumen obtuse, to 10 mm long; midrib impressed above, prominent below; lateral veins 6–12 on each side of midrib, barely prominent below; intercostal venation faint on both surfaces; petiolules 0.5–1 cm long. **Inflorescences** to 22 cm long, to 20 cm wide, densely covered with scales like that of the twigs. **Flowers** 1.5–2 × 1.7–2 mm; calyx 0.5–1.5 mm long, densely covered with peltate, fimbriate scales; *petals 5*; *staminal tube* cup-shaped, 0.8–1.2 × 1–1.5 mm, *aperture more than 0.3 mm diameter, margin incurved and shallowly lobed*, *anthers 5*, 0.3–0.5 × 0.3–0.4 mm, *protruding through the aperture of staminal tube*; ovary ovoid, 0.2–0.4 × 0.2–0.5 mm, densely covered with scales like that of the twigs, locules 2, stigma subglobose or depressed globose, 0.2–0.5 × 0.4–0.5 mm. **Fruits** indehiscent, *locules 2 (rarely 1)*, each containing 0 or 1 seed, *obovoid, 2.3–3 × 1.7–2.7 cm*, red, orange or brown when ripe; *pericarp c. 1 mm thick, brittle, without dehiscing lines*. **Seeds** arillate, the aril *c. 2 mm thick, translucent, yellow or orange, edible, firmly adhering to the testa*; seeds without aril *c. 1.6 × 1.3 × 0.8 cm*.

Distribution. Sumatra, Peninsular Malaysia, Borneo and Sulawesi. In Borneo, known only in Sabah from Keningau, Ranau, Sandakan and Tambunan districts (e.g., *Pennington 7926, SAN 40301, SAN 41886, SAN 87421 and SAN 87883*) and in Sarawak from Lundu and Miri district (e.g., *S 406, S 26596, S 27569 and S 82971*).

Ecology. In forests at altitudes to 1350 m.

52. ***Aglaia spectabilis*** (Miq.) S.S.Jain & Bennet
(Latin, *spectabilis* = visible, worth seeing)

Fig. 9.

Sect. **Amoora**

Ind. J. For. 9 (1987) 271; Pannell *op. cit.* (1992) 79, *op. cit.* (1995) 221; PROSEA *op. cit.* (1995) 53; Turner *op. cit.* 339. **Basionym:** *Amoora spectabilis* Miq. *op. cit.* (1868) 37. **Syntypes:** *Anon. Herb. E.I.C. 1278 (K) and 1278.1 (K-W)*, Cult. in Hortus Calcuttensis. **Synonyms:** *Amoora ridleyi* King *op. cit.* 56, *Ridley op. cit.* (1922) 398, Whitmore, Tantra & Sutisna *op. cit.* 224; *Amoora wallichii* King *op. cit.* 56; *Aglaia ridleyi* (King) Pannell *op. cit.* (1982) 455, *op. cit.* (1989) 223.

Tree to 30 m tall, to 60 cm diameter, branched; buttresses plank-shaped, to 2 m tall and out. **Bark** greyish brown, yellowish brown or pale orange-brown, flaking in squarish scales, sometimes with large orange lenticels; inner bark pink, pale yellow or brown; latex white. **Sapwood** pale brown or white, reddish brown towards the heartwood. **Twigs** stout, *densely covered with reddish brown or pale yellowish brown stellate hairs or scales, or peltate*

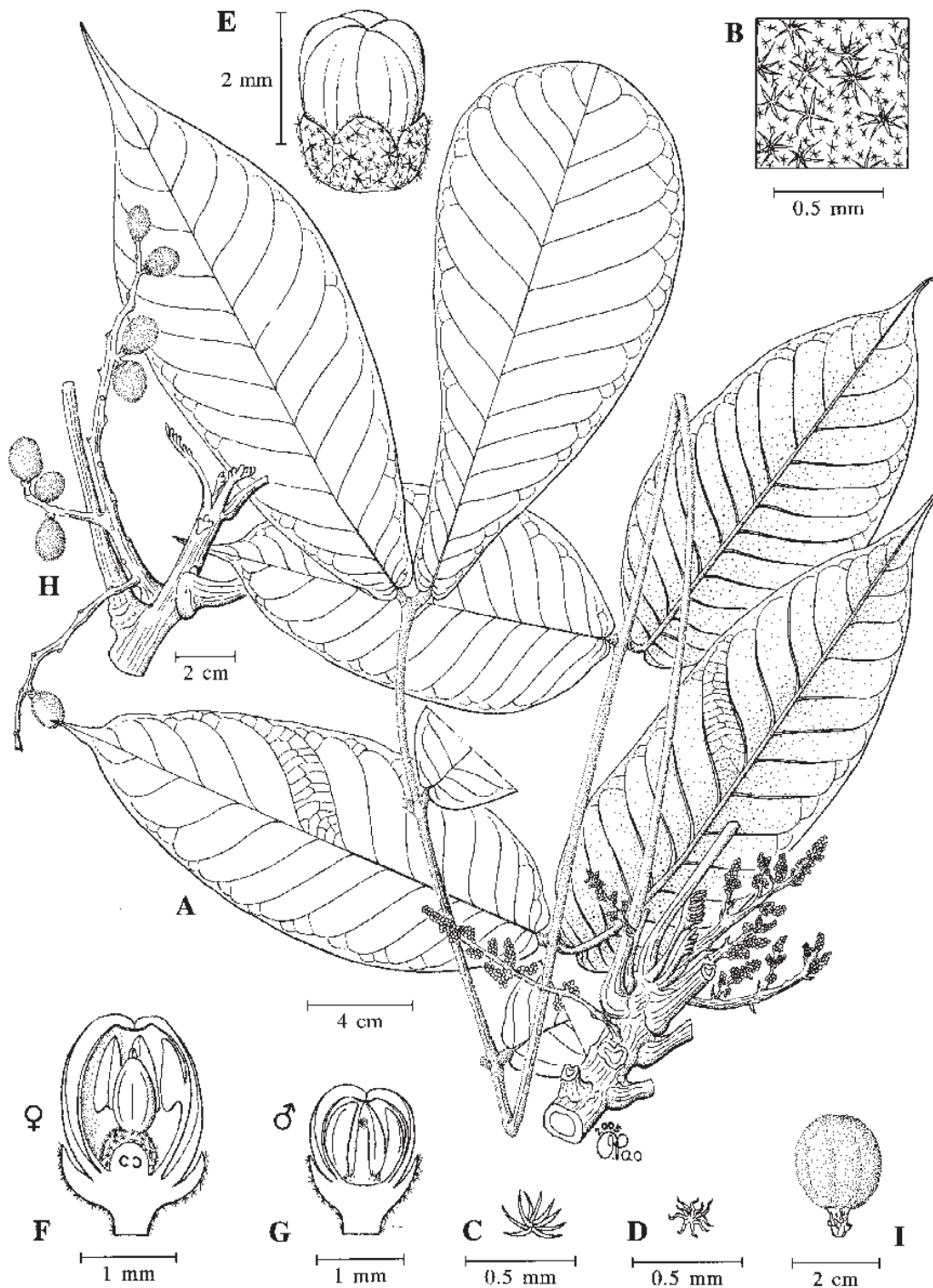


Fig. 8. *Aglaia soepadmoi*. A, leafy twig with young male inflorescences; B, detail of lower leaflet surface showing indumentum; C, stellate hairs; D, stellate scales; E, female flower; F, longitudinal section of female flower; G, longitudinal section of young male flower; H, young infructescence; I, young fruit. (A–D and G from *S* 41873, E–F from *S* 59970, H from *S* 54426, I from *Jacobs* 8190.)

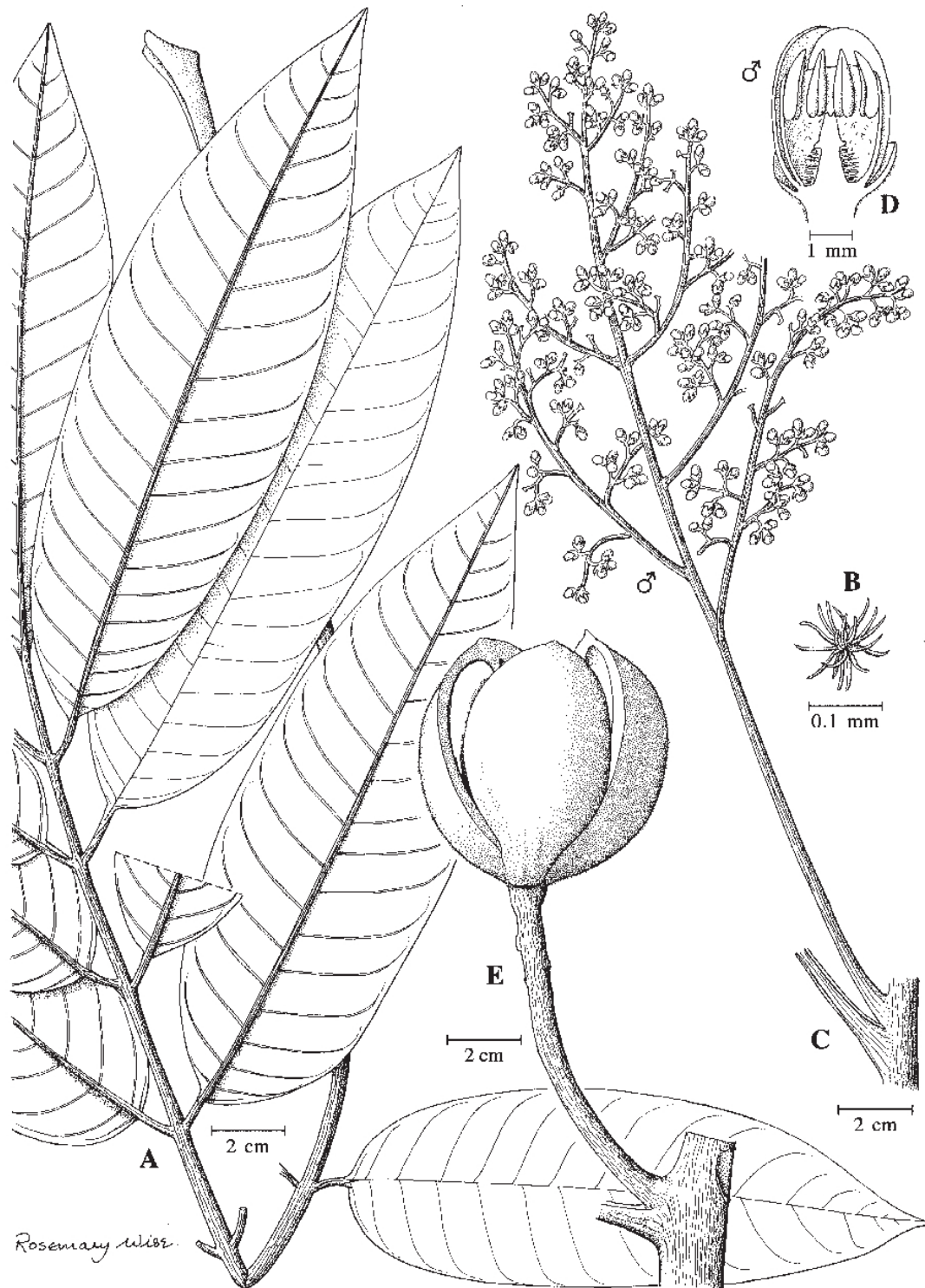


Fig. 9. *Aglaia spectabilis*. A, leaf; B, stellate hair; C, inflorescence; D, longitudinal section of male flower; E, infructescence. (After Pannell, Kew Bull. Add. Ser. 16 (1992) 82, f. 13 and FMI, 12(1) (1995) 220, f. 33; A–B from Putz FR123647, C–D from Wray 2107; E from Ridley 5027.)

scales with a fimbriate margin. **Leaves** imparipinnate, 50–135 cm long; petioles 14–25 cm long; leaflets coriaceous, dull brownish when dry, upper surface rugulose and sometimes pitted, lower surface pitted, with few to dense pale brown or orange-brown stellate hairs or scales on the midrib and a few or occasionally dense on the lateral veins and the blade, sometimes with a few darker peltate fimbriate scales scattered on the rest of that surface; lateral leaflets 7–10 on each side of rachis, opposite or subopposite; blades lanceolate, oblong or elliptical, 8.5–26 × 3.5–7 cm, base rounded, asymmetrical, margin planar, apex acuminate, acumen acute, to 15 mm long; midrib impressed above, prominent below; lateral veins 9–19 on each side of midrib, impressed above, prominent below, usually the same colour as the leaflet surface; intercostal venation subprominent below; petiolules 0.8–2 cm long. **Inflorescences** to 50 cm long, to 30 cm wide, with indumentum like that of the twigs. **Flowers** ellipsoid, 5–7 × 3–6 mm; calyx divided to halfway into 3 obtuse lobes, outside densely covered with stellate hairs; corolla tube c. 4 mm long, deeply divided into 3 lobes; staminal tube cup-shaped, c. 3 × 2.5 mm, anthers 6–9, 1.3 × 0.7 mm; ovary subglobose, c. 0.4 × 0.9 mm, stigma ovoid, c. 0.6 × 0.8 mm. **Infructescences** to 13 cm long. **Fruits** ellipsoid, 8–10 × 6–8 cm, locules 3 (rarely 4), each containing 0 or 1 seed, dehiscing into 3 lobes when ripe; pericarp to 1 cm thick, with white latex, shiny reddish brown inside. **Seeds** c. 3.5 × 2.5 × 1.8 cm; aril c. 1 mm thick, brown, red or yellow.

Vernacular names. Sabah—*balim* (Kedayan), *langsar-langsar* (Malay), *lantupak* (Dusun Kinabatangan), *merasam* (Banjar-Malay).

Distribution. India (Sikkim), Myanmar, Laos, Cambodia, Vietnam, China, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi, Nusa Tenggara (Sumba), New Guinea, New Britain, Solomon Islands, Santa Cruz Islands and Australia (Cape York Peninsula). In Borneo, known only in Sabah from Labuk Sugut, Sandakan and Tawau districts (e.g., *SAN 31301*, *SAN 40895*, *SAN 42151*, *SAN 62942* and *SAN 81407*) and in Sarawak from Lundu district (e.g., *S 41879*).

Ecology. In lowland forest, at altitudes to 250 m.

53. *Aglaia squamulosa* King

(Latin, *squamulosus* = covered with small scales; the indumentum on the lower leaflet surface and other parts of the plant)

Sect. *Aglaia*

J. As. Soc. Beng. 64, 1 (1895) 68; Ridley *op. cit.* (1922) 407; Pannell *op. cit.* (1989) 225, *op. cit.* (1992) 129, *op. cit.* (1995) 239; Whitmore, Tantra & Sutisna *op. cit.* 225; Turner *op. cit.* 339; Coode *et al.* (eds.) *op. cit.* 202; Beaman & Anderson *op. cit.* 124. **Syntypes:** *King's collectors 8805*, Peninsular Malaysia, Perak, near Ulu Kerling (K, SING); *King's collectors 11013*, Perak, Ulu Bubong (BM, K); *King's collectors 10145*, Perak, Ulu Bubong (BM, K, SING). **Synonym:** *Aglaia cuprea* Elmer *op. cit.* 3287.

Tree to 20 m tall, to 40 cm diameter, branched; buttresses (if present) L-shaped, to 55 cm tall and 36 cm out. **Bark** brown, pale green, pale orange-brown, pinkish brown, pale brownish grey or grey, sometimes with transverse and longitudinal striations or rows of

lenticels; inner bark yellowish brown, orange or green; sometimes with white latex. **Sapwood** brown or pale yellowish pink, pale brown or orange; heartwood magenta. **Twigs** stout, *thickly covered with shiny, large (at least 0.25 mm diameter) peltate scales with a brown centre and brown or pale brown shortly fimbriate margin.* **Leaves** *imparipinnate*, to 90 cm long; petioles to 20 cm long; *leaflets* coriaceous, dark yellowish green above, paler below, *when young both surfaces densely covered with pale brown or colourless, shiny, peltate scales, when mature upper surface rugose and with a few scattered scales, lower surface with numerous to dense scales, that of the midrib reddish brown; lateral leaflets 4–7 on each side of rachis*, usually alternate, sometimes subopposite; *blades oblong, elliptical or elliptical-oblong, 4–30 × 2–10 cm*, base rounded or cuneate, asymmetrical, margin recurved, apex acuminate, acumen obtuse or acute, to 15 mm long; midrib prominent below; lateral veins 4–13 on each side of midrib, subprominent below; intercostal venation inconspicuous on both surfaces; petiolules 0.3–2 cm long. **Inflorescences** to 39 cm long, 20 cm wide, *thickly covered with scales like that of the twigs.* **Flowers** 3.2–5 × 2(–2.9) mm; *calyx* wrinkled and densely covered with peltate scales near the base, *divided almost to the base into 5 (rarely 6) subrotund obtuse lobes*; corolla *c.* 2 × 2.9 mm long, *petals* 5; staminal tube obovoid, 1–2.1 × 1–2.3 mm, yellow, shallowly 5-lobed, anthers ovoid, *c.* 0.5 × 0.3 mm, densely covered with white stellate hairs; ovary depressed globose, *c.* 0.4 × 0.7 mm, densely covered with brown peltate scales, locules 2, stigma ovoid with two small apical lobes, *c.* 0.7 × 0.5 mm. **Fruits** *indehiscent, locules* 2, each containing 1 seed, narrowly obovoid when young, subglobose when mature, 5–5.7 × 3.5–4.7 cm, often with beak to 5 mm long and stalk to 5 mm long, brown or yellow; pericarp to 1 cm thick. **Seeds** *c.* 1.8 cm diameter; aril 0.3–1 mm thick, translucent, white.

Vernacular names. Sabah—*lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi and Nusa Tenggara (Sumbawa). In Sabah, known from Kinabatangan, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Tawau and Tenom districts (e.g., *SAN 65861, SAN 73523, SAN 76806, SAN 87879* and *SAN 99426*) and in Sarawak from Kapit, Limbang and Sri Aman districts (e.g., *S 28538, S 36074, S 36213, S 52437* and *S 60769*). Also occurring in Brunei (e.g., *Ashton 1256, BRUN 1067, Simpson 5238* and *Wong WKM 1908*) but not yet recorded from Kalimantan.

Ecology. In forests on sandstone-derived, sandy, clay and loam soils, at altitudes to 2000 m.

54. *Aglaia stellatopilosa* Pannell

Fig. 5L–P.

(Latin, *stellato-pilosus* = having stellate hairs)

Sect. *Aglaia*

Kew Bull. 59 (2004) 88. **Type:** *Awa & Lee S 47672*, Borneo, Sarawak, Limbang district, G. Pagon, Ulu Sg. Sipayan (holotype FHO; isotypes K, KEP, L, SAN, SAR).

Tree to 8 m tall, to 10 cm diameter, *branched.* **Bark** greyish green, sometimes pale brownish orange with V-shaped fissures; inner bark orange; latex white. **Twigs** *densely covered with pale brown or orange brown stellate hairs with wavy arms.* **Leaves** *imparipinnate, 15–25 cm long; petioles 3–5 cm long; leaflets with numerous pits on both surfaces*, lower surface with a few pale brown stellate hairs or scales on the midrib; lateral leaflets (rarely 3) 4–6 on

each side of rachis, alternate or subopposite, *basal ones only slightly smaller than the rest; blades narrowly ovate-elliptical, 2–6 × 1–1.8 cm, usually pale green when dry*, sometimes blackish green, base attenuate-acute, somewhat asymmetrical, margin recurved, apex acuminate-caudate, acumen to 10 mm long, with blunt tip; midrib prominent below, subprominent above; *lateral veins 4–6 on each side of midrib, darker or paler than the rest of the blade when dry; intercostal venation inconspicuous on both surfaces; petiolules to 0.5 cm long.* **Inflorescences** to 12 cm long and wide. **Flowers** 1.5–1.9 × 1.2–1.8 mm; *calyx densely covered with stellate scales; petals 5 (rarely 6);* staminal tube 1–1.3 × 0.8–1 mm, anthers 0.5–0.6 × 0.3 mm; ovary ovoid, 0.3–0.4 × 0.3–0.4 mm, locules 2, stigma 0.3 × 0.2–0.3 mm. **Fruits** *indehiscent, locules 2, subglobose, c. 2.3 × 2 cm, yellow, orange or deep yellowish brown when ripe, without longitudinal ridges.*

Vernacular name. Sarawak—*kela bunu* (Kelabit), *segera* (Iban).

Distribution. Endemic in Borneo. In Sabah, known from Keningau, Pensiangan, Ranau, Sandakan, Tenom and Tawau districts (e.g., *SAN 72091, SAN 114451, SAN 18554, SAN 24037* and *SAN 124794*) and in Sarawak from Kuching, Limbang, Lubok Antu, Marudi and Sri Aman districts (e.g., *S 37961, S 35354, S 47672, S 54001* and *S 58339*). Also occurring in Kalimantan (e.g., *Church et al. 458* and *Endert 3618*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp, riparian and *kerangas* forests, at altitudes to to 1200 m.

55. *Aglaia sterculioides* Kosterm.

Fig. 7J–N.

(like *Sterculia*, Malvaceae *s.l.* [Sterculiaceae]; referring to the fruit)

Sect. *Aglaia*

Reinwardtia 7, 5 (1969) 434. **Type:** *Hallier 3114*, Borneo, Kalimantan, Amai Ambit (holotype BO; isotypes K, L). **Synonym:** *Aglaia simplicifolia* auct. non (Bedd.) Harms (1896), *p.p.*: Pannell *op. cit.* (1992) 306, *p.p.*, *op. cit.* (1995) 298, *p.p.*

Slender tree to 8 m tall, to 8 cm diameter, branched. **Bark** surface brown, smooth. **Twigs** grey or dark brown, *densely covered with reddish brown stellate hairs when young.* **Leaves** simple, dull brownish green when dry; midrib, lateral veins on lower surface and petioles with numerous to dense cover of hairs like that of the twigs; *blades elliptical, (7–)14–29 × (3–)4–10 cm, base rounded or cuneate*, margin recurved, apex acute, acumen to 15 mm long; midrib prominent below; lateral veins 9–14(–18) on each side of midrib, subprominent below; *intercostal venation just visible on both surfaces;* petioles 1–2 cm long. **Inflorescences** *c. 13 cm long and c. 12 cm wide, densely covered with hairs like that of the twigs;* peduncles to 15 mm long. **Flowers** 1.3–1.5 × 1.8–2 mm; pedicels 0.3–1.5 mm long; calyx *c. 0.5 mm long, divided almost to the base into 5 ovate lobes;* petals 5, yellow, aestivation quincuncial; staminal tube shallowly cup-shaped, 0.7–1.2 × 1.4–1.5 mm, anthers 5; ovary *c. 0.1 × 0.1 mm, densely covered with pale orange-brown stellate hairs,* style 0.5 mm long, stigma ovoid, 0.2–0.3 × 0.2 mm. **Infructescences** 8.5–21 cm long, with 1–4 fruits; peduncles 3.5–11 cm long. **Fruits** *indehiscent, ellipsoid, 4.6–6 × 1.3–3.5 cm, curved with a stalk to 1 cm long, a beak to 3 mm long and a longitudinal ridge around it, greenish brown, ripening orange.*

Distribution. Endemic in Borneo. In Sabah, known from Lahad Datu district (e.g., *SAN* 58129) and in Sarawak from Bintulu, Miri and Tatau districts (e.g., *S* 21330, *S* 27853, *S* 39858, *S* 44821 and *S* 51427). Also occurring Brunei (e.g., *BRUN* 15386 and *BRUN* 15387) and in Kalimantan (e.g., the type collection).

Ecology. In lowland mixed dipterocarp on alluvial soil, at altitudes to 50 m.

Notes. Pannell (*op. cit.* 1992 & *op. cit.* 1995) treated this species as conspecific with *Aglaia simplicifolia*. It differs from *A. simplicifolia*, however, in its persistent indumentum on the midrib and lateral veins below and its curved fruit with a short stalk and beak.

56. *Aglaia subsessilis* Pannell

(Latin, *sub* = almost, *sessilis* = sessile, stalkless; the leaflets)

Sect. *Aglaia*

Kew Bull. Add. Ser. 16 (1992) 273, *op. cit.* (1995) 286; Beaman & Anderson *op. cit.* 125. **Type:** *Dewol SAN 93651*, Borneo, Sabah, Kinabatangan district, Pinangah, Kg. Saguean (holotype FHO; isotypes KEP, SAN).

Tree to 15 m tall, *branched*. **Bark** thin, dark reddish brown or white with black patches, scaly, with brown lenticels; inner bark reddish brown or pale yellow, laminated; latex white. **Sapwood** pale purple, white or red. **Twigs** with numerous to dense cover of orange-brown to reddish brown stellate hairs. **Leaves** imparipinnate, to 21 cm long; petioles 3–10(–30) cm long; leaflets differing markedly in size, pale yellowish green when dry, below with numerous orange-brown pits; lateral leaflets 1 or 2 on each side of rachis, opposite; blades of basal leaflets subrotund or obovate, 2.5–8 × 1.5–5 cm, with 5–8 lateral veins on each side of midrib and rounded base, that of lateral leaflets obovate, 11–18 × 4.5–6.5 cm and of terminal leaflets obovate, to 29 × 13 cm, both with 10–14(–17) lateral veins on each side of midrib and acute to obtuse base; midrib subprominent and densely covered with orange-brown stellate hairs below; lateral veins subprominent below; intercostal venation faint below; petioles of lateral leaflets to 0.3 cm long, that of terminal leaflets to 1.4 cm long. **Inflorescences** 21–26 cm long, 15–28 cm wide, with numerous to densely packed orange-brown stellate hairs. **Flowers** 0.5–1.2 × 0.5–1.2 mm; calyx with a few orange-brown stellate hairs or scales; petals 5; staminal tube cup-shaped, to 0.5 mm high, margin shallowly lobed, anthers 5, to 0.3 × 0.3 mm; ovary subglobose, densely covered with pale yellow stellate hairs, locule 1, containing 1 ovule, stigma ovoid, pale brown with two minute dark brown apical lobes. **Fruits** indehiscent, locule 1, containing one seed, narrowly ellipsoid, 5.4–6.5 × 2.1–2.5 cm, red when young, yellow when ripe, with a stipe (narrowed region at base of fruit) to 5 mm long and a beak to 5 mm long; pericarp thin and leathery when dry, with 10 longitudinal ridges from base to apex, along two of which the pericarp splits when dry, densely covered with compact reddish brown stellate hairs outside. **Seeds** ellipsoid, 3.6–4.2 × 1.2–1.7 × 0.6–1.0 mm.

Vernacular name. Sabah—*lantupak* (Dusun Kinabatangan).

Distribution. Endemic in Borneo. In Sabah, recorded from Kinabatangan, Kota Kinabalu, Ranau, Sandakan and Tawau districts (e.g., *SAN* 30091, *SAN* 41153, *SAN* 72360, *SAN*

89002 and SAN 93651) and in Sarawak from Kuching district (e.g., S 39858, S 41077 and S 48771). Also occurring in Kalimantan (e.g., McDonald & Ismail 3609) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp forest, at altitudes to 800 m.

57. *Aglaia tenuicaulis* Hiern

(Latin, *tenuis* = slender, *caulis* = stem)

Sect. *Aglaia*

In Hooker *f.*, Fl. Brit. Ind. 1 (1875) 556; King *op. cit.* 76; Ridley *op. cit.* (1922) 408; Pannell *op. cit.* (1989) 226, *op. cit.* (1992) 313, *op. cit.* (1995) 301; Whitmore, Tantra & Sutrisna *op. cit.* 225; Turner *op. cit.* 339; Coode *et al.* (eds.) *op. cit.* 202; Beaman & Anderson *op. cit.* 125. **Lectotype** (Pannell, 1992): *Maingay Kew Dist.* 335/3, Peninsular Malaysia, ? Penang (K).

Small tree to 15 m tall, to 10 cm diameter, *often unbranched*. **Bark** smooth, pale brown, pale green or grey with minute longitudinal cracks; inner bark pale yellowish brown; without or with white latex. **Sapwood** pale brown or pale pinkish brown. **Twigs** stout, *densely covered with reddish brown stellate hairs*. **Leaves** *imparipinnate*, to 130 cm long; petioles to 25 cm long; *leaflets* coriaceous, dull dark green above, yellowish green below, usually pale green when dry, *below with numerous reddish brown stellate hairs, the hairs sometimes with a few long arms which overlap with those of adjacent hairs but usually with arms all short and not overlapping; lateral leaflets 3–5 on each side of rachis*, alternate or subopposite; *blades elliptical, ovate or obovate, 11–25.5 × 5.5–9 cm*, base cuneate or rounded, margin recurved, apex shortly acuminate, acumen obtuse or acute, to 15 mm long; midrib prominent below; lateral veins 10–19 on each side of midrib, subprominent below; *intercostal venation faint*; petiolules to 2.5 cm long. **Inflorescences** 10–40 cm long, 10–40 cm wide, densely covered with reddish brown stellate hairs. **Flowers** subglobose, 1.2–1.5 × 1.5 mm; *calyx deeply divided into 5 acute lobes*, outside densely covered with brown stellate scales; corolla *c.* 1 × 1–1.1 mm, *petals* 5; staminal tube 0.6–1.5 × 0.9–1.3 mm, anthers ovoid, *c.* 0.3 × 0.25 mm, with a few pale yellow simple hairs at apex; ovary depressed globose, 0.2–0.3 × 0.3–0.6 mm, stigma obovoid, 0.2–0.5 × 0.4 mm, truncate at apex with a lobed margin. **Fruits** *indehiscent, locules 1 or 2*, each containing 1 seed, ellipsoid or subglobose, 1.5–3 × 1.2–2.5 cm; *pericarp outside densely covered with orange-brown or reddish brown stellate, short-armed hairs*, yellow inside. **Seeds** reddish brown, completely surrounded by a translucent, edible, sweet aril.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Singapore, Bunguran Island, Borneo (Brunei, Sabah and Sarawak) and the Philippines (Samar).

Notes. In Borneo, two subspecies, viz. subsp. *tenuicaulis* and subsp. *semengohensis*, are recognised.

Key to subspecies

Small tree to 5 m tall, unbranched or with a few ascending branches. Stellate hairs on lower leaflet surface with arms of different lengths.....

subsp. **tenuicaulis**

Small tree to 5 m tall, to 5 cm diameter; unbranched or with a few ascending branches; latex white. Leaflets with numerous reddish brown stellate hairs on lower surface sometimes with a few long arms which overlap with those of adjacent hairs but usually with arms all short and not overlapping; lateral leaflets 3 or 4 on each side of rachis; blades 11–23 × 5.5–8 cm. Flowers: staminal tube c. 0.6 × 0.9 mm, anthers c. 0.3 × 0.25 mm; ovary c. 0.2 × 0.3 mm, stigma obovoid, c. 0.2 × 0.4 mm, truncate at apex with a lobed margin. Fruits 1.5–3.5 × 3 cm.

Distribution as the species. In Borneo, known in Sabah from Sipitang and Tambunan districts (e.g., *SAN 133228* and *SAN 139449*) and in Sarawak from Betong, Kapit, Lundu, Marudi, Miri and Song districts (e.g., *S 19933*, *S 34828*, *S 34902*, *S 64750* and *S 74020*). Also occurring in Brunei (e.g., *BRUN 496*, *Kirkup DK 887* and *Prance 30559*).

In forest on sandy clay soil, at altitudes to 1000 m.

Tree to 15 m tall, branched. Stellate hairs on lower leaflet surface with arms of even length.....

subsp. **semengohensis** Pannell

(of Semengoh FR, Sarawak)

Kew Bull. 59 (2004) 90. Type: *Pennington 7952*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype FHO; isotype KEP).

Tree to 15 m tall, to 10 cm diameter, branched; without latex. Leaflets with numerous reddish brown stellate hairs with arms of even length not overlapping with those of adjacent hairs; lateral leaflets 4 or 5 on each side of rachis; blades 11.5–25.5 × 5.5–9 cm. Flowers: staminal tube c. 1.5 × 1.3 mm, anthers c. 0.5 × 0.4 mm; ovary c. 0.3 × 0.6 mm, stigma ovoid, c. 0.5 × 0.4 mm. Fruits 1.6–2.3 × 1.2–1.8 cm.

Only known in Sarawak from Semengoh FR, Kuching district (e.g., *Pennington 7952*, *S 15052*, *S 36644*, *S 36991*, *S 40586* and *S 72748*).

In mixed dipterocarp forest on undulating lands and hillsides, at 50–100 m altitude.

58. Aglaia teysmanniana (Miq.) Miq.

(Johannes Elias Teijsmann, 1809–1882; Curator of the Bogor Botanic Gardens, Indonesia)

Sect. **Neoaglaia**

Ann. Mus. Bot. Lugd. Bat. 4 (1868) 48; Pannell *op. cit.* (1989) 226, *op. cit.* (1992) 108, *op. cit.* (1995) 231; Whitmore, Tantra & Sutisna *op. cit.* 225; Turner *op. cit.* 339; Beaman & Anderson *op. cit.* 125.

Basionym: *Amoora teysmanniana* Miq. *op. cit.* (1861) 196, 503. **Lectotype** (Pannell, 1992): *Teysmann HB 4423*, Sumatra, S Lampong, Tarabangi River (U [Acc. No. 39203]; isolectotypes BO, L [Acc. No. 9081321044 & 9081321064]). **Synonyms:** *Aglaia heptandra* Koord. & Valetton *op. cit.* (1896) 132, *op. cit.* (1913) t. 157, Backer & Bakhuizen *f. op. cit.* 126.

Tree to 20 m tall, to 40 cm diameter, branched; bole with short plank buttresses. **Bark** pale greyish brown or brown with longitudinal cracks and lenticels; inner bark yellowish brown; latex white. **Sapwood** pale yellowish brown. **Twigs** densely covered with pale yellowish brown stellate hairs. **Leaves** imparipinnate, to 60 cm long; petioles to 9.5 cm long; leaflets below densely but not completely covered with pale yellowish brown stellate hairs on the surface and midrib; lateral leaflets 2 or 3 on each side of rachis, usually subopposite, sometimes alternate; blades elliptical or obovate, 5–17.5(–25) × 2.5–7(–9.5) cm, base cuneate or rounded, asymmetrical, margin planar to slightly recurved, apex acuminate or

shortly caudate, acumen obtuse or acute, to 15 mm long; midrib prominent below; *lateral veins 8–16 on each side of midrib*, subprominent below; *intercostal venation faint*; *petiolules 1–2 cm long*. **Inflorescences** to 15 cm long and wide, with numerous pale yellowish brown stellate short-armed hairs or scales. **Flowers** *c.* 2.2 × 2.2 mm; *calyx shallowly divided into 3 or 5 rounded lobes*, densely covered with scales like those on the twigs; *petals 3 or 5*; *staminal tube cup-shaped, c. 1.1 × 1.3 mm*, anthers 7 or 8, *c.* 0.3 × 0.3 mm; *ovary subglobose, c. 0.4 × 0.6 mm*, densely covered with stellate scales, *locules 3*, stigma *c.* 0.2 × 0.3 mm with three small apical lobes. **Fruits** subglobose, *1–2.2 × 1.3–2 cm*, *3-locular, dehiscing into 3 lobes when ripe*; pericarp *c.* 2 mm thick, white, turning pink on exposure to air, densely covered with pale brown stellate scales, containing some latex, innermost layer in each locule a detachable membrane surrounding the seed. **Seeds** 1–3, *obovoid, (0.7–)1.1–1.4 × (0.4–)0.6–0.9 cm*; aril orange or red.

Vernacular names. Sabah—*bibilad* (Malay), *malangsatsat* (Bajau), *mumutah* (Dusun).

Distribution. China, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Java and Sulawesi. In Sabah, recorded from Lahad Datu, Ranau and Semporna districts (e.g., *SAN 31507, SAN 42715, SAN 76757, SAN 135304* and *SPN 7275*) and in Sarawak from Kuching, Lawas and Lundu districts (e.g., *S 21844, S 31145, S 40238, S 49880* and *S 96531*). Also occurring in Kalimantan (e.g., *Leighton 793*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp and riparian forests, including on sandy alluvial soil, at altitudes to 1650 m. In Peninsular Malaysia, the seeds are eaten and thought to be dispersed by barbets (Capitonidae), broadbills (Eurylaimidae) and bulbuls (Pycnonotidae).

59. *Aglaia tomentosa* Teijsm. & Binn.
(Latin, *tomentosus* = thickly and evenly covered with hairs)

Fig. 10, Plate 4C.

Sect. *Aglaia*

Nat. Tijdschr. Ned. Ind. 27 (1864) 43; Pannell *op. cit.* (1989) 226, *op. cit.* (1992) 331, *op. cit.* (1995) 306; Whitmore, Tantra & Sutisna *op. cit.* 225; Kessler & Sidiyasa *op. cit.* 168; PROSEA *op. cit.* (1995) 54; Turner *op. cit.* 339; Coode *et al.* (eds.) *op. cit.* 202; Beaman & Anderson *op. cit.* 125. **Lectotype** (Pannell, 1992): *Teysmann s.n.*, Sumatra, Bangka Island, Plangas Djeboes (BO). **Synonyms:** *Argophilum pinnatum* Blanco, Fl. Filip. ed. 1 (1837) 186; *Aglaia rufa* Miq. *op. cit.* (1868) 49; *Aglaia dyeri* Koord. *op. cit.* 634; *Aglaia glomerata* Merr. *op. cit.* (1906) 30, *op. cit.* (1921) 323; *Aglaia pinnata* (Blanco) Merr. *op. cit.* (1918) 212, *non* Druce (1914); *Aglaia kabaensis* Baker *f.*, J. Bot. London 62, Suppl. (1924) 19; *Aglaia cordata* Hiern *op. cit.* 557, King *op. cit.* 73, *p.p.*, Ridley *op. cit.* (1922) 409, *p.p.*, Pannell *op. cit.* (1989) 214. (For further synonyms *cf.* Pannell *op. cit.* 1992 & *op. cit.* 1995.)

Tree, 9–20 m tall, 10–25 cm diameter, *branched*; often flowering and fruiting at 1.5–2.5 m tall. **Bark** pale reddish brown or grey with green patches, with longitudinal cracks and lenticels arranged in longitudinal rows; inner bark yellow, fibrous or granular; latex white. **Sapwood** pale brown or pinkish brown. **Twigs** slender, *densely covered with reddish brown or orange-brown stellate hairs with arms to 1 mm long*. **Leaves** *imparipinnate*, to 60 cm long; petioles to 13 cm long; *leaflets with hairs like that of the twigs either few or dense on the midrib above or numerous to dense on the midrib, lateral veins and surface of the blade below*; *lateral leaflets 2–5 (rarely 6) on each side of rachis*, opposite or subopposite; *blades obovate, elliptical or narrowly elliptical, 1.7–23 × 0.8–11.5 cm*, base rounded, cordate or

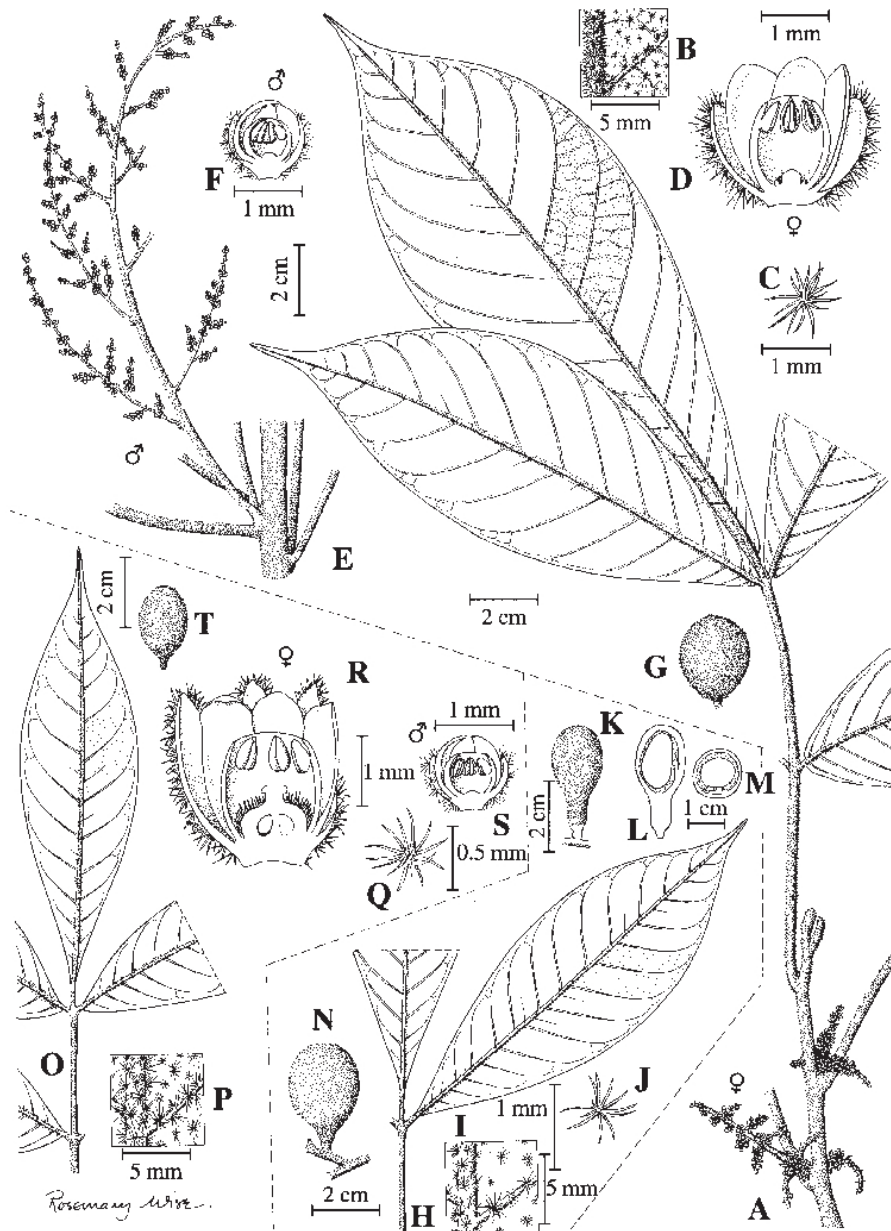


Fig. 10. *Aglaia tomentosa*, subsp. *cordata* (A–G), subsp. *kabaensis* (H–N), subsp. *tomentosa* (O–T). A, leafy twig with female inflorescences; B, detail of midrib and lateral vein on the lower leaflet surface showing the indumentum; C, stellate hair; D, longitudinal section of female flower; E, male inflorescence; F, longitudinal section of male flower; G, fruit; H, distal part of leaf; I, detail of midrib and lateral vein on the lower leaflet surface showing the indumentum; J, stellate hair; K, young fruit; L, longitudinal section of young fruit; M, cross-section of young fruit; N, mature fruit; O, distal portion of leaf; P, detail of midrib and lateral vein on lower leaflet surface showing indumentum; Q, stellate hair; R, longitudinal section of female flower; S, longitudinal section of male flower; T, fruit. (A–D from *S* 42630, E–F from *SAN* 79063, G from *SAN* 64755; H–J from *SAN* 94273, K–M from *Pennington* 7947, N from *SAN* 94273; O–Q from *SAN* 90238, R from *S* 32216, S from *SAN* 94577, T from *SAN* 81143.)

tapering and cuneate, asymmetrical, margin sometimes recurved, apex acuminate or caudate, acumen obtuse or acute, to 35 mm long; midrib prominent below; *lateral veins* 5–19 on each

side of midrib, subprominent below; *intercostal venation* visible but faint below; petiolules 0–2 cm long. **Inflorescences** densely covered with stellate hairs like that of the twigs; males 9–18 cm long, 3–22 cm wide; females smaller, with fewer branches. **Flowers** subglobose, 1–2.3 mm diameter, sessile; *calyx* outside densely covered with stellate hairs, *deeply divided into 5 acute or obtuse lobes with ciliate margins*; *petals* 5, white or yellow, glabrous; staminal tube cup-shaped or subglobose, apical margin slightly incurved and shallowly 5-lobed, *anthers* 5, broadly ovoid, 0.2–0.4 × 0.1–0.3 mm; ovary 0.1–0.5 × 0.3–0.9 mm, locules 2, each containing 1 ovule, stigma ovoid, 0.2–0.5 mm across. **Fruits** indehiscent, *locules* 2, each containing 0 or 1 seed, subglobose, obovoid or pear-shaped, 1.6–3 × 1.2–2.2 cm, with dense indumentum like that of twigs, sometimes glabrescent; *pericarp* brittle, less than 2 mm thick; stalk to 7 mm long. **Seeds** with brown testa; aril orange, red or brown, gelatinous, translucent, acidic-tasting, completely covering the seed.

Vernacular names. Sabah—*langsar monyet* (Malay), *lantupak* (Dusun Kinabatangan). Sarawak—*punyau* (Punan), *segera* (Iban).

Distribution. S India, Vietnam, Laos, Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo, the Philippines, Sulawesi, Nusa Tenggara (Flores), New Guinea and Australia.

Ecology. In evergreen forests at altitudes to 2000 m. Fruits are eaten and seeds are probably dispersed by monkeys.

Notes. In Borneo, three subspecies, viz. subsp. *cordata*, subsp. *kabaensis* and subsp. *tomentosa* are recognised.

Key to subspecies

1. Lower leaflet surface with few hairs. Fruits pear-shaped.....
 subsp. **kabaensis** (Baker f.) Pannell Fig. 10H–N.
 (of Kaba volcano in Palembang, Sumatra)
 Kew Bull. 59 (2004) 91; Beaman & Anderson *op. cit.* 126. Basionym: *Aglaia kabaensis* Baker f. *op. cit.* 19. Lectotype (Pannell, 1992): *Forbes s.n.*, Sumatra, Palembang, foot of Kaba volcano (BM; isoelectotypes K, L [*Acc. Nos.* 9081411382 and 908143169]).
 Leaflets pale green or pale brown when dry, venation pale yellow or pale brown, *lower surface with a few compact orange-brown stellate hairs and few to numerous pale yellow or white stellate scales in between*; blades 4.5–23 × 1.8–8 cm, base rounded or cuneate; lateral veins 7–19 on each side of midrib; petiolules 0.5–2 cm long. Flower *c.* 1.2 × 1 mm. *Fruits pear-shaped*, to 3 × 1.8 cm.
 Sumatra, Peninsular Malaysia and Borneo. In Sabah, common and known from Keningau, Kinabatangan, Kota Merudu, Lahad Datu, Ranau, Sandakan, Tawau and Tenom districts (e.g., *SAN 71024*, *76891*, *SAN 78268*, *SAN 80096* and *SAN 94273*). In Sarawak rare, known only from a single collection (*Clemens 6708*) from Mt. Poi. Also occurring in Kalimantan (e.g., *Church et al. 759* and *Church et al. 1213*) but not yet recorded from Brunei.
 Hairs numerous on lower leaflet surface, the arms of the stellate hairs usually overlapping. Fruits subglobose or obovoid2

2. Leaflet base rounded or cuneate Fig. 100–T.
 subsp. **tomentosa**
 Pannell, Kew Bull. 59 (2004) 91; Beaman & Anderson *op. cit.* 125. Synonyms: *Argophilum pinnatum* Blanco *op. cit.* 186; *Aglaia rufa* Miq. *op. cit.* (1868) 49, Merrill *op. cit.* (1921) 323, Masamune *op. cit.* 373; *Aglaia dyeri* Koord. *op. cit.* 634; *Aglaia glomerata* Merr. *op. cit.* (1906) 30; *Aglaia pinnata* (Blanco) Merr. *op. cit.* (1918) 212, Anderson *op. cit.* (1980) 249.
Leaflets with hairs like that of the twigs numerous to dense on the midrib and veins and numerous on the rest of the lower surface, with the arms of adjacent hairs overlapping or not, with smaller paler hairs which have fewer and shorter arms interspersed on the surface in between; blades 1.7–16 × 0.8–11.5 cm, often recurved at the margin when dry, tapering to a rounded or cuneate base. Flowers 1.3–1.9 × 1.1–2.3 mm. Fruits subglobose, 1.6–2.4 × 1.2–2.2 cm.
 Distribution as the species. In Sabah and Sarawak common; in Sabah recorded from Beaufort, Kalabakan, Keningau, Kota Belud, Kota Kinabalu, Lahad Datu, Nabawan, Pensiangan, Ranau, Sandakan and Tawau districts (e.g., *SAN 39042*, *SAN 81143*, *SAN 87037*, *SAN 89808* and *SAN 91071*) and in Sarawak from Baram, Belaga, Kapit, Kuching, Limbang, Lubok Antu, Marudi, Miri and Tubau districts (e.g., *S 24820*, *S 34988*, *S 35608*, *S 42389* and *S 61153*). Also occurring in Brunei (e.g., *Coode 7929*, *Dransfield JD 6844*, *Kirkup DK 537*, *Sands 5903* and *Wong WKM 646*) and Kalimantan (e.g., *Ambriansyah et al. AA 1206*, *Burley et al. 804*, *Kessler et al. PK 1355*, *Laman et al. 1054* and *Veldkamp 8067*).
- Leaflet base cordate Fig. 10A–G.
 subsp. **cordata** (Hiern) Pannell
 (Latin, *cordatus* = heart-shaped; the base of leaflets)
 Kew Bull. 59 (2004) 91; Beaman & Anderson *op. cit.* 126. Basionym: *Aglaia cordata* Hiern *op. cit.* 557, King *op. cit.* 73, *p.p.*, Merrill *op. cit.* (1921) 322, Ridley *op. cit.* (1922) 409, *p.p.*, Merrill *op. cit.* (1929) 124, Masamune *op. cit.* 371, Anderson *op. cit.* (1980) 247, Pannell *op. cit.* (1989) 213, Whitmore, Tantra & Sutisna *op. cit.* 221. Lectotype (Pannell, 1992): *Maingay 2969* (= *Kew Dist. 335/2*), Peninsular Malaysia, Malacca (K).
Leaflet lower surface with numerous reddish brown or pale orange-brown stellate hairs with arms to 0.5 mm long, those of adjacent hairs usually overlapping, interspersed with smaller paler hairs with fewer arms in between, usually sessile; blades 5.3–22 × 2.5–11, base cordate. Flowers 1–2.3 × 1.2–3 mm. Fruits subglobose, to 2.1 × 2.2 cm.
 Thailand, Sumatra, Peninsular Malaysia, Singapore, Anambas Islands, Java, Borneo and the Philippines. In Sabah, known from Beaufort, Kinabatangan, Kuala Penyu, Kudat, Sandakan and Tawau districts (e.g., *SAN 63249*, *SAN 64755*, *SAN 72246*, *SAN 78680* and *SAN 91802*) and in Sarawak from Belaga, Kapit, Lubok Antu, Miri, Marudi and Serian districts (e.g., *S 27647*, *S 36802*, *S 16532*, *S 39477* and *S 87184*). Also occurring in Brunei (e.g., *BRUN 15239*, *BRUN 15618*, *BRUN 17502*, *Sands 5829* and *Wong WKM 851*) and Kalimantan (e.g., *Burley et al. 3216*, *Church et al. 218*, *Hansen 1342* and *Kessler et al. PK 1071*).

60. *Aglaia variisquama* Pannell (Latin, *varius* = various, *squama* = scale)

Sect. *Aglaia*

Kew Bull. Add. Ser. 16 (1992) 153, *op. cit.* (1995) 245; Turner *op. cit.* 339. **Type:** *Tong S 34271*, Borneo, Sarawak, Sabal Tapang FR (holotype FHO; isotypes KEP, L, SAR).

Tree to 20 m tall, to 30 cm diameter, branched. **Bark** smooth, green, brown, reddish grey or black; inner bark pale yellow or red. **Sapwood** pale yellow. **Twigs** densely covered with dark orange-brown peltate scales to 0.3 mm diameter and with an irregular margin, interspersed with some scales with dark orange-brown centres and paler margins. **Leaves** imparipinnate, to 79 cm long; petioles 7–15 cm long; leaflets coriaceous, slightly asymmetrical, lower surface with numerous scales like that of the twigs, the scales evenly distributed and usually visible to the naked eye as tiny dark and pale brown spots; lateral leaflets 4–6 on each side of rachis, subopposite, terminal ones not folded at the base; blades obovate, 7.5–30 × 4–13 cm, base cuneate, margin recurved, apex acuminate, acumen obtuse, to 5 mm long; midrib impressed above, prominent below; lateral veins 10–17 on each side of midrib, subprominent below; intercostal venation inconspicuous on both surfaces; petiolules 0.5–1.9 cm long. **Inflorescences** to 32 cm long, to 22 cm wide, densely covered with scales like that of the twigs. **Flowers** depressed globose, 1.5–3 × 2–4 mm; calyx c. 0.5 mm long, divided into 5 subrotund lobes, with numerous pale peltate, fimbriate scales; petals 5 or 6, yellow or white; staminal tube depressed globose, 1.2–1.8 × 1.5–2 mm, anthers 5, c. 0.6 × 0.4 mm, with a few simple hairs at the base and apex; ovary depressed globose, 0.2–0.6 × 0.6–0.9 mm, densely covered with pale orange-brown peltate fimbriate scales, locules 1 or 2, each containing 1 or 2 ovules, stigma ovoid, c. 0.7 × 0.8 mm. **Fruits** indehiscent, locules 1 or 2, subglobose, c. 4 × 4 cm, sometimes with a small beak, yellowish brown, outside densely covered with pale orange-brown peltate scales; latex white. **Seed** 1, with a fleshy translucent aril; testa dark brown.

Vernacular names. Sabah—*lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Peninsular Malaysia and Borneo. In Sabah, recorded from Kinabatangan, Lahad Datu, Sandakan and Tawau districts (e.g., *Kokawa & Hotta 1501*, *SAN 40869*, *SAN 46062*, *SAN 79205* and *SAN 80967*) and in Sarawak from Belaga, Bintulu, Kuching, Lundu, Mukah, Serian and Simunjan districts (e.g., *Burley & Lee 251*, *S 34271*, *S 34303*, *S 35640* and *S 77370*). Also occurring in Kalimantan (e.g., *Kostermans 9811*). Not yet recorded from Brunei.

Ecology. In mixed dipterocarp, *kerangas*, and swamp forests, at altitudes to 950 m.

2. APHANAMIXIS Blume

(Greek, *aphanos* = invisible, *mixis* = mating;
an allusion to the sex organs enclosed in the staminal tube)

lantupak (Dusun), *segan* (Iban), *segera* (Malay)

Bijdr. Fl. Ned. Ind. (1825) 165; Ridley, FMP 1 (1922) 400; Masamune, EPB (1942) 374; Pennington & Styles, Blumea 12 (1975) 485; Anderson, CLTS (1980) 250; Mabberley, Blumea 31 (1985) 136, in Mabberley & Pannell, TFM 4 (1989) 230, PB 2nd. ed. (1997) 46; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 226; Mabberley *et al.*, FM 1, 12 (1995) 187; Coode *et al.* (eds.), CLBD (1996) 202; Argent *et al.* (eds.), MNDR-CK 2 (1997) 412; PROSEA 5, 3 (1998) 78; Beaman & Anderson, PMK 5 (2004) 126. **Synonyms:** *Amoora* Roxb. sect. *Aphanamixis* (Blume) C.DC. in A.P. de Candolle, Mon. Phan. 1 (1878) 579; *?Ricinocarpodendron* Boehm. in Ludwig, Defin. Gen. Pl. ed. 3 (1760) 512. (For complete synonymy cf. Mabberley *op. cit.* 1985.)

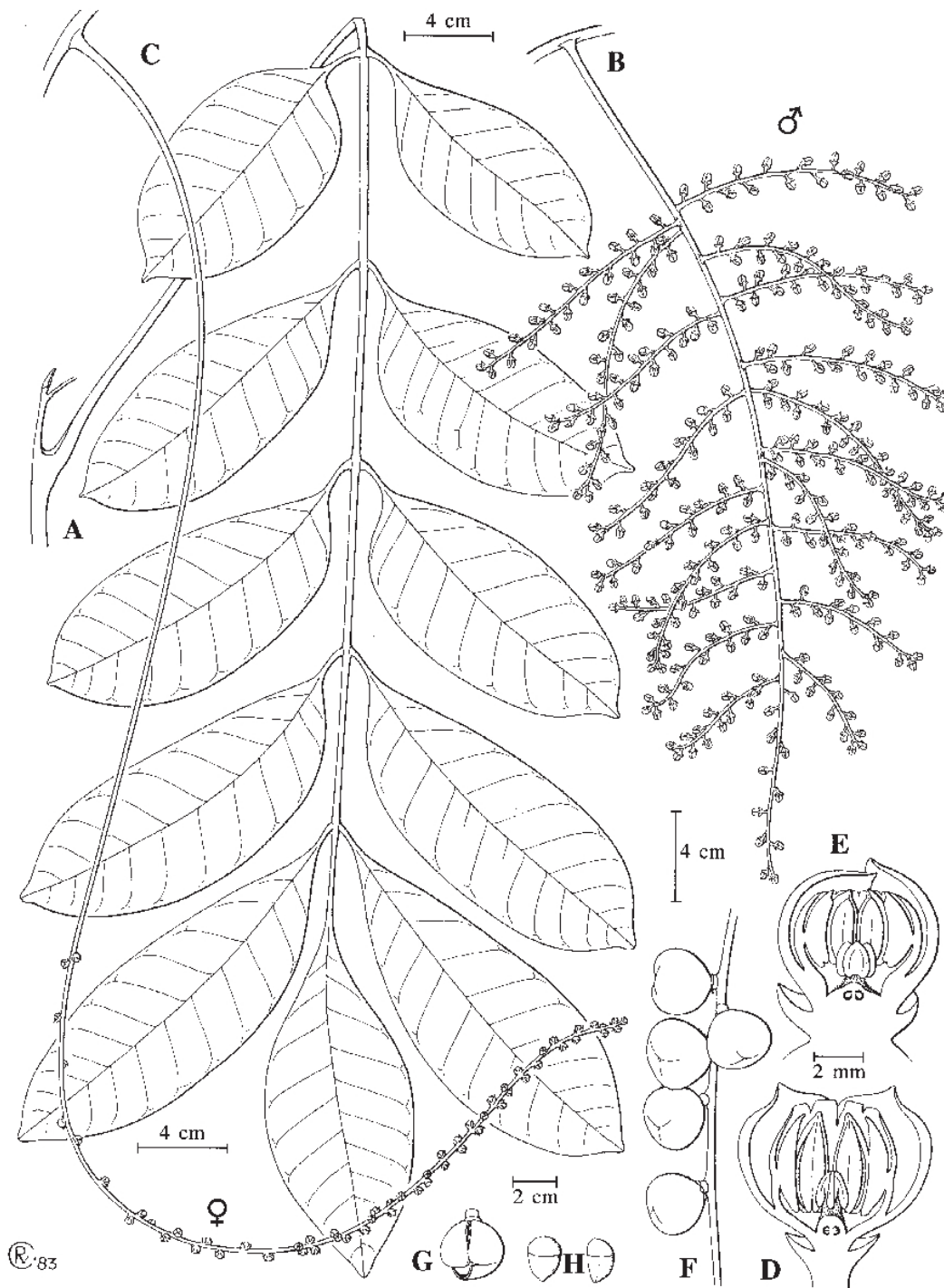


Fig. 11. *Aphanamixis borneensis*. A, leafy apical shoot; B, male inflorescence; C, female inflorescence; D, longitudinal section of male flower; E, longitudinal section of female flower; F, part of infructescence; G, dehiscing fruit; H, seeds. (Reproduced with permission and minor modification from FMI, 12 (1995): Fig. 29, p. 192; A from *Bianchi* 35, B from *SAN* 61233, C from *SAN* 26412, D from *Mabberley* 1706, E from *Clemens* 30483, F–H from *S* 13657.)

Trees or pachycaul treelets. **Twigs** with distinct petiole scars. **Indumentum** of simple (rarely basally bifid and stellate) hairs. **Bud scales** absent. **Leaves** imparipinnate, without pseudogemmula; lateral leaflets 3–10 on each side of rachis, opposite. **Inflorescences** axillary to supra-axillary panicles (males), or spikes, racemes or rarely panicles (females, bisexuals). **Flowers:** males smaller than females or bisexuals; calyx deeply 5-lobed, lobes imbricate; *petals* 3, imbricate, united with staminal tube basally; staminal tube globose to deeply cup-shaped, anthers 6 (or 8), glabrous, inserted within tube; *disc* absent; ovary 3 (or 4)-locular, each locule with (1 or) 2 collateral to superposed ovules; style stout, stylehead conical to truncate, 3-angled or with impressions of anthers. **Fruit** a 2- or 3 (or 4)-valved, loculicidal capsule, each locule with 1 or 2 seeds. **Seeds** arillate; embryo with planoconvex, collaterally(?) united cotyledons; radicle small, superior, included. Germination cryptocotylar; ephylls opposite, simple, toothed.

Distribution. Three very closely related species in Indo-Malesia from Sri Lanka and India to Bhutan, tropical China and Indo-China, throughout Malesia, to the Solomon Islands. In Sabah and Sarawak, two species are recorded.

Notes. All three species were originally referred to *Andersonia* Roxb. or *Amoora* Roxb. (i.e. *Aglaia* Lour.), to which *Aphanamixis* is very closely related. Except for the apparent unity of the cotyledons (a feature not investigated in all *Aglaia* spp. so far), there is no other macroscopic character that separates them absolutely. At the microscopic level, only one *Aglaia* sp. examined has the 4-colporate pollen grains found in *Aphanamixis* and the wood of the latter differs from that of the *Aglaia* species formerly included in *Amoora* in having confluent and banded paratracheal parenchyma.

Key to *Aphanamixis* species

Lateral veins conspicuously looped well clear of margin; petiolules 1.5–3 cm long, the terminal ones to 4.5 cm long..... **1. A. borneensis**
 Lateral veins not so; petiolules 0.4–1 cm long, the terminal ones to 1.5 cm long.....
 **2. A. polystachya**

1. *Aphanamixis borneensis* (Miq.) Harms (from Borneo)

Fig. 11, Plate 5A.

In Engler & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296; Merrill, EB (1921) 321; Masamune *op. cit.* 374; Anderson *op. cit.* (1980) 250; Mabberley *op. cit.* (1985) 138; Whitmore, Tantra & Sutisna *op. cit.* 226; Mabberley *et al. op. cit.* 193; Coode *et al. (eds.) op. cit.* 202; Beaman & Anderson *op. cit.* 126. **Basionym:** *Amoora borneensis* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 36. **Lectotype** (here designated): *Korthals s.n.*, Borneo, Kalimantan, Mt. Prarawin (U; ?isolectotype L [Acc. No. 9081321611]). **Synonyms:** *Aphanamixis sumatrana auct. non* Harms (1896); Merrill, PEB (1929) 123; *Aphanamixis pedicellata* Ridl., Bull. Misc. Inform. Kew (1930) 370, Anderson *op. cit.* (1980) 250; *Walsura punctata* Süss. var. *papillosa* Süss. & Heine, Mitt. Bot. Staats. Münch. 2 (1950) 59; *Ricinocarpodendron borneense* (Miq.) Mabb., Mal. For. 45 (1982) 454.

Tree to 13.5 m tall, to 15 cm diameter. **Bark** reddish; inner bark orangeish-mottled, soft, with watery latex. **Sapwood** orange. **Twigs** 5–10 mm diameter apically, greyish. **Leaves** 30–80 cm long; petioles 15–18 cm long, c. 5 mm diameter, terete, puberulous, flattened to

grooved or hollowed adaxially at base, the groove appressed fulvous-pubescent; leaflets coriaceous (particularly at high altitudes), glabrous; lateral leaflets 3–8 on each side of rachis; blades lanceolate to narrowly elliptical-oblong or oblanceolate, 7–25 × 4–7.5 cm, base acute to attenuate, weakly asymmetrical, margin recurved, apex acute to cuspidate or acuminate, acumen to 15 mm long; midrib prominent below, subprominent above; *lateral veins* 9–12 on each side of midrib, *conspicuously looped well clear of margin*, often prominent below, faint above; intercostal venation reticulate; *petiolules* 1.5–3 cm long, *the terminal ones to 4.5 cm long*, swollen at base. **Inflorescences** to 65 cm long; males with subsquarrose (= somewhat projecting outwards at an angle of *c.* 90°) branches to 15 cm long, strongly supra-axillary; axes puberulous. **Flowers** 5–7 mm diameter; bracteoles scale-like *c.* 0.5 mm; pedicels 0–1 mm long in females, 3–6 mm long in males; calyx lobes 4–5 mm across, subrotund to erose (= irregularly toothed), pubescent outside, pinkish, margin glandular-ciliate; petals 5–7 mm long, subrotund, glabrous, creamy-white or pinkish; staminal tube with small pore, anthers 6, narrowly oblong, *c.* 3 mm long, glabrous. **Fruits** borne towards tip of axis, 3–4 cm diameter, glabrous, pink to dark red, white inside. **Seeds** 1–3, *c.* 18 × 12 mm, planoconvex, covered with vermilion aril; testa dark brown to black.

Distribution. Borneo, the Philippines (Palawan) and Maluku (Halmahera). In Borneo, recorded in Sabah from Beaufort, Keningau, Kinabatangan, Kota Marudu, Lahad Datu, Penampang, Pitas, Ranau, Sandakan, Sipitang, Tambunan and Tawau districts (e.g., *Mabberley 1691*, *Pereira 745*, *SAN 39900*, *SAN 80312* and *SAN 131356*) and in Sarawak from Bau, Belaga, Kapit and Marudi districts (e.g., *S 46907*, *S 48266*, *S 72968* and *S 81303*). Also occurring in Brunei (e.g., *S 5802* and *Johns et al. 7598*) and Kalimantan (e.g., *Veldkamp 8130* and *Veldkamp 8479*).

Ecology. Common small tree of lowland, hill and lower montane forests and heath forest at altitudes to 1800 m.

Notes. It has been confused with *Aphanamixis sumatrana* (Miq.) Ridl. (Sumatra and Peninsular Malaysia) because of similarities in the leaflets, but that species is unique in the flower having only three anthers.

2. *Aphanamixis polystachya* (Wall.) R.N.Parker

(Greek, *poly-* = many, *stachys* = branch; referring to the much-branched male inflorescence)

Ind. For. 57 (1931) 486; Anderson *op. cit.* (1980) 250; Mabberley *op. cit.* (1985) 136, *op. cit.* (1989) 230; Whitmore, Tantra & Sutisna *op. cit.* 227; Mabberley *et al. op. cit.* 188; Turner, Gard. Bull. Sing. 47 (1995) 339; Coode *et al. (eds.) op. cit.* 203; Argent *et al. (eds.) op. cit.* 413. **Basionym:** *Aglaiia ?polystachya* Wall. in Roxb., Fl. Ind. 2 (1824) 429. **Type:** *de Silva in EIC 1277* (holotype K-W; isotypes G-DC, K). **Synonym:** *Ricinocarpodendron polystachyum* (Wall.) Mabb. *op. cit.* (1982) 454; *Aphanamixis rohituka auct. non* (Roxb.) Pierre (1895); Anderson *op. cit.* (1980) 250. (For further synonyms *cf.* Mabberley *et al. op. cit.* 1995.)

Pachycaul treelet or tree to 20(–35) m tall, often flowering when very small; bole to 70 cm diameter, often crooked, sometimes with buttresses to 1(–2) m tall. **Bark** reddish brown, flaking; inner bark pinkish, often with white latex. **Sapwood** white; heartwood pink. **Twigs** 7–22 mm diameter apically, lenticellate, sometimes myrmecophilous, subglabrous to finely fulvous-tomentellous. **Leaves** 45–125 cm long, red when young, glabrous or less often with petiole, rachis and lower surface of leaflets and upper surface of lateral veins more or less brown pubescent, the hairs simple, basally bifid or stellate; petioles 5–15 cm, 6–9 mm

diameter, more or less lenticellate, terete but greatly swollen and flattened or channelled adaxially near base; leaflets subcoriaceous; lateral leaflets (4–)6–10 on each side of rachis; blades oblong to elliptical-oblong, 7.5–25 × 4–9 cm, base rounded to acute or attenuate, usually markedly asymmetrical, margin planar to slightly recurved, apex cuspidate; midrib prominent on both surfaces; *lateral veins* 10–12 on each side of midrib, *spreading*; intercostal venation sometimes subprominent in dry leaflets; *petiolules* 0.4–1 cm long, *the terminal ones to 1.5 cm long*, swollen. **Inflorescences** to 110 cm long in females, to 50 cm long in males and bisexuals, but often very much shorter, more or less supra-axillary; branches to 15 cm long, squarrose; axes more or less puberulous or pubescent. **Flowers** 4–9 mm diameter, sweetly scented; pedicels 0–4(–8) mm long; bracteoles scale-like, *c.* 0.5 mm; calyx lobes 2–3 mm across, subrotund, more or less pubescent outside, reddish margin ciliate; petals 3–5(–7) mm across, subrotund, more or less pubescent outside, glabrous inside, cream to yellow or bronze, sometimes tinged red, waxy; staminal tube cream, anthers (5 or) 6 (or 8), 2.5–4 mm long, elliptical, apiculate, glabrous. **Infructescences** spicate, very rarely paniculate. **Fruits** 2–4 cm diameter, yellowish at first, pink or red at maturity, glabrous; pericarp sometimes with white latex, white inside. **Seeds** 1–3, 1.7–2.2 cm long, planoconvex, hanging by strips of endocarp from fruit, more or less covered with brownish red or orange oily aril; testa dark brown or black.

Distribution. As for genus. In Borneo, known in Sabah from Keningau, Kota Kinabalu, Kota Marudu, Kuala Penyu, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN 39140*, *SAN 39900* and *SAN 142369*) and in Sarawak from Belaga, Kapit, Lundu, Serian and Sri Aman districts (e.g., *Mabberley 1642*, *S 36072*, *S 49253*, *S 65082* and *S 76869*). Also occurs in Brunei (e.g., *Coode et al. 6609*) and Kalimantan (e.g., *Endert 2966*).

Ecology. Lowland and hill forest at altitudes to 1400 m, including seasonally flooded forest and forest on limestone.

Uses. The timber is used in house construction in New Guinea and Thailand and is suitable for furniture. In India, a commercially valuable oil for soapmaking is extracted from the seeds (43.5% by weight) and this, like the bark, has some medicinal value, the latter in a liniment used in the treatment of rheumatism. In Maluku (C Halmahera), the mashed leaves in a water solution are sprayed on fruiting heads of rice against disease and research in China and Bangladesh has shown extracts from twigs, bark, fruits and seeds to be efficacious antifeedants, deterring a range of insect pests.

Notes. This is a polymorphic species across its range but is relatively uniform in Borneo.

3. AZADIRACHTA A.Juss.

(Latinised form of the Persianised Indian name, *azad-dirakht*, for neem, *Azadirachta indica*)

Bull. Sci. Nat. Géol. 23 (1830) 236; Jacobs, Gard. Bull. Sing. 18 (1961) 71; Backer & Bakhuizen *f.*, FJ 2 (1965) 120; Pennington & Styles, Blumea 22 (1975) 464; Anderson, CLTS (1980) 250; Mabberley *in* Mabberley & Pannell, TFM 4 (1989) 231, PB 2nd. ed. (1997) 70; Whitmore, Tantra & Sutisna CLK (1990) 227; Mabberley *et al.*, FM 1, 12 (1995) 337; PROSEA 5, 2 (1995) 72; Coode *et al.* (eds.), CLBD (1996) 203; Argent *et al.* (eds.), MNDR-CK 2 (1997) 413. **Synonym:** *Antelaea auct. non Gaertn.* (1788); Adelbert, Blumea 6 (1948) 315.

Trees. **Indumentum** of simple hairs. **Buds** thinly encrusted with resin; *scales absent*. **Leaves** *paripinnate or imparipinnate* with 2 pairs of glands at base of petioles, *without pseudogemma*; lateral leaflets 4–10 on each side of rachis, opposite or subopposite. **Inflorescences** thyrsoid, axillary. **Flowers** bisexual and male on same individual (polygamous); calyx 5-lobed to halfway, the lobes imbricate; *petals 5*, free, imbricate; staminal tube cylindrical, slightly expanded at mouth, margin (8–)10-lobed, the lobes rounded, truncate, emarginate or bifid, anthers (8–)10, glabrous, inserted at base of and opposite lobes; *disc annular, united with base of ovary*; ovary 3-locular, each locule with 2 collateral ovules, *stylehead with apical swollen torus with 3 acute, partially united papillose stigmatic lobes*. **Fruit** a 1(or 2)-seeded drupe; endocarp thin, cartilaginous. **Seeds** ovoid, distally pointed; testa thin, membranous with small adaxial sarcotesta; endosperm very thin; embryo with planoconvex, collateral cotyledons; radicle superior, short projecting from cotyledons. Germination phanerocotylar; eophylls opposite, trifoliolate, leaflets deeply incised or pinnatifid.

Distribution. Two species native to Indo-Malesia, though one, *A. indica* A.Juss., the *neem*, perhaps native in Myanmar, is widely cultivated in warm countries throughout the world and naturalised in some of them.

Ecology. Lowland forest of various types, *Azadirachta indica* also colonising deforested land.

Notes. Formerly confused with *Melia* L., *Azadirachta* differs in its simple indumentum, pinnate leaves, collateral ovules, 3-lobed stylehead and 1(or 2)-seeded drupes.

Key to *Azadirachta* species

Leaflets with entire margin (native).....**A. excelsa**
 Leaflets with serrate margin (planted).....

A. indica A.Juss.

Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 221; Backer & Bakhuizen *f. op. cit.* 120; Radwanski & Wickens, *Econ. Bot.* 35 (1981) 398; Tewari, *Monogr. Neem* (1992); Mabblerley *et al. op. cit.* 341; PROSEA *op. cit.* (1995) 77. Synonyms: *Melia azadirachta* L., *Sp. Pl.* (1753) 385, Ridley, *FMP* 1 (1922) 384; *M. indica* (A. Juss.) Brandis, *For. Fl. NW & C India* (1874) 67, *nom. illeg.*, Corner, *WTM* 3rd. ed. 2 (1988) 504.

Tree to 16 m tall. Inflorescences to 30 cm long. Fruits 1–2 cm long. Planted (*neem*) and seeding about (as in Kuching) in the Tree Flora area.

Notes. Azadirachtin is absorbed by plants and acts as a systemic insecticide so efficient that Japanese beetles and other insects, even including the desert locust, will starve rather than eat plants treated with it. Of the five limonoids known from the tree, deacetylaxadirachnol (salannin) is as potent as azadirachtin in inhibiting ecdysis in tobacco budworm. Neem seed powder with carbofuran greatly reduces leaf-hoppers and rice tungro virus in rice. The leaves, bark and seed oil have been used in the treatment of a wide range of ailments, including malaria, eczema, dysentery and ulcers, but particularly effective as a parasiticide for skin diseases such as scabies. Neem oil also has significant post-coital contraceptive action.

Azadirachta excelsa (Jack) Jacobs

Fig. 12.

(Latin, *excelsus* = tall)

Gard. Bull. Sing. 18 (1961) 75; Anderson *op. cit.* (1980) 250; Mabberley *op. cit.* (1989) 233; Whitmore, Tantra & Sutisna *op. cit.* 227; Mabberley *et al. op. cit.* 337; PROSEA 5, 2 (1995) 77; Turner, Gard. Bull. Sing. 47 (1995) 339; Coode *et al.* (eds.) *op. cit.* 203; Argent *et al.* (eds.) *op. cit.* 413. **Basionym:** *Melia excelsa* Jack, Mal. Misc. 1, 1 (1820) 12; Corner, Gard. Bull. Str. Sett. 10 (1939) 263, *op. cit.* (1988) 504; Corner & Watanabe, Ill. Guide Trop. Pl. (1969) 404. **Type:** *Jack s.n.*, Peninsular Malaysia, Penang (holotype[†]; isotypes E, K-W [*'178' in EIC 1253b*]). **Synonyms:** *Trichilia excelsa* (Jack) Spreng., Syst. 4, 2 (1827) 252 *excl. syn.* Blume; *Azedarach excelsa* (Jack) Kuntze, Rev. Gen. 1 (1891) 110.

Tree to 50 m tall; bole to 120 cm diameter, regularly cylindrical or rarely slightly buttressed over major roots. **Bark** smooth, pinkish grey or pinkish brown, in large trees becoming longitudinally fissured and scaling, the flakes oblong, greyish, breaking off at upper end and curling up from both ends before shedding, the bole appearing pale brownish or greyish buff and shaggy. **Sapwood** white; heartwood light red. Crown rounded but rather open and uneven, deciduous for up to 3 months a year, the major branches ascending. **Twigs** 8–12 mm diameter apically, the pith pinkish but odourless or weakly onion-scented. Young shoots puberulous, soon glabrous. **Leaves** 20–60(–90) cm long, paripinnate or imparipinnate, tufted at ends of twigs; petioles 5–8 cm long, subterete, swollen at base; lateral leaflets 7–11 on each side of rachis; blades lanceolate-elliptical, 4–12.5 × 2–3.5 cm, the largest near the middle, asymmetrical, subfalcate, glabrous, pink when young, yellow when withering, base unequal, margin entire, apex subacute to subacuminate; lateral veins 6–11 on each side of midrib, arcuate; intercostal venation laxly reticulate; petiolules *c.* 2 mm long. **Inflorescences** 20–45 cm long, erect; axes puberulous, green with 3 or 4 orders of branching, main proximal branches to 8 cm long; bracts *c.* 1 mm long, narrowly triangular. **Flowers** sweetly scented; pedicels 1–3 mm long, articulated with pseudopedicel of same length; calyx *c.* 1 mm diameter, puberulous outside, lobes *c.* 1 mm long, rounded to subacute, pale green, margin ciliolate; petals oblong-spathulate, 5–6.5 × 1.5–2.2 mm, puberulous outside, pale creamy-white; staminal tube 2–2.5 mm diameter, glabrous outside, sparsely hairy distally inside, white or greenish, 10-ribbed, each rib terminating in a sub-bifid lobe, anthers (8–)10, *c.* 0.8 mm long, sessile, slightly exserted. **Fruits** ellipsoid, 2.4–3.2 × 1.3–1.6 cm, glabrous, green turning yellow at maturity; pericarp leathery; mesocarp soft, edible, with some white latex. **Seeds** smelling of garlic when damaged. **Seedlings** with serrate leaflets with long-acuminate tips.

Vernacular names. Sabah—*limpaga* (preferred name), *ranggu* (Dusun). Sarawak—*ranggu* (preferred name), *segera* (Malay; also applicable for a number of species of *Aglaia* and *Chisocheton*).

Distribution. Vietnam (?), Sumatra, Peninsular Malaysia (where also a village tree), Borneo (north and east), the Philippines, Sulawesi, Maluku (Aru) and Irian Jaya (W New Guinea). In Sabah, known from Beaufort, Keningau, Lahad Datu, Labuk Sugut, Ranau, Semporna, Tawau and Tenom districts (e.g., *Mabberley 1670*, *SAN 16843*, *SAN 43024*, *SAN 96653* and *SAN A 148*) and in Sarawak from Miri district (e.g., *S 1412*). Also occurs in Brunei (e.g., *BRUN 3123*) and Kalimantan (e.g., *bb. 23991*).

Ecology. Rain forest at altitudes to 350 m.

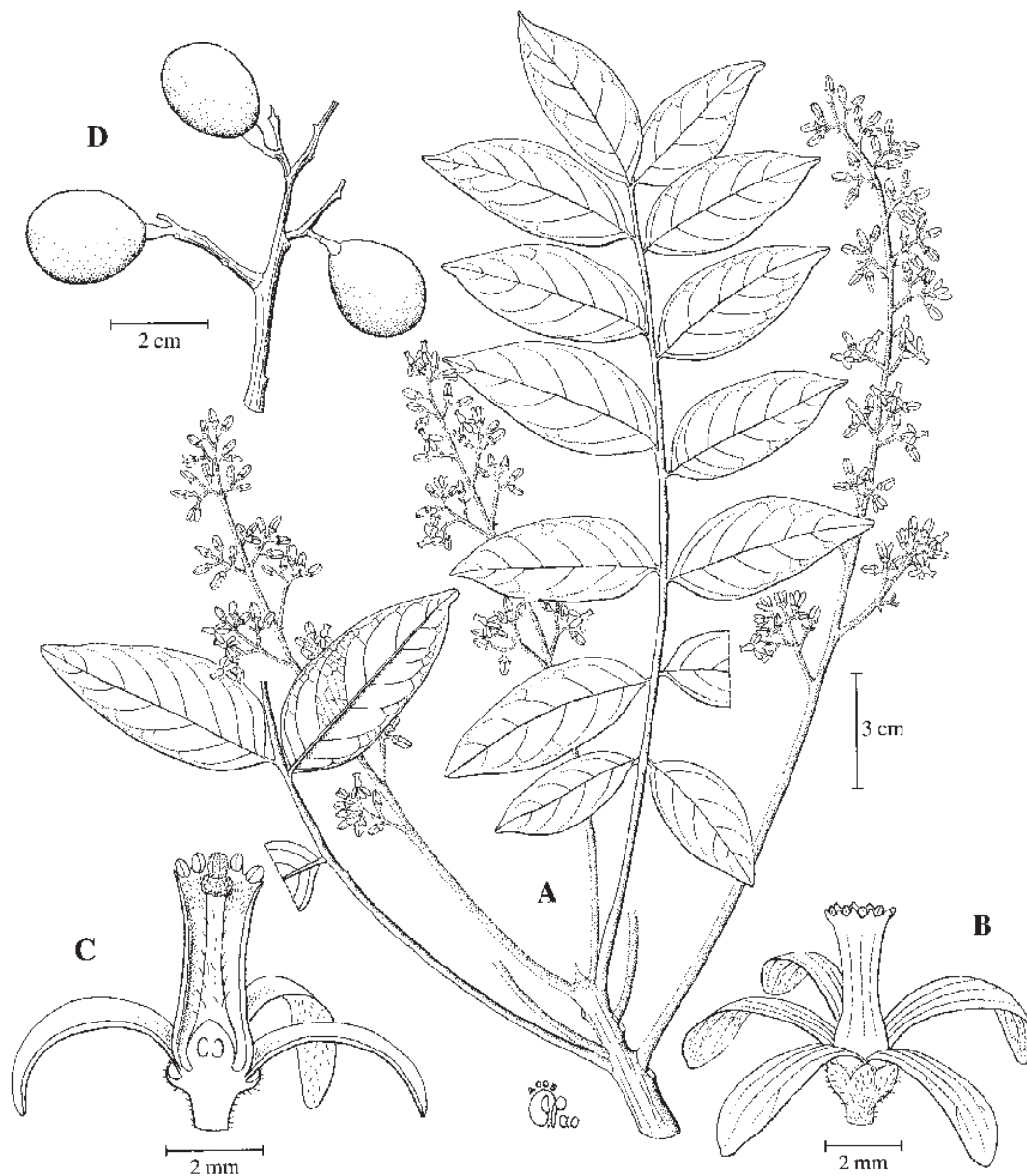


Fig. 12. *Azadirachta excelsa*. A, flowering leafy twig; B, flower; C, longitudinal section of flower; D, part of infructescence. (A from *FD FMS 48757*, B and C from *SAN A 904*, D from *SAN A 790*.)

Uses. The pink-red to brown timber is considered as one of the most attractive furniture timbers of Borneo. Grown in small-scale plantations, its timber is used in house building and also for handles and scabbards for knives, while the young shoots eaten as a vegetable. It coppices. The seeds yield azadirachtin (see *A. indica*) and the more effective insect antifeedant, marrangin.

Notes. At a distance the tree may be confused with *Ailanthus integrifolia* Lam. (Simaroubaceae) but the bark of that tree seems always to be smooth and leaflets wither red and not yellow (Corner *op. cit.* 1988).

4. CHISOCHETON Blume

(Greek, *schizos* = split, *chiton* = tunic; an allusion to the deeply lobed staminal tube of *C. patens*)

segera (preferred name in Sarawak)

Bijdr. Fl. Ned. Ind. 1 (1825) 168; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 550; King, J. As. Soc. Beng. 64, 1 (1895) 24; Merrill, EB (1921) 319, PEB (1929) 122; Ridley, FMP 1 (1922) 386; Masamune, EPB (1942) 374; Backer & Bakhuizen *f.*, FJ 2 (1965) 124; Pennington & Styles, Blumea 22 (1975) 497; Mabberley, Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 301, *in* Mabberley & Pannell, TFM 4 (1989) 233, PB 2nd. ed. (1997) 152, Gard. Bull. Sing. 55 (2003) 189; Anderson, CLTS (1980) 250; Whitmore, Tantra & Sutisna CLK 2, 1 (1990) 227; Mabberley *et al.*, FM 1, 12 (1995) 136; Coode *et al.* (eds.), CLBD (1996) 203; Argent *et al.* (eds.), MNDD-CK 2 (1997) 416; PROSEA 5, 3 (1998) 159; Beaman & Anderson, PMK 5 (2004) 127. **Synonyms:** *Dasycoleum* Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 414; *Megaphyllaea* Hemsl. *in* Hooker, Ic. Pl. 18 (1887) t. 1708; *Clemensia* Merr., Phil. J. Sci. (1908) 143.

Trees, pachycaul to leptocaul, sometimes unbranched, sometimes laticiferous, very rarely foetid, dioecious or polygamous. **Bud scales** *absent*. **Indumentum** *usually of simple*, rarely of 4-armed stellate hairs, sometimes irritant, with small glandular hairs. **Leaves** *pinnate and pseudogemmulate* (gemmulate = terminated in a crozier-like undeveloped leaflet bud) *or imparipinnate, very rarely paripinnate*. **Inflorescences** *thyrsoid or with long peduncles and congested racemes*, axillary to supra-axillary, borne on branches or rarely congested on bole. **Flowers** usually unisexual, rarely bisexual (e.g. *C. koordersii*), sometimes with elongated receptacle (pseudopedicel); calyx more or less cup-shaped, usually obscurely 3–6-lobed; *petals* (3 *or*) 4–6(–14) in 1 (or 2) whorls, free, aestivation imbricate, quincuncial or alternate, often merely at apices, or valvate, rarely weakly united below or with base of staminal tube; staminal tube cylindrical, margin entire, crenate or with 4–10(–30) emarginate, truncate or narrowly lanceolate 2(or 3)-fid lobes, anthers (3 *or*) 4–10(–30), usually attached within the tube, alternating with lobes, usually locellate (= divided into secondary, smaller compartments); disc usually absent, less often stipitate, annulate or discoid, occasionally lobed; ovary 2–8-locular, each locule with 1 or 2 collateral or superposed orthotropous ovules, stylehead clavate or discoid. **Fruits** 2–5(–8)-valved *capsules*, the valves 1(or 2)-seeded. **Seeds** obovoid-spheroid to scutelliform (= platter-shaped) or orange-segment-shaped, variously arillate or sarcotestal, orthotropous, with large chalaza; embryo with collateral, oblique or superposed cotyledons; radicle abaxial or included. Germination cryptocotylar; eophylls spirally arranged, simple, entire.

Distribution. About 53 species from India (Assam) and tropical China throughout Malesia south-eastwards to northern New South Wales and Vanuatu. In Sabah and Sarawak, the genus is represented by 21 species (including 2 incompletely known ones).

Ecology. Rain forest at altitudes to 1500 m, typically understorey trees, occasionally persisting in relict forest edges, rarely colonists of clearings.

Notes. Within the genus, there are species with imparipinnate leaves, paripinnate leaves (some forms of *Chisocheton patens*), but the majority have the leaf terminated by a pseudogemmula, which is a crozier-like bud of undeveloped leaflets, from which leaflets unfold at intervals. Some species are intermediate between the truly pseudogemmate and the imparipinnate in that all the leaflets that will develop are produced in one flush, though the most apical may be tardy in expanding. Such is a common state of affairs in some species of *Dysoxylum*.

Uses. The wood of several *Chisocheton* species is locally used for various types of light construction, e.g., boat-building, interior finishing, furniture and cabinet work, flooring, mouldings, wall-panelling, for making sport-goods, boxes, crates and toys. It has also been utilised for manufacturing rotary veneer, plywood, block-board and particle-board and has been reported as suitable for the production of pulp. The seeds of some species yield an oil which has been used as an illuminant (PROSEA 5, 3 (1998) 159–162).

Key to *Chisocheton* species

1. Inflorescences borne on long-lived bosses on bole.....2
 Inflorescences otherwise.....3
2. Twigs 12–15 mm diameter apically. Petioles 8–20 cm long. Leaflets oblong, base strongly asymmetrical; petiolules *c.* 6 mm long. Inflorescences to 12 cm long. Calyx cup-shaped, margin 4- or 5-lobed. Petals 5 or 6, red towards apex (when fresh). Anthers non-locellate. Fruits to 5 cm diameter.....**15. C. ruber**
 Twigs 5–7 mm diameter apically. Petioles 5–10 cm long. Leaflets ovate or elliptical, base slightly asymmetrical; petiolules (4–)6–12 mm long. Inflorescences to 50 cm long. Calyx campanulate (bell-shaped), margin more or less entire. Petals (3 or) 4 (or 5), pale yellow to white (when fresh). Anthers locellate. Fruits to 7 cm diameter.....**4. C. cumingianus** (subsp. **kinabaluensis**)
3. Calyx (10–)13–20(–23) mm tall.....4
 Calyx shorter.....5
4. Twigs to 5 cm diameter apically. Petioles glabrescent or sparsely hairy. Leaflets more or less puberulous below, base obtuse to subacute. Inflorescences to 220 cm long. Petals 6–10. Anthers 16–30. Stylehead capitate. Fruits bright vermilion-tomentose (when fresh), with deciduous irritant hairs. Seeds arillate.....**9. C. macranthus**
 Twigs to 2.5 cm diameter apically. Petioles more or less fulvous-tomentose. Leaflets densely fulvous-tomentose below, base narrowed into the petiole. Inflorescences to 30 cm long. Petals 9–14. Anthers 15–20. Stylehead discoid to shallowly cylindrical. Fruits golden-brown when fresh, densely hispid (beset with coarse rigid erect hairs). Seeds sarcotestal.....**11. C. medusae**

5. Leaves imparipinnate.....6
 Leaves pseudogemmulate.....8
6. Petals to 16 mm long.....**3. C. crustularii**
 Petals 20 mm or longer.....7
7. Leaves to 100 cm long; petioles to 35 cm long; leaflets more or less densely ferruginous-setose (beset with bristly hairs) on both surfaces, dry setae tinkling when stroked, base rounded to attenuate, symmetrical; lateral veins 17–20 on each side of midrib; petiolules 5–6(–10) mm long. Inflorescences more or less densely setose. Calyx *c.* 3 × 4 mm. Petals more than 32 mm long, glabrous. Margin of staminal tube with 6–8 truncate lobes or irregularly lobed, anthers 6–8, *c.* 2 mm long, scarcely locellate. Fruits densely setose (hairs non-irritant).....**18. C. setosus**
 Leaves to 150 cm long; petioles 1–5 cm long; leaflets glabrous or pubescent on veins above, appressed hirsute below, base cuneate or subcordate, asymmetrical; lateral veins *c.* 15 on each side of midrib; petiolules to 2 mm long. Inflorescences ferruginous-pubescent. Calyx 5–8 × 5–6 mm. Petals 28–32 mm long, densely pubescent outside. Margin of staminal tube with 12–14 linear lobes, anthers 12–14, *c.* 4 mm long, locellate. Fruits beset with reddish irritant hairs..**14. C. polyandrus (in part)**
8. Leaves with stellate hairs.....**7. C. koordersii**
 Leaves with only simple hairs.....9
9. Petals 28–32 mm long. Pachycaul treelet with irritant fruit hairs.....**14. C. polyandrus (in part)**
 Petals smaller. Fruits glabrous or if hairy, the hairs non-irritant.....10
10. One or more petals narrower than and enclosed by the others.....**16. C. sarasinorum**
 Petals more or less of the same width or, at least, none completely enclosed by the others.....11
11. Staminal tube not conspicuously lobed (if unclear follow alternative).....12
 Staminal tube crenate to conspicuously lobed.....13
12. Twigs non-lenticellate, without distinct petiole scars. Leaves to 200 cm long; pseudogemmula not markedly circinate (crozier-like); lateral leaflets to 26 on each side of rachis; blades elliptical to elliptical-oblong, apex abruptly caudate-acuminate with an acumen to 2 cm long; lateral veins 10–14 on each side of midrib, strongly prominent below when dry; petiolules *c.* 6 mm long. Inflorescences to 50 cm long. Anthers somewhat ciliate posteriorly. Ovary 2-locular, stylehead subcapitate. Fruits *c.* 4 cm diameter, densely ferruginous-pubescent. Seeds 2, partly arillate.....
**17. C. sarawakanus**
 Twigs lenticellate, with distinct petiole scars. Leaves to 120 cm long; pseudogemmula markedly circinate; lateral leaflets to 12 on each side of rachis; blades oblong to oblong-ovate, apex abruptly short-acuminate, lateral veins *c.* 22 on each side of midrib, subprominent below; petiolules 8–12 mm long. Inflorescences to 25 cm long. Anthers glabrous. Ovary 5-locular, stylehead shortly cylindrical. Fruits to 9 cm diameter, glabrous. Seeds 4 or 5, non-arillate.....**6. C. granatum**
13. Corolla aestivation imbricate.....14
 Corolla aestivation valvate.....19

14. Ovary 4-locular. Seeds (3 or) 4.....15
 Ovary 2-locular. Seeds 2.....16
15. Twigs 3–7 mm apically. Leaves 20–95 cm long; leaflets elliptical to elliptical-oblong, apex long-caudate; petiolules 2–5 mm long. Calyx 3–4 mm tall, subglabrous to sparsely pubescent. Petals narrowly obovate, 15–25 × 2–3 mm. Anthers scarcely locellate, included. Disc prominent, subtubular, 0.5–1 mm tall. Fruits *c.* 4 cm diameter.....**1. C. amabilis**
 Twigs 12–15 mm diameter apically. Leaves to 130 cm long; leaflets oblong-ovate, apex acute to short-acuminate; petiolules to 9 mm long. Calyx *c.* 2 mm tall, sericeous. Petals linear-spathulate, *c.* 11 × 1.8 mm. Anthers locellate, slightly exerted. Disc obscure. Fruits at least 9 cm diameter.....**10. C. maxilla-pisticis**
16. Disc present.....17
 Disc absent.....18
17. Lateral leaflets to 5 on each side of rachis; blades to 42 × 10.5 cm, apex acuminate, acuminate to 18 mm long; intercostal venation prominent on both surfaces; petiolules 6–11 mm long. Calyx *c.* 1.5 mm tall, margin obscurely 4-lobed. Anthers weakly locellate. Disc annular, thick. Fruits to 7 cm diameter. Seeds *c.* 3 cm diameter....**8. C. lansiifolius**
 Lateral leaflets to 14 on each side of rachis; blades 6–28 × 2.5–10.5 cm, apex short-acuminate, intercostal venation often conspicuous but not prominent; petiolules 3–6 mm long. Calyx 2.5–3 mm tall, margin subentire to minutely, irregularly toothed. Anthers locellate. Disc absent or very short. Fruits to 4.5 cm diameter. Seeds *c.* 0.8 cm diameter.....**12. C. patens** (in part)
18. Leaves to 200 cm long; lateral leaflets to 26 on each side of rachis. Margin of staminal tube crenate, anthers somewhat ciliate posteriorly; style head subcapitate.....**17. C. sarawakanus**
 Leaves to 70 cm long; lateral leaflets to 14 on each side of rachis. Margin of staminal tube with (5 or) 6–8 linear-triangular lobes, anthers glabrous. Style head cylindrical to clavate.....**12. C. patens** (in part)
19. Twigs deciduously tawny-pubescent to subglabrous.....20
 Twigs fawn-pubescent.....21
20. Twigs 4–12 mm diameter apically. Leaves to 150 cm long; petioles 10–15 cm long; lateral leaflets to 17 on each side of rachis. Inflorescences paniculate. Petals 13–19 mm long. Lobes of staminal tube subtruncate. Fruits *c.* 4.5 cm diameter....**2. C. ceramicus**
 Twigs 2.5–6 mm diameter apically. Leaves to 45 cm long; petioles 2–10 cm long; lateral leaflets to 9 on each side of rachis. Inflorescences spicate to thyrsoid. Petals 8–12(–18) mm long. Lobes of staminal tube lacinate (cut into narrow lobes). Fruits to 2.1 cm diameter.....**13. C. pentandrus**
21. Twigs 4–5 mm diameter apically. Leaves to 36 cm long; petioles 5–8 cm long; lateral leaflets to 6 on each side of rachis; blades *c.* 10 × 8 cm, softly and shortly rusty-pubescent below; lateral veins 6–8 on each side of midrib. Inflorescences to 14(–25) cm long. Calyx *c.* 4 mm tall, margin truncate to praemorse (appearing gnawed). Petals narrowly boat-shaped, 9–13 mm long.....**5. C. erythrocarpus**

Twigs 12–25 mm diameter apically. Leaves to 100 cm long; petioles 10–15 cm long; lateral leaflets at least 12 on each side of rachis; blades to 24 × 9 cm, densely velutinous below; lateral veins 15–17 on each side of midrib. Inflorescences to 40 cm long. Calyx *c.* 6 mm tall, margin obscurely 4-lobed or truncate. Petals linear-spathulate, to 16 mm long.....**19. C. velutinus**

1. *Chisocheton amabilis* (Miq.) C.DC.

(Latin, *amabilis* = lovely)

In A.P. de Candolle, Mon. Phan. 1 (1878) 537; Merrill *op. cit.* (1921) 319; Masamune *op. cit.* 374; Mabberley *op. cit.* (1979) 344, *op. cit.* (1989) 234; Whitmore, Tantra & Sutisna *op. cit.* 227; Mabberley *et al. op. cit.* 163; Turner, Gard. Bull. Sing. 47 (1995) 339; Coode *et al.* (eds.) *op. cit.* 203. **Basionym:** *Schizochiton amabile* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 26, 27. **Type:** *Korthals s.n.*, Borneo, Kalimantan, Barito River, 1836 (holotype U; isotype L). **Synonyms:** *Schizochiton amabile* Miq. var. *sumatranum* Miq. *op. cit.* (1868) 28; *Chisocheton illustris* Ridl., Bull. Misc. Inform. Kew (1930) 366; *Chisocheton hackenbergii* Harms, Notizbl. Bot.Gart. Berlin 15 (1941) 476; *Chisocheton brachyanthus auct. non* Merr. (1922); Anderson, Gard. Bull. Sing. 20 (1963) 165, *op. cit.* (1980) 251.

Tree, 6–17 m tall; bole to 10 cm diameter. **Bark** smooth to finely cracked or pustulate, grey-green; inner bark cream. **Sapwood** white. **Twigs** 3–7 mm diameter apically, non-lenticellate, drying reddish. **Leaves** 20–95 cm long, pseudogemmulate, pseudogemma fulvous-tomentose; petioles 5–15 cm long; rachis terete or drying laterally channelled; leaflets coriaceous, shiny above, duller below, glabrous on both sides, or midrib brown-tomentose above and/or venation pubescent below (hairs simple); lateral leaflets (4–)7–20 on each side of rachis, opposite; blades of most proximal leaflets regularly elliptical, 2.2–11.5 × 1.9–4.8 cm, that of most distal leaflets elliptical-oblong, somewhat asymmetrical, 7.5–25.5 × 2.4–8.5 cm, base subequally acute to obtuse, apex long-cuspidate; lateral veins 5–14 on each side of midrib, ascending, subprominent to prominent below; petiolules 2–5 mm long. **Inflorescences** thyrsoid, 8–45 cm long, pendent, fragrant, borne in axils of youngest leaves, thus sometimes appearing terminal, often supra-axillary; axes glabrous to weakly pubescent, 3–5 mm diameter; males 1- or 2-branched with pubescent pedicels articulated on slender branchlets 3–4 mm long arising from first-order branches to 9 cm long; females unbranched, spicate and minutely pedunculate with subsessile flowers condensed into short dense cymules, mostly at distal end of rachis. **Flowers:** calyx cup-shaped, 3–4 mm tall, 4- or 5-lobed, subglabrous to weakly pubescent, green; petals 5 or 6, narrowly obovate, 15–25 × 2–3 mm, white or sometimes also pink at the tips, outside sparsely hairy or glabrous, drying reddish, aestivation imbricate (alternate to quincuncial); staminal tube subglabrous to villous outside, especially at base of lobes, villous inside especially near base, margin 5–7-lobed, the lobes subentire to irregularly 2- or 3-fid, anthers 8–10, *c.* 1.5 mm long, scarcely locellate, long-pubescent outside, included within lobes; disc prominent, 0.5–1 mm tall, subtubular, thick; ovary 4-locular, style pubescent, particularly in proximal half, stylehead subcylindrical to spherical. **Infructescences** borne on leafy twigs to 8 mm diameter. **Fruits** spherical, *c.* 4 cm diameter, long-stipitate, glabrous, pink ripening to bright rose-red, clustered in groups of 3–10 at end of rachis; stipe 1.7–2.2 cm long; valves 3 or 4. **Seeds** (3 or) 4, *c.* 9 mm long with chestnut-brown testa half covered in circumhilar yellow-orange aril.

Vernacular name. Sarawak—*buah pesak kanan* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known in Sarawak from Daro, Miri, Mukah, Sarikei and Sibul districts (e.g., *S 4161*, *S 8087*, *S 9269*, *S 12947* and *S 25565*), in Brunei (e.g., *BRUN 15641*, *KEP 32552* and *SAN 17454*) and in Kalimantan (e.g., *Kostermans 8026*). Not yet recorded from Sabah.

Ecology. Peatswamp forest and riparian forest at 0–20 m altitude. According to Corner (Gard. Bull. Sing. Suppl. 1 (1978) 30) it flowers gregariously in April–May at Sg. Sedili, Johore, Peninsular Malaysia, where it is restricted to the *mempisang* (*Polyalthia sclerophylla* Hook.f. & Thoms.) belt.

Notes. Specimens with inflorescences borne on reduced axillary branches are known from Sarawak and Kalimantan.

2. *Chisocheton ceramicus* (Miq.) C.DC.

(from Ceram (Seram), Maluku)

In A.P. de Candolle, Mon. Phan. 1 (1878) 533; Mabblerley *op. cit.* (1979) 361, *op. cit.* (1989) 234; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabblerley *et al. op. cit.* 179; Turner *op. cit.* 339; Coode *et al.* (eds.) *op. cit.* 203; Argent *et al.* (eds.) *op. cit.* 416; PROSEA 5, 3 (1998) 161; Beaman & Anderson *op. cit.* 127. **Basionym:** *Schizochiton ceramicum* Miq. *op. cit.* (1868) 27, 29. **Type:** *Teijsmann [& de Vriese] s.n [HB 5027]*, Maluku, Seram (holotype U [Acc. No. 0004298]). **Synonyms:** *Schizochiton spectabile* Miq. *op. cit.* (1868) 27, 29; *Chisocheton spectabilis* (Miq.) C.DC. *op. cit.* (1878) 539, Merrill *op. cit.* (1921) 320; *Chisocheton clementis* Merr., Philip. J. Sc. 3 (1908) 145; *Chisocheton rhytidocalyx* Airy Shaw, Bull. Misc. Inform. Kew (1940) 256. (For full synonymy *cf.* Mabblerley *op. cit.* 1979.)

Tree to 30 m tall; bole to 40 cm diameter; buttresses to 3 m tall, 2 m out. **Bark** dippled, lenticellate, dark brown, tardily white-laticiferous; inner bark dark red-brown. **Sapwood** yellow. **Twigs** *subglabrous*, with conspicuous petiole scars, 4–12 mm diameter apically. **Leaves** to 150 cm long, *pseudogemmate*; petioles 10–15 cm long; rachis 2.5–6(–11) mm diameter, terete to angled; leaflets reddish when expanding, inconspicuously appressed hairy (*hairs simple*) notably on veins below; lateral leaflets to 17 on each side of rachis, opposite; blades ovate to oblong, (4–)10–38 × (2.7–)5.5–14.5 cm, base acute to rounded, apex acuminate; midrib sunken above; lateral veins 10–15 on each side of midrib; petiolules (3–)6–13 mm long. **Inflorescences** *paniculate*, axillary or supra-axillary, to 65 cm long, branched to 2nd or 3rd orders; branches to 45 cm long, more or less ascendant. **Flowers** fragrant; pedicels short, pseudopedicels 2.5–3.5 mm long; calyx shallowly cup-shaped to cylindrical, 2–5.5 mm tall, sometimes thickened annularly, margin truncate to obscurely 5-lobed; petals (4 or) 5 (or) 6, 13–19 × 2–3 mm, pinkish, aestivation valvate; staminal tube sericeous except at both ends, occasionally subglabrous outside, margin (4 or)5(–8)-lobed, the lobes to 4 mm long, more or less truncate, anthers (4 or) 5 or 6 (–9), 2.8–3.8 mm long, locellate; ovary 2- or 3-locular, style densely pubescent except at apex, stylehead shortly cylindrical. **Infructescences** to 45 cm long, pendent. **Fruits** *subglobose*, to 3.2 × 4.5 cm, velutinous (*hairs non-irritant*), fleshy, orange-red; stipe to 1.5 cm long; pericarp thick, spongy, with 2 strong and 2 faint sutures; latex white to colourless. **Seeds** 1 or 2, shining pale orange; sarcotesta with 1.5 mm hole near micropyle.

Vernacular names. Sabah—*bekak* (Malay), *kalantopak* or *lantupak* (Dusun). Sarawak—*bekak* (Malay), *segera* (Iban).

Distribution. Vietnam, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Maluku, New Guinea and New Britain. In Borneo, known in Sabah from Beaufort, Kinabatangan, Kota Belud, Kota Marudu, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN 30677*, *SAN 32026*, *SAN 62166*, *SAN 94712* and *SAN 106067*) and in Sarawak from Bintulu, Kapit, Kuching, Limbang, Lubok Antu, Marudi, Miri and Sri Aman districts (e.g., *Mabberley 1624*, *S 28269*, *S 38388*, *S 40144*, *S 60007* and *S 68179*). Also occurring in Brunei (e.g., *BRUN 5221*) and Kalimantan (e.g., *Kostermans 10588 A*).

Ecology. In forests and as a relic in forest edges, at 0–700(–1100) altitude.

3. *Chisocheton crustularii* Mabb.

(Latin, *crustularius* = a pastry maker; an allusion to the tart-shaped disc)

Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 327; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 146. **Type:** *Ilias S 22921*, Borneo, Sarawak, Marudi district, Tinjar, Ulu Sg. Dapoi (holotype K; isotypes FHO, SAR).

Tree to 8 m tall; bole to 8 cm diameter, sometimes with small rounded buttresses. **Bark** greyish, narrowly fissured. **Twigs** *c.* 1.5 cm diameter apically. **Leaves** to 135 cm long, *imparipinnate*; rachis terete, subglabrous; leaflets glabrous above, sparsely strigose, especially on the venation below; lateral leaflets up to 10 on each side of rachis, opposite; blades to 38 × 10 cm distally, to 1.8 × 1 cm and pseudostipulate proximally, that of the terminal ones narrowly elliptical or oblong, *c.* 45 × 13.5 cm, base shortly attenuate to subtruncate, apex acuminate; lateral veins *c.* 24 on each side of midrib, prominent below; intercostal venation conspicuous, subscalariform; petiolules 0–16 mm long, swollen. **Inflorescences** (only males known) 38(–150) cm long, *axillary*, pendent, slender; axes 2–3 mm diameter, sericeous, the flowers in fascicles in the distal half. **Flowers:** pedicels 2–4.5 mm long, recurved, hispid; *calyx* cup-shaped, *c.* 3 × 5.5 mm, pubescent outside, margin entire to weakly crenate; *petals* 5, *narrowly oblong*, *c.* 16 × 4.5 mm, white, appressed pilose outside, glabrous inside; staminal tube *c.* 14.5 mm tall, subglabrous save for broad band of appressed hairs apically outside, margin with 11 irregularly bifid lobes *c.* 3.5 mm long, anthers 11, *c.* 2 mm long, included, hardly locellate; disc *c.* 0.5 mm tall, margin with recurved lobes; style filiform with a tuft of long hairs at its base, stylehead spherical, *c.* 1 mm diameter. **Fruits** unknown.

Distribution. Endemic in Borneo and known from only two collections from Tinjar, Marudi district, in northern Sarawak (*S 22921* and *S 23329*).

Ecology. Presumably rain forest.

Notes. Very close to *Chisocheton setosus* but differs in its subglabrous twigs, leaf rachis and leaflets (vs. densely ferruginous-setose); narrowly oblong less than 16 mm long petals (vs. subspathulate petals more than 20 mm long) and shorter staminal tube to 14.5 mm long (vs. to 32 mm long) with 11 irregularly bifid lobes (vs. with 6–8 truncate lobes).

4. *Chisocheton cumingianus* (C.DC.) Harms

(Hugh Cuming (1791–1865), English traveller, naturalist and plant collector)

In Engler & Prantl, Pflanzenfam. 3, 4 (1896) 296; Mabberley, Taxon 26 (1977) 528, *op. cit.* (1979) 347; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 164; PROSEA 5, 3 (1998) 161; Beaman & Anderson *op. cit.* 127. **Basionym:** *Dasycoleum cumingianum* C.DC. *op. cit.* (1878) 541. **Type:** *Cuming 842*, the Philippines, Luzon, Albay (holotype G; isotypes A, BM, K, L, LE). **Synonym:** *Chisocheon kinabaluensis* Merr., J. Str. Br. Roy. As. Soc. 86 (1922) 316, Masamune *op. cit.* 374.

Distribution. Continental Asia from India (Assam) and tropical China through Indo-China to the Philippines, Borneo, Sulawesi, Maluku, New Guinea and Bismarck Archipelago.

Ecology. Rain forest at altitudes to 1300 m.

Notes. Three subspecies are recognized: subsp. *cumingianus* (Philippines to New Ireland) with inflorescences borne on short shoots, supra-axillary or on twigs, rarely supra-axillary and simple; subsp. *kinabaluensis* with inflorescences borne on bole and subsp. *balansae* (C.DC.) Mabb. (Asian mainland) usually with rather pubescent leaves and axillary or supra-axillary thyrses. Of these, only subsp. *kinabaluensis* occurs in Borneo (Sabah only).

subsp. **kinabaluensis** (Merr.) Mabb.
(from Mt. Kinabalu)

Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 349; Mabberley *et al. op. cit.* 166. **Basionym:** *Chisocheon kinabaluensis* Merr. *op. cit.* (1922) 316, Beaman & Anderson *op. cit.* 127. **Type:** *Clemens 10116*, Borneo, Sabah, Mt Kinabalu, Minitindok Gorge (holotype PNH†; isotype A).

Tree to 37 m tall; bole to 14 m tall, to 50 cm diameter; buttresses to 3 m tall, 2 m out of bole fluted to 10 m tall. **Bark** scaly, pale grey-brown; inner bark chestnut-brown. **Sapwood** straw. Larger branches with conspicuous petiole scars. **Twigs** 5–7 mm diameter apically, dark brownish black, smooth but conspicuously lenticellate, sometimes with white latex. Innovations more or less rusty-pubescent. **Leaves** to 120 cm long, *pseudogemmate*, crowded in dense terminal spirals; *petioles* 5–10 cm long, 2.5–5 mm diameter, terete or weakly flattened adaxially; leaflets papery to coriaceous, drying red-brown, glabrescent or hispid-pubescent on the lateral veins above or, exceptionally, softly velutinous, *hairs simple*; lateral leaflets to 15 on each side of rachis, opposite or subopposite (proximally); *blades ovate to elliptical*, (6–)10–42 × (2–)5–14 cm, *base slightly asymmetrical*, acute, apex shortly cuspidate; lateral veins 10–15 on each side of midrib, ascending, arcuate, more or less prominent below; intercostal venation subprominent; *petiolules* (4–)6–12 mm long, glabrescent to tawny-tomentose. **Inflorescences** to 50 cm long, borne on short shoots (with 3–8 thyrses per shoot) on bole, 2- or 3-branched; branches to 10 cm long, more or less pubescent. **Flowers:** pedicels to 3(–4) mm long; bracteoles linear, *c.* 2 mm long; pseudopedicels to 1 mm long; *calyx campanulate* (= bell-shaped), 1–3 mm tall, puberulous outside, *margin more or less entire*; *petals* (3 or) 4 (or 5), spatulate, 12–20(–25) × 2.5 mm, acute, *pale yellow to white*, drying reddish; staminal tube *c.* 1 mm diameter, more or less glabrous outside, more or less pubescent inside from just below anthers to base, margin 6–9-lobed, lobes to 2.5 mm long, entire to 2- or 3-fid, *anthers* 6–9, elliptical-oblong, 1.5–2.2 mm long, *locellate*, glabrous to villous; disc annular, to 0.5 mm tall, glabrous; ovary in female (? and bisexual) flowers 3- or 4-locular, each locule with 1 (or 2) ovule(s), style pubescent in proximal 3/4, stylehead disciform to capitate. **Infructescences** to 30 cm long, pendent. **Fruits** globose to pyriform (= pear-shaped), to 7 cm diameter, occasionally weakly rostrate, orange-red, *glabrous to velutinous (hairs non-irritant)*; stipe to 1.5 cm long; pericarp usually with white latex. **Seeds** 3 or 4; testa blackish brown; aril circumhilar, margin crenate, sometimes with extension to micropyle, orange-red.

Distribution. Endemic in Sabah and known from Keningau, Labuk Sugut and Ranau districts (e.g., *Pennington 7946*, *RSNB 2693A*, *RSNB 2827*, *SAN 74460* and *SAN 94514*).

Notes. The inflorescences are always borne on the bole, often very close to the ground indeed. It is noteworthy that, contrary to general expectation, it is the high altitude taxon which is the truly cauliflorous one in this species.

5. *Chisocheton erythrocarpus* Hiern

Plates 5B & C.

(Greek, *erythros* = red, *karpus* = fruit; red-fruited)

In Hooker *f.*, Fl. Br. Ind. 1 (1875) 550; King *op. cit.* 31; Ridley *op. cit.* (1922) 388; Mabberley *op. cit.* (1979) 368, *op. cit.* (1989) 235; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 183; Turner *op. cit.* 339; Coode *et al. (eds.) op. cit.* 203; PROSEA 5, 3 (1998) 161. **Type:** Maingay '322', Peninsular Malaysia, Malacca (holotype K). **Synonym:** *Chisocheton* sp. C, Mabberley *op. cit.* (1979) 372.

Tree to 25(–40) m tall; bole to 25(–40) cm diameter; buttresses to 1 m tall and out, 10 cm thick. **Bark** smooth to cracking, dark grey to chocolate-brown; inner bark reddish brown. **Sapwood** cream. Crown small. **Twigs** rough, dark brown, 4–5 mm diameter apically, densely and minutely rusty-tomentose. **Leaves** to 36 cm long, pseudogemmate; petioles 5–8 cm long; leaflets chartaceous, glabrous above save for the puberulous midrib, softly and shortly rusty-pubescent (hairs simple) below; lateral leaflets to 6 on each side of rachis, opposite; blades elliptical-oblong to broadly ovate, c. 10 × 8 cm, base somewhat asymmetrical, cuneate or rounded, apex shortly, abruptly and bluntly acuminate; lateral veins 6–8 on each side of midrib, somewhat arcuate; petiolules to 1 cm long. **Inflorescences** to 14(–25) cm long, supra-axillary in upper axils, minutely rusty-tomentose; lateral branches short, squarrose, cymose. **Flowers:** pedicels short; calyx cylindrical, c. 4 mm tall, densely tomentose outside, glabrous inside, margin truncate to praemorse (= appearing gnawed); petals 5 or 6, narrowly boat-shaped, 9–13 × 3–3.5 mm, creamy-white, aestivation valvate, separating when dry, fleshy, appressed sericeous outside, glabrous inside; staminal tube, sericeous outside except at base and on lobes, pubescent similarly inside, 5- or 6-lobed, lobes toothed, c. 2.5 mm long, anthers c. 3 mm long, locellate, subsessile, basifixed at notches between lobes; ovary minutely pubescent save for a narrow band below stylehead, stylehead cylindrical, apically mamillate, glabrous. **Fruits** globose, peach-like, to 6 cm diameter, minutely beaked, minutely tomentose (hairs non-irritant), yellow when immature, blood-red when ripe; pericarp with white latex. **Seeds** 2, c. 2.5 cm long, somewhat flattened; sarcotesta thick, orange-red.

Vernacular name. Sabah—*lantupak* (Dusun). Sarawak—*segera* (Iban).

Distribution. Peninsular Malaysia, Borneo and the Philippines. In Borneo, recorded in Sabah from Beaufort, Kinabatangan, Kota Kinabalu, Kudat, Lahad Datu, Labuk Sugut, Papar, Ranau, Sandakan and Tenom districts (e.g., *SAN 41320*, *SAN 60109*, *SAN 67234*, *SAN 126959* and *SAN 139247*) and in Sarawak from Lundu and Miri districts (e.g., *S 47122* and *S 76724*). Also occurring in Brunei (e.g., *BRUN 5033* and *Dransfield JD 7259*) and Kalimantan (e.g., *Burley et al. 829*).

Ecology. Predominantly in forest near the coast.

6. *Chisocheton granatum* Mabb.

(Latin, pomegranate (*Punica granatum* L., Lythraceae [Punicaceae]); alluding to the fruit-shape similar to that of *Xylocarpus granatum*)

Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 354; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 170; Beaman & Anderson *op. cit.* 127. **Type:** *Clemens 27299*, Borneo, Sabah, Mt. Kinabalu, Dallas (holotype K; isotypes A, B, BM, G, L).

Tree to 15 m tall; bole to 8 m tall, to 17 cm diameter. **Bark** smooth, pale; inner bark pale yellow. **Sapwood** pale yellow. **Twigs** with distinct petiole scars, lenticellate, c. 6 mm diameter apically. **Leaves** to 120 cm long, pseudogemmulate, pseudogemmula markedly circinate, in lax terminal spirals, more or less pubescent (hairs simple); petioles 5–10 cm long; lateral leaflets to 12 on each side of rachis, opposite; blades oblong to oblong-ovate, to 24 × 7.5 cm, drying pale below, base cuneate, somewhat asymmetrical, apex abruptly short-acuminate; lateral veins c. 22 on each side of midrib, weakly arcuate, almost reaching margin, drying subprominent below; petiolules 8–12 mm long. **Inflorescences** to 25 cm long, supra-axillary, often borne in axils of unexpanded leaves; branches to 6 cm long or short-stalked cymules (females). **Flowers:** calyx campanulate, 2.5–3 mm tall, pubescent, margin truncate; petals 4, linear-spathulate, 12–16 × 3.5 mm, creamy-white, pubescent outside, aestivation imbricate, forming a clavate corolla in males; staminal tube pubescent in distal half outside, glabrous inside, inflated near anthers, margin obscurely crenate or truncate, anthers 6, oblong, to 1.5 mm long, locellate, glabrous; ovary 5-locular, style pilose in proximal 3/4, stylehead shortly cylindrical, glabrous, apically lobed. **Fruits** depressed globose, to 9 cm diameter; valves 5, glabrous, tough, red-brown outside, white inside, without latex. **Seeds** 4 or 5, c. 3 cm long, when 4 scutiform (= shield-shaped), when 5 like orange-segments, non-arillate.

Distribution. Endemic in Borneo, known only in Sabah from Keningau, Kinabatangan, Pensiangan, Ranau, Tawau and Tenom districts (e.g., *Pennington 7941*, *SAN 88971*, *SAN 91868*, *SAN 109155*, *SAN 112998*, *SAN 118790* and *SAN 136989*) and in Kalimantan (e.g., *Leighton 1057B*).

Ecology. In hill forest at altitudes (?300–)900–1500 m.

7. *Chisocheton koordersii* Mabb.

(Sijfer Hendrik Koorders, 1863–1919, Dutch Forest Officer, prolific collector and botanical author, based in Java)

Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 368; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 184; PROSEA 5, 3 (1998) 161. **Lectotype** (designated here): *Koorders 17978β*, Sulawesi, Minahasa, Manado (L; isolectotype BO, n.v.). **Synonyms:** *Chisocheton kingii auct. non* Harms (1896); *Koorders*, Minah. (1898) 385, 636, Fl. N.O. Celebes, Supl. 2 (1922) t. 43.

Tree to 30 m tall; bole to 14 m tall, to 60 cm diameter; buttresses to 1.5 m tall. **Bark** rather rough, finely fissured, brown, c. 0.5 mm thick; inner bark c. 5 mm thick, yellow to whitish. **Sapwood** white. **Twigs** (6–)8–12 mm diameter apically; pith wide, sometimes housing ants. *Young twigs, petioles, rachises, pseudogemmulae and leaflets (especially the veins) minutely stellate pubescent (hairs 4-armed).* **Leaves** to at least 35 cm long,

pseudogemmulate; petioles to 18 cm long, terete; lateral leaflets at least 7 on each side of rachis, opposite; blades elliptical to suboblong, to 25(–35) × 10 cm, base rounded, symmetrical, apex acuminate; lateral veins to 17 on each side of midrib; petiolules 5–9 mm long. **Inflorescences** to 45 cm long, *axillary*, thyrsoid, branched to third order; major proximal branches to 18 cm long. **Flowers** apparently bisexual and non-bracteate, sessile, with short pseudopedicels, scented; *calyx* tubular-urceolate, 3.5–4 × 2.5–3 mm, minutely stellate-pubescent outside, glabrous inside, margin obscurely lobed, almost praemorse; petals 5 or 6, narrowly spatulate, 11–12 mm long, white, densely and minutely stellate-pubescent outside, glabrous inside, aestivation valvate, connate in the most proximal 1/4 to 1/3; staminal tube long simple-villous outside in band below lobes, glabrous inside save for a band of small ascendant simple hairs just below anthers, margin 5- or 6-lobed, lobes *c.* 2.5 mm long, more or less bifid, glabrous, anthers 5 or 6, 2–2.5 mm long, minutely apiculate, non-locellate, glabrous, sessile, basifixed in angle or lobes; disc cup-shaped, *c.* 1.5 mm tall, adnate to ovary, glabrous; ovary *c.* 2.5 mm long, minutely pubescent, style minutely pubescent in proximal 1/3 to 1/2, stylehead capitate. **Fruits** spherical, to 5 cm diameter, shortly stipitate, reddish tomentellous, 2-valved. **Seeds** 2, *c.* 3.5 cm diameter, scutellar (= platter-shaped), sarcotestal.

Distribution. Borneo and Sulawesi. In Borneo, known only in Sabah from Keningau and Tambunan districts (e.g., *SAN 44563* and *SAN 113582*) and in Kalimantan (e.g., *Kostermans 5592*).

Ecology. In rain forest at 10–600 m altitude.

8. *Chisocheton lansiifolius* Mabb.

Fig. 13, Plate 5D.

(Latin, *Lansium* (= *langsai*), *folium* = leaf; an allusion to the leaves resembling those of *Lansium domesticum*)

Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 352; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 169; Coode *et al.* (eds.) *op. cit.* 203; Beaman & Anderson *op. cit.* 128. **Type:** *Ashton S 12141*, Borneo, Sarawak, Kapit district, Balleh, Ulu Mujong, Nanga Temiai (holotype K; isotypes A, FHO, KEP, L, SAN, SAR, SING).

Tree to 30 m tall; bole to 15 m tall, 25 cm diameter, sometimes fluted; buttresses (if present) to 2 m tall, *c.* 5 cm wide, concave. **Bark** smooth, dark brown; inner bark yellow. **Sapwood** pale brown. **Twigs** *c.* 8 mm diameter apically, dark brown, lenticellate, with distinct petiole scars. **Leaves** to 54 cm long, *paripinnate*, *pseudogemmulate*; petioles 8–15 cm long; leaflets coriaceous, subglabrous (*hairs simple*); *lateral leaflets to 5 on each side of rachis*, opposite; *blades* oblong-elliptical or oblong-ovate, to 42 × 10.5 cm, base acute to obtuse, *apex acuminate*, *acumen to 18 mm long*; lateral veins *c.* 14 on each side of midrib, arcuate; *intercostal venation drying prominent on both surfaces*; *petiolules 6–11 mm long*, drying blackish. **Inflorescences** to 65 cm long, paniculate, *axillary or extra-axillary*; proximal branches to 18 cm long, squarrose, branched, with the branches passing interceptibly, like the major branches on the main axis, into cymose fascicles of 1–6 flowers. **Flowers:** *calyx* cup-shaped, *c.* 1.5 mm tall, rugose, *margin obscurely 4-lobed*; *petals 4, 8–9 × 1.5 mm*, weakly pubescent outside, glabrous inside, creamy-white to pinkish, *aestivation imbricate*; *staminal tube* glabrous outside, cottony pubescent inside, *margin 6-lobed*, the lobes entire, lanceolate, *c.* 2 mm long, *anthers 6, c.* 2.5 mm long, glabrous, *weakly locellate*; *disc annular, thick*; *ovary 2-locular*, style terete, pilose in proximal 3/4, stylehead subcylindrical. **Infructescences** to 85 cm long; axis *c.* 8 mm diameter; branches bearing 1

or 2 fruits. **Fruits** subspherical, to 7 cm diameter, stipitate, red; valves 4. **Seeds** 2, scutiform, c. 3 cm diameter.

Distribution. Endemic in Borneo. In Sabah, known from Keningau, Kinabatangan, Kota Belud, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., SAN 26978, SAN 30737, SAN 34971, SAN 87939 and SAN 134172) and in Sarawak from Limbang and Marudi districts (e.g., S 34950, S 34984 and S 42378). Also occurring in Brunei (e.g., Coode 6805) and Kalimantan (e.g., Balgooy 5501, Endert 5127, Kostermans 5490 and Kostermans 13249).

Ecology. In rain forests including peatswamp forest at altitudes to 1050 m.

9. *Chisocheton macranthus* (Merr.) Airy Shaw

(Greek, *makro* = large, *anthos* = flower; large-flowered)

In Hooker, Ic. Pl. 34 (1937) t. 3333; Mabblerley *op. cit.* (1979) 320; Anderson *op. cit.* (1980) 251; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabblerley *et al. op. cit.* 141; Coode *et al. (eds.) op. cit.* 203; Beaman & Anderson *op. cit.* 128. **Basionym:** *Clemensia macrantha* Merr., Phil. J. Sci. Bot. 3 (1908) 144, *op. cit.* (1921) 321, *op. cit.* (1923) 371, *op. cit.* (1929) 122, Masamune *op. cit.* 375. **Syntypes:** *Clemens* 725 and *Clemens s.n.*, the Philippines, Mindanao, Lake Lanao, Camp Keithley (syntypes PNH†; probable isosyntype [see Mabblerley *op. cit.* (1979) 320] G). **Synonym:** *Chisocheton medusae* auct. non Airy Shaw (1937): Heine, Mitt. Bot. Staat. Münch. 6 (1953) 233.

Tree to 13(–20) m tall; bole to 22(–30) cm diameter, buttressed; branching fastigiate, often with several limbs from near base. **Bark** smooth; inner bark pale yellow. **Twigs** to 5 cm diameter apically, blackish, with large scutellar petiole scars. **Leaves** to 220 cm long, pseudogemmate, crowded in dense terminal spirals; petioles 5–20 cm long, woody, dark coloured, glabrescent to sparsely hairy; leaflets weakly bullate, glabrous above, more or less puberulous below; lateral leaflets to 19 on each side of rachis, opposite, sometimes more or less alternate at base of rachis; blades oblong-lanceolate or ovate when smaller, 20–45(–55) × (5–)8–12(–15) cm, base obtuse to subacute, apex acute to acuminate; lateral veins 15–24 on each side of midrib; intercostal venation scalariform; petiolules to 8 mm long. **Inflorescences** to 220 cm long, axillary or extra-axillary, pendent; axes terete to weakly angled, weakly branched; branches crowded towards apex, pilose, with up to 12 flowers each; bracts c. 6 mm long, pubescent, caducous. **Flowers:** pedicels c. 10 mm long, articulated with pseudopedicels; calyx cup-shaped to cylindrical, 14–20 mm tall, pubescent, red-brown, margin truncate to irregularly 3- or 4-lobed; petals 6–10, 30–45 × 4–7(–12) mm, creamy-pink; staminal tube 25–40 × 6–7 mm, creamy-white, glabrous outside except on lobes, pilose inside at base, margin entire or with lobes 4–6 mm long, anthers 16–30, c. 5 mm long, rather recurved, connective somewhat pubescent; disc flattened to weakly annular, glabrous; ovary c. 5 mm diameter, 5- or 6-locular, pilose, style pilose in proximal half or glabrous, stylehead capitate, c. 2 mm diameter. **Infructescences** borne in axils of last flush of leaves; axis to 3 m long with terminal bunches of up to 60 fruits. **Fruits** to 12 cm diameter, recurved, rostrate when immature, when fresh, bright vermilion-tomentose with irritant deciduous hairs. **Seeds** 2.5–3.3 cm long, triangular in cross-section; aril reddish, covering inner edges of black testa.



Fig. 13. *Chisocheton lansiifolius*. A, flowering leafy twig; B, male flower; C, longitudinal section of male flower; D, fruit. (A–C from SAN 79773, D from SAN 34971.)

Distribution. Borneo and the Philippines. In Sabah, known from Beaufort, Keningau, Kinabatangan, Kota Marudu, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *Clemens 10431*, *Pereira et al. 204*, *SAN 28119*, *SAN 66051* and *SAN 79842*) and in Sarawak from Belaga, Bintulu, Kapit, Marudi, Miri and Tatau districts (e.g., *S 17706*, *S 39918*, *S 45331* and *S 65084*). Also occurring in Brunei (e.g., *Johns 7145*) and Kalimantan (e.g., *Endert 2591* and *Hallier 1938*).

Ecology. Lowland rain forest, including that on limestone, at altitudes to 400 m.

10. *Chisocheton maxilla-pisticis* Mabb. Fig. 14.
(Latin, *maxilla* = jaw, *pisticis* = shark; an allusion to the appearance of the young leaves)

Gard. Bull. Sing. 55 (2003) 189. **Type:** *Sawan SAN 136830*, Borneo, Sabah, Telupid district, Pinangah FR (holotype SAN; isotypes KEP, SAR).

Tree with sparsely branched crown to 45 m tall; fluted bole to 90 cm diameter, with steep buttresses to 1(–3) m tall. **Bark** smooth to scaly, markedly lenticellate; inner bark red-brown. **Sapwood** pale yellow-white. **Twigs** 1.2–1.5 cm diameter apically, brown, with longitudinal cracks, petiole scars conspicuous, latex white, fulvous-tomentellous. **Leaves** in dense terminal spirals, to 130 cm long, pseudogemmulate, pseudogemma of rather unfurled leaflets, densely long-hairy; petioles 8.5–16.5 cm long, more or less angled or grooved, like rachis, sericeous to pilose; leaflets weakly falcate, young ones brownish or reddish, densely pilose (hairs simple) on midrib and lateral veins, also scattered between veins below; lateral leaflets at least 17 on each side of rachis, opposite; blades oblong-ovate, to 21 × 8.5 cm, base asymmetrical, rounded or, particularly in juveniles, cuneate, apex acute to shortly acuminate; lateral veins c. 17 on each side of midrib, spreading, when dry rather prominent above; petiolules to 9 mm long, densely pilose. **Inflorescences** narrowly paniculate thyrses, to 50 cm long, axillary or extra-axillary, tomentellous; peduncles c. 18 cm long, branches rather distant, to 10 cm long, squarrose; ultimate branchlets cymulose, many-flowered. **Flowers:** pedicels tomentellous; calyx cup-shaped, c. 2 mm tall, sericeous, margin truncate to weakly 4-lobed; petals 4 or 5, linear-spathulate, c. 11 × 1.8 mm, sericeous outside, glabrous inside, aestivation imbricate, apex concave (corolla clavate in males); staminal tube swollen at mouth, weakly adherent to petals at base, hairy along interlobe sutures near apex outside, hairy inside, margin with 6–8 linear, 2- or 3-toothed lobes to 2.5 mm long, anthers 5–8(or 9), oblong, c. 2 mm long, locellate, basifixed, slightly exerted; disc obscure; ovary 4-locular, sericeous, style sericeous in proximal 5/6, stylehead subcylindrical with flattened apex. **Infructescences** to 30 cm long, axillary or on twigs behind leaves. **Fruits** spherical, to at least 9 cm diameter, red-brown, latex white; pedicel to 9 mm across. **Seeds** unknown.

Distribution. Borneo and the Philippines (Palawan). In Borneo, known only in Sabah from Kinabatangan, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN 31087*, *SAN 39141*, *SAN A 3696* and *SAN A 4769*) and in Kalimantan (e.g., *bb. 16168*, *Kostermans 6834* and *Kostermans 8897*).

Ecology. Lowland rain forest.

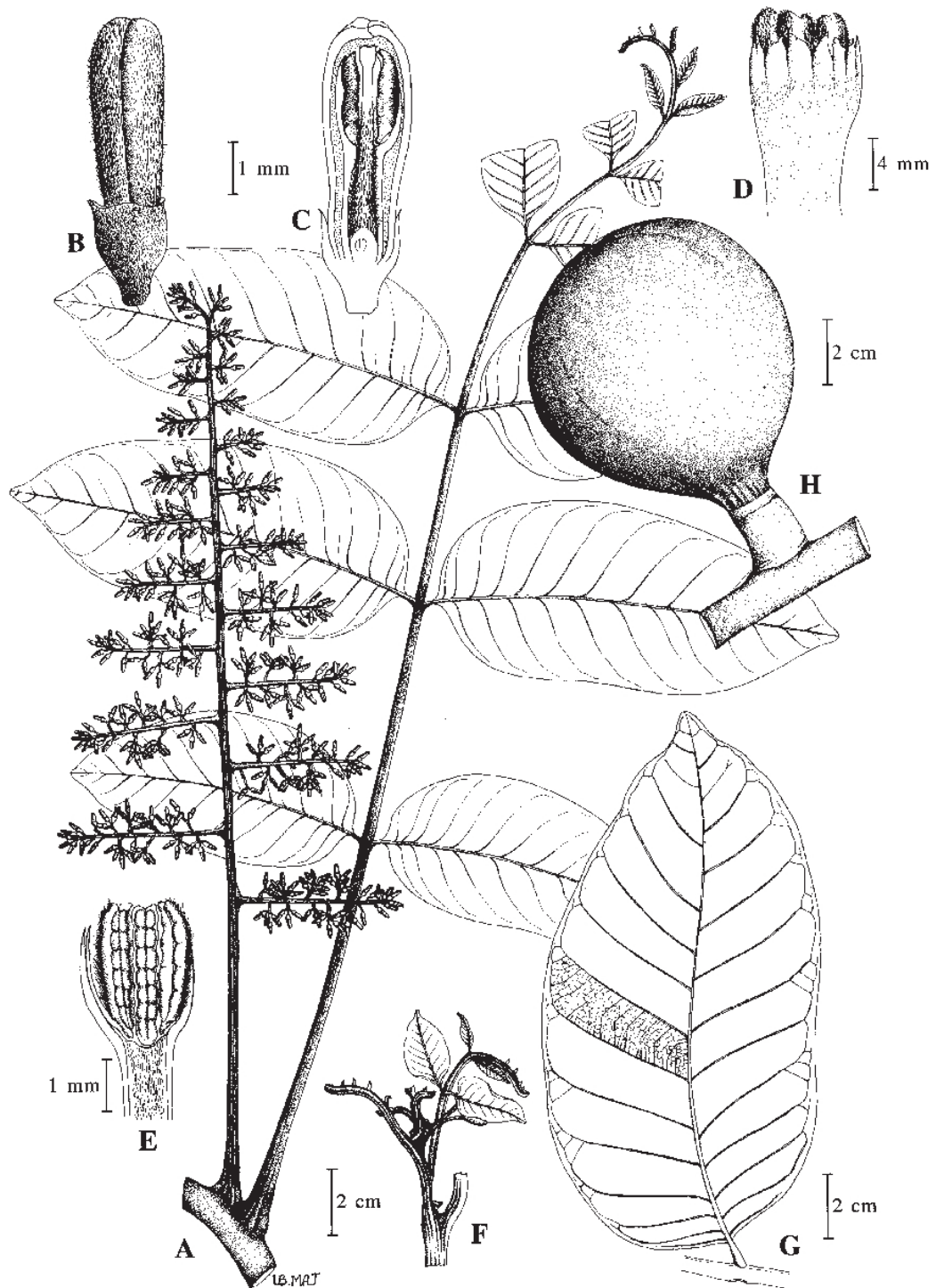


Fig. 14. *Chisocheton maxilla-pisticis*. A, flowering leafy twig; B, female flower bud; C, longitudinal section of female flower bud; D, abaxial view of distal part of staminal tube; E, adaxial view of distal part of staminal tube; F, young leafy shoot; G, older leaflet; H, fruit. (A–E from SAN 31087, F from SAN 136830, G from Pennington 7915, H from SAN A 4769.)

11. *Chisocheton medusae* Airy Shaw

Fig. 15.

(Medusa, the only human of the Gorgons, snake-haired sisters in Classical mythology; an allusion to the 'reflexed or subrevolute' petals)

In Hooker, Ic. Pl. 34 (1937) t. 3333; Mabblerley *op. cit.* (1979) 322; Anderson *op. cit.* (1980) 251; Mabblerley *et al. op. cit.* 142. **Type:** *Richards 2631*, Borneo, Sarawak, Marudi district, Mt Dulit (Ulu Tinjar), near Long Kapa (holotype K; isotype SING). **Synonyms:** *Megaphyllaea* sp. Merr. *op. cit.* (1929) 123; *Chisocheton medusae* Airy Shaw forma *hiascens* Jacobs, Reinwardtia 3 (1955) 265.

Tree to 28 m tall; bole to 30 cm diameter, sparsely branched, buttressed. **Bark** black with fine striations; inner bark dark brown. **Heartwood** yellowish. **Twigs** to 2.5 cm diameter apically, fulvous-tomentose. **Leaves** to 200 cm long, *pseudogemmulate* (imparipinnate and with up to 4 lateral leaflets on each side of rachis when young), bunched in terminal spirals; *petioles* 10–20 cm long, terete or flattened adaxially, decurrent with twig and forming axillary cavity with it, *more or less fulvous-tomentose*; rachis somewhat angular, glabrescent to fulvous-tomentose; *leaflets* glabrous above when mature, *more or less densely fulvous-pubescent below*, green when young; lateral leaflets to 14 on each side of rachis, opposite except for those near base of rachis; blades lanceolate to elliptical-lanceolate, to 40 × 11 cm, *base narrowed into petiole*, apex acute to acuminate, acumen to 2 cm long; midrib stout, densely fulvous-tomentose below; lateral veins 20–24 on each side of midrib, weakly arcuate near margin, subpubescent above, prominent and pubescent below. **Inflorescences** to 30 cm long, borne in axils of upper or undeveloped leaves, weakly branched to narrowly paniculate at base; axes flattened to angular, shortly fulvous-tomentose when young, glabrescent; branches rather more densely pubescent, few-flowered with caducous bracts. **Flowers:** pedicels 3–20 mm long, somewhat angular, light-brown hirtellous, articulated with pseudopedicels, swollen at articulation; *calyx* cup-shaped to subcylindrical, (10–)13–20(–23) × 15–20 mm, more or less densely ferruginous-velutinous, reddish brown, margin truncate or irregularly split to halfway into 2 or 3 more or less triangular lobes; *petals* 9–14, 35–40 × 2–6 mm, white; staminal tube 27–32 mm long, glabrous, thin proximally, margin truncate, *anthers* 15–20, slightly exserted or included, 3–4 mm long, glabrous; disc glabrous; ovary in female flowers 3–5 mm diameter, 7- or 8-locular, glabrous to densely yellow-hairy, style more or less pubescent, especially below, *stylehead discoid to shallowly cylindrical*, c. 2 mm diameter, glabrous. **Infructescences** to 30 cm long. **Fruits** to 13 × 10 cm diameter, *golden-brown, densely hispid*. **Seeds** to 5 cm long, orange-segment-shaped; *sarcotesta densely vascularised*.

Distribution. Endemic in Borneo. In Sabah, known from Kinabatangan, Labuk Sugut, Sandakan, Semporna and Tawau districts (e.g., *Mabblerley 1680*, *SAN 37378*, *SAN 40604*, *SAN 63783* and *SAN 83437*) and in Sarawak from Bau, Belaga, Kapit, Marudi and Tatau districts (e.g., *ITTO/BB 498*, *S 19233*, *S 21788*, *S 39834* and *S 73871*). Also occurring in Kalimantan (e.g., *Kostermans 5897*) but not yet recorded from Brunei.

Ecology. Lowland rain forests, sometimes on limestone, at altitudes to 400 m.

Notes. This species has a short infructescence with sarcotestal seeds, whereas its apparently closest ally, *C. macranthus*, has a bell-rope-like infructescence and arillate seeds. *Chisocheton tomentosus* (Roxb.) Mabb. of Peninsular Malaysia (sarcotesta) and *C. polyandrus* of Borneo (aril) are a similar pair, but geographically vicarious.

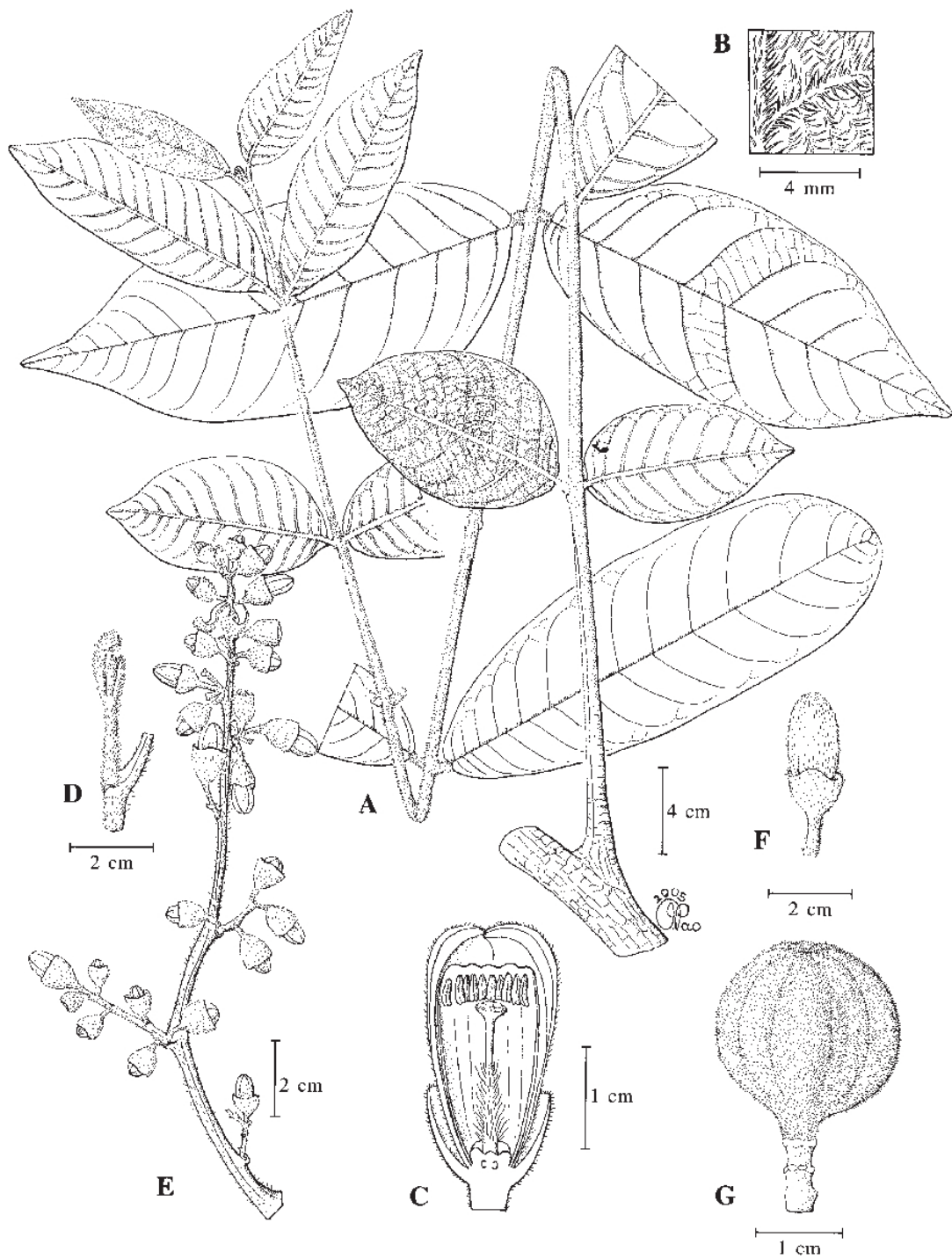


Fig. 15. *Chisocheton medusae*. A, leaf; B, details of lower leaflet surface showing indumentum; C, longitudinal section of flower bud; D, distal part of young shoot showing developing leaf bud; E, inflorescence with young flowers; F, flower bud; G, fruit. (A–C from S 23304, D from S 64629, E from S 21788, F from SAN 16501, G from SAN 83437.)

12. *Chisocheton patens* Blume

(Latin, *patens* = spreading; referring to the inflorescence)

Bijdr. Fl. Ned. Ind. (1825) 169; King *op. cit.* 522; Mabberley *op. cit.* (1979) 350, *op. cit.* (1989) 235; Whitmore, Tantra & Sutisna *op. cit.* 229; Mabberley *et al. op. cit.* 167; Turner *op. cit.* 340; Coode *et al. (eds.) op. cit.* 203; Argent *et al. (eds.) op. cit.* 416; PROSEA 5, 3 (1998) 162; Beaman & Anderson *op. cit.* 128. **Type:** *Blume s.n.*, Java (holotype L [Acc. No. 9081321993]; isotypes G, U [Acc. No. 0004305]). **Synonyms:** *Chisocheton divergens* Blume *op. cit.* (1825) 169, Ridley *op. cit.* (1922) 390, Backer & Bakhuizen *f. op. cit.* (1965) 124; *Chisocheton divergens* Blume var. *patens* (Blume) Ridl. *op. cit.* (1922) 390, *nom. illeg.*

Tree to 35 m tall, but often flowering when 2–3 m tall; bole to 20 m tall and 70 cm diameter, sometimes fluted or buttressed; buttresses to 2 m tall, to 1 m out and to 8 cm thick, concave. **Bark** pale greenish to black, smooth to faintly cracked, lenticellate, the lenticels in horizontal rows; inner bark pale to dark brown. **Sapwood** pale to dirty-cream, often smelling of methyl mercaptan. **Twigs** *c.* 6 mm diameter apically, glabrous to deciduously tomentose, bark dark, petiole scars conspicuous. **Leaves** to 70 cm long, *paripinnate*, *pseudogemmate*, in terminal bunches; petioles 7–15 cm long, glabrous to pubescent; leaflets thinly coriaceous, often conspicuously paler below, glabrous or with tomentose midrib and pubescent lateral veins on both surfaces, *hairs simple*; *lateral leaflets to 14 on each side of rachis*, opposite to subopposite, often maturing all together; blades narrowly oblong to oblong- or elliptical-lanceolate, 6–28 × 2.5–10.5 cm, base more or less rounded or rarely subcordate, more or less unequal, *apex shortly acuminate*; lateral veins 9–14 on each side of midrib, more or less prominent below; *intercostal venation often conspicuous*; *petiolules 3–6 mm long*. **Inflorescences** to 90 cm long, *borne in upper leaf axils or supra-axillary*, pendent, thyrsoid; most proximal branches to 17 cm long (10 cm long in females), ultimate branchlets cymes of subsessile or shortly pedicellate flowers; axes glabrous to tomentose. **Flowers** fragrant; bracteoles minute; *calyx cup-shaped to shortly tubular, 2.5–3 mm tall, puberulous, margin subentire to minutely, irregularly toothed*; *petals 4, subspathulate-elliptical, 5–10 mm long, aestivation imbricate*, glabrous to glabrescent; *staminal tube 5–7(–8) mm tall, glabrescent or minutely pubescent near mouth outside, pubescent, tomentellous or very rarely villous inside, margin with (5 or) 6–8 linear-triangular lobes a little shorter than anthers, anthers (5 or) 6 or 7 (or 8), basifixed, glabrous, locellate; disc absent or very short, fleshy*, glabrous, more or less lobed; *ovary 2-locular, pubescent, style glabrous to densely short-pubescent, stylehead cylindrical to clavate*. **Fruits** subglobose, to 5 × 4.5 cm, stipitate, *glabrous to tomentose* (especially when unripe; *hairs non-irritant*), *2-locular*; stipe to 2 cm long. **Seeds** 2, scutiform, 5–11 × 8 mm, half covered by an aril.

Vernacular name. Sabah—*berindu* (preferred name).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines and Sulawesi. In Sabah, known from Keningau, Kinabatangan, Kudat, Labuk Sugut, Lahad Datu, Pensiangan, Pitas, Ranau, Sandakan, Semporna, Tawau, and Tenom districts (e.g., *SAN 24761*, *SAN 34930*, *SAN 71008*, *SAN 94744* and *SAN 129746*) and in Sarawak from Kapit, Kuching and Lundu districts (e.g., *S 27053*, *S 33183*, *S 34201*, *S 39091* and *S 78277*). Also occurring in Brunei (e.g., *Kirkup DK 944a* and *Hotta 12947*) and Kalimantan (e.g., *Kostermans 8127*, *Kostermans 9963* and *Kostermans 10195*).

Ecology. Common in lowland rain forest, at altitudes to 500 m.

Notes. Some specimens (particularly in Peninsular Malaysia) have a stench like methyl mercaptan but this seems not to be constant in populations – its occurrence would make an interesting study. Across its range, *Chisocheton patens* is an extremely variable species, of which *C. lansiiifolius* is a ‘satellite’, though it is rather uniform in Borneo. Some specimens from Sarawak, particularly from Semengoh FR near Kuching and Miri (e.g., *S* 27053, *S* 34201 and *S* 39091), however, are curious for their large coriaceous leaflets, which resemble those of *C. lansiiifolius*. These are treelets to 3 m tall and require further study (*cf.* discussion under *Walsura pinnata* and *W. grandifolia*).

13. *Chisocheton pentandrus* (Blanco) Merr.

(Greek, *penta* = five, *andros* = man; referring to the five stamens in each flower)

Phil. Gov. Lab. Bur. Bull. 27 (1905) 210; Masamune *op. cit.* 375; Mabberley *op. cit.* (1979) 363, *op. cit.* (1989) 237; Mabberley *et al. op. cit.* 180; Turner *op. cit.* 340; Coode *et al.* (eds.) *op. cit.* 203; PROSEA 5, 3 (1998) 162; Beaman & Anderson *op. cit.* 128. **Basionym:** *Trichilia pentandra* Blanco, Fl. Filip. (1837) 355. **Neotype** (Mabberley, 1979): *Species Blancoanae* 6, the Philippines, Luzon, Mt Maquiling, Nov 1912 (fls) & Mar 1913 (fr) mounted on same sheet (BM). **Synonyms:** *Schizochiton paucijugum* Miq. *op. cit.* (1868) 27 & 30; *Chisocheton paucijugus* (Miq.) B.D. Jackson, Index Kew. 1 (1895) 517, Merrill *op. cit.* (1921) 319, Masamune *op. cit.* 374; *Dasycoleum beccarianum* Baill., Adansonia 11 (1874) 263; *Chisocheton beccarianus* (Baill.) Harms *op. cit.* (1896) 296, Merrill *op. cit.* (1921) 319, Masamune *op. cit.* 374, Anderson *op. cit.* (1980) 250.

Tree or treelet, 3–18(–40) m tall; bole to 10 m tall; buttresses to 60 cm tall. **Bark** greenish grey; inner bark pale fawn or pinkish. **Sapwood** pale cream. **Twigs** 2.5–6 mm diameter apically, deciduously tawny-pubescent to subglabrous. **Leaves** to 45 cm long, pseudogemmate; petioles 2–10 cm long, terete, minutely pubescent; leaflets dark green above, paler below, glabrous or sparsely pubescent (*hairs simple*) on veins; lateral leaflets to 9 on each side of rachis, opposite; blades elliptical to ovate-oblong, 16.5(–26.5) × 6(–9) cm, base more or less asymmetrical, acute to obtuse, apex acuminate to acutely cuspidate; lateral veins 8–16 on each side of midrib; petiolules to 8 mm long. **Inflorescences** spicate to thyrsoid, to 63 cm long, axillary to supra-axillary, sometimes in axils of unexpanded leaves; axes finely velvety-puberulous. **Flowers** pedicellate, more or less fragrant; calyx c. 4 mm tall, more or less sparsely puberulous outside, margin truncate to obscurely or irregularly lobed; petals (4 or) 5, 8–12(–18) × 2 mm, cream, densely fulvescent-hirsute outside, aestivation valvate, apex acute; staminal tube white, more or less densely pilose, rarely subglabrous inside, pubescent outside, margin 5-lobed, lobes lacinate, anthers 5 (or 6), c. 3 mm long, glabrous; ovary 2-locular, shortly stipitate, hirsute, style glabrous to pubescent. **Infructescences** to 30 cm long. **Fruits** globose or beaked, to 2.1 cm diameter, dull red, minutely rusty-tomentose (*hairs non-irritant*); pericarp with white latex. **Seeds** 2, to 15 mm diameter, flattened, sarcotestal.

Vernacular name. Sabah—*lisi-lisi* (preferred name).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, Nusa Tenggara, the Philippines and Maluku.

Notes. This species is represented by two distinct subspecies, *i.e.* subsp. *pentandrus* and subsp. *paucijugus* that are allopatric save in northern Borneo and Palawan (the Philippines), where, as pointed out by Mabberley (*op. cit.* 1979 and Mabberley *et al. op. cit.*), there are intermediate populations. Since the publication of the monograph, many more intermediate

collections have been made. Notable among these are those with spherical fruits on scarcely branched infructescences. In Sarawak, forms with the beaked fruits typical of subsp. *paucijugus* as found in Peninsular Malaysia have been collected from sites very close to those with spherical fruits. In Sabah, there are both the subsp. *paucijugus* form and form identical with typical *C. pentandrus* from the Philippines. Among the intermediates some were referred to subsp. *medius* Mabb. but with the torrent of intermediates linking subsp. *paucijugus* and subsp. *pentandrus*, the value of recognising that at subspecific rank is increasingly dubious. The polymorphic populations of these very commonly collected trees would make an interesting field study for undergraduates: are two species introgressing or are the extreme forms of the northern Borneo populations acting as distinct species elsewhere, e.g., Peninsular Malaysia? For the time being, a selection of specimens typical of the two ends of the range, i.e. subsp. *paucijugus* and subsp. *pentandrus*, are listed, as are a number of the intermediates under 'subsp. *medius*', until the matter is more fully resolved. It cannot be overstressed, though, that a great number, perhaps the majority, of specimens, especially from Sabah, presently in herbaria belong to the intermediate group. Needless to say, many specimens will be difficult to pigeonhole.

Key to subspecies

1. Fruit conspicuously beaked. Inflorescence more or less unbranched.....
 - subsp. **paucijugus** (Miq.) Mabb.
 (Latin *paucus* = few, *jugum* = yoke; referring to the few leaflets)
 Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 366, *op. cit.* (1989) 238; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 183; Turner *op. cit.* 340; Coode *et al.* (eds.) *op. cit.* 203; Beaman & Anderson *op. cit.* 129. Basionym: *Schizochiton paucijugum* Miq. *op. cit.* (1868) 27 & 30. Syntypes: *Korthals s.n.*, Sumatra, Mt. Singgalang (U [Acc. No. 39425]); *Korthals s.n.*, Kalimantan, Mt Sakumbang and near R. Punay (U [Acc. No. 39425], L [Acc. No. 9081321114]). Synonyms: *Dasycoleum beccarianum* Baill., Adans. 11 (1874) 263; *Chisocheton paucijugus* (Miq.) B.D. Jackson, Ind. Kew. 1 (1893) 517, Merrill *op. cit.* (1921) 319, Masamune *op. cit.* 374; *Chisocheton beccarianus* (Baill.) Harms, *op. cit.* (1896) 296, Merrill *op. cit.* (1921) 319, *op. cit.* (1929) 122, Masamune *op. cit.* 374, Anderson *op. cit.* (1980) 250.
 Small tree to 8 m tall. Twigs 2.5–3 mm diameter apically. Leaves to 45 cm long, with 3–5 (or 6) leaflets on each side of rachis; blades ovate-oblong, base cuneate, apex acutely cuspidate; lateral veins 8–12 on each side of midrib; petiolules 6–8 mm long. Inflorescences to 24 cm long, usually unbranched, bearing cymes of 1–few flowers; petals to 18 mm long. Infructescences with fruits borne at the tips. Fruits tapering at each end, the distal acute, proximal terete.
 Peninsular Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines (Palawan). In Sabah, recorded from Beaufort, Keningau, Kota Belud, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., SAN 22542, SAN 49801, SAN 79499, SAN 84710, SAN 95797 and SAN 116937) and in Sarawak from Kuching, Lawas, Lundu, Marudi, Miri and Sri Aman districts (e.g., S 13402, S 24440, S 31541, S 47392, S 56604 and S 74321). Also known from Brunei (e.g., Kirkup DK 857) and Kalimantan (e.g., Kostermans 13460).
 Wetter forests of W Malesia, including limestone.
- Fruit spherical. Inflorescence more or less branched.....2
2. Inflorescence branched to four orders; flowers to 8 mm long. Leaflet lateral veins *c.* 16 on each side of midrib.....

subsp. **pentandrus** Mabb.

Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 364, *op. cit.* (1989) 237; Mabblerley *et al. op. cit.* 182; Turner *op. cit.* 340. Synonyms: *Chisocheton* sp., Merrill *op. cit.* (1929) 122.

Tree to 16(–40) m tall. Twigs 4–6 mm diameter apically. Leaflets: blades elliptical-oblong, base asymmetrical, obtuse or acute; lateral veins *c.* 16 on each side of midrib. Inflorescences branched to 3 or 4 orders; branches to 12 cm long; petals to 8 mm long. Fruits spherical, to 21 mm diameter, abruptly stipitate and minutely beaked; stipe to 8 mm long, 3 mm diameter.

Peninsular Malaysia (Johore), Java, Borneo, the Philippines, Sulawesi, Nusa Tenggara (Bali, Sumbawa, Flores) and Maluku (Halmahera, Ambon). In Borneo, known only in Sabah from Kudat, Lahad Datu, Ranau, Sandakan, Semporna and Tawau districts (e.g., *SAN* 28928, *SAN* 29410, *SAN* 29724, *SAN* 32550 and *SAN* 42120) and in Kalimantan (e.g., *Kostermans* 4892).

Drier lowland forest of west and central Malesia.

Inflorescence sparsely branched; flowers 8–16 mm long. Leaflet lateral veins *c.* 13 on each side of midrib.....

subsp. **medius** Mabb.

(Latin, *median* = intermediate; referring to its being intermediate between the other two subspecies)

Bull. Brit. Mus. Nat. Hist. 6 (1979) 365; Mabblerley *et al. op. cit.* 182; Coode *et al.* (eds.) *op. cit.* 203; Beaman & Anderson *op. cit.* 128. Type: *Mabblerley 1676*, Borneo, Sabah, Sandakan district, Sepilok FR (holotype FHO; isotypes K, L, SAN, SAR).

Small tree to *c.* 8 m tall. Intermediate in all features between subsp. *paucijugus* and subsp. *pentandrus*. Fruits globose.

Borneo and the Philippines (Palawan). In Borneo, known in Sabah from Beaufort, Keningau, Kinabatangan, Kota Belud, Kudat, Labuk Sugut, Lahad Datu, Pensiangan, Ranau, Sandakan, Semporna, Sipitang, Tawau and Tenom districts (e.g., *SAN* 40533, *SAN* 84710, *SAN* 93805, *SAN* 109960 and *SAN* 143513), in Brunei (e.g., *BRUN* 15009) and Kalimantan (e.g., *Kostermans* 6224). Not yet recorded from Sarawak.

Lowland rain forest. In the absence of fruits, it is difficult to assign some specimens. Such gatherings could represent either of the other two subspecies.

14. **Chisocheton polyandrus** Merr.

(Greek, *poly* = many, *andros* = man; an allusion to the many stamens in each flower)

Phil. J. Sci. Bot. 21 (1922) 520; Mabblerley *op. cit.* (1979) 324; Whitmore, Tantra & Sutisna *op. cit.* 229; Mabblerley *et al. op. cit.* 144; Coode *et al.* (eds.) *op. cit.* 203; Beaman & Anderson *op. cit.* 129.

Syntypes: *Wood 657*, Sabah, Sandakan, Labuk (PNH†; isosyntypes A, K) and *Ramos BS 1217*, Batu Lima (PNH†; isosyntype A).

Tree to 15 m tall, unbranched or very sparsely branched, occasionally with stiltroots or small buttresses. **Bark:** inner bark pinkish. **Sapwood** fawn. **Leaves** to 150 cm long, *imparipinnate* or *pseudogemmate*, when pseudogemmate densely long-pubescent (*hairs simple*); *petioles* 1–5 cm long, terete, woody; rachis terete; lateral leaflets shiny, bullate at altitude, *glabrous* or *veins more or less pubescent (hairs simple)* above, *appressed hirsute* below, particularly at high altitudes; lateral leaflets to 14 on each side of rachis, opposite or subalternate at base of rachis, where they are often very small and even irregularly lobed; blades oblong-lanceolate, 11–43 × 5–13 cm, *base asymmetrical, cuneate to subcordate*, apex somewhat

acuminate; *lateral veins* *c.* 15 on each side of midrib, often sunken above; *petiolules* to 2 mm long. **Inflorescences** borne in upper leaf axils, up to 4 at a time, to 200 cm long, unbranched or with a few squarrose branches to 13 cm long near tip, where flowers are condensed; axes *ferruginous-pubescent* when young. **Flowers:** *calyx* cup-shaped to subcylindrical, 5–8 × 5–6 mm, densely ferruginous-pubescent, green to deep red, margin truncate; *petals* 5 or 6, subspathulate, 28–32 mm long, fleshy, creamy-white with conspicuous pink or red tinge, *densely pubescent* outside; *staminal tube* cylindrical, white, subglabrous save for the conspicuous bands of hairs apically and basally inside, *margin* with 12–14 linear lobes, *c.* 3 mm tall, *anthers* 12–14, *c.* 4 mm long, *locellate*, connective sparsely ferruginous-pubescent; disc *c.* 1 mm tall, thick, glabrous, margin truncate; ovary ?3–5-locular, style cylindrical, glabrous, stylehead subcapitate, *c.* 1 mm diameter. **Infructescence** to 200 cm long, pendent, with fruits aggregated at tip. **Fruits** spherical, *c.* 2.5 cm diameter, covered with reddish irritant hairs, splitting into 3 or 4 valves. **Seeds** 3; testa black, covered on inner surface by orange-red aril.

Distribution. Endemic in Borneo. In Sabah, known from Beaufort, Keningau, Kinabatangan, Kota Belud, Kudat, Labuk Sugut, Pensiangan, Pitas, Ranau, Sandakan, Tawau and Tenom districts (e.g., *Mabberley 1688*, *SAN 42075*, *SAN 49763*, *SAN 76067* and *SAN 82406*) and in Sarawak from Kapit, Kuching, Lawas and Miri districts (e.g., *S 31130*, *S 31533*, *S 43683*, *S 49549* and *S 56406*). Also occurring in Brunei (e.g., *BRUN 349*) and Kalimantan (e.g., *Chai P.K. ITTO/BA 196* and *Kuswata 703*).

Ecology. Mixed dipterocarp forest, at 150–300 m altitude.

15. *Chisocheton ruber* Ridl.

(Latin, *ruber* = red; the flowers)

Bull. Misc. Inform. Kew (1930) 365; *Mabberley op. cit.* (1979) 342; *Anderson op. cit.* (1980) 251; Whitmore, Tantra & Sutisna *op. cit.* 229; *Mabberley et al. op. cit.* 160. **Type:** *Haviland 594*, Borneo, Sarawak, Kuching district, Padawan, G. Braang (holotype K; isotype SAR).

Tree to 15 m tall; bole to 20 cm diameter, fluted. **Bark** smooth to weakly and irregularly flaking, greenish grey or reddish, with conspicuous inflorescence bosses, sometimes bearing leafy shoots, arranged more or less spirally from ground level to 5 m. **Sapwood** ivory. **Twigs** 12–15 mm diameter apically. **Leaves** to 150 cm long, *pseudogemmate*, subglabrous, in terminal spirals; *petioles* 8–20 cm long; rachis somewhat 3-ribbed; leaflets coriaceous, brilliant carmine when young and appearing in flushes of up to 11 pairs at once, very sparsely puberulous; lateral leaflets to 15 on each side of rachis, opposite; *blades* oblong, to 42 × 10 cm, *base* subacute, *strongly asymmetrical*, apex acuminate; lateral veins 12–14 on each side of midrib; intercostal venation conspicuous below; *petiolules* *c.* 6 mm long. **Inflorescences** to 12 cm long, not or once branched, borne near base of bole, on bosses that produce them over several seasons; rachis pubescent. **Flowers** sweetly scented; pedicels 1–3 mm long, pubescent, minutely bracteolate; *calyx* cup-shaped, *c.* 4 mm tall, rugose, pubescent, red, *margin* more or less 4- or 5-lobed; *petals* 5 or 6, linear-oblong to spathulate, 20–22 mm long, *c.* 4 mm wide at widest, *c.* 2.5 mm at narrowest, fleshy distally, pubescent outside, aestivation imbricate to quincuncial, *outside* pink, *becoming red towards apex*, white inside; *staminal tube* pubescent distally outside, villous inside, white, adnate to corolla at base, margin shallowly 6–8-lobed, each lobe praemorse or irregularly 2- or 3-fid, *anthers* 8–10, oblong, *c.* 2 mm long, *non-locellate*, yellow, sparsely hairy near connective,

basifixed; disc obscure; ovary conical, 5-locular, appressed pubescent, style white, hairy in proximal 3/4 or throughout, stylehead very shortly cylindrical to subdiscoid, to 1.8 mm diameter. **Fruits** top-shaped when young, to 5 × 5 cm, stipitate, *glabrous*, reddish brown; pericarp with white latex. **Seeds** bean-shaped (when dry), *c.* 2 cm long.

Distribution. Endemic in Borneo and known only in Sarawak from Bau and Serian districts (e.g., *Mabberley 1635, S 37440, S 39274, S 49252, S 50328 and S 75808*).

Ecology. Restricted to forest on limestone formation, at 80–250 m altitude.

16. *Chisocheton sarasinorum* Harms

(Karl Friedrich Sarasin (1859–1942) and Paul Benedkt Sarasin (1856–1929), Swiss gentlemen, zoologists and explorers)

In Fedde, Rep. 42 (1937) 8; Mabberley op. cit. (1979) 356; Whitmore, Tantra & Sutisna op. cit. 229; Mabberley et al. op. cit. 172. Type: K.F. & P. B. Sarasin 2137, Sulawesi, near Bada (holotype B†; isotype not located).

Treelet or small tree to 15 m tall with open crown. **Bark** smooth greyish green; inner bark pale brown. **Sapwood** pale fawn. **Twigs** rather rough, brown, with vertical lenticels, *c.* 8 mm diameter apically. **Leaves** to 150 cm long, *pseudogemmate*, dull above, pale below, in terminal spirals; *rachis* green, subglabrous to *weakly pilose (hairs simple)*; petioles to 20 cm long or more, subglabrous to weakly pilose; *leaflets* glabrous or *subglabrous when sparsely pubescent on veins (hairs simple)*; lateral leaflets to 7 on each side of rachis, opposite; blades oblong or oblong-lanceolate, 10–28 × 3.5–10 cm, base acute or weakly obtuse, apex acuminate; lateral veins *c.* 15 on each side of midrib, prominent and pale below when dry; petiolules to 15 mm long, sometimes pubescent. **Inflorescences** to 35 cm long, *axillary to supra-axillary*, narrow, sparsely branched; most proximal branches to 14 cm long, ascendant, weakly pilose to subglabrous, each with 1–4 flowers. **Flowers:** pedicels 2–3 mm long, stout; *calyx* shallowly cup-shaped, 5–6 × 7–8 mm, densely tomentose outside, margin truncate to obscurely undulate; *petals (5 or) 6 in 2 ranks*, white, adhering to tube at base, 3 *outer petals narrowly oblong, 16–20 × 6 mm*, obtuse, (2 or) 3 *inner ones almost linear, 14–18 mm long*, obtuse, *apex hooded*; staminal tube thick, tough, white, glabrous to subglabrous outside, laxly pilose proximally inside, margin truncate to obscurely dentate, anthers 8–10 (or 11), linear, 2–2.5 mm long, basifixed, included; ovary 6–8-locular, densely villous, style villous in proximal half, stylehead discoid to stoutly cylindrical. **Fruits** flattened globose, beaked when young, to 7 × 8 cm, 6–8-locular, borne singly or paired on rachis to 20 cm long, 8 mm diameter; pericarp *c.* 4 mm thick, tough, *greenish brown velutinous (hairs non-irritant)*, exuding white latex on damage. **Seeds** to 5 cm long, like an orange-segment; sarcotesta vascularised.

Distribution. Borneo and Sulawesi. In Sabah, recorded from Keningau, Kota Belud, Pensiangan, Ranau and Sandakan districts (e.g., *Lugas 2697, SAN 29528 and SAN 66291*) and in Sarawak from Belaga, Kapit, Lawas, Lubok Antu and Marudi districts (e.g., *S 31577, S 41507, S 43626, S 46925 and S 68179*). Also known in Brunei (e.g., *BRUN 17630*) and Kalimantan (e.g., *Kostermans 21485*).

Ecology. In swampy and hill rain forest, at altitudes to 1150 m.

Notes. The leaves closely resemble those of *Chisocheton ceramicus* and sterile material may be readily confused, though when dry that of *C. sarasinorum* has a rather more sickly pallor.

17. *Chisocheton sarawakanus* (C.DC.) Harms
(from Sarawak)

Fig. 16.

In Engler & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296; Merrill *op. cit.* (1921) 320; Masamune *op. cit.* 375; Anderson *op. cit.* (1980) 251; Mabberley *op. cit.* (1979) 342, *op. cit.* (1989) 238, *op. cit.* (1995) 161; Whitmore, Tantra & Sutisna *op. cit.* 230; Mabberley *et al. op. cit.* 161; Turner *op. cit.* 340; Coode *et al. (eds.) op. cit.* 204; Argent *et al. (eds.) op. cit.* 416. **Basionym:** *Dasycoleum sarawakanum* C. DC. *op. cit.* (1878) 541. **Type:** Beccari 3186, Borneo, Sarawak (holotype K). **Synonyms:** *Chisocheton brachyanthus* Merr. *op. cit.* (1922) 315, *op. cit.* (1929) 122, Masamune *op. cit.* 374; *Chisocheton glomeratus auct. non* Hiern (1875): Meijer, Bot. News Bull. Sabah 8 (1967) 79.

Tree, 5–20 m tall; bole to 30 cm diameter, fluted below, with small buttresses to 2 m tall. **Bark** fawn to chocolate, smooth to weakly flaking; inner bark brownish yellow. **Sapwood** white to pale fawn. Innovations more or less pale ferruginous-pubescent. **Twigs** terete, dark brown, *non-lenticellate*, *without distinct petiole scars*, glabrous when leafless, *c.* 5 mm diameter apically, rarely myrmecophilous. **Leaves** to 200 cm long, *pseudogemmulate*, *pseudogemmula not markedly circinate*; petioles 5–12 cm long; rachis brown, pubescent to ultimately glabrous; leaflets subcoriaceous, shiny and glabrous on both surfaces to ferruginous-pubescent (*hairs simple*) below, particularly on veins, and on veins above; *lateral leaflets to 26 on each side of rachis*, opposite, flushing in up to 3 pairs at a time; *blades elliptical to elliptical-oblong*, 8–29 × 4–8 cm, base slightly narrowed or rounded, sometimes asymmetrical, *apex rather abruptly caudate-acuminate with acumen to 2 cm long*; *lateral veins 10–14 on each side of midrib*, spreading, depressed above and *prominent below when dry*; *petiolules c. 6 mm long*, pubescent. **Inflorescences** to 50 cm long, narrowly paniculate or subspicate, *supra-axillary*; primary branches few, squarrose, bearing few secondary branches of cymules, with the flowers usually borne in pairs, sessile. **Flowers** sweetly scented; *calyx cup-shaped*, 2–3 × 1.8 mm, glabrous to puberulous outside, glabrous inside, margin truncate to obscurely crenate; *petals 4, linear*, *c.* 12 × 1.8 mm, white, drying black, puberulous outside, glabrous inside, *aestivation imbricate*, apex obtuse, slightly concave; *staminal tube cylindrical*, *c.* 2 mm diameter, somewhat appressed hairy distally, *margin crenate*, *anthers* (3 or) 4–6, 1–2 mm long, inserted just below rim, *somewhat ciliate posteriorly*; *disc absent*; *ovary 2-locular*, appressed pubescent, style pubescent proximally, *stylehead subcapitate*, *c.* 0.5 mm diameter. **Infructescences** with branches to 6 cm with up to 8 fruits on each. **Fruits** depressed globose, *c.* 4 cm diameter, shortly stipitate, crimson, obovoid and *densely ferruginous-pubescent when young (hairs non-irritant)*; pericarp sometimes with white latex. **Seeds** 2; testa dark brown, *partly enveloped by aril*.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, known from Beaufort, Kinabatangan, Kota Kinabalu, Ranau, Sandakan, Semporna and Tawau (e.g., *Mabberley 1646*, *SAN 54462*, *SAN 57196*, *SAN 66873*, *SAN 67192* and *SAN 83010*) and in Sarawak from Betong, Kapit, Lawas, Lundu, Miri, Serian and Sri Aman districts (e.g., *Pennington 8013*, *S 18476*, *S 31542*, *S 39190* and *S 44007*). Also known in Brunei (e.g., *Forman 1182*) and Kalimantan (e.g., *Veldkamp 8506*).

Ecology. A commonly collected tree of rain forest at altitudes to 250 m.

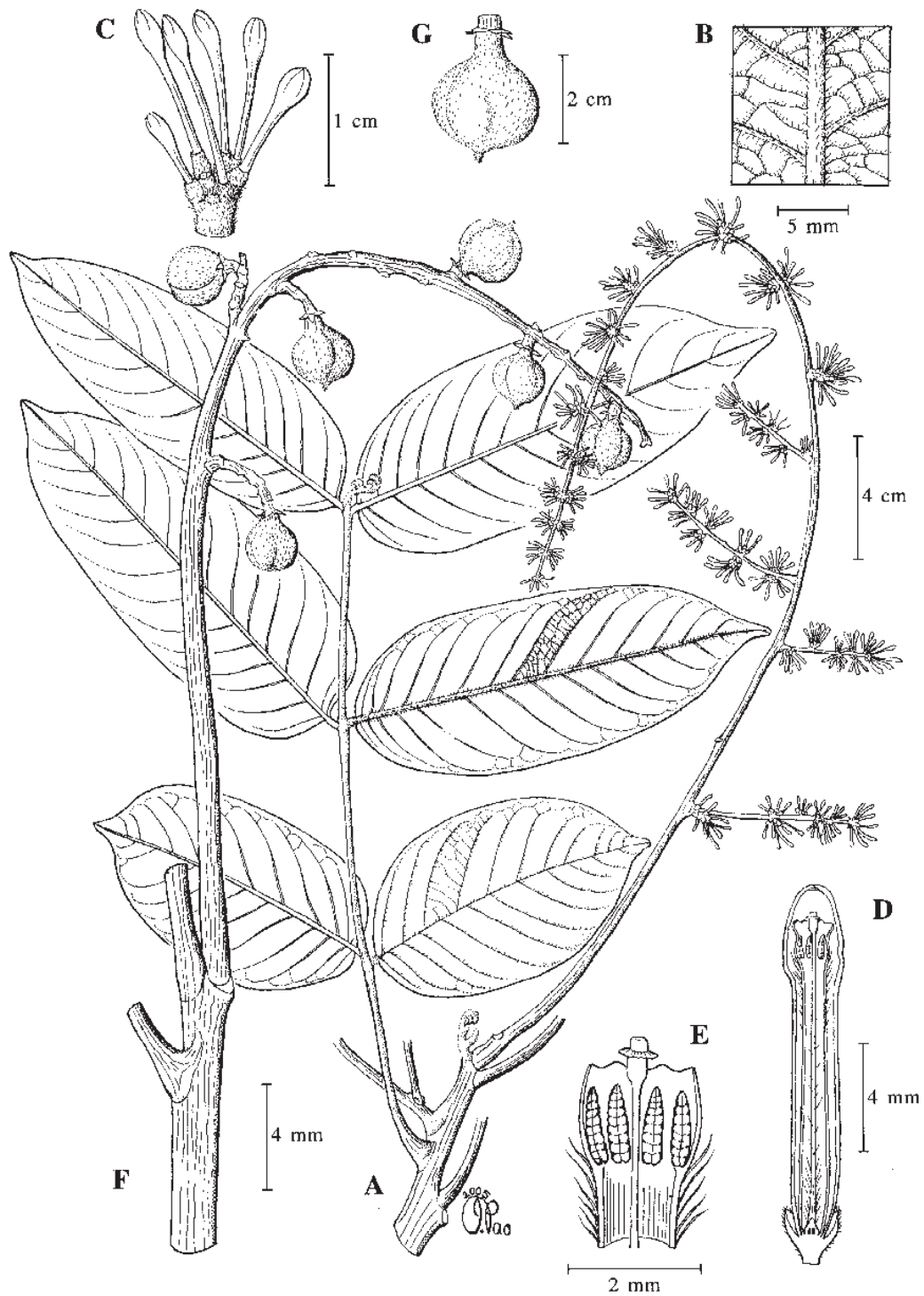


Fig. 16. *Chisocheton sarawakanus*. A, flowering (male) leafy twig; B, detail of leaflet lower surface showing venation and indumentum; C, fascicle of male flowers; D, longitudinal section of male flower; E, distal adaxial side of staminal tube showing stamens and style and stylehead; F, infructescence; G, fruit. (A–E from SAN 21476, F–G from SAN 85475.)

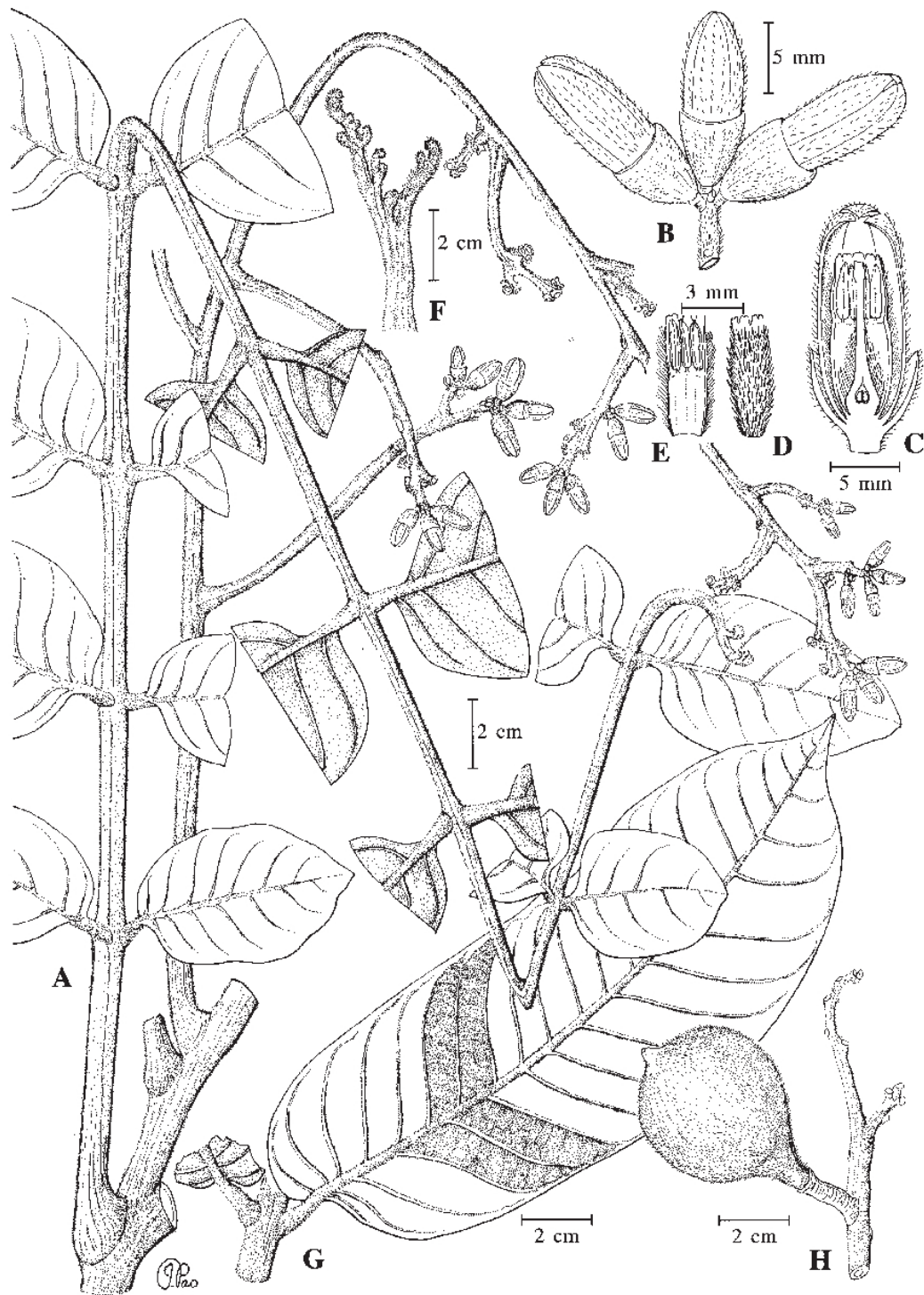


Fig. 17. *Chisocheton velutinus*. A, flowering (female) leafy twig; B, distal fascicle of female flowers; C, longitudinal section of female flower; D, abaxial side of staminal tube; E, adaxial side of staminal tube; F, apical young shoot with developing leaflets; G, older leaflet; H, fruit. (A–E from Wong WKM 1536, F–H from Kirkup et al. DK 940.)

Notes. There is a complete gradation between the more or less glabrous and hairy forms, the latter being readily distinguished from hairy forms of *Chisocheton patens* in Borneo, where they occur together, by their prominent leaf venation.

18. *Chisocheton setosus* Ridl.

(Latin, *setosus* = beset with bristly hairs)

Bull. Misc. Inform. Kew (1930) 366; Mabblerley *op. cit.* (1979) 327; Anderson *op. cit.* (1980) 251; Whitmore, Tantra & Sutisna *op. cit.* 230; Mabblerley *et al. op. cit.* 146; Coode *et al.* (eds.) *op. cit.* 204. **Type:** *Haviland 598*, Borneo, Sarawak, Limbang district (holotype K [photo FHO]; isotypes ?BM, SAR).

Treelet to 5.5 m tall, ?unbranched; bole *c.* 8 cm diameter. **Bark** smooth; inner bark pale yellow. **Twigs** *c.* 1 cm diameter apically, densely ferruginous-setose. **Leaves** to 100 cm long, imparipinnate; *petioles* to 35 cm long, subterete, sometimes grooved adaxially, to 6 mm diameter, ferruginous-setose, hairs 2–3 mm long, base swollen with conspicuous hollow at junction with shoot; rachis 1- or 2-sulcate, setose as petioles; *leaflets* more or less densely ferruginous-setose on both sides, dry *setae* tinkling when stroked, pale when dry; lateral leaflets at least 6 on each side of rachis, opposite; *blades* of proximal leaflets elliptical-oblong, to 20 × 8.5 cm, that of distal leaflets oblanceolate to oblong, to 36 × 10 cm, base rounded to attenuate, symmetrical, apex acuminate, acumen 10–20 mm long; *lateral veins* 17–20 on each side of midrib, prominent below; intercostal venation somewhat prominently scalariform; *petiolules* 5–6 mm long, densely tomentose, that of terminal leaflets to 10 mm long. **Inflorescences** to 200 cm long, axillary or extra-axillary, pendulous, more or less densely setose, drying irregularly angled with flowers crowded in condensed cymes at distal end like a bellrope; bracts *c.* 7 mm long, setose. **Flowers** recurved, shortly pedicellate; *calyx* cup-shaped, *c.* 3 × 4 mm, somewhat elongated into a pseudopedicel, reddish, setose to pubescent, margin truncate to obscurely 3- or 4-lobed; corolla weakly clavate, 3–3.5 × 0.3 cm, glabrous, white or greenish, *petals* 4–6, subspathulate, to 32 (or longer) × 4 mm, glabrous, imbricate at apex; *staminal tube* to 3.2 cm tall, glabrous except for a band of hairs below lobes outside, white, margin with 6–8 truncate lobes or irregularly lobed, *anthers* 6–8, *c.* 2 mm long, glabrous, scarcely locellate; disc cupular, *c.* 1 mm tall, glabrous, margin truncate to obscurely lobed; ovary in female flowers unknown, style sparsely pilose proximally, glabrous distally, stylehead capitate, distinctly narrow-annular apically. **Fruits** (unripe) pale yellow, densely setose.

Distribution. Endemic in Borneo. Known in Sabah from Beaufort, Ranau and Sandakan districts (e.g., SAN 30162, SAN 34282 and SAN 90226) and in Sarawak from Mt. Dulit, Marudi district (e.g., Richards 2539). Also occurring in Kalimantan (e.g., Mogeia 3636). Not yet recorded from Brunei.

Ecology. Presumably rain forest.

19. *Chisocheton velutinus* Mabb.

Fig. 17.

(Latin, *velutinus* = velvety; the indumentum of leaves and fruits)

Gard. Bull. Sing. 55 (2003) 192. **Type:** *Wong WKM 1536*, Borneo, Brunei, Temburong district, Bt. Belalong (holotype SAN; isotypes KEP, SAR). **Synonym:** *Chisocheton* sp. B., Mabblerley *op. cit.* (1979) 372, Mabblerley *et al. op. cit.* 186., *p.p.*, *quoad specim. S 21307 et S 28793*.

Tree to 25 m tall; bole to 35 cm diameter with small buttresses. **Bark** smooth, medium brown to greyish, hoop-marked; inner bark pinkish to red-brown. **Sapwood** straw. **Twigs** 1.2–2.5 cm diameter apically, fawn-pubescent. **Leaves** to 100 cm long, pseudogemmate; petioles 10–15 cm long, more or less angled, like rachis, fulvo-velutinous; leaflets minutely pubescent on sunken midrib, densely velutinous below (hairs simple); lateral leaflets to at least 12 on each side of rachis, opposite; blades oblong, to 24 × 9 cm, base asymmetrical, rounded, apex shortly acuminate; lateral veins 15–17 on each side of midrib, spreading, rather prominent above (when dry); petiolules to 9 mm long. **Inflorescences** to 40 cm long, axillary or extra-axillary, paniculate, velutinous; branches rather distant, to 13 cm long, ultimate branchlets cymulose, few-flowered. **Flowers:** pedicels densely pubescent; calyx cup-shaped, c. 6 mm tall, pubescent, green, margin very obscurely 4-lobed to truncate; petals 4 (or 5), linear-spathulate, to 16 mm long, aestivation valvate, puberulous to pubescent outside, glabrous inside, cream; staminal tube cream, weakly adherent to petals at base, more or less hairy outside, 6–8-lobed, lobes 2-toothed to 1 mm long, anthers 6–8, oblong, c. 3 mm long, locellate, basifixed, apices within the tube; disc obscure; ovary 4-locular, sericeous, style more or less glabrous, stylehead shortly cylindrical. **Infructescences** to 30 cm long, axillary or on twigs behind leaves. **Fruits** globose, c. 5 cm diameter (immature), rostrate when young, velutinous (hairs non-irritant), yellow turning red. **Seeds** (immature) 2.

Distribution. Endemic in Borneo. Known in Sarawak from Kapit and Miri districts (e.g., *S* 21307 and *S* 28793) but not yet recorded from Sabah. Also occurring in Brunei (e.g., *Kirkup DK* 940) and Kalimantan (e.g., *Kostermans* 10024 and *Kostermans* 10558A).

Ecology. Rain forest at altitudes to 650 m.

Incompletely known species

Chisocheton sp. B

Mabberley *op. cit.* (1979) 372; Mabberley *et al. op. cit.* 186, p.p., *quoad specim. S* 25844.

Tree, 12–14 m tall; bole c. 20 cm diameter. **Leaves** to 40 cm long; leaflet blades to 17 × 8 cm, bluntly long-acuminate, brown velutinous below, weakly pubescent on veins above; lateral veins c. 15 on each side of midrib. **Inflorescences** supra-axillary, c. 70 cm long, branches to 22 cm long, all brown long-tomentose (flowers very immature). **Flowers:** calyx irregularly lobed; petals 5; anthers 5, locellate; disc absent; style glabrous. **Fruits** densely brown-tomentose.

Distribution. Known in Sarawak only from one flowering (buds only) specimen (*S* 25844) from Bt. Salong, Ulu Sapurau, Kapit district (K, SAR), and one fruiting specimen (*S* 45515) from Sg. Iban, Belaga district (SAR). Other (fruiting) specimens cited by Mabberley (*op. cit.* 1979) belong to *Chisocheton velutinus* Mabb. (*q.v.*).

Ecology. Ridge forest at altitudes above 1100 m.

Chisocheton *sp. nov. aff. diversifolius* Miq.

Mabberley, Gard. Bull. Sing. 55 (2003) 194.

Treelet to 4 m tall with delicate twigs. **Leaves** with 7 lateral leaflets on each side of rachis; blades multi-veined, very narrow (5–6x as long as wide). Fruiting rachis very delicate, to 20 cm long. **Fruits** pubescent, spherical, 3–4 cm diameter.

Distribution. Known in Sarawak from a single fruiting specimen (*S 48450*) from Bt. Melatai, Batang Balleh, Kapit district (FHO, SAR).

5. CHUKRASIA A.Juss.

(from the Bengali name, *chikrassee*)

surian batu (standard ASEAN and Malaysian trade name)

Bull. Sci. Nat. Géol. 23 (1830) 239; Pennington & Styles, Blumea 22 (1975) 519; Anderson, CLTS (1980) 251; Mabberley *in* Mabberley & Pannell, TFM 4 (1989) 254; Mabberley *et al.*, FM 1, 12 (1995) 354; PROSEA 5, 2 (1995) 127. **Synonyms:** *Chickrassia* Wight & Arn., Prodr. (1834) 122 *nom. superfl.*; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 567; King, J. As. Soc. Beng. 64, 1 (1895) 88; Ridley, FMP 1 (1922) 415.

Deciduous trees. **Indumentum** of simple hairs. **Bud scales** present. **Leaves** *paripinnate* with terminal spike, *imparipinnate* and *bipinnate* with incised or lobed leaflets in juveniles, rarely retained at maturity, *without pseudogemmula*; leaflets more than 8 on each side of rachis, opposite. **Inflorescences** axillary thyrses, often subterminal appearing terminal. **Flowers** unisexual; calyx 4- or 5-lobed; petals 4 or 5, 12–16 mm long, free, contorted and much longer than calyx in bud; staminal tube cylindrical, somewhat narrowing distally, margin entire to crenulate, anthers attached to margin; disc obscure to narrowly cushion-shaped; ovary flask-shaped, 3–5-locular, each locule with numerous ovules, stylehead capitate with 3–5 stigmatic ridges. **Fruits** ovoid or ellipsoid, woody capsules, opening by 3–5 valves from the apex, the valves splitting into an outer and inner bifid layer; columella with 3–5 sharply angled ridges, extending to apex of capsule; seed-scars conspicuous. **Seeds** 60–100 per locule, wings terminal, arranged laterally in tiers in two ranks; endosperm present; embryo with subcircular cotyledons; radicle obliquely exerted. Germination phanerocotylar; eophylls opposite, irregularly imparipinnate, the leaflets lobed or irregularly toothed.

Distribution. One somewhat variable species from India and Sri Lanka, eastwards through tropical Asia to W Malesia.

Chukrasia tabularis A.Juss.

F i g . 1 8 .

(Latin, *tabularis* = flattened; referring to the seeds)

Bull. Sci. Nat. Géol. 23 (1830) 241; Anderson *op. cit.* (1980) 251; Mabberley *op. cit.* (1989) 256; Mabberley *et al. op. cit.* 355; PROSEA 5, 2 (1995) 127; Turner, Gard. Bull. Sing. 47 (1995) 340.

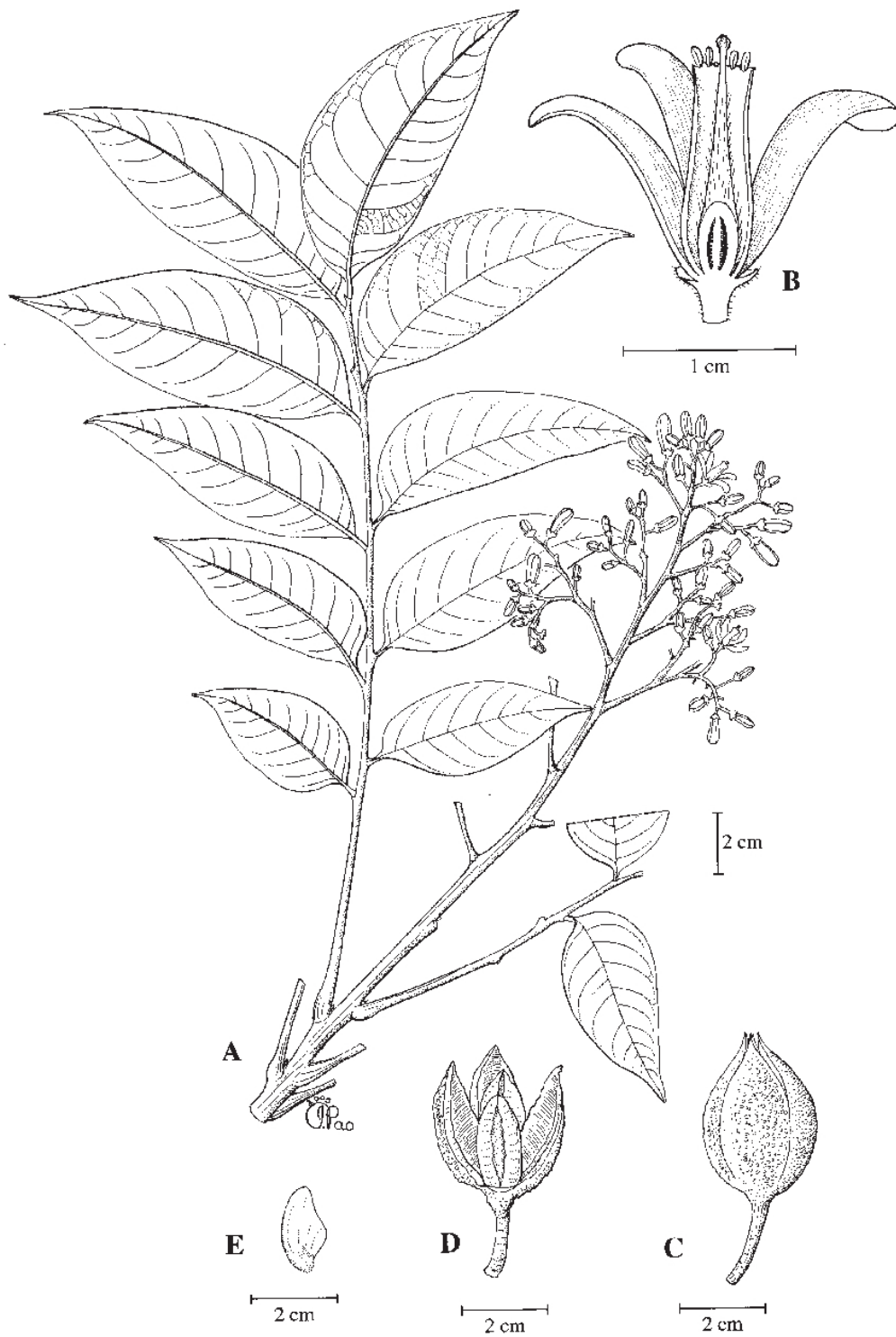


Fig. 18. *Chukrasia tabularis*. A, flowering leafy twig; B, longitudinal section of flower; C, fruit; D, dehiscent fruit; E, seed. (A from *Mabberley 1633*, B from *S 20274*, C–E from *S 22093*.)

Type: *Roxburgh s.n.*, India (holotype P, *n.v.*; isotype BM). **Synonym:** *Chickrassia tabularis* (A. Juss.) Wight & Arn., Prodr. (1834) 123, Hiern *op. cit.* 568, King *op. cit.* 88, Ridley *op. cit.* (1922) 415. (For complete synonymy, *cf.* Mabberley *et al. op. cit.*)

Tree to 40 m tall; bole to 25 m tall, fluted below, to 120 cm diameter; buttresses convex, to 1.5 m tall. **Bark** dark brown, fissured vertically and scaling or cracking into rectangular blocks; inner bark red-brown or pinkish. **Sapwood** straw; heartwood yellow to reddish brown. **Twigs** grey, bark cracking horizontally, 4–6 mm diameter apically, lenticellate. **Leaves** 30–50 cm long; petioles 4–9 cm long, more or less terete, swollen at base; leaflets chartaceous to subcoriaceous, more or less asymmetrical or even falcate, the subapical the largest, upper surface subglabrous to finely scattered short-pubescent, lower surface subglabrous except for short hairs on veins and domatia in axils of lateral veins; lateral leaflets 6–12 on each side of rachis, alternate; blades ovate to oblong, 10–17.5 × 3.5–6.5 cm, the most proximal as small as 4 × 2.2 cm, base obtuse to rounded distally, acute to cuneate proximally, apex acute to acuminate; lateral veins (in largest leaflet) 9–11 on each side of midrib, arcuate, more or less bifurcating near margin; petiolules 2–6 mm long. **Inflorescences** 10–30 cm long, primary branches to 16 cm long, secondary branches to 4 cm long, bearing fascicles of flowers; axes short-pubescent; bracts narrowly triangular, 2–7(–10) mm long, often caducous. **Flowers** sweetly scented; bracteoles similar to bracts but smaller; pedicels 3–4 mm long, articulated with pseudopedicels *c.* 2 mm long, continuous with calyx; calyx shallowly cup-shaped, 2.5–3.5 mm diameter, more or less pubescent outside, lobes obtuse, *c.* 1/3 the length of calyx; petals narrowly oblong to subspathulate, 12–16 mm long, creamy-green or yellowish, often tinged pink, subglabrous or puberulent (especially on sectors exposed before anthesis); staminal tube glabrous, colour as petals, anthers oblong, *c.* 1 mm long; ovary densely appressed pubescent. **Infructescence** pendulous with up to 6 fruits. **Fruits** (2.5–)3.5–5 × 2.5–4 cm, dark brown, lenticellate. **Seeds** *c.* 1.2 cm long.

Distribution. India and Nepal, east and southeastwards from S China (including Hainan), Sri Lanka and the Andaman Islands to Sumatra (north but rare), Peninsular Malaysia (but not in the south) and Borneo. In Borneo, known only in Sarawak and recorded from Bau and Serian districts (e.g., *Jacobs 5171, Mabberley 1640, S 12520, S 22093, S 28037 and S 31612*).

Ecology. Rain forest and semi-deciduous forest, including bamboo forests and those on limestone, at altitudes to 900 m. In Sarawak, the species is locally frequent in forest on limestone hills, often associated with igneous-derived soils (Anderson *op. cit.*). It is a colonist of bare ground, including road cuttings in Peninsular Malaysia and tropical Australia where it has been introduced.

Uses. The timber is an export of Myanmar and India and is known in world commerce as *chickrassy*, *yinma* or Chittagong wood. It may be coppiced and it has been tried in tropical Australian plantations, but it is susceptible to the depredations of *Hypsipela* moths. It yields a gum that is marketed mixed with others in India, while the flowers are the source of a yellow or red dye. The bark is astringent. An extract from the twigs has proved an efficacious antifeedant against caterpillars of *Pieris rapae* in S China. In ASEAN countries, the timber is commonly used for interior finishing, panelling, moulding, flooring, decorative furniture, handicrafts, sliced veneer, and also suitable for medium to heavy, under cover construction work. (For details, *cf.* PROSEA 5, 2 (1995) 127 and Wong, T.M. (revised by S.C. Lim & R.C.K. Chung, 2002). A dictionary of Malaysian Timbers, 2nd ed., Mal. For. Rec. 30: 33 & 171.)

Notes. The trees from Sarawak (and Peninsular Malaysia) are almost glabrous, whilst in Sumatra both this form and a densely pubescent one have been collected. In SE Asia pubescence is correlated with bark form and other characters, indicating some ecogeographical morphological variation within the species there (Kalingire *et al.*, Austr. J. Bot. 50 (2002) 319).

6. DYSOXYLUM Blume

(Greek, *dys* = unpleasant, *xylon* = wood; referring to the foetid tissues of some species)

jarum-jarum (Malay), *membalun* (standard ASEAN trade name), *segera* (Iban)

Bidjr. Fl. Ned. Ind. (1825) 172; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 546; King, J. As. Soc. Beng. 64, 1 (1895) 36; Merrill, EB (1921) 320, Enum. Philip. Pl. 2 (1923) 562, PEB (1929) 120; Ridley, FMP 1 (1922) 390; Masamune, EPB (1942) 375; Backer & Bakhuizen *f.*, FJ 1 (1964) 121; Pennington & Styles, Blumea 22 (1975) 504; Anderson, CLTS (1980) 251; Corner, WSTM 3rd. ed. 2 (1988) 499; Mabberley *in* Mabberley & Pannell, TFM 4 (1989) 239, Blumea 38 (1994) 303, PB 2nd. ed. (1997) 246; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 230; Mabberley *et al.*, FM 1, 12 (1995) 61; Coode *et al.* (eds.), CLBD (1996) 204; Argent *et al.* (eds.), MNDT-CK 2 (1997) 416; PROSEA 5, 3 (1998) 197; Beaman & Anderson, PMK 5 (2004) 129. **Synonyms:** *Epicharis* Blume *op. cit.* (1825) 166; *Didymocheton* Blume *op. cit.* (1825) 177; *Goniocheton* Blume *op. cit.* (1825) 177; *Hartighsea* A.Juss., Bull. Sci. Nat. Géol. 23 (1830) 237; *Prasoxylon* M.J.Roem., Fam. Nat. Syn. Monogr. (1846) 83, 101, *nom. superfl.*; *Macrocheton* (Blume) M.J.Roem. *op. cit.* 84, 104 ('*Macrochiton*'); *Piptosaccos* Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 415; *Alliaria* Kuntze, Rev. Gen. 1 (1891) 108, *nom. superfl.*, *non* Fabr. (1759). (For further synonymy *cf.* Mabberley *et al. op. cit.*)

Trees or shrubs, often very pachycaul, usually dioecious. **Indumentum** of simple hairs, very rarely with stellate ones. **Bud scales** absent. **Leaves** in spirals, rarely opposite, *pinnate*, occasionally with tardily developed apical leaflets. **Inflorescences** *thyrsoid*, *racemose* or *spicate*, sometimes reduced to fascicles or solitary flowers, axillary, on twigs or bole. **Flowers** unisexual, rarely bisexual; calyx tubular, 3–5(or 6)-lobed; *petals* 3–6, free or adnate to base of staminal tube; staminal tube cylindrical to urceolate (= urn-shaped), margin entire, lobed or tipped with 6–10(–13) appendages, anthers 6–16, within throat of staminal tube; *disc free*, tubular though sometimes short or even subannular, margin sometimes lobed; ovary 2–6-locular, each locule with 1 or 2 ovules, stylehead capitate to discoid. **Fruits** *capsular*, 2–6-valved, each valve with 1 or 2 seeds. **Seeds** anatropous, very variable, usually with aril or sarcotesta; embryo with thick, collateral, oblique or superposed cotyledons; radicle superior or adaxial, extending to the surface or included. Germination cryptocotylar or less frequently phanerocotylar; eophylls usually opposite, rarely spirally arranged, simple, trifoliate, or pinnate, entire or toothed.

Distribution. About 80 species of tropical E Asia from India and Sri Lanka (3) to S China, Indo-China, throughout Malesia (including Christmas Island, 1) to the Pacific south to Australia (15), New Caledonia (9), Norfolk Island (1), Lord Howe Island (1, endemic), New Zealand (1, endemic) and east to Niue (1). In Sabah and Sarawak, 22 (including one incompletely known) species are recognised. The greatest distribution of any Indo-Pacific genus in the family with high levels of endemism in New Guinea (16 of 28; *cf.* Borneo with 2 of 22, Peninsular Malaysia with 2 of 17, Fiji with 7 of 9 and New Caledonia with 8 of 9), demonstrating a distinctly austral richness by comparison with its ally *Chisocheton* and the largest genus in Borneo, *Aglaiia*.

Ecology. Various types of humid rain forest at 0–2580 m altitude with one rheophyte, *D. angustifolium* King, of Peninsular Malaysia.

Uses. The timber of several species of *Dysoxylum* in Sabah and Sarawak (e.g., *D. acutangulum* subsp. *acutangulum*, *D. alliaceum*, *D. arborescens*, *D. carolinae*, *D. cauliflorum*, *D. crassum*, *D. cyrtobotryum*, *D. densiflorum*, *D. excelsum*, *D. flavescens*, *D. grande*, *D. macrocarpum*, *D. mollissimum*, *D. oppositifolium*, *D. parasiticum* and *D. rigidum*) is suitable for medium to heavy construction work, planking, flooring, panelling, and for manufacturing high grade furniture, wood-pallets, veneer and plywood. (For details, cf. PROSEA 5, 3 (1998) 197 and Wong, T.M. (revised by S.C. Lim & R.C.K. Chung, 2002). A Dictionary of Malaysian Timbers, 2nd ed., Mal. For. Rec. No. 30: 46 & 65.)

Notes. *Dysoxylum* differs from *Chisocheton* in its anatropous seeds, though otherwise there are great similarities in those species of *Chisocheton* with a prominent disc and no pseudogemma, notably *C. macranthus* and allies, where there are fruits with stinging hairs similar to those in *D. sessile* Miq. of Maluku for instance. The genus is divisible into two sections, sect. **Cyrtochiton** and sect. **Dysoxylum** which can be distinguished as follows:

Sect. **Cyrtochiton:** Apical buds composed of stiletto- or spike-like young leaves. Inflorescences usually spicate (= unbranched). Flowers 4-merous. Seeds unitegmic. Species occurring in Sabah and Sarawak are: 1. *D. acutangulum*, 4. *D. brachybotrys*, 5. *D. carolinae*, 8. *D. cyrtobotryum*, 11. *D. flavescens*, 12. *D. grande*, 13. *D. macrocarpum*, 16. *D. oppositifolium*, 17. *D. pachyrhache*, 21. *D. rugulosum* and 22. *Dysoxylum* sp. 3.

Sect. **Dysoxylum:** Apical buds composed of fist-like young leaves. Inflorescences usually branched. Flowers (3 or)4–6-merous. Seeds bitegmic. Species known in Sabah and Sarawak are: 2. *D. alliaceum*, 3. *D. arborescens*, 6. *D. cauliflorum*, 7. *D. crassum*, 9. *D. densiflorum*, 10. *D. excelsum*, 14. *D. magnificum*, 15. *D. mollissimum*, 18. *D. papillosum*, 19. *D. parasiticum* and 20. *D. rigidum*.

Key to *Dysoxylum* species (excluding species 22 [*Dysoxylum* sp. 3])

1. Leaves opposite or subopposite or subdecussate.....2
Leaves in spirals.....4
2. Leaflets pubescent, at least on the lower surface.....**16. D. oppositifolium**
Leaflets glabrous.....3
3. Apical buds stiletto-like. Leaves subdecussate. Leaflets subopposite; blades elliptical, 9–15 × 5–6.5 cm; lateral veins 14–16 on each side of midrib; lateral and intercostal veins obscure.....**1. D. acutangulum**
Apical buds spike-like. Leaves opposite or subopposite. Leaflets opposite; blades

- oblong, 7(–12) × 3(–4) cm; lateral veins *c.* 20 on each side of midrib; lateral and intercostal veins prominent.....**5. D. carolinae**
4. Terminal leaflet present.....5
Terminal leaflet absent; small ‘spike’ or scar almost always present.....9
5. Inflorescences axillary.....6
Inflorescences on branches or bole.....7
6. Twigs 3–5 mm diameter apically. Leaves with up to 4 leaflets on each side of rachis; blades elliptical to obovate, apex conspicuously acuminate. Inflorescences 2–8(–25) cm long. Petals 5. Anthers 10 (or 11). Fruits usually 5-valved.....**3. D. arborescens**
Twigs *c.* 10 mm diameter apically. Leaves with up to 14(–17) leaflets on each side of rachis; blades oblong to ovate, apex apiculate to acute. Inflorescences to 60 cm long. Petals 4. Anthers 8. Fruits usually 4-valved.....**15. D. mollissimum**
7. Calyx 7–15 mm tall.....**19. D. parasiticum**
Calyx less than 4 mm tall.....8
8. Twigs with prominent petiole scars. Leaves to 150 cm long, with up to 8 strongly asymmetrical lateral leaflets on each side of rachis. Inflorescences racemose or thyrsoid, on branches. Fruits silky hairy.....**9. D. densiflorum**
Twigs lenticellate. Leaves to 60 cm long, with 3–6 not strongly asymmetrical leaflets on each side of rachis. Inflorescences spicate, on branches and bole. Fruits more or less glabrous.....**6. D. cauliflorum**
9. Apical bud not spike-like, the young leaves like clenched fists.....10
Apical bud spike-like or stiletto-shaped.....15
10. Leaves strictly paripinnate with terminal pair of leaflets.....**7. D. crassum**
Leaves different.....11
11. Leaflets glabrous; intercostal venation markedly scalariform. Petals 5. Tissues onion-scented.....**20. D. rigidum**
Leaflets glabrous or not; intercostal venation different. Petals 4 or 5. Tissues onion-scented or not.....12
12. Lower surface of leaflets densely reddish-velutinous or yellowish-pilose. Inflorescences spicate.....13
Leaflets and inflorescences different.....14
13. Shoots and lower surface of leaflets densely reddish-velutinous. Leaves to 100 cm long; leaflets 5 or 6 on each side of rachis; blades oblong. Inflorescences to 60 cm long. Calyx 5-crenate. Petals 5. Anthers 10. Fruits depressed globose, at least 8 cm diameter.....**14. D. magnificum**
Shoots and lower surface of leaflets yellowish-pilose. Leaves to 45 cm long; leaflets 2 or 3 on each side of rachis; blades elliptical to obovate. Inflorescences 1.5–7.5 cm long. Calyx 4-toothed. Petals 4. Anthers 8. Fruits pear-shaped, *c.* 2 cm diameter.....**18. D. papillosum**

14. Leaflets asymmetrical at base, rarely subequal, shining above. Calyx and corolla glabrous. Infructescences more or less branched. Whole plant, or at least fruit, onion-scented.....**2. D. alliaceum**
 Leaflets more or less symmetrical, not markedly shining above. Calyx and corolla pubescent. Infructescences more or less unbranched. Whole plant not smelling of onions.....**10. D. excelsum**
15. Lower surface of leaflets yellow-tomentose.....16
 Lower surface of leaflets glabrous to subglabrous.....17
16. Leaves with 6–9 leaflets on each side of rachis; lateral veins of leaflets 23–25 on each side of midrib. Inflorescences 10–30 cm long. Fruits depressed globose..**12. D. grande**
 Leaves with 2–4 leaflets on each side of rachis; lateral veins of leaflets 15–18 on each side of midrib. Inflorescences to 8 cm long. Fruits subpyriform..**17. D. pachyrhache**
17. Intercostal venation scarcely distinguishable from lateral veins.....**1. D. flavescens**
 Lateral veins distinct; intercostal venation often obscure.....18
18. Leaves strictly paripinnate.....19
 Leaves more or less imparipinnate with almost alternate leaflets.....20
19. Petioles 6–15 cm long. Lateral veins of leaflets prominent below. Inflorescences supra-axillary. Petals *c.* 8 mm long. Staminal tube crenate to toothed.....**21. D. rugulosum**
 Petioles 4–7 cm long. Lateral veins of leaflets subprominent below. Inflorescences in the axils of leaves or petiole scars. Petals *c.* 6 mm long. Staminal tube truncate.....**4. D. brachybotrys**
20. Twigs 7–13 mm diameter apically. Apical buds spike-like. Leaflet blades elliptical-ovate, to 30 × 10 cm; lateral veins 13–18 on each side of midrib. Inflorescences with spreading branches. Fruits to 10 cm diameter.....**13. D. macrocarpum**
 Twigs 5–7 mm diameter apically. Apical buds stiletto-like. Leaflet blades oblong-ovate, 18–23 × 6–12 cm; lateral veins 7–13 on each side of midrib. Inflorescences subspicate to scarcely branched. Fruits *c.* 5 cm diameter.....
**8. D. cyrtobotryum**

1. *Dysoxylum acutangulum* Miq.

(Latin, *acutangulus* = acute-angled; referring to the petiole)

Sect. *Cyrtochiton*

Fl. Ind. Bat., Suppl. (1861) 196, 503; King *op. cit.* 41; Ridley *op. cit.* (1922) 393; Anderson *op. cit.* (1980) 251; Mabberley *op. cit.* (1989) 240, *op. cit.* (1994) 303; Mabberley *et al. op. cit.* 129; Turner, Gard. Bull. Sing. 47 (1995) 340; Argent *et al.* (eds.) *op. cit.* 419; PROSEA 5, 3 (1998) 200; Beaman & Anderson *op. cit.* 129. **Type:** *Teijsmann s.n. [HB 3218]*, Sumatra, Banka, near Jebus (holotype U [Acc. No. 39415]; isotypes BO, K L [Acc. No. 9032951]). **Synonym:** *Alliaria acutangula* (Miq.) Kuntze *op. cit.* 109.

Distribution. A widespread but locally uncommon species distributed from Peninsular Thailand, throughout Malesia, to tropical Australia and the Solomon Islands.

Notes. Two subspecies, subsp. *acutangulum* and subsp. *foveolatum* (Radlk.) Mabb. are recognised with the latter differing from the former in being a smaller tree with leaflets 4–6 (or 7) on each side of rachis (vs. 2–4), narrowly elliptical (vs. elliptical), usually with domatia (vs. without domatia), and is not found in Borneo.

subsp. **acutangulum**

Tree to 47 m tall; bole to 140 cm diameter, fluted and clear to 18 m tall; buttresses to 3 m tall and 2 m out. **Bark** smooth, yellowish, with conspicuous lenticels, becoming irregularly cracked and shedding large scales; inner bark yellowish to bright orange, somewhat speckled and with groups of conspicuously thickened lenticels. **Sapwood** orange-brown, hard. **Twigs** c. 6 mm diameter apically, with conspicuous petiole scars and lenticels. **Apical buds** *stiletto-like* with minute fulvous-tomentum. **Leaves** *subdecussate*, 15–30(–40) cm long, *paripinnate* with minute apical spike or its scar; petioles 8–11 cm long, 3–4 mm diameter, grooved and angled adaxially when dry, base somewhat swollen; *leaflets glabrous* to minutely puberulous, 2–4 on each side of rachis, *subopposite*; *blades* of largest leaflets (the most distal) *elliptical*, 9–15 × 5–6.5 cm, coriaceous, when fresh minutely pellucid-punctate, minutely rugulose when dry, base acute, more or less asymmetrical, apex acute to acuminate; *lateral veins* 14–16 on each side of midrib, rather *obscure*, spreading, without domatia in their axils; petiolules 5–8(–10) mm long, scarcely swollen. **Inflorescences** *spicate*, 3–8 cm long, narrow, axillary to borne on twigs; axes pubescent, bearing fascicles of 1–few flowers; bracts c. 0.5 mm long, densely pubescent. **Flowers** sweetly scented; pedicels to 1 mm long; *calyx* c. 2.5 mm diameter, very shallowly crateriform (= bowl-shaped), confluent with pseudopedicel c. 1 mm long, sparsely shortly pubescent outside, *margin somewhat 4-lobed*; *petals* 4, oblong, 12–13 mm long, more or less puberulous on both sides, yellow or creamy-yellow, apices acute; staminal tube sometimes sparsely pubescent outside, glabrous inside, margin crenulate, *anthers* 8 (or 10), ovate to elliptical, c. 1 mm long, weakly exerted; disc shallowly cup-shaped, c. 1.5 mm tall, fleshy, glabrous or sometimes pubescent inside, red; ovary densely pubescent, (3 or)4-*locular*, each locule with 2 collateral ovules, style pubescent in proximal half, stylehead subdiscoid. **Fruits** subglobose to pyriform (= pear-shaped), 5–8 cm diameter, (3 or)4-valved, glabrous, orange; pericarp to 1 cm thick, heavily veined when old, latex white. **Seeds** (3 or) 4, sometimes some aborted, ellipsoid, c. 2 cm long, black with small orange ariloid hilum on one side.

Distribution. ?Peninsular Thailand, Sumatra (including Riau-Lingga Archipelago, Billiton, Banka), Peninsular Malaysia, Borneo (Sabah, Sarawak and Kalimantan) and the Philippines (Palawan). In Sabah, known from Ranau and Tawau districts (e.g., *SAN* 26459, *SAN* 30761, *SAN* 53882 and *SAN* 94226) and in Sarawak from Lawas district (e.g., *S* 27922). Also occurring in E Kalimantan (e.g., *Sabana* 2).

Ecology. Rain forest at altitudes to 1000 m.

Uses. *Dysoxylum acutangulum* subsp. *acutangulum* is perhaps traditionally the most important native Meliaceous timber tree in the region and was formerly much exported from Sumatra (Banka) to Java. The wood of the bole, and particularly the buttresses, is beautifully marked but difficult to work (Burkill, DEPMP 1 (1935) 884 and PROSEA 5, 3 (1998) 197): it has been largely used for furniture but also beams, cartwheels and coffins.

2. *Dysoxylum alliaceum* (Blume) Blume

Fig. 19.

(Latin, *alliaceus* = onion-like; referring to the smell of the tissues when bruised)**Sect. *Dysoxylum***

Bijdr. Fl. Ned. Ind. (1825) 172; Backer & Bakhuizen *f. op. cit.* 123; Anderson *op. cit.* (1980) 251; Mabberley *op. cit.* (1989) 240; Kessler & Sidiyasa, TBSK-EK (1994) 169; Mabberley *et al. op. cit.* 106; Turner *op. cit.* 340; Coode *et al. (eds.) op. cit.* 204; Argent *et al. (eds.) op. cit.* 419; PROSEA 5, 3 (1998) 200; Beaman & Anderson *op. cit.* 129. **Basionym:** *Guarea alliacea* Blume *apud* Nees, Flora 7 (1824) 290. **Type:** Blume '196', Java, G. Salak (holotype L [Acc. No. 903257765]; isotypes L [Acc. No. 903257762 & 90325776]). **Synonyms:** *Prasoxylon alliaceum* (Blume) M.J.Roem. *op. cit.* 101, *nom. superfl.*; *Dysoxylum lampongum* Miq. *op. cit.* (1861) 196, 503, Merrill *op. cit.* (1921) 320, Masamune *op. cit.* 376; *Dysoxylum thyrsoideum* Hiern *op. cit.* 547, Merrill *op. cit.* (1921) 320, Ridley *op. cit.* (1922) 393, Masamune *op. cit.* 376, Anderson *op. cit.* (1980) 252. (For complete synonymy, *cf.* Mabberley *et al. op. cit.*)

Tree to 38 m tall, often of poor form; bole to 80 cm diameter, fluted to *c.* 4 m with buttresses to 60 cm tall and 1 m out. **Bark** thin, lenticellate to finely fissured and shedding irregular strips; inner bark red-brown, yellower inside, *usually with strong smell of onions*. **Sapwood** fawnish; heartwood red-brown. **Twigs** with conspicuous petiole scars, striate, non-lenticellate, 5–8 mm diameter apically. **Apical buds** with *fist-shaped young leaves*, more or less pubescent. **Leaves** spirally arranged, to 60(–120) cm long, *more or less paripinnate, usually smelling of onions when crushed*; petioles 5–15 cm long, flattened adaxially, weakly swollen at base; *leaflets subglabrous*, subcoriaceous, 3–6(–8) on each side of rachis, opposite to subopposite, *with an apical pair or one of these appearing terminal and with a small apical scar*; blades elliptical or ovate, or subfalcate, 7.5–25 × 2.5–7.5 cm, *shiny dark green above, base more or less asymmetrical*, apex acuminate; lateral veins 8–12(–14) on each side of midrib, arcuate, subprominent below; petiolules 5–20 mm long, sulcate. **Inflorescences** to 40 cm long, *pyramidal; proximal branches 8–20 cm long with branchlets to 5 cm long*, bearing cymules of 1–3 flowers; axes puberulous; bracts and bracteoles minute. **Flower** sweetly scented; buds oblong with truncate apex; pedicels 2.5–4 mm long; *calyx* shallowly cup-shaped or salver-shaped, 2.5–3 mm diameter, *glabrous* to subpuberulous outside, *margin 4-toothed*; *petals* 4 or 5, linear, 5–8 mm long, *valvate, glabrous* or pubescent inside, white, or pinkish, drying black; staminal tube glabrous or puberulous outside, more or less hairy inside, margin subtruncate to 8(–10)-denticulate, *anthers* 8 (or 10), *c.* 1 mm long, included; disc *c.* 1 mm tall, more or less pubescent on both sides, truncate to obscurely lobed, margin ciliate; *ovary* glabrous to hirsute, *3-locular*, each locule with 2 ovules, style terete, stylehead subdiscoïd, somewhat dimpled. **Infructescences** *more or less branched*, to 25 cm long. **Fruits** to 7.5 cm diameter, subglobose or lobed and constricted between seeds or beaked, occasionally markedly so (the beak to 15 mm long) when 1-seeded, greenish white when unripe, red at maturity, drying black. **Seeds** 1–4 per fruit, oblong-globose; testa (= seed coat) red, non-arillate, when cut producing white latex and (usually) *strong smell of onions*.

Vernacular names. Sabah—*langsats-langsats* (Malay), *lantupak* (Malay), *polong longom* (Dusun Kinabatangan). Sarawak—*kayu tunying* (Punan), *segera* (Iban).

Distribution. Andaman Islands and Peninsular Thailand, throughout Malesia to the Solomon Islands and Queensland. In Borneo, known in Sabah from Beaufort, Keningau, Kinabatangan, Kota Belud, Labuk Sugut, Lahad Datu, Papar, Ranau, Sandakan, Sipitang and Tawau districts (e.g., Mabberley 1705, SAN 21470, SAN 29811, SAN 36280 and SAN

99296) and in Sarawak from Bintulu, Limbang, Lubok Antu, Lundu and Miri districts (e.g., *S* 33919, *S* 38056, *S* 39496, *S* 40316 and *S* 43137). Also occurring in Brunei (e.g., *SAN* 17493) and Kalimantan (e.g., *Burley et al.* 831 and *Wilkie* 93414).

Ecology. Rain forest, including that on limestone, at altitudes to 1800 m. A similar onion scent of the slashed barks/trees is also found in *Dysoxylum magnificum*, *D. mollissimum* and *D. rigidum*. That it is not universal in *D. alliaceum* deserves study.

Notes. Although rather uniform in Borneo, this is a polymorphic species across its range yet it cannot be readily subdivided formally. It is closely related to *Dysoxylum excelsum*; sterile dried material of the two species sometimes being particularly difficult to separate. Large-flowered forms of *D. alliaceum* approach the small-flowered forms of *D. excelsum*, though the latter never have the onion smell, but have larger bracts and bracteoles and, generally, smaller infructescences, than does *D. alliaceum*.

3. *Dysoxylum arborescens* (Blume) Miq.

(Latin, *arborescens* = tree-like)

Sect. *Dysoxylum*

Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 24; King *op. cit.* 38; Merrill *op. cit.* (1921) 320; Ridley *op. cit.* (1922) 391; Masamune *op. cit.* 375; Backer & Bakhuizen *f. op. cit.* 123; Anderson *op. cit.* (1980) 252; Mabberley *op. cit.* (1989) 242; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabberley *et al. op. cit.* 103; Turner *op. cit.* 341; PROSEA 5, 3 (1998) 200; Beaman & Anderson *op. cit.* 129. **Basionym:** *Goniocheton arborescens* Blume *op. cit.* (1825) 177. **Type:** Blume *s.n.* [‘905’], Java, foot of G. ‘Salak et Seribu’, 1824 (holotype L [*Acc. No.* 90329565]; isotype L [*Acc. No.* 90329566]). **Synonyms:** *Trichilia arborescens* (Blume) Spreng., *Syst. Veg.* 4, 2 (1827) 252; *Alliaria arborescens* (Blume) Kuntze *op. cit.* 109; *Dysoxylum rubrum* Merr., Philip. Govt. Lab. Bur. Bull. 35 (1906) 32, Anderson *op. cit.* (1980) 252.

Treelet or tree to 20(–30) m tall, but usually less and often flowering when *c.* 1 m or so high; bole to 45 cm diameter, fluted or with buttresses to 1 m tall and 45 cm out. **Bark** smooth to weakly cracked, lenticellate, grey-brown to blackish, sometimes mottled; inner bark straw to pale brown. **Sapwood** fawnish. **Twigs** slender, 3–5 mm diameter apically, rough with prominent lenticels, grey-brown. **Apical buds** with fist-shaped young leaves. **Leaves** spirally arranged, to 45 cm long, *imparipinnate*, though some leaves *paripinnate* also; petioles to 7 cm long, subterete to weakly angled, glabrous, base swollen, drying blackish; leaflets chartaceous to subcoriaceous, glabrous; *lateral leaflets to 4 on each side of rachis; blades elliptical*, sometimes narrowly so, *to obovate*, 8.5–18 × 3–7 cm, most proximal the smallest, base cuneate, sometimes more or less asymmetrical, *apex conspicuously acuminate*, acumen to 12 mm long; lateral veins 7–9(–10) on each side of midrib, spreading, arcuate; petiolules to 6 mm long, swollen, drying blackish. **Inflorescences** *subaxillary*, 2–8(–25) cm long, tawny-puberulous; *branches somewhat congested, subascending or subsquarrose*, to 5(–12) cm long. **Flowers** sweetly scented; bracteoles triangular, to 1.5 mm, tawny pubescent, fugacious (= ephemeral); *calyx* shallowly cup-shaped, 2.5–4 mm diameter distally, articulated with pedicel by slender pseudopedicel 3–6 mm long, somewhat appressed fawn-pubescent, *margin irregularly 5-lobed*; corolla weakly clavate in bud, adhering to staminal tube at base, *petals (4 or) 5 (or 6)*, 7–10 × 1.8–2.2 mm, valvate, waxy,

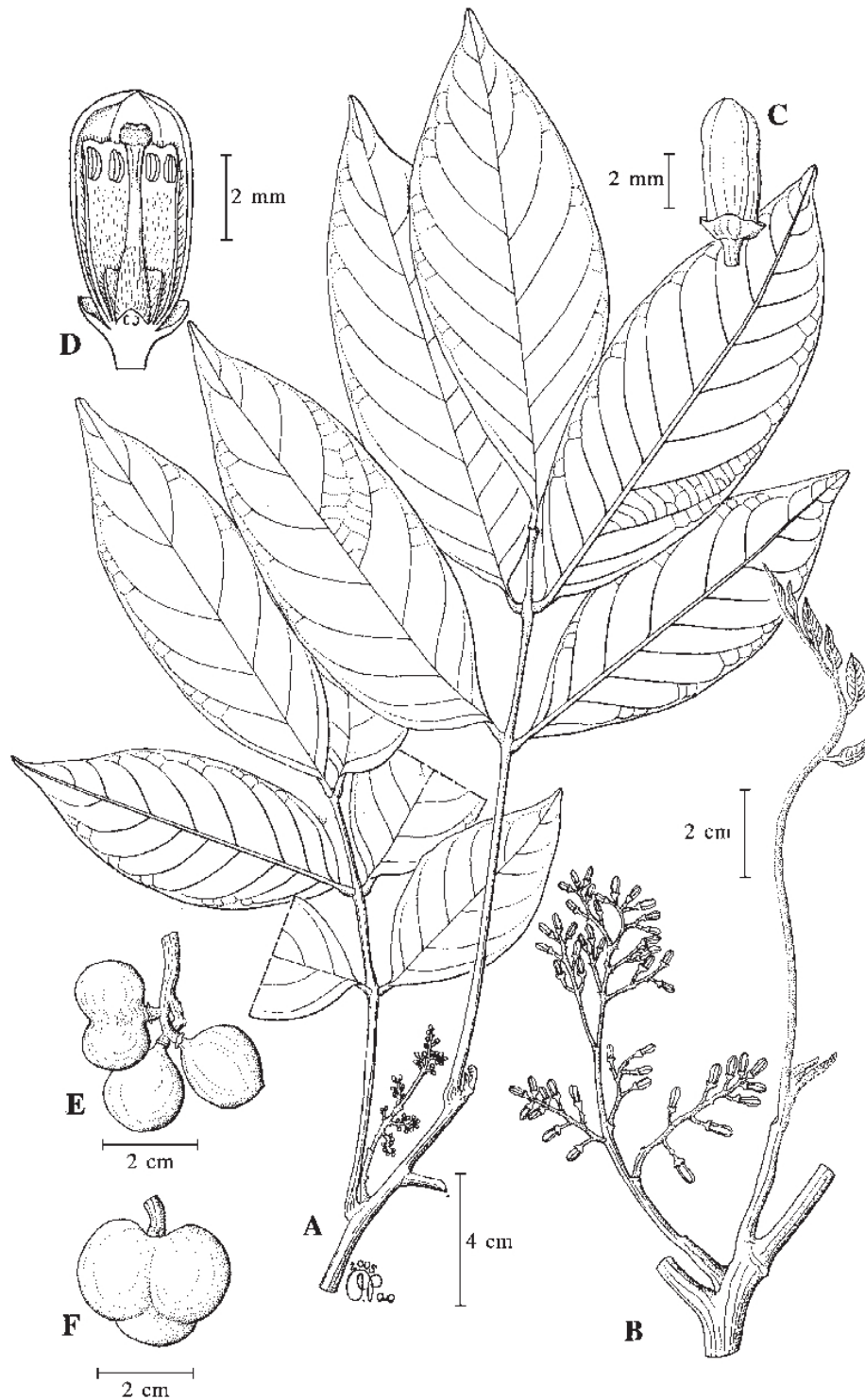


Fig. 19. *Dysoxylum alliaceum*. A, flowering leafy twig; B, male inflorescence; C, male flower bud; D, longitudinal section of male flower bud; E, infructescence; F, fruit. (A from SAN A 4034, B–D from SAN A 2578, E from SAN 44502, F from SAN A 4808.)

creamy-green to off white, glabrous or sometimes with minute hairs outside, apex boat-shaped; staminal tube sparsely appressed pubescent inside, glabrous outside, margin subtruncate to weakly crenulate, *anthers* 10 (or 11), *c.* 1 mm long, inserted near margin; disc shortly tubular, 1–1.5 mm tall, ascendant pubescent inside, glabrous outside, margin crenulate; *ovary* pubescent, (3 or)4- or 5-locular, each locule with 2 collateral ovules, style terete, ascendant-pubescent in proximal 2/3, stylehead subdiscoid, often dimpled, *c.* 1 mm diameter. **Infructescences** to at least 25 cm long, sometimes appearing terminal, suberect; axes *c.* 5 mm diameter, subterete. **Fruits** depressed globose, to 3 cm diameter, (*rarely* 3)5-valved, often somewhat irregular and weakly angled between valves, bright pink-red, drying black, glabrous; endocarp white within. **Seeds** 1–6, *c.* 18 × 15 mm, planoconvex, non-arillate; testa bright orange, sarcotestal; hilum *c.* 8 mm diameter, white.

Vernacular names. Sabah—*kalimangang* (Ranau), *olop-olop* (preferred name), *tama malid* (Malay, Tambunan).

Distribution. Nicobar and Andaman Islands, Taiwan (Lan Yü), throughout Malesia to Solomon Islands, Queensland and Vanuatu. In Borneo, recorded in Sabah from Kinabatangan, Kota Belud, Kota Marudu, Lahad Datu, Papar, Ranau, Sandakan, Tambunan and Tenom districts (e.g., *Pennington* 7932, *SAN* 15317, *SAN* 27269, *SAN* 89310 and *SAN* 109760) and in Sarawak from Bau, Kuching, Limbang, Lundu and Serian districts (e.g., *S* 5769, *S* 28101, *S* 37402 and *S* 76648). Also occurring in Kalimantan (e.g., *Endert* 1716 and *Kostermans* 5756). Not yet recorded from Brunei.

Ecology. A very common tree of various forest types including that on limestone, at altitudes to 1500 m, also persisting in village orchards and edges of forest.

Notes. Most of the specimens I have examined have bisexual flowers. Specimens from Borneo (and New Guinea) often have fasciated proliferating inflorescences, though none with mature flowers has been seen. Similar conditions are known in *Dysoxylum cyrtobotryum* (*q.v.*).

4. *Dysoxylum brachybotrys* Merr.

(Greek, *brachy-* = short, *-botrys* = bunch (of grapes); referring to the inflorescence)

Sect. *Cyrtochiton*

Phil. J. Sci. 26 (1925) 461; Mabblerley *et al. op. cit.* 128; Coode *et al. (eds.) op. cit.* 204; Beaman & Anderson, *op. cit.* 130. **Type:** *BS* 37012, the Philippines, Mindanao, Zamboanga, Malangas (holotype PNH†; isotypes A, K, L, P, US). **Synonym:** *Dysoxylum brachystachys* Ridl., Bull. Misc. Inform. Kew (1930) 364.

Tree to 20 m tall, flowering when only a few metres tall; bole to 15 cm diameter. **Bark** rugulose; inner bark bright orange. **Sapwood** straw. **Twigs** *c.* 5 mm diameter apically. **Apical buds** *stiletto-like*, puberulent. **Leaves** *spirally arranged*, 20–30 cm long, *strictly paripinnate*, with *apical pair of leaflets and spike to 8 mm long or its scar between them*; *petioles* 4–7 cm long, swollen at base; *leaflets* 2–4 on each side of rachis, alternate to subopposite, chartaceous to subcoriaceous, *glabrous*, surface minutely verruculose when dry, paler below; blades oblong to narrowly elliptical or ovate, 8–18 × 3–7 cm, base acute, attenuate, apex cuspidate-acuminate acumen to 2 cm long; midrib prominent on both sides; *lateral veins* 7–9 on each side of midrib, some at least opposite, *subprominent*

below, obscurely looped at extreme margin, domatia in axils of most; *intercostal venation obscure*; petiolules 5–8 mm long, rather swollen, especially apical ones, drying blackish. **Inflorescences** spicate, to 5 cm long, *in axils of leaves or petiole scars*; axes 2–3 mm diameter, puberulous, bearing congested cymules of subsessile flowers (*n.v.*); *calyx* cup-shaped, puberulous outside, yellowish, *margin 4-lobed*; *petals 4*, *c. 6 × 2.5 mm*, subpuberulous outside, cream; *staminal tube* glabrous, *truncate*, *anthers 8*, *c. 1 mm* long; disc *c. 1 mm* tall; ovary puberulous, style subpuberulous, stylehead orbicular. **Fruits** solitary, pyriform, *c. 3.5 cm* long and diameter, deeply 3- or 4-lobed, glabrous, veined, bright red when mature, drying black. **Seeds** 3 or 4, flattened ellipsoid, *c. 2 × 1.5 cm*, green; hilum *c. 1 cm* long.

Vernacular names. Sarawak—*bunyau* (Iban), *segera* (Iban).

Distribution. Borneo and the Philippines (Mindanao). In Borneo, known only in Sarawak from Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu, Miri and Tatau districts (e.g., *Mabberley 1597*, *Pennington 7975*, *S 35174*, *S 41800* and *S 53827*) and in Brunei (e.g., *Dransfield JD 7164*).

Ecology. Rain forest to mossy forest at altitudes to 1200 m, common on ridges as at G. Lundu, Sarawak.

Notes. Several specimens have marked perforations, usually running along veins of expanded leaves, due to (?) insects. The domatia are characteristic, but the species is very closely related to *Dysoxylum rugulosum*.

5. *Dysoxylum carolinae* Mabb.

(Caroline M. Pannell (1955–), English botanist, monographer of *Aglaia*)

Sect. *Cyrtochiton*

Blumea 38 (1994) 305; *Mabberley et al. op. cit.* 131; *Turner op. cit.* 341; *Coode et al. (eds.) op. cit.* 204; *PROSEA* 5, 3 (1998) 200. **Type:** *Symington FD 49827*, Peninsular Malaysia, Pahang, Kemasul FR (holotype KEP [seen 1994, not found 2003]). **Synonym:** *Dysoxylum* sp. I, *Mabberley op. cit.* (1989) 246.

Tree to 45 m tall; bole to 110 cm diameter, fluted; buttresses to 4 m tall and 3 m out, 15 cm wide, concave. **Bark** smooth with large oblong lenticels to 6 mm long, to flaking, grey to dark brown; inner bark white with coarse orange flecks and strong smell of stewing vegetables. **Sapwood** yellow-brown. All young parts fulvous-tomentellous. **Twigs** 4–8 mm diameter apically, angled, greyish, held erect. **Apical buds** *spike-like*, plump. **Leaves** *opposite or subopposite*, 10–25 cm long, paripinnate, with small apical scar; petioles 5–8 cm long; *leaflets 3–5* on each side of rachis, *opposite*, coriaceous, *upper surface* shining and *glabrous*, lower surface minutely rugulose; *blades oblong*, (subapical the largest) to 7(–12) × 3(–4) cm, base rounded to weakly oblique, apex acuminate; midrib sericeous, pale below, with domatia, strongly keeled above when fresh; *lateral veins c. 20 on each side midrib*, *prominent*, looped at margin; intercostal veins not distinct from lateral veins. **Inflorescences** (not yet collected in Borneo) to 10 cm long, *weakly branched*. **Flowers** faintly citronella-scented; *calyx c. 5 mm* diameter, *c. 1.5 mm* tall, *margin 4-lobed*; *petals 4*, *c. 6 mm* long, puberulous outside; staminal tube narrowed at apex, puberulous outside, becoming yellow,

anthers 8, ovate, *c.* 0.8 mm long, weakly exerted; disc shallowly cup-shaped, *c.* 1 mm high, yellow, margin truncate; *ovary* 4-locular, each locule with 1 ovule. **Infructescences** in axils of fallen leaves. **Fruits** depressed globose, to 6 × 8 cm, splitting into 4 valves, orange-red. **Seeds** 1 or 2 (or 3), *c.* 3 × 2.5 cm, black with orange sarcotesta.

Distribution. Vietnam (1 collection), Sumatra, Peninsular Malaysia, Singapore (extinct) and Borneo. In Borneo, recorded in Sabah from Keningau, Lahad Datu and Sandakan districts (e.g., *SAN 47101* and *SAN 40680*). Also known in Brunei (e.g., *Coode et al. 7113*) and Kalimantan (e.g., *Sidiyasa & Arifin 2105*). Not yet recorded from Sarawak.

Ecology. Lowland and hill forests at altitudes to 1100 m.

6. *Dysoxylum cauliflorum* Hiern

Fig. 20, Plates 5A & B.

(Latin, *cauliflorus* = bearing flowers on the trunk)

Sect. *Dysoxylum*

In Hooker *f.*, *Fl. Br. Ind.* 1 (1875) 549; King *op. cit.* 45; Merrill *op. cit.* (1921) 320; Ridley *op. cit.* (1922) 396; Masamune *op. cit.* 375; Anderson *op. cit.* (1980) 252; Corner *op. cit.* 501; Mabberley *op. cit.* (1989) 242; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabberley *et al. op. cit.* 86; Turner *op. cit.* 341; Coode *et al.* (eds.) *op. cit.* 204; PROSEA 5, 3 (1998) 200; Beaman & Anderson *op. cit.* 130. **Type:** *Maingay 1612* [= *Kew Distr.* 327], Peninsular Malaysia, 'Malacca', 1865-6 (holotype K; isotype L). **Synonyms:** *Dysoxylum beccarianum* C.DC. in A.P. de Candolle, *Mon. Phan.* 1 (1878) 495; Merrill *op. cit.* (1921) 320; *Alliaria beccariana* (C.DC.) Kuntze *op. cit.* 109; *Alliaria hiernii* Kuntze *op. cit.* 109; *Epicharis hierniana* Harms in Engler & Prantl, *Nat. Pflanzenfam.* ed. 2, 19b, 1 (1940) 168, *t.* 35K, *nom. superfl.*; *Lepisanthes forbesii* Baker *f.*, *J. Bot. London* 62, *Suppl.* (1924) 25; *Dysoxylum foxworthyi* Elmer, *Leafl. Philip. Bot.* 9 (1937) 3363.

Tree, 5–20(–30) m tall; clear bole to 16 m tall, to 50 cm diameter, sometimes fluted or with small buttresses to 60 cm tall, 5 cm wide and 30 cm out. **Bark** grey and smooth with lenticels and bosses of defunct inflorescences to mottled brown with rectangular flakes; inner bark fawn with sour smell and no conspicuous latex. **Sapwood** straw-coloured. **Twigs** 3–6 mm diameter apically, *lenticellate*. **Apical buds** with *fist-shaped young leaves*, more or less fulvous-pubescent. **Leaves** *spirally arranged, to 60 cm long, imparipinnate*; petioles 8–16 cm long, 4–5 mm diameter, terete to flattened or grooved adaxially when dry, more or less rusty puberulous or even tomentose, swollen at base; leaflets sparsely pubescent to densely rusty-tomentose, particularly on lower surface of veins and upper surface of midrib, papery when dry, rather bullate when fresh; *lateral leaflets 3–6 on each side of rachis*, opposite or subopposite; blades ovate-elliptical to ovate or obovate (terminal ones), to 17(–30) × 7 cm, the apical one the largest, base cuneate or acute, *lateral ones often asymmetrically so*; venation brochidodromous; lateral veins 9–12 on each side of midrib, prominent below; intercostal venation conspicuously reticulate; petiolules 4–9 mm long (to 15 mm on terminal leaflet), pubescent, somewhat swollen. **Inflorescences** *spicate*, to 8 cm long, *borne on persistent woody tubercles to 7 cm diameter on bole almost to ground level and major branches and sometimes axillary as well*, usually in fascicles, tawny-tomentose; bracts *c.* 1 mm long, triangular, appressed pubescent. **Flowers** sweetly scented; pedicels 2–3 mm long, pubescent; *calyx* cup-shaped 2–3 mm tall, with 3 or 4 irregular shallow teeth, appressed pubescent; *petals* (3 or) 4, linear-oblong, acute, 7–10 mm long, imbricate at least at apices, glabrous or sparsely hairy outside, white to pinkish or creamish; staminal tube

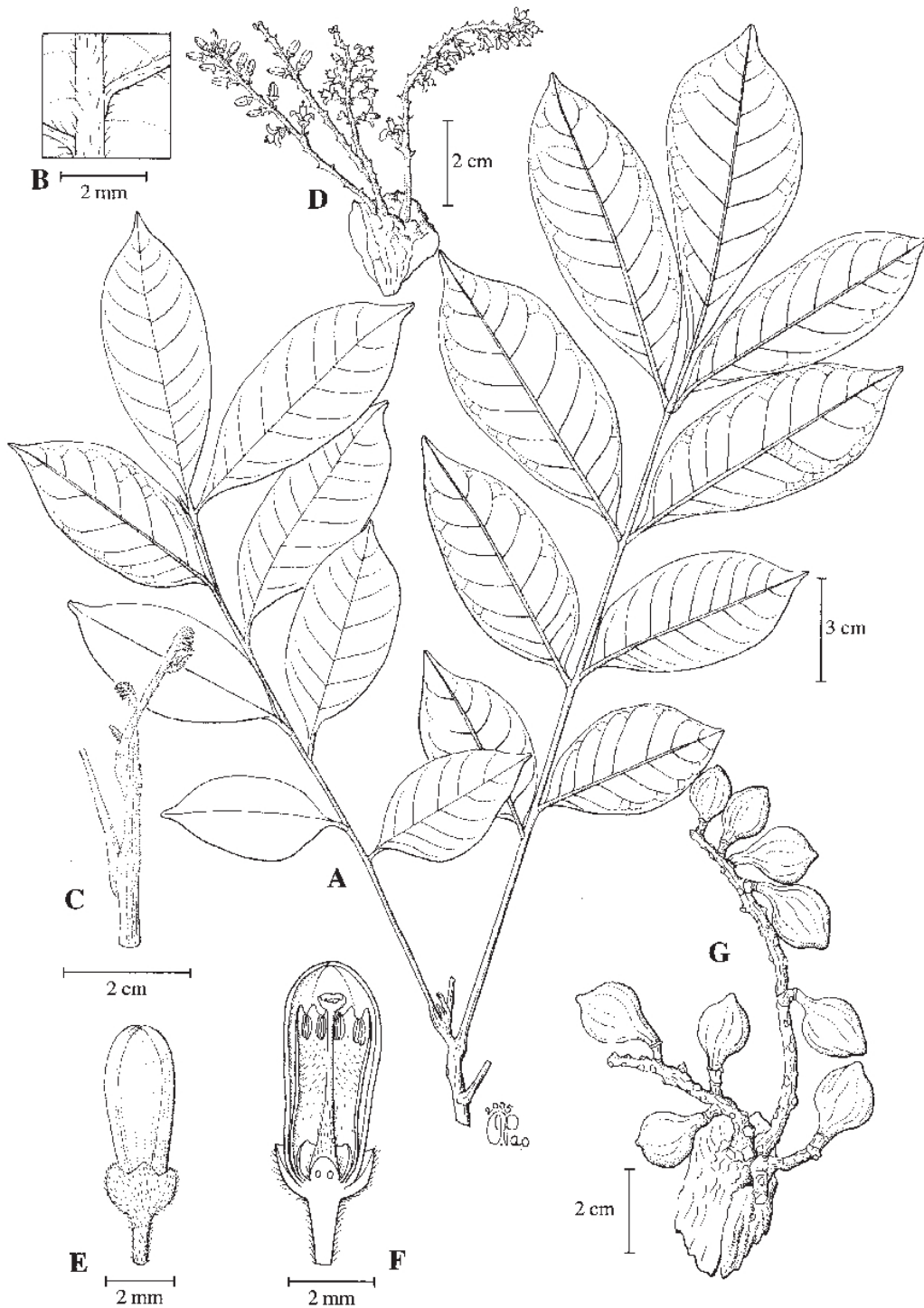


Fig. 20. *Dysoxylum cauliflorum*. A, leafy twig; B, detail of lower leaflet surface showing indumentum; C, distal part of young shoot showing developing young leaves; D, inflorescences; E, flower bud; F, longitudinal section of flower bud; G, infructescences. (A–B from *S* 54515, C from *S* 67556, D from *S* 24818, E–F from *SAN* 16866, G from *SAN* 87626.)

glabrous to puberulent outside, sericeous inside, white margin with (6 or) 8 bifid lobes, *anthers* (6 or) 8 at base of notches between lobes, ovate, *c.* 1 mm long; disc 3–4 mm long, glabrous, margin irregularly lobed; *ovary* (3 or)4(or 5)-locular, pilose, style terete, pilose in proximal half, stylehead subdiscoid, yellow, **Fruits** solitary or clustered at end of rachis to 8 cm long, top-shaped, to 4 × 4 cm, 3- or 4(or 5)-locular, sometimes 3–4-angled or weakly-winged, *glabrous*, red; pericarp with milky latex; valves bright orange inside. **Seeds** 1–4, to 2 × 8 mm, planoconvex, borne on white placenta; aril basal, bright orange; testa black.

Vernacular names. Sabah—*golurut* (Brunei), *tapah* (Dusun Kinabatangan). Sarawak—*segera* (Iban), *uchong chit* (Iban).

Distribution. Myanmar, Indo-China (Vietnam, Cambodia), Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines (Palawan). In Borneo, recorded in Sabah from Kinabatangan, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Tawau and Tenom districts (e.g., *FRI 41277*, *Mabberley 1692*, *SAN 73260*, *SAN 88688* and *SAN 93289*) and in Sarawak from Kapit, Kuching, Lawas, Limbang, Lundu, Miri and Samarahan districts (e.g., *Mabberley 1576*, *S 24818*, *S 30420*, *S 42930* and *S 52441*). Also occurring in Brunei (e.g., *BRUN 120*, *BRUN 3380* and *Kirkup DK 618*) and Kalimantan (e.g., *Burley et al. 2567*).

Ecology. Lowland, hill and lower montane rain forests at altitudes to 1500 m, including ridge forest, freshwater swamp forest and heath forest. A common tree in Borneo, where it is often the most conspicuous of all Meliaceae on account of its striking cauliflory.

7. *Dysoxylum crassum* Mabb.

Fig. 21.

(Latin, *crassus* = thick; referring to the floral parts)

Sect. *Dysoxylum*

Blumea 38 (1994) 305; Mabberley *et al. op. cit.* 98. **Type:** *Murthy S 22671*, Borneo, Sarawak, Marudi district, Dapoi, Long Nyalau (holotype FHO; isotypes BO, K, KEP, L, SAN, SAR, SING).

Tree to 30 m tall; bole to 45 cm diameter. **Bark** fawn to dark purplish brown, fissured to flaking; inner bark pinkish. **Twigs** 5–7 mm diameter apically, striate. **Apical buds** with more or less fist-shaped pubescent young leaves. Lateral buds supra-axillary, pale, pubescent, conspicuous. **Leaves** spirally arranged, 16–30 cm long, strictly paripinnate, with terminal spike or its stub; petioles 4–6 cm long, deeply sulcate to winged, rather warty; leaflets 3–5 on each side of rachis, coriaceous, glabrous; blades elliptical-oblong, 9–14 × 3.5–6 cm, base weakly asymmetrical, cuneate, apex acute to subacuminate; midrib sunken above, prominent below; lateral veins 6–9 on each side midrib, very obscure; petiolules 5–9 mm long, sulcate, blackish when dry. **Inflorescences** 2–4 cm long, branched, few-flowered, supra-axillary or borne on lateral dwarf shoots; axes stout, woody, fawn-pubescent; bracts triangular, *c.* 2 mm long, pubescent. **Flowers** sweetly scented; pedicels *c.* 3 mm long, articulated with pseudopedicels; *calyx* *c.* 4.5 × 8 mm, with pseudopedicel *c.* 1 mm long, more or less pubescent outside, margin irregularly 5-lobed; *petals* 5, lanceolate, *c.* 15 × 6 mm, papillose, pale green to creamy-white; staminal tube glabrous, margin minutely *c.* 20-lobed, the lobes truncate, *anthers* 10, ellipsoid, *c.* 1 mm long, more or less minutely hairy, weakly exerted; disc cushion-like, *c.* 1 mm tall, fleshy, glabrous; *ovary* glabrous, 5-locular, each locule with 2 collateral ovules, style terete, glabrous, stylehead depressed capitate,

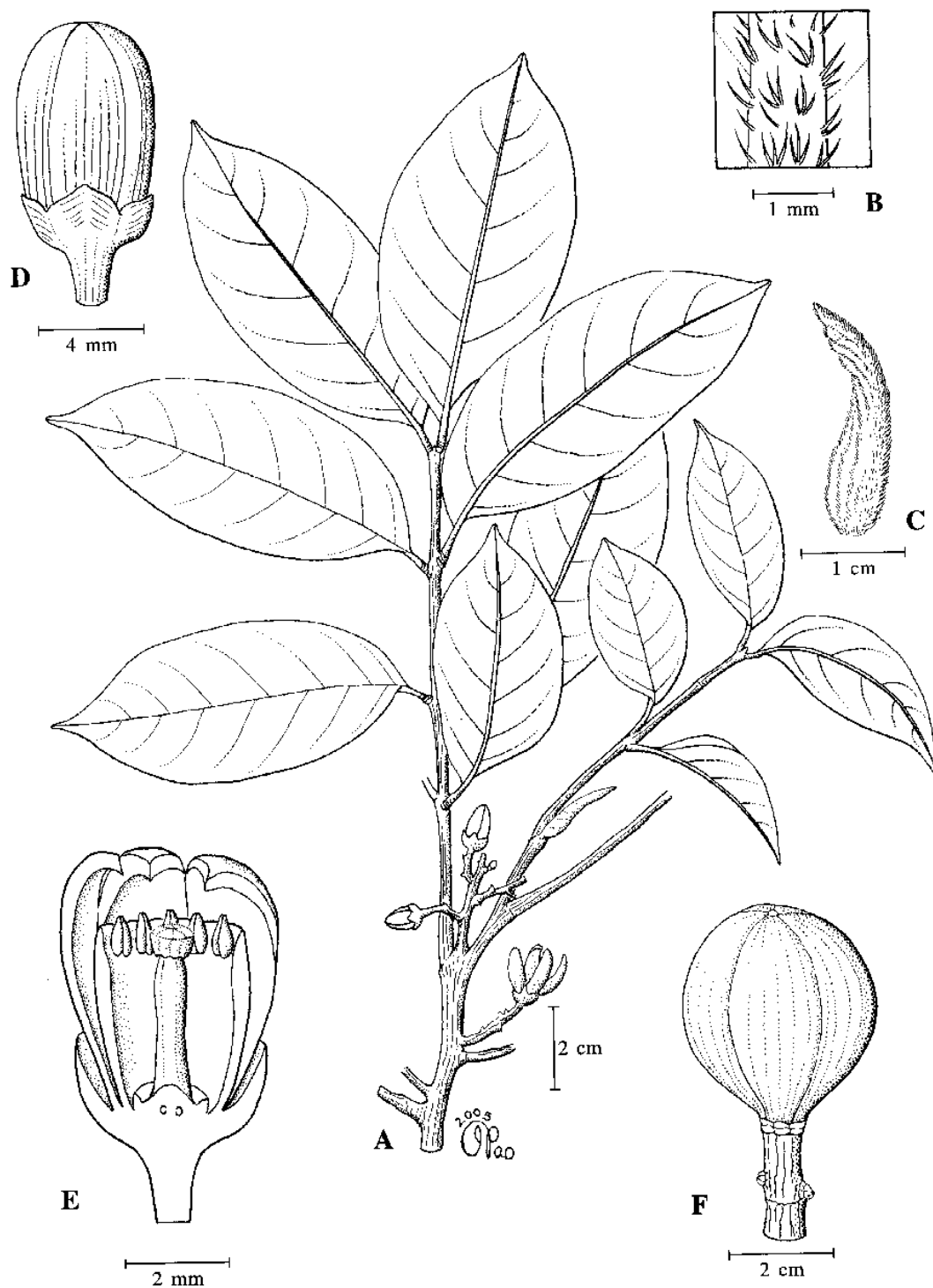


Fig. 21. *Dysoxylum crassum*. A, flowering leafy twig; B, detail of indumentum on lower surface of midrib; C, expanding apical bud; D, female flower bud; E, longitudinal section of female flower bud; F, fruit. (A from *S* 32877, B–C from *S* 22671, D–E from *S* 19970, F from *Nooteboom* 2115.)

apically dimpled. **Fruits** globose, at least 3 cm diameter, apically mamillate, weakly stipitate, 5-locular. **Seeds** unknown.

Distribution. Endemic in Borneo; known only in Sarawak from Kapit, Lawas and Marudi districts (e.g., *Nooteboom & Chai 2115, S 19970 and S 32877*) and in Brunei (*Kirkup et al. 961*).

Ecology. Mixed dipterocarp and *kerangas* forest, at 700–1150 m altitude.

8. *Dysoxylum cyrtobotryum* Miq.

Fig. 22.

(Greek, *kurtos* = curve, *botrys* = bunch; with a curved bunch of fruits)

Sect. *Cyrtochiton*

Fl. Ind. Bat. Suppl. 1 (1861) 196, 504; Merrill *op. cit.* (1921) 320; Masamune *op. cit.* 375; Mabberley *op. cit.* (1989) 243; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabberley *et al. op. cit.* 123; Turner *op. cit.* 341; Coode *et al.* (eds.) *op. cit.* 205; Argent *et al.* (eds.) *op. cit.* 419; PROSEA 5, 3 (1998) 200; Beaman & Anderson *op. cit.* 130. **Type:** *Teijsmann s.n.* [*HB 578*], Borneo, Sumatra, near Panti (holotype U [*Acc. No. 39403*]; isotype L [*Acc. No. 903295118*]). **Synonyms:** *Dysoxylum cyrtobotryum* var. *borneense* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 12; *Alliaria cyrtobotrya* (Miq.) Kuntze *op. cit.* 103; *Dysoxylum kinabaluense* Merr., Phil. J. Sci. Bot. 13 (1918) 75, *op. cit.* (1921) 320, *op. cit.* (1929) 120, Masamune, *op. cit.* 376.

Tree to 30 m tall, but often much less; bole to 60 cm diameter, sometimes fluted at base or with buttresses to 1 m tall, to 30 cm out. **Bark** pale brownish grey, smooth and lenticellate to scaling, brittle; inner bark pale yellowish brown, sometimes mottled. **Sapwood** pale yellow; heartwood red-brown with sour smell. **Twigs** angled and marked by distinct petiole scars, often dull purple-tinged when young, 5–7 mm diameter apically. **Apical buds** stiletto-like. **Leaves** spirally arranged, to 67 cm long, more or less imparipinnate with a scar next to the ‘terminal’ leaflet; petioles 15–22 cm, 3–5 mm diameter, flattened adaxially, glabrescent; leaflets subglabrous, sometimes sparsely hairy on venation below, coriaceous, subsessile, lateral leaflets 4 or 5 (or 6) on each side of rachis, almost alternate; blades oblong-ovate, sometimes narrowly so, 18–23 × 6–12 cm, base more or less asymmetrical, acute to subcuneate, apex acute-acuminate; lateral veins 7–13 on each side of midrib, distinct, squarrose at origin, looping but scarcely joining at margin, on drying sometimes yellowish; petiolules 0–5 mm long. **Inflorescences** 8–25 cm long, subspicate to scarcely branched, squarrose, axillary to ramiflorous; axes sparsely hairy; subsessile cymules 1–7-flowered; bracts c. 1 mm long, subtriangular. **Flowers** fragrant; bracteoles minute; calyx c. 4 mm tall, apically cup-shaped, basally a pseudopedicel, subpuberulent outside, olive-green, margin 4(or 5)-toothed, valvate; petals 4 (or 5), elliptical-oblong, 5–7 × 2 mm, valvate to apically imbricate, puberulent outside, yellowish, sometimes pinkish apically; staminal tube glabrous, off-white, weakly hairy outside, margin 8(–10)-toothed, anthers (6 or) 8 (or 10), elliptical-ovate, c. 1.5 mm long, yellow, more or less included; disc 1–1.5 mm tall, not exceeding ovary, glabrous, margin irregularly 8–12-toothed; ovary hairy, (2 or)3-locular, each locule with 2 collateral ovules, style cylindrical, furrowed, hairy, pale green, stylehead subcapitate, with basal annulus, white to pale orange. **Fruits** globose to fig-shaped, c. 4 × 5 cm, often veiny or wrinkled, orange-red (black on drying); pericarp with white latex. **Seeds** 1–6, ellipsoid to suboblong, 25–35 mm long, 15–20 mm across, shiny brown-orange, (?) sarcotestal.

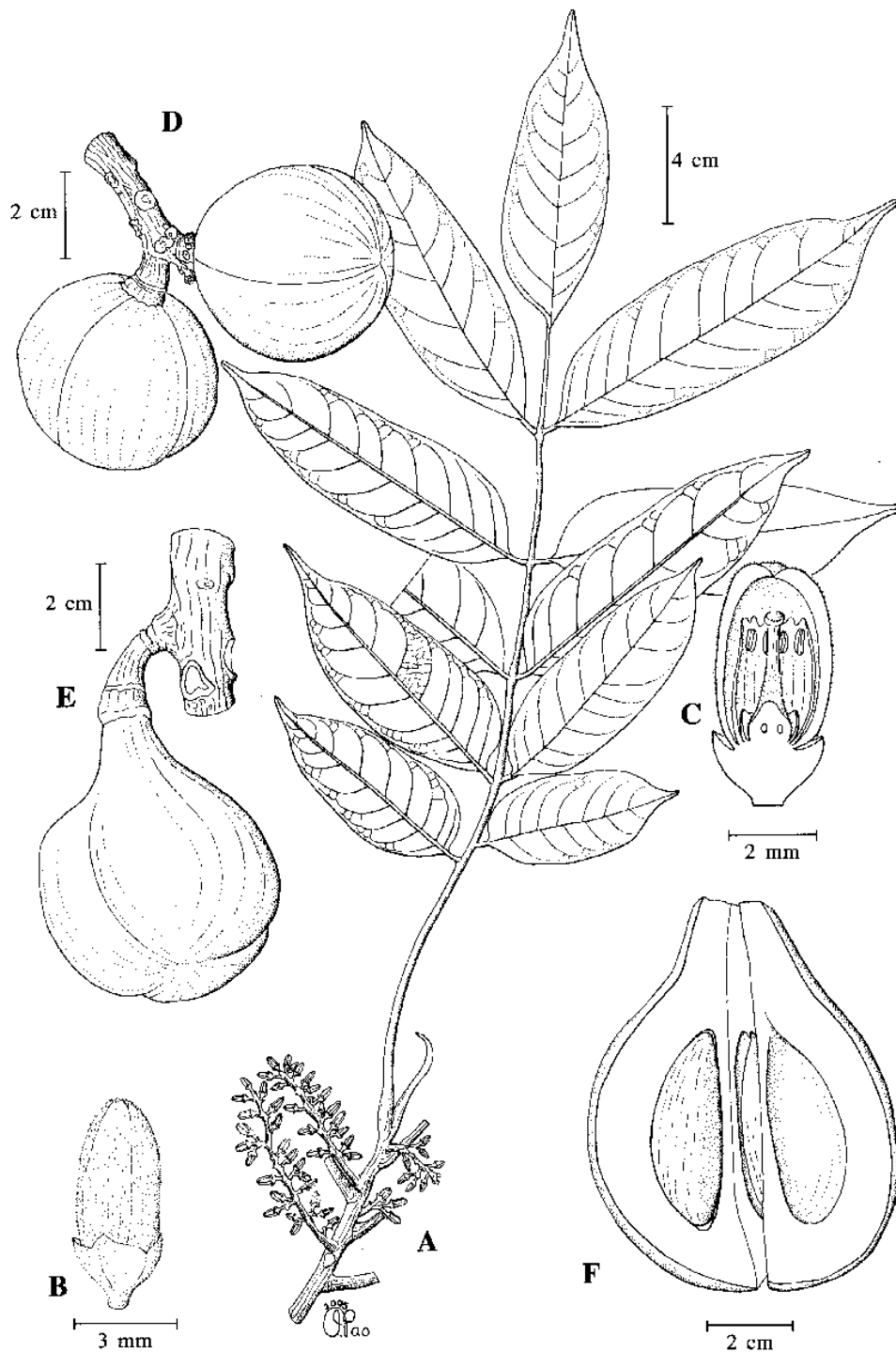


Fig. 22. *Dysoxylum cyrtobotryum*. A, flowering (female) leafy twig; B, female flower bud; C, longitudinal section of female flower bud; D, unlobed fruits; E, 3-lobed fruit; F, dehiscing fruit showing arilate seeds. (A–C from McDonald & Ismail 4915, D from S 48331, E from Kostermans 212, F from Jacobs 8355.)

Vernacular names. Sabah—*binkang* (Dusun Lahad Datu), *kamoayau burong* (Malay, Sandakan), *lantupak* (Malay), *tantau* (Dusun Ranau). Sarawak—*bunya* (Iban), *kelampu* (Iban), *segera* (Iban).

Distribution. SE Asia to Nicobars, Andamans, Sumatra, Peninsular Malaysia, Java, Lesser Sunda Islands (Bali, ?Flores), Borneo and the Philippines. In Borneo, known in Sabah from Beaufort, Keningau, Kinabatangan, Kota Belud, Kota Kinabalu, Lahad Datu, Papar, Ranau, Sandakan, Tambunan, Tawau, Tenom and Tuaran districts (e.g., *Mabberley 1713*, *SAN 29307*, *SAN 33014*, *SAN 84806* and *SAN 116878*) and in Sarawak from Bau, Kapit, Kuching, Lawas, Limbang, Lubok Antu, Lundu, Marudi and Miri districts (e.g., *Mabberley 1587*, *S 34043*, *S 36267*, *S 42941* and *S 49572*). Also occurring in Brunei (e.g., *BRUN 692*) and Kalimantan (e.g., *Kostermans 9795* and *McDonald & Ismail 4915*).

Ecology. In forests including that on limestone and in peatswamps at altitudes to 1800 m.

Notes. Specimens from Borneo sometimes have fasciated proliferating inflorescences (*cf. Dysoxylum arborescens*). The leaflets often have the facies of subglabrous *Aglaia* spp. especially *A. spectabilis* (*q.v.*), so that sterile material can readily be confused, though the latter differ in having truly imparipinnate leaves and the former usually have a few simple hairs as opposed to stellate hairs or scales.

I am still not altogether convinced that this species as defined here is homogeneous in that upland plants from Borneo with smaller leaves and thicker leaflets resembling those of *D. rugulosum* (e.g., *Mabberley 1587 & 1713*, *S 33824* *SAN 32315*) seem to be distinct, though they are apparently linked by intermediate specimens to the main corpus of material. There are also small trees from both Sabah (e.g., *SAN 47780*, *SAN 59456*, *SAN 62438*, *SAN 91089*, *SAN 92499*, *SAN 93841* and *SAN 114495*) and Sarawak (e.g., *S 26134*, *S 27866*, *S 39037*, *S 42072*, *S 42380* and *S 42941*) as well as Brunei (e.g., *Dransfield JD 7276*) with strikingly large leaflets (*cf. Chisocheton patens*, *Dysoxylum rugulosum*, *Walsura grandifolia*) drying a bilious yellow-brown, largely known from fruiting specimens and whose status is even less clear: narrow-leafleted forms (e.g., *SAN 59456* and *Sugau et al. 312*) match the type of *D. alternatum* Ridl. from Peninsular Malaysia and closely approach *Dysoxylum* sp. 3 of *Flora Malesiana*. A number of taxa may eventually be distinguishable, but the complex needs analysis in the field.

9. *Dysoxylum densiflorum* (Blume) Miq. (Latin, *densiflorus* = with closely packed flowers)

Sect. *Dysoxylum*

Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 9; King *op. cit.* 46; Ridley *op. cit.* (1922) 396; Backer & Bakhuizen *f. op. cit.* 122; Mabberley *op. cit.* (1989) 243; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabberley *et al. op. cit.* 81; Turner *op. cit.* 341; Coode *et al.* (eds.) *op. cit.* 205; PROSEA 5, 3 (1998) 200; Beaman & Anderson *op. cit.* 131. **Basionym:** *Epicharis densiflora* Blume, Bijdr. Fl. Ned. Ind. (1825) 167. **Type:** *Blume s.n.*, Java, G. Salak (holotype L [*Acc. No. 903257823*]). **Synonyms:** *Guarea densiflora* (Blume) Spreng. *op. cit.* 251; *Alliaria densiflora* (Blume) Kuntze *op. cit.* 109; *Dysoxylum cauliflorum* var. *tomentellum* Stapf, Trans. Linn. Soc. Bot. 4 (1894) 138, Merrill *op. cit.* (1921) 320; *Dysoxylum elmeri* Merr. *op. cit.* (1929) 121.

Tree to 30(–45) m tall; clear bole to 13 m tall and 65 cm diameter; buttresses to 3.5 m tall, forming plank-roots to 5 m long at base. **Bark** grey-green, smooth and lenticellate to fissured or flaking, the more or less rectangular flakes leaving brown patches; inner bark thin, fibrous and pinkish, red-mottled, creamy-yellow inside. **Sapwood** straw. **Twigs** 6–8 mm diameter apically, grey-brown with prominent petiole scars and sometimes white latex. **Apical buds** with fist-shaped young leaves. **Leaves** in dense terminal spirals, to 150 cm long, imparipinnate; petioles 6–11 cm long, terete to grooved adaxially proximally, swollen somewhat at base, more or less finely pubescent; leaflets shiny midgreen above, paler and more or less pubescent below, sometimes conspicuously brown-pubescent; lateral leaflets 5–8 on each side of rachis, opposite to subopposite; blades of apical leaflets elliptical-ovate to elliptical-obovate, symmetrical, the lateral ones elliptical-ovate, the most proximal ones ovate and smallest, 14–20 × 5–8 cm, base obtuse to subcordate (to cuneate in apical leaflet), markedly asymmetrical especially in most proximal leaflets, apex acuminate; venation brochidodromous; lateral veins *c.* 14 on each side of midrib, arcuate, drying paler above, prominent and pubescent below; petiolules 1–4(–6) mm (to 12 mm in apical leaflet) long. **Inflorescences** racemose or narrowly thyrsoid, to 10 cm long, solitary or fasciculate in axils or on twigs, sericeous; bracts *c.* 2 mm long, triangular, pubescent. **Flowers** sometimes in sessile cymules, sweetly scented; pedicels 2–3 mm long, pubescent; calyx campanulate (= bell-shaped), *c.* 2.5 mm tall, appressed pubescent, deeply 4-lobed, lobes acute; petals 4, linear-oblong, 8–11 mm long, acute, imbricate, sparsely hairy outside, white; staminal tube subglabrous outside, pilose inside, conspicuously 8(or 9)-striate, white, margin 8-lobed, lobes subtruncate, emarginate or irregularly toothed, anthers 8 (or 9), oblong-ovate, *c.* 1 mm long, alternating with lobes; disc 3–4 mm tall, glabrous or sparsely hairy inside, margin irregularly lobed; ovary (3 or)4-locular, appressed pubescent, style appressed pubescent, stylehead discoid, yellow. **Infructescences** to 10 cm or fruits solitary; rachis to 9 mm diameter. **Fruits** pyriform to fusiform (= spindle-shaped), to 4 × 2 cm, (3 or)4-valved, silky, grey-green hairy; pericarp soft, with white latex. **Seeds** 2–4; testa black, partially enveloped in a white hilar (?) aril.

Vernacular names. Sabah—*langkabang* (Dusun Bundu Tuhan). Sarawak—*segera* (Iban).

Distribution. S Myanmar, China (Yunnan), Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines (Palawan), Java, Lesser Sunda Islands (Bali, Lombok, Flores) and Sulawesi. In Borneo, known in Sabah from Beaufort, Keningau, Lahad Datu, Ranau, Sandakan, Semporna and Tawau districts (e.g., *Mabberley 1717*, *SAN 30507*, *SAN 31414*, *SAN 73180* and *SAN 89413*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Lubok Antu, Lundu, Miri and Serian districts (e.g., *Mabberley 1608*, *Pennington 7986*, *S 18258*, *S 31830* and *S 37991*). Also occurring in Brunei (e.g., *Coode 7791*) and Kalimantan (e.g., *Leighton 163*).

Ecology. Rain forest at altitudes to 1700 m.

10. *Dysoxylum excelsum* Blume

(Latin, *excelsus* = tall)

Sect. *Dysoxylum*

Bijdr. Fl. Ned. Ind. (1825) 176; Backer & Bakhuizen *f. op. cit.* 124; Mabberley *op. cit.* (1989) 244; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabberley *et al. op. cit.* 109; Turner *op. cit.* 341; Coode *et al. (eds.) op. cit.* 205; PROSEA 5, 3 (1998) 201. **Type:** *Blume s.n.*, Java, Bogor, Tjiandjur, 1824,

(holotype L [Acc. No. 903295149], isotypes ?BO, L [Acc. No. 903295141 & 903295152], ?NY, ?P). **Synonyms:** *Macrocheton excelsum* (Blume) M.J.Roem. *op. cit.* (1846) 104 ('*Macrochiton*'); *Dysoxylum procerum* Hiern var. *motleyanum* C.DC. *op. cit.* (1878) 487, Merrill *op. cit.* (1921) 320, Masamune *op. cit.* 376; *Dysoxylum motleyanum* (C.DC.) Ridl. *op. cit.* (1930) 364; *Dysoxylum havilandii* Ridl. *op. cit.* (1930) 365. (For complete synonymy cf. Mabberley *et al. op. cit.*)

Tree to 36 m tall; bole to 80 cm diameter; buttressed to 3 m tall, to 2.5 m out, concave. **Bark** smooth to slightly flaking, lenticellate; inner bark reddish brown with resinous smell. **Sapwood** fawnish white; heartwood brownish red. **Twigs** 5–9 mm diameter apically, lenticellate, more or less pubescent when young. **Apical buds** with fist-shaped young leaves. **Leaves** spirally arranged, 25–90 cm long, subparipinnate with terminal scar; petioles 5–10 cm long, more or less puberulent, somewhat flattened adaxially, weakly swollen at base; leaflets subcoriaceous, glabrous to rufescent-pubescent below, especially on veins; lateral leaflets 2–4 (or 5) on each side of rachis, opposite to alternate; blades ovate-elliptical to ovate-lanceolate, 10–25(–51) × 4–10(–21) cm (the most distal the largest), base more or less symmetrical, acute to attenuate, apex obtuse to acuminate; lateral veins 9–12 on each side of midrib, arcuate, obscurely anastomosing at margin, impressed above, prominent below like the midrib when dry; petiolules 5–15 mm long, sulcate when dry. **Inflorescences** to 100 cm long, but usually less and sometimes (in females) as short as 10 cm, axillary to supra-axillary; axes more or less densely rufescent-pubescent, most proximal branches to 20 cm long with secondary branches to 3 cm long, bearing cymules of 1–3 flowers; bracts triangular, c. 1.5 mm, pubescent. **Flowers** sweetly scented; pedicels c. 1 mm long, articulated with pseudopedicels to 3 mm long; calyx continuous with pseudopedicel, shallowly cup-shaped, 1–2 mm tall, 4–5 mm diameter, pubescent outside, pinkish, margin rather irregularly 4(or 5)-toothed; petals 4 (or 5), narrowly oblong, 6–15 × 3–4 mm, valvate, minutely sericeous outside, creamy or pinkish white; staminal tube glabrous or weakly puberulent inside or outside, white, margin truncate to weakly 8(–10)-crenate, anthers 8 (or 10), c. 1 mm long, included, glabrous; disc up to half as long as staminal tube, with descending hairs inside and more or less 8(–10)-toothed margin, markedly pilose; ovary densely sericeous, 3- or 4-locular, each locule with 1 or 2 ovules, style glabrous in distal half, otherwise sericeous, stylehead discoid to subcapitate. **Infructescences** more or less unbranched. **Fruits** depressed globose to pyriform, to 4 × 5(–7.5) cm, 3- or 4-lobed, glabrous to scurfy, chestnut-brown when ripe. **Seeds** 1–4, subreniform, c. 2.5 × 1.5 cm, pendent on funicles at fruit dehiscence; testa bright red; hilum white.

Vernacular names. Sabah—*lantupak* (Dusun Labuk), *lombunan* (Dusun Sandakan). Sarawak—*durong* (Kelabit), *segera* (Iban).

Distribution. Sri Lanka, Nepal and NE India, S China and Indo-China throughout Malesia to Solomon Islands. In Borneo, known in Sabah from Beaufort, Lahad Datu, Sandakan, Sipitang and Tawau districts (e.g., Mabberley 1657, SAN 34335, SAN 42912, SAN 87714 and SAN 90408) and in Sarawak from Kapit, Kuching, Lawas, Lubok Antu and Tatau districts (e.g., S 16466, S 27944, S 20063, S 36386 and S 37327). Also occurring in Brunei (e.g., BRUN 692) and Kalimantan (e.g., Kostermans 6219).

Ecology. Rain forest including riverine and swamp forest and that on limestone at altitudes to 1000 m.

Notes. Although reasonably uniform in Borneo, *Dysoxylum excelsum* as presently understood, is, across its range, a complex of forms insufficiently differentiated from one

another to make possible an arrangement of closely related species or, indeed, of infraspecific taxa associated with differences in geography or ecology. In Borneo, there are some rather characteristically pubescent forms (described as *D. havilandii*) but these can be matched with materials from Java, Sumatra and Peninsular Malaysia as well as mainland Asia.

11. *Dysoxylum flavescens* Hiern

(Latin, *flavescens* = yellowish; referring to the petals)

Sect. *Cyrtochiton*

In Hooker *f.*, Fl. Br. Ind. 1 (1875) 549; King *op. cit.* 49; Ridley *op. cit.* (1922) 396; Mabblerley *op. cit.* (1989) 244; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabblerley *et al. op. cit.* 128; Turner *op. cit.* 341; Coode *et al.* (eds.) *op. cit.* 205; PROSEA 9, 3 (1998) 201. **Type:** *Maingay 3341* [= *Kew Distr. 321*], Peninsular Malaysia, Malacca (holotype K).

Tree to 33 m tall; bole to 70 cm diameter; buttresses to 1 m tall and 60 cm out. **Bark** superficially cracked, brown with star-shaped pustulate lenticels; inner bark pinkish to orangeish. **Sapwood** straw; heartwood pale reddish brown, hard, aromatic. **Twigs** *c.* 7 mm diameter apically. **Apical buds** *stiletto-like*. **Leaves** *spirally arranged*, to 48 cm long, *paripinnate*; petioles 8–13 cm long, flattened adaxially, swollen and often blackish (when dry) at base; *leaflets* 3–5 on each side of rachis, subcoriaceous, subopposite, *glabrous*, often shiny above; blades narrowly elliptical-ovate, 7.5–13 × 3.4–4.7 cm, base rounded to subcuneate, more or less asymmetrical, apex acuminate; lateral veins 13–19 on each side of midrib, indistinct, subsquarrose and spreading, inarched only near margin but not looped; *intercostal venation scarcely distinguishable from lateral veins*; petiolules 3–4(–9) mm long, blackened at base when dry. **Inflorescences** 5–10 cm long, *subspicate* with fascicles of 1 or a few sessile flowers; bracts triangular, *c.* 0.5 mm. **Flowers:** *calyx* *c.* 2.5 mm diameter, puberulent outside, confluent with pseudopedicel *c.* 1 mm long, *margin deeply 4-lobed*; *petals* 4, *c.* 7 mm long, creamy-yellow, subglabrous to puberulent outside; staminal tube thick, tough, weakly pilose distally, margin crenate, *anthers* 8, ovate, included; disc shortly cup-shaped, glabrous, fleshy; *ovary* pubescent, *4-locular*, each locule with 2 collateral ovules, style pubescent in proximal half, stylehead discoid. **Fruits** depressed globose, at least 4 cm diameter, weakly stipitate, reddish orange. **Seed** brown to black with small ariloid hilum on one side; testa apparently largely pachychalazal.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, recorded in Sabah from Papar district (e.g., *SAN 32207*) and in Sarawak from Kuching district (e.g., *SAN 37981* and *Fuchs 21009*). Also occurring in Brunei (e.g., *Kirkup DK 631*) and Kalimantan (e.g., *Kostermans 7950*).

Ecology. Rain forest at altitudes to 1700 m. Very rarely collected.

12. *Dysoxylum grande* Hiern

(Latin, *grandis* = large)

Sect. *Cyrtochiton*

In Hooker *f.*, Fl. Br. Ind. 1 (1875) 547; Mabberley, *op. cit.* (1989) 244; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabberley *et al. op. cit.* 117; Turner *op. cit.* 341; Coode *et al.* (eds.) *op. cit.* 205; PROSEA 5, 3 (1998) 201; Beaman & Anderson *op. cit.* 131. **Type:** Bruce in *EIC* 4883, India, Assam, Sylhet (holotype K-W; isotypes BM, P). **Synonym:** *Alliaria grandis* (Hiern) Kuntze *op. cit.* 109. (For full synonymy *cf.* Mabberley *et al. op. cit.*)

Tree to 39 m tall; bole to 70 cm diameter, with plank buttresses to 2 m tall and 7.5 m out. **Bark** smooth to dippled, greyish brown, lenticellate; inner bark with cream and pinkish purple tangential bands. **Sapwood** yellow-brown. **Twigs** 1.3–2 cm diameter apically, with wide pith, often fulvous-tomentellous. **Apical buds** with long stiletto-like young leaves. **Leaves** spirally arranged, to 100 cm long, with apical stub or spike, one of the lateral leaflets often appearing terminal; petioles 10–15 cm long, somewhat 3-angled, more or less fulvous-pubescent, base swollen; leaflets brittle when dry, upper surface reddish brown in young leaves, rugulose with minute black glandular dots, glabrous except midrib and veins sometimes yellow-pubescent, lower surface gland-dotted, subglabrous to densely yellow-pubescent; lateral leaflets 6–9 on each side of rachis, alternate or opposite; blades oblong, the most proximal ones sometimes lanceolate, 10–19 × 3.5–6 cm, base rounded to shortly cuneate, margin subrevolute, apex acuminate to subcaudate; lateral veins 23–25 on each side of midrib, subsquarrose, arching but not looping at margin; petiolules 5–9 mm long, sulcate, more or less pubescent. **Inflorescences** narrow (unbranched), to 10 cm long in females, to 30 cm long with branches to 5 cm in males; axes angled, more or less finely tomentose; bracts and bracteoles *c.* 0.5 mm, ephemeral. **Flowers** subsessile in cymules of 3 or 4, fragrant; calyx shallowly cup-shaped, *c.* 4.5 mm tall (*c.* 2 mm in males), *c.* 7 mm diameter (*c.* 5 mm in males), more or less pubescent outside, margin 4-lobed; petals 4, oblong, *c.* 9 mm long (*c.* 7 mm in males), densely tomentose outside, creamy-yellow; staminal tube minutely pubescent outside, glabrous inside, margin with 8 short, broadly triangular lobes, anthers 8, oblong, *c.* 1.2 mm long, included; disc shortly cylindrical, *c.* 1.3 mm tall, often closely enveloping ovary, subglabrous outside, densely long yellow pilose inside; ovary densely pilose, (3 or)4(or 5)-locular, each locule with (?)1 ovule, style 4-angled, pubescent in proximal half, stylehead cylindrical-capitate, with basal annulus. **Infructescences** sparingly branched, with watery sticky latex. **Fruits** 1–4 on stout peduncles, depressed globose, 5–8 × 7–11 cm, apically dimpled, 3–5-sulcate, orange. **Seeds** 1–4 (or 5), *c.* 2.5 cm long, with thick (?)sarcotesta.

Distribution. India (Assam) and S China (including Hainan), Thailand, Sumatra, Peninsular Malaysia, Borneo and probably in the Philippines. In Borneo, known in Sabah from Kinabatangan, Lahad Datu and Ranau districts (e.g., Mabberley 1712, SAN 25400, SAN 38522, SAN 56723 and SAN 74136) and in Sarawak from Kapit and Kuching districts (e.g., S 19604 and S 44087). Also occurring in Kalimantan (e.g., Church *et al.* 616). Not yet recorded from Brunei.

Ecology. Rain forest, especially hill forest at altitudes to 1400 m.

13. *Dysoxylum macrocarpum* Blume

(Greek, *makro* = large, *karpos* = fruit; large-fruited)

Sect. *Cyrtochiton*

Bijdr. Fl. Ned. Ind. (1825) 175; Ridley *op. cit.* (1930) 365; Backer & Bakhuizen *f. op. cit.* 123; Anderson *op. cit.* (1980) 252; Mabberley *op. cit.* (1989) 244; Whitmore, Tantra & Sutisna *op. cit.* 232; Mabberley *et al. op. cit.* 116; Turner *op. cit.* 341; Beaman & Anderson *op. cit.* 131. **Lectotype** (designated here): *Blume s.n.* [‘572’], Java, G. Salak, (L [Acc. No. 903295229]; isolectotype L [Acc. No. 903295217]).

Tree to 33 m tall; bole to 50 cm diameter with plank buttresses to 2 m tall and 1 m out. **Bark** smooth, grey-green, faintly hooped and finely lenticellate; inner bark cream, flecked orange, fibrous within. **Sapwood** pale yellow. **Twigs** 7–13 mm diameter apically, with wide pith, conspicuously set with petiole scars and lenticellate, yellowish when dry. **Apical buds** spike-like, to 5 cm long. **Leaves** spirally arranged, to 100 cm long, more or less imparipinnate; petioles to 38 cm long, swollen at base; leaflets subglabrous, drying ochreous, dull and thin when fresh; lateral leaflets 3 or 4 on each side of rachis, alternate; blades elliptical-ovate, to 30 × 10 cm, base subcuneate, apex acuminate; lateral veins 13–18 on each side of midrib, ascendant, looping indistinctly at margin, prominent below; intercostal venation obscure; petiolules to 6 mm long, slightly swollen. **Inflorescences** to 25 cm long, with spreading branches. **Flowers** foetid; calyx with irregular margin; petals 4, finely hairy, creamy-white to orangeish; staminal tube hairy inside, margin more or less truncate, anthers 8 (or 9), inserted within staminal tube; disc more or less truncate; ovary pubescent, style terete, stylehead discoid. **Infructescences**: axes to 8 mm diameter, with 1–3 fruits. **Fruits** globose to pyriform, to 10 cm diameter, 8-locular, shallowly ridged, bright orange-red; pericarp with white latex; mesocarp fleshy, orange-yellow. **Seeds** 1 or 2 with dark brown testa and thick pale orange (?) aril.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines and Sulawesi. In Borneo, known in Sabah from Keningau, Papar and Sandakan districts (e.g., SAN 28393, SAN 61641, SAN 68028 and SAN 78451) and in Sarawak from Kuching, Marudi, Miri and Serian districts (e.g., Burley & Lee 319, S 12635, S 24421, S 29861 and S 38930). Also occurring in Kalimantan (e.g., Kostermans 21585). Not yet recorded from Brunei.

Ecology. Forests including riparian ones and those on limestone at altitudes to 1800 m.

14. *Dysoxylum magnificum* Mabb.

(Latin, *magnificus* = magnificent)

Sect. *Dysoxylum*

Blumea 38 (1994) 309; Mabberley *et al. op. cit.* 113. **Type:** Sibat S 24337, Borneo, Sarawak, Kuching district (holotype FHO; isotypes K, L, SAN, SAR, SING).

Tree to 15(–25) m tall; all parts onion-scented when bruised; bole to 25 cm diameter, fluted with buttresses to 30 cm tall and out. **Bark** smooth to cracking into small blocks, often hooped and with prominent brown lenticels, brownish; inner bark pinkish brown. **Sapwood** pale cream. **Twigs** smooth to striate, pale brown, 9–12 mm diameter apically, rusty-brown velutinous when young. **Apical buds** densely velutinous, fist-shaped young leaves. **Leaves** in lax terminal spirals, to 100 cm long, not strictly paripinnate; petioles 8–14 cm long, flattened to channelled adaxially, more or less densely velutinous, swollen at base; leaflets 5 or 6 on each side of rachis, opposite to alternate, one often appearing apical through fall of spike, leaving scar on other side, the largest the most distal, somewhat coriaceous, upper surface glossy and glabrous save sometimes for the pubescent midrib, lower surface brown-

velutinous, especially on veins; *blades oblong*, 17–29 × 6–14 cm, base obtuse, apex shortly acuminate to cuspidate; veins somewhat sunken above, prominent below; lateral veins 12–14 on each side of midrib, obtuse, inarching only at margin, some secondary ones, particularly proximally, almost as conspicuous; *intercostal venation subscalariform*; petiolules 4–8 mm long, somewhat sulcate. **Inflorescences** to 60 cm long, *spicate or with few subsquarrose branches to 10 cm long*; axes more or less densely brown-velutinous. **Flowers:** bracteoles lanceolate, 4–6 mm, densely pilose; *calyx* shallowly cup-shaped, *c.* 2.5 × 5 mm, more or less velutinous outside, *margin subirregularly 5-crenate*; *petals* 5, narrowly spatulate, *c.* 12 × 2.5 mm, valvate, white, densely appressed pubescent outside, tips acute, thickened; staminal tube white, glabrous, margin subcrenulate, *anthers* 10, narrowly oblong, *c.* 1.5 mm long, sublocellate, glabrous, inserted *c.* 3 mm within staminal tube, free filament *c.* 0.5 mm long; disc cylindrical, *c.* 2.5 mm tall, densely appressed hairy on both surfaces; *ovary* densely appressed hairy, (?) *3-locular*, each locule with (?) 2 ovules, style terete, appressed pubescent, stylehead capitate *c.* 0.8 mm diameter. **Fruits** *depressed globose, at least 8 cm diameter*, deeply sunken between the 2 or 3 fertile locules, brown and velvety when young, pale cream when ripe. **Seeds** subhemispherical, *c.* 2 cm diameter, flattened adaxially, covered with shining thick sarcotesta (?), pink when mature.

Vernacular name. Sarawak—*empawas* (Iban).

Distribution. Sumatra and Borneo (Sarawak only). Known in Sarawak from Kapit, Kuching and Lundu districts (e.g., *Jacobs* 5226, *Mabberley* 1577, *Pennington* 8014, *S* 37972 and *S* 76713).

Ecology. Rain forest at altitudes to 500 m.

15. *Dysoxylum mollissimum* Blume

(Latin, *mollissimus* = very soft; referring to the pubescence of the leaves)

Sect. *Dysoxylum*

Bijdr. Fl. Ned. Ind. (1825) 175; Backer & Bakhuizen *f. op. cit.* 123; Mabberley *op. cit.* (1989) 245; Whitmore, Tantra & Sutisna *op. cit.* 232; Mabberley *et al. op. cit.* 90; Turner *op. cit.* 341; PROSEA 5, 3 (1998) 201; Beaman & Anderson *op. cit.* 131. **Lectotype** (selected here): *Blume s.n.* [‘602’], Java, G. Salak (L [Acc. No. 903295276]; isoelectotypes L [Acc. No. 903295281 & 903295282]). **Synonyms:** *Trichilia mollissima* (Blume) Spreng. *op. cit.* 252; *Hartighsea mollissima* (Blume) A.Juss., Mém. Mus. Hist. Nat. Paris 19 (1832) 228; *Alliaria mollissima* (Blume) Kuntze *op. cit.* 109; *Dysoxylum mollissimum* Blume var. *halmaheirae* Miq. & var. *sumatranum* Miq. *op. cit.* (1868) 18; *Dysoxylum molle* Miq. *op. cit.* (1868) 18; *Dysoxylum teysmannii* C.DC. *op. cit.* (1878) 510; *Alliaria teysmannii* (C.DC.) Kuntze *op. cit.* 109.

Distribution. From India (Sikkim and Assam) and S China, Malesia, to Australia and W Pacific.

Uses. This species was one of the biggest trees of Java, though it has not been collected in west Java since before the 1860s. Its wood has been used sporadically for houseposts and other construction and it is recorded as an important commercial lumber tree from which

boards are made in Hainan. *Dysoxylum mollissimum* subsp. *molle* (Miq.) Mabb. is the red bean, kedgy-kedgy or pencil cedar of tropical Australia used in cabinet work.

Notes. Two subspecies, subsp. *molle* and subsp. *mollissimum*, are recognised. The first differs from the second in its pustular lenticellate fruit (vs. smooth), and does not occur in Sabah and Sarawak.

subsp. **mollissimum**

Tree to 34(–60) m tall; clear bole to 25 m tall and 1.5 m diameter, fluted; buttresses to 2(–5) m tall, to 1 m out, concave. **Bark** grey-brown, smooth with elongated brown lenticels, becoming pustular and cracking vertically or scaling; inner bark yellow-brown, flecked orange. **Sapwood** pale brown, often with strong smell of garlic, onions, potatoes or turnips; heartwood hard, deep red. **Twigs** with conspicuous petiole scars, brown or reddish, often conspicuously lenticellate, to 10 mm diameter apically, glaucous to reddish, subglabrous to densely yellow-pubescent. **Apical buds** with fist-shaped young leaves. **Leaves** spirally arranged, 25–95 cm long, imparipinnate, with the distal leaflets developing more or less some time after the more proximal ones; petioles 5–10 cm long, subglabrous to softly pubescent, often lenticellate, somewhat flattened adaxially or subterete, base weakly swollen to clasping; leaflets glabrous to sparsely pubescent, especially on veins above, subglabrous to densely soft-pubescent below, rarely with domatia, the apical one often and the most distal laterals sometimes falling before developing; lateral leaflets 14(–17) on each side of rachis, opposite to subopposite; blades oblong to ovate, 13–16 × 4–5 cm, the most proximal smaller, c. 6.5 × 3.5 cm, base symmetrical to asymmetrical, obtuse to subcordate distally, acute to cuneate proximally, apex apiculate to acute; lateral veins 10–12 on each side of midrib, prominent below, mostly more or less bifid 2/3 from midrib and anastomosing; petiolules 2–7 mm long. **Inflorescences** to 60 cm long, axillary to supra-axillary, pendent, 1- or 2-branched, the primary branches to 12 cm long, the more distal shorter, the secondary ones to c. 1 cm long bearing multiflowered fascicles; bracts and bracteoles 2 or 3, triangular, c. 1 mm long, more or less densely pubescent. **Flowers** sweetly scented; pedicels 0–1 mm long; calyx salver-shaped to shallowly cup-shaped, c. 1 × 1.5 mm, more or less densely appressed pubescent, 4-lobed, the lobes irregularly triangular; petals 4 (or 5), linear, 8–12 mm long, cream, more or less sparsely pubescent outside, somewhat imbricate at apices, adnate to staminal tube in proximal half; staminal tube hairy on both sides, especially villous inside, weakly ribbed, the margin subtruncate to 8-lobed, the lobes somewhat emarginate, anthers 8, oblong, c. 0.5 mm long, weakly locellate, glabrous, included; disc cylindrical, 2–4 mm long, glabrous to pubescent, green, margin irregularly 4-toothed; ovary subsericeous, 4-locular, each locule with 1 ovule, style terete, sericeous to villous in proximal half, stylehead subdiscoid to short-cylindrical. **Fruits** depressed globose, 1.5–2.5 cm diameter, glabrous, 4-valved, reddish brown, smooth; pericarp with white latex. **Seeds** 1–4, to 16 mm long, planoconvex, with red aril.

Distribution. India (Assam), China (Yunnan, Hainan), Myanmar, Sumatra, Peninsular Malaysia, Java (including Kangean Archipelago), Borneo (Sabah and Sarawak), the Phillipines (Luzon, Mindanao) and Lesser Sunda Islands (Bali). In Sabah recorded from Kinabatangan, Ranau and Tenompok districts (e.g., Clemens 26662, Clemens 28520, S 10648, SAN 74109 and SAN 142663) and in Sarawak from Bau district (e.g., S 37541).

Ecology. In forests at altitudes to 1900 m, including coastal forests behind mangrove.

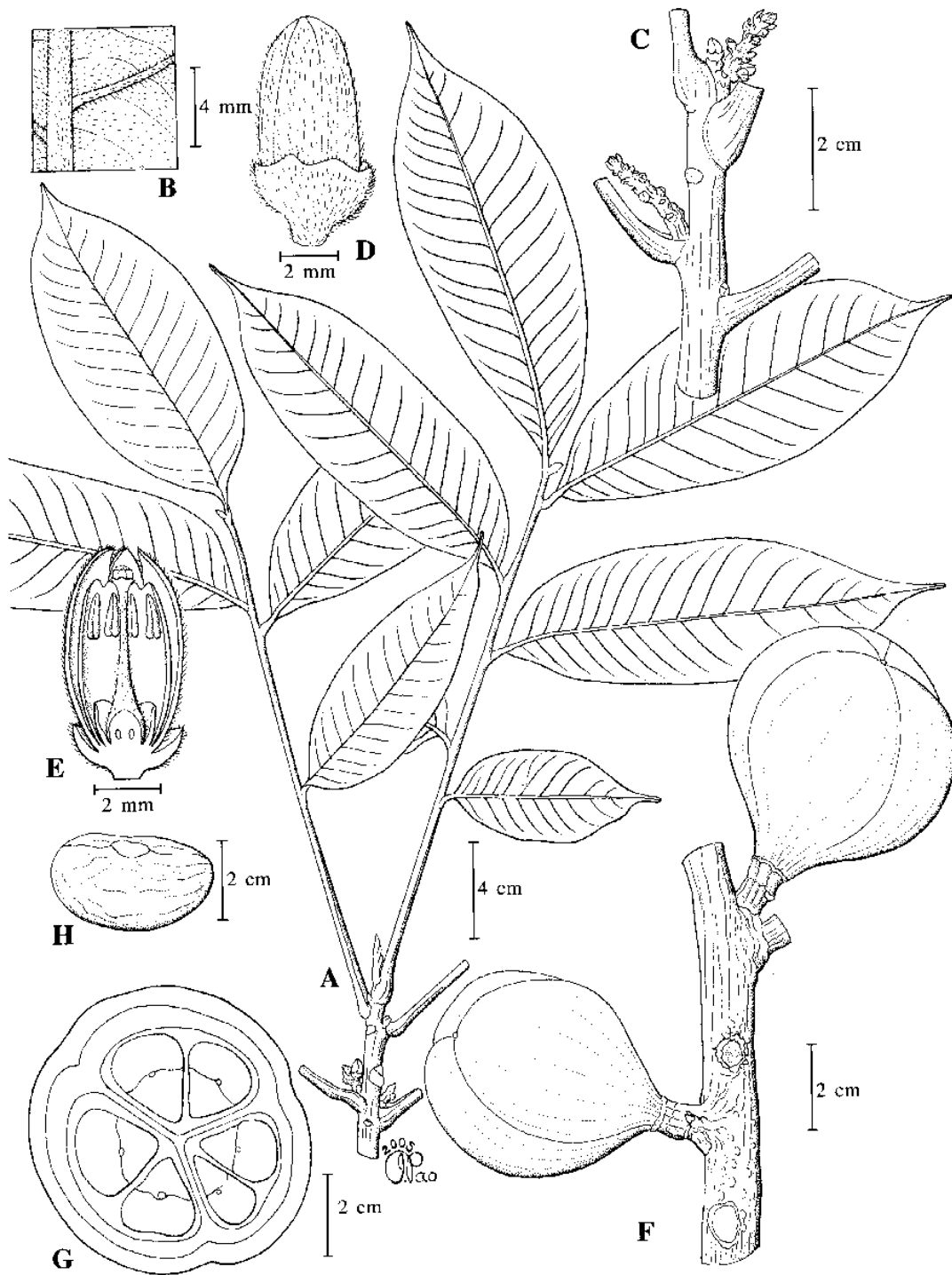


Fig. 23. *Dysoxylum pachyruche*. A, flowering leafy twig; B, detail of leaflet lower surface showing indumentum; C, inflorescences; D, flower bud; E, longitudinal section of flower bud; F, fruits; G, cross-section of fruit; H, seed. (A–B from *S* 14609, C–E from *S* 36905, F from *S* 37751, G–H from *S* 40422.)

16. *Dysoxylum oppositifolium* F. Muell.(Latin, *oppositus* = opposite, *folium* = leaf; with opposite leaves)**Sect. *Cyrtochiton***

Fragm. 5 (1866) 177; Mabberley *et al. op. cit.* 122; PROSEA 5, 3 (1998) 201. **Type:** *Dallachy s.n.*, Australia, Queensland, Rockingham Bay (holotype MEL; isotypes [?] BRI, E, K, NSW). **Synonym:** *Alliaria oppositifolia* (F. Muell.) Kuntze *op. cit.* 109.

Small tree to 10(–30) m tall; bole to 40 cm diameter; buttresses to 1.5 m tall. **Bark** flaking, yellow-brown; inner bark reddish. **Twigs** with conspicuous petiole scars, 5–7 mm diameter apically, pale brown when dry, more or less brownish-puberulent. **Apical buds** *stiletto-like*, to 8 cm long. **Leaves** *opposite*, 15–45 cm long, *paripinnate with apical scar*; petioles 6–10 cm long, drying yellowish, swollen at base, subpuberulent; leaflets 3–6 on each side of rachis, subcoriaceous, opposite or the more proximal sometimes alternate, *subglabrous to pilose on midrib above and on lower surface*, particularly the veins; blades oblong to elliptical, the subapical the largest, (4–)8–17 × (2–)3.5–5.5 cm, base more or less markedly asymmetrical, rounded to acute, apex obtuse to shortly acuminate; lateral veins 12–14 on each side of midrib, arcuate, obscurely looped, somewhat impressed above, prominent below; petiolules 3–6 mm long, weakly swollen. **Inflorescences** 5–9 cm long, *racemose or thyrsoid*, axillary or in axils of petiole scars; axes pubescent; *branches to 8 mm long*, bearing 3-flowered cymules. **Flowers:** pedicels *c.* 1 mm long, articulated with very short pseudopedicels; *calyx c.* 3 mm diameter, puberulent outside, *margin 4-toothed*, the teeth *c.* 1.5 mm long; *petals 4*, oblong, *c.* 7 × 3–3.5 mm, obtuse, subpubescent outside, creamish; staminal tube glabrous or very sparsely pubescent apically outside, margin subcrenate, *anthers 8*, ellipsoid, *c.* 1 mm long, included; disc cup-shaped, *c.* 2 mm tall and diameter, glabrous outside, subpubescent inside, margin somewhat undulate; *ovary* pubescent, *4-locular*, style terete, pubescent in proximal half, stylehead discoid. **Fruits** apparently pyriform, *c.* 3 cm diameter, 4-valved, veined, orange-black turning to black when dry. **Seeds** 2–4, ellipsoid, *c.* 1 cm long, with red (?) sarcotesta.

Distribution. Borneo (Sabah only), the Philippines, New Guinea and NE Australia. In Sabah rare, known only by two collections from Semporna district (*SAN 40823* and *SAN 48801*).

Ecology. Rain forest, at 300–500 m altitude.

17. *Dysoxylum pachyrhache* Merr.

Fig. 23.

(Greek, *pachy-* = thick, *rhachis* = axis; referring to the stout inflorescence axes)**Sect. *Cyrtochiton***

PEB (1929) 120; Masamune *op. cit.* 376; Whitmore, Tantra & Sutisna *op. cit.* 232; Mabberley *et al. op. cit.* 119; Coode *et al. (eds.) op. cit.* 205. **Type:** *Elmer 21692*, Borneo, Sabah, Tawau (holotype UC; isotypes A, BM, BO, BP, DS, G, GH, K, L, M, MO, NY, P, SING, U, Z). **Synonym:** *Epicharis pachyrhachis* (Merr.) Harms *op. cit.* (1940) 170.

Tree to 20 m tall; clear bole to 10 m tall and 40 cm diameter, sometimes with short buttresses. **Bark** smooth with large corky lenticels, chocolate-brown, to superficially

fissured and finely cracking; inner bark bright orange, granular. **Sapwood** pale brown; heartwood brown. **Twigs** stout, angled, with conspicuous petiole scars, greyish brown with bright brown lenticels, densely tomentose when young, 10–15 mm diameter apically. **Apical buds** *stiletto-like*. **Leaves** in terminal spirals, to 100 cm long, with terminal spike or its scar; petioles 10–16 cm long, terete to flattened adaxially, more or less densely brown tomentose, weakly swollen at base; leaflets subcoriaceous, glabrous except on midrib above, softly pubescent below; lateral leaflets 2–4 on each side of rachis, subalternate; blades elliptical, 12–25 × 7–12 cm, base somewhat asymmetrical, acute to rounded; lateral veins 15–18 on each side of midrib, spreading, inarched but not looped at margin; petiolules 5–11 mm long, drying dark brown, weakly swollen. **Inflorescences** to 8 cm long, usually much shorter, *subspicate*, with congested branchlets of subsessile flowers, axillary, supra-axillary in axils of leaves or petiole scars; axes 4–6 mm diameter, densely pubescent. **Flowers** weakly scented; calyx shallowly cup-shaped, 3–4 mm tall, 5–6 mm diameter, densely pubescent outside, pale brown, margin irregularly 4-lobed; petals 4, 8–9 × 3 mm, densely pubescent outside, creamish; staminal tube glabrous, margin subcrenate, anthers 8, narrowly oblong, c. 1.5 mm long, inserted within the staminal tube; disc 2–3 mm tall, glabrous, margin obscurely crenulate; ovary 4-locular, densely appressed pubescent, style appressed pubescent at base, stylehead subcapitate, c. 1 mm diameter, with a basal annulus and impressions of stamens. **Fruits** solitary or in groups of 2 or 3, *subpyriform*, 5–8 × 5–8 cm, glabrous when ripe, orange-red; stipe 1–1.5 cm long; pericarp pale along sutures, to 1.5 cm thick, ochreous inside. **Seeds** orange-segment-shaped c. 2.5 cm long, with creamy laticiferous (?) sarcotesta.

Distribution. Endemic in Borneo. Known in Sabah from Keningau, Penampang, Sandakan and Tawau districts (e.g., *Mabberley 1659*, *SAN 35393*, *SAN 65475*, *SAN 73771* and *SAN 142589*) and in Sarawak from Kapit, Kuching, Limbang, Marudi and Miri districts (e.g., *Mabberley 1601*, *S 37751*, *S 39177*, *S 47860* and *S 48174*). Also occurring in Brunei (e.g., *Wong WKM 260*) and Kalimantan (e.g., *Ambriansyah & Arifin W 723*).

Ecology. Rain forest at altitudes to 1600 m.

18. *Dysoxylum papillosum* King

(Latin, *papillosus* = with small pimples; referring to the surfaces of dry leaflets)

Sect. *Dysoxylum*

J. As. Soc. Beng. 64, 1 (1895) 50; Ridley *op. cit.* (1922) 397; Mabberley *op. cit.* (1989) 245; Mabberley *et al. op. cit.* (1995) 116; Turner *op. cit.* 341. **Type:** King's collector 10755, Peninsular Malaysia, Perak (holotype CALC, *n.v.*; isotypes BM, G, K).

Small tree to 6 m tall, flowering when a metre or so tall. **Bark** grey-green; inner bark orange. **Twigs** 6–8 mm diameter apically, *tawny-tomentose*. **Apical buds** with *fist-shaped young leaves*, *densely tawny-tomentose*. **Leaves** spirally arranged, to 45 cm long, with apical spike to 15 mm long or its scar; petioles 10–14 cm long, somewhat angled, swollen weakly at base, *densely yellow-pilose*; leaflets coriaceous, minutely rugulose when dry, glabrous above, *yellow-brown pilose* below especially on midrib and veins, apical ones largest; lateral leaflets 2 or 3 on each side of rachis, opposite or subopposite; blades elliptical to obovate, 15–30 × 6–12 cm, base gradually acute, more or less symmetrical, apex acuminate; midrib stout; lateral veins 10–15 on each side of midrib, obtuse arcuate, inarched only near

margin and scarcely anastomosing, depressed above and prominent below when dry; petiolules 3–5 mm long, stout, densely tawny-tomentose. **Inflorescences** *spicate*, 1.5–7.5 cm long, supra-axillary on leafy or leafless twigs; rachis *c.* 4 mm diameter, sericeous, woody. **Flowers** [only known in bud; description largely from King, *op. cit.*] sweetly scented; *calyx* 4-toothed, broadly ovate, densely appressed pubescent outside, apices subacute; *petals* 4, waxy; staminal tube glabrous, margin 8-emarginate, *anthers* 8, oblong, exerted; disc very small; style pilose basally, stylehead discoid, dimpled. **Fruits** *pear-shaped*, at least 3 × 2 cm, apiculate, densely tomentose, orange-red, 3- or 4-valved. **Seeds** 2–4; testa brown.

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo. In Borneo rare, known only by a single collection (*S 40015*) from Long Jakah, Belaga district, Sarawak.

Ecology. Rain forest, at altitude *c.* 550 m.

Notes. This is a very poorly known plant having the habit and facies of *Dysoxylum rugulosum* King and its allies, with which it shares a spicate inflorescence and 4-merous flowers but lacks the stiletto-like apical buds typical of that group.

19. *Dysoxylum parasiticum* (Osbeck) Kosterm.

(Latin, *parasiticus* = parasitic; referring to the mistaken notion that the cauline inflorescence was a parasite on a tree of another species)

Sect. *Dysoxylum*

Reinwardtia 7, 3 (1966) 247; Backer & Bakhuizen *f.*, FJ 3 (1968) 654; Whitmore, Tantra & Sutisna *op. cit.* 232; Mabblerley *et al. op. cit.* 76; PROSEA 5, 3 (1998) 202. **Basionym:** *Melia parasitica* Osbeck, *Dagb. Ostind. Resa* (1757) 278. **Type:** *Osbeck s.n.*, Java [P. Peutjang, 20 Jan 1752] (holotype S [photo FHO, K], *n.v.*, [fragm. BO, *n.v.*]; isotype LINN). **Synonyms:** *Piptosaccos hypophyllantha* Turcz. *op. cit.* 415; *Dysoxylum ramiflorum* Miq. *op. cit.* (1868) 10, *nom. illeg.*

Tree, 20–27(–36) m tall, somewhat pachycaul, sometimes flowering as an unbranched or sparsely branched treelet; bole to 45(–60) cm diameter; buttresses to 1.5 m tall and out, concave, when present then bole fluted. **Bark** smooth, yellowish, with scattered pustular lenticels to flaking, grey-brown with inflorescence bosses to 8 × 8 cm; inner bark pale brown with orange streaks. **Sapwood** white; heartwood red. **Twigs** suberect, brownish to pinkish grey with brown lenticels and conspicuous scutellar (= platter-shaped) petiole scars, 5–12 mm diameter apically, pithy, more or less fulvous-pubescent to tomentose. **Apical buds** with *fist-shaped young leaves*, more or less fulvous-tomentose. **Leaves** *spirally arranged*, bunched at twig apices, 100–150 cm long when mature, *imparipinnate*, the apical portion developing throughout a season and the terminal leaflet sometimes undeveloped or lost; petioles 8–12 cm long, 3–7 mm diameter, terete, swollen and flattened to grooved adaxially at base, more or less pubescent, lenticellate; leaflets dull dark green above, paler below, chartaceous when dry, subglabrous to densely fulvous-tomentose below and on veins above; lateral leaflets 17(–19) on each side of rachis, opposite to subopposite, the largest the more apical; blades narrowly elliptical to oblong, to 19(–28) × 6(–8) cm, the most proximal smallest, subelliptical to suborbicular, base obtuse to rounded, more or less asymmetrical, apex subacuminate; venation brochidiodromous; lateral veins 15–20 on each side of midrib,

arcuate; intercostal venation conspicuously reticulate, prominent below; petiolules 3–8(–18 on terminal leaflet) mm long, more or less densely tomentose. **Inflorescences** *racemose*, to 30 cm long, pendent, *borne in fascicles on bosses on the bole, major branches and twigs*, and/or in axils, where usually solitary, sometimes few-flowered or even flowers solitary; rachis subglabrous to densely pilose or tomentose; bracts triangular, *c.* 1 mm long, rarely lanceolate, foliaceous, to 8 mm long. **Flowers** sweetly scented; pedicels 6–13 mm long, subglabrous to densely appressed pubescent; *calyx* cylindrical, *7–15 mm tall*, cream, subglabrous or with ciliate margin to densely appressed pubescent, *margin irregularly (2 or) 3–5-lobed*, lobes 4–6 mm long, triangular, reflexed at anthesis; *petals* 4 (or 5), linear-lanceolate, 15–20(–28) mm long, imbricate at apices, where thicker, white or creamish, more or less appressed pubescent outside especially apically; staminal tube glabrous or rarely sparsely hirtellous inside or outside, margin with 8 (rarely 10 or 12) lobes, truncate, emarginate or shallowly bifid, reflexed at anthesis, *anthers* 8 (rarely 10 or 12), oblong, *c.* 1.2 mm long, brown; disc cylindrical, 4–5 mm tall, glabrous, margin truncate to crenulate; *ovary* densely appressed pilose, *4(or 5)-locular*, each locule with 1 or 2 superposed ovules, style densely appressed pilose in proximal half, stylehead subcapitate to discoid. **Infructescences** to 30 cm long or fruits solitary. **Fruits** obovoid-globose to depressed globose, to 4 cm diameter, conspicuously 4- or 5-ribbed, red-brown, dehiscing starwise; carpels white inside. **Seeds** 2–5, *c.* 2 cm long, brownish black with basal orange-red aril.

Vernacular name. Sabah—*jarum-jarum* (Bajau).

Distribution. Taiwan (Lan Yü), Sumatra, Java, Borneo, the Philippines, Sulawesi, Nusa Tenggara, Maluku, New Guinea, Bismarck Archipelago, Solomon Islands and NE Australia. In Borneo, known only in Sabah from Kinabatangan, Lahad Datu, Ranau and Semporna districts (e.g., *SAN 26339*, *SAN 77181*, *SAN 87951*, *SAN 117116*, *SAN 134808* and *SAN 143610*) and in Kalimantan (e.g., *de Vogel 911*).

Ecology. Rain forest, including that on limestone, at altitudes to 2100 m. Flowers pollinated by butterflies.

20. *Dysoxylum rigidum* (Ridl.) Mabb.

(Latin, *rigidus* = rigid; probably referring to the leaflets)

Sect. *Dysoxylum*

Mal. For. 45 (1982) 450, *op cit.* (1989) 245; Whitmore, Tantra & Sutisna *op. cit.* 232; Mabberley *et al. op. cit.* 105; Turner *op. cit.* 341; PROSEA 5, 3 (1998) 202. **Basionym:** *Chisocheton rigidus* Ridl., Bull. Misc. Inform. Kew (1929) 122. **Lectotype** (Mabberley, 1982): *Hamid KEP 10880*, Peninsular Malaysia, Pahang, Temerloh, Kemasul FR (K; isolectotypes E, SING).

Tree to 30 m tall; bole to 60 cm diameter; buttresses to 2.5 m tall and 50 cm out. **Bark** smooth and lenticellate to cracking, reddish grey; inner bark pale yellow to red- or brown-mottled, *slash onion-scented*. **Sapwood** creamy-yellow. **Twigs** *c.* 5 mm diameter apically, with distinct petiole scars. **Apical buds** *with tomentose fist-shaped young leaves*. **Leaves** *spirally arranged*, 25–55 cm long, with *apical scar, one of the lateral leaflets often appearing terminal*; petioles 10–13 cm long, *c.* 3.5 mm diameter, conspicuously swollen at base, drying rather blackish like the rachis and petiolules; *leaflets* coriaceous, *glabrous*; lateral leaflets 4 or 5 on each side of rachis; blades broadly elliptical-ovate or weakly

obovate, 15–20(–28) × 5–8(–17) cm, base cuneate to obtuse, somewhat asymmetrical, apex acuminate; venation brochiodromous; lateral veins (7–)9–11 on each side of midrib, prominent below, sunken above; *intercostal venation conspicuously scalariform*; petiolules 0.5–1.2 cm long, swollen. **Inflorescences** to 23 cm long, axillary (sometimes in axils of undeveloped leaves); axes finely appressed fawn-pubescent; *branches to 16 cm long*; bracts lanceolate, 2–6 mm long, fawn-pubescent. **Flowers:** *calyx* c. 6 mm diameter, with 3 or 4 ovate lobes c. 4 mm long, acute, pubescent; *petals* 5, oblong, 5–8 mm long, obtuse, attached to staminal tube at base, finely pubescent outside; staminal tube pubescent inside, margin subentire, *anthers* 10, narrowly oblong, c. 1 mm long, glabrous; disc cup-shaped, c. 1 mm tall, fleshy, densely pilose; *ovary* (?) 5-locular. **Fruits** depressed globose, at least 2.8 cm diameter, sparsely pubescent near sutures, pink to purplish brown. **Seeds** with bright red testa.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known only in Sabah from Kinabatangan, Lahad Datu and Ranau districts (e.g., *SAN 16891*, *SAN 99296*, *SAN 141895* and *SAN 141896*) and in Kalimantan (e.g., *bb. 20730*).

Ecology. Lowland rain forest at altitudes to 260 m. Very rarely collected.

Notes. The strong onion scent of the slash is also found in some *Dysoxylum alliaceum* trees, as well as *D. magnificum* and *D. mollissimum*. The venation is reminiscent of that of *Aglaia oligophylla*, *Chisocheton lansiifolius* and *Lansium domesticum*.

21. *Dysoxylum rugulosum* King

(Latin, *rugulosus* = slightly wrinkled; referring to the surface of the dry leaflets)

Sect. *Cyrtochiton*

J. As. Soc. Beng. 64, 1 (1895) 49; Ridley *op. cit.* (1922) 397; Mabberley *op. cit.* (1989) 245; Whitmore, Tantra & Sutisna *op. cit.* 232; Mabberley *et al. op. cit.* 127; Turner *op. cit.* 341; Coode *et al.* (eds.) *op. cit.* 205; Beaman & Anderson *op. cit.* 132. **Lectotype** (selected here): *King's collector 3158*, Peninsular Malaysia, Perak, Larut (SING; isoelectotypes BM, K, UC, Z). **Synonyms:** *Dysoxylum undulatum* Hend., Gard. Bull. Str. Settl. 7 (1933) 90, Anderson *op. cit.* (1980) 252; *Dysoxylum fulvum* Airy Shaw, Bull. Misc. Inform. Kew (1940) 255.

Small tree to 20 m tall; bole to 20 cm diameter, flowering when a sapling. **Bark** smooth, brown, to finely fissured and scaling; inner bark yellow-brown, mottled. **Sapwood** cream. **Twigs** striate, with conspicuous petiole scars, 4–6 mm diameter apically, fulvous-tomentellous when young. **Apical buds** *stiletto-shaped*. **Leaves** *spirally arranged*, 20–40 cm long, *strictly paripinnate*, with a terminal pair of leaflets with a scar between them or one leaflet and a spike or its scar; *petioles* 6–15 cm long, more or less finely puberulous, flattened adaxially, conspicuously swollen at base; *leaflets* chartaceous to subcoriaceous, *glabrous or subglabrous below*, rugulose, minutely black gland-dotted, (1 or) 2–4 (or 5) on each side of rachis, alternate to subopposite; blades oblong-lanceolate, 10–27 × 2.5–8 cm, the most distal the largest, base acute, attenuate, apex abruptly acuminate; *lateral veins* 8–14 on each side of midrib, sometimes with domatia in axils, arcuate, *prominent below*; *intercostal venation obscure*; petiolules 4–10 mm long, swollen, blackish when dry. **Inflorescences** thyrsoid or spicate, 1–8 cm long, *supra-axillary*; rachis 2–3 mm diameter, puberulous, bearing congested cymes of 3 or 4 flowers; bracts triangular, c. 1 mm. **Flowers** sweetly scented; *calyx* very shallowly cup-shaped, c. 2 × 5 mm, puberulous outside, *shortly 4-toothed*; *petals* 4, elliptical, c. 8 × 3 mm, puberulous outside, yellowish,

valvate; *staminal tube* more or less 4-angled, glabrous or sparsely puberulous on angles outside, *margin crenate to (7 or)8(or 9)-toothed*, the teeth emarginate, *anthers (7 or) 8 (or 9)*, elliptical, *c.* 1 mm long, included; disc *c.* 2 mm tall and diameter, fleshy, glabrous or somewhat pubescent inside, margin irregularly toothed; *ovary* pubescent, *4-locular*, style puberulent in proximal half, stylehead discoid with basal annulus. **Fruits** solitary or paired, 3–5 × 2–2.5 cm, deeply 3- or 4-lobed, glabrous and orange when mature, blackish when dry, veined. **Seeds** black.

Vernacular names. Sabah—*lisi-lisi* (Dusun Kalabakan). Sarawak—*segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, recorded in Sabah from Beaufort, Keningau, Labuk Sugut, Lahad Datu, Penampang, Ranau, Tambunan and Tenom districts (e.g., *SAN 27459*, *SAN 31883*, *SAN 94947*, *SAN 110566* and *SAN 124767*) and in Sarawak from Kapit, Kuching, Lawas, Limbang, Lundu, Miri, Sri Aman and Tatau districts (e.g., *S 21872*, *S 36892*, *S 41290*, *S 52580* and *S 69745*). Also occurring in Brunei (e.g., *Coode et al. 7270*) and E Kalimantan.

Ecology. Lowland, hill and montane rainforests at altitudes to 2050 m. Plants are not infrequently attacked resulting in leaf damage like that recorded for *Dysoxylum brachybotrys* while the ovaries are sometimes abnormally large through their being occupied by larvae.

Notes. *Dysoxylum brachybotrys* may merely be a rather distinct form of this species. There are other forms with particularly large leaflets and fruits with very short stipes (e.g., *S 21872* and *S 41290*). There is extremely little flowering material of this species, which, like the closely allied *D. cyrtobotryum* complex (to which sheets from the Bornean uplands cited by Mabberley *et al. op. cit.* 127 [Note] are here referred), needs analysis in the field: a number of distinct taxa may be involved.

Incompletely known species

Dysoxylum sp. 3.

Mabberley *et al.*, FM 1, 12 (1995) 133.

A treelet to 3 m tall, of weeping habit with grey twigs. Leaves with 2 or 3 narrow, glabrous leaflets on each side of rachis. Fruits solitary, orange, containing 4 black seeds with orange arils. Flowers unknown.

Distribution. Borneo and the Philippines. In Borneo, known only in Sabah from Kinabatangan, Lahad Datu, Sandakan and Tawau districts (e.g., *Mabberley 1694*, *SAN 24476*, *SAN 51910*, *SAN 117633* and *Sugau 312*) and in Brunei (e.g., *Dransfield JD 7239*).

Notes. This taxon approaches some of the small trees discussed under *D. cyrtobotryum*.

7. HEYNEA Roxb.

(Benjamin Heyne (1770–1819), German Moravian Missionary, superintendent of Bangalore Gardens, India)

Bot. Mag. 41 (1815) *t.* 1738; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 565; King, J. As. Soc. Beng. 64, 1 (1895) 86; Ridley, FMP 1 (1922) 413; Merrill, Enum. Philip. Pl. 2 (1923) 380; Mabberley *et al.*, FM 1, 12 (1995) 41; Coode *et al.* (eds.), CLBD (1996) 206; Mabberley, PB 2nd. ed. (1997) 340; Beaman & Anderson, PMK 5 (2004) 132. **Synonyms:** *Walsura* Roxb. sect. *Heynea* (Roxb.) Harms *in* Engler & Prantl, Nat. Pflanzenfam. 1, 3 (4) (1896) 30, *nom. illeg.*; *Trichilia sensu auctt. non L.*: Bentv., Acta Bot. Neerl. 11 (1962) 11, *p.p.*, Pennington & Styles, Blumea 22 (1975) 467, *p.p.*, Mabberley *in* Mabberley & Pannell, TFM 4 (1989) 251, *p.p.*

Trees. **Indumentum** of simple hairs. **Bud scales** absent. **Leaves** spirally arranged, *imparipinnate*, without pseudogemmula; rachis compressed, not swollen at points of attachment of leaflets; lower surface of leaflets papillate, glandular. **Inflorescences** corymbose-cymes with long peduncles. **Flowers** unisexual (plants dioecious) or bisexual; calyx 4- or 5-lobed, the lobes imbricate; petals 4 or 5, aestivation more or less imbricate; androecium with cylindrical staminal tube to 1/3 its length with 8 or 10 filaments with bifid apices; disc annular; ovary 2- or 3-locular, each locule with 2 ovules, stylehead 2- or 3-lobed. **Fruits** capsular; pericarp with sclereids. **Seeds** 1 or 2, pre-raphe-funicular-arillate.

Distribution. Two species, *H. trijuga* and *H. velutina* How & Chen in E and SE Asia. Of these, only *H. trijuga* is found in Sabah and Sarawak.

Notes. Apparently very close to *Walsura* with which it has been combined in the past. The generic and specific descriptions used by Sims in Bot. Mag. (*op. cit.*) were taken directly from the manuscript of Roxburgh's *Plants of the Coast of Coromandel*, which is cited there, and are therefore attributable to Roxburgh.

Heynea trijuga Roxb.

Fig. 24.

(Latin, *tri* = three, *jugum* = yoke; referring to leaves with three pairs of leaflets)

Bot. Mag. 41 (1815) *t.* 1738, Pl. Corom. 3 (1820) 56, *t.* 260; Hiern *op. cit.* 565; King *op. cit.* 86; Ridley *op. cit.* (1922) 413; Mabberley *et al. op. cit.* 41; Turner, Gard. Bull. Sing. 47 (1995) 342; Coode *et al.* (eds.) *op. cit.* 206; Beaman & Anderson *op. cit.* 132. **Lectotype** (selected here): Cultivated (from seeds coll. Buchanan-Hamilton, Nepal 1802), India, HEIC Garden, Calcutta, *c.* 1808/9, *Icones Roxburghianae 1843* (K). **Synonyms:** *Heynea sumatrana* Miq., Fl. Ind. Bat. Suppl. (1861) 197, 505, Merrill *op. cit.* (1921) 323, *op. cit.* (1923) 380, Masamune *op. cit.* 376; *Walsura trijuga* (Roxb.) Kurz, J. As. Soc. Beng. 44, 2 (1875) 148; *Walsura sumatrana* (Miq.) Koord., Exkurs. Fl. Java 2 (1912) 447, Merrill, EB (1921) 323, Masamune, EPB (1942) 376. (For further synonymy *cf.* Mabberley *et al. op. cit.*)

Small tree to 15 m tall; bole to 20 cm diameter but usually much smaller. **Bark** dark brown, lenticellate to grey and weakly cracking into irregular rectangles; inner bark whitish. **Twigs** (young) very dark brown to blackish, lenticellate, 4–7 mm diameter apically. All foliage and inflorescences in current flush. **Leaves** to 50 cm long; petioles 5–15 cm long, terete; leaflets articulated at petiolule apices, upper surface glabrous, shining, lower surface glabrous to hairy, glaucous; lateral leaflets 5 (or 6) on each side of rachis, opposite; blades ovate-oblong, 4.5–20 × 2–7.5 cm, base asymmetrical, rounded to acute, apex acuminate; lateral veins 5–8 on each side of midrib, looping together but not reaching margin. **Inflorescences**

foamy subcorymbose cymes, to 50 cm across, axillary; peduncles over half as long, with 3–7 pairs of decussate branches, each with 1–3 (or 4) orders of branchlets; bracts small, caducous. **Flowers** scented; pedicels 1.5–2 mm long, each with 2 small persistent bracteoles; calyx *c.* 1 mm tall, pale pink, lobes broadly triangular, apices rounded to acuminate, often hairy outside, margin sometimes ciliate; petals oblong, 0.7–1 mm wide, acute, often hairy outside, white to pink or cream, margin sometimes ciliate; stamens 8 or 10(–14), alternately long and short, strigose inside, sometimes puberulous outside, pink, anthers ovate, *c.* 1 mm long, apiculate, subglabrous, bright yellow, inserted between 2 linear acute glabrous teeth; disc fleshy; ovary glabrous. **Fruits** globose, 1–2 cm diameter, pink. **Seed** 1, ovoid, almost covered in a white aril, dangling from long funicle; testa dark brown.

Vernacular names. Sabah—*langitan* (Kedayan), *linkas* (Dusun Kinabatangan), *merbau lalat* (Malay), *takalis* (Ranau). Sarawak—*buah pasat* (Iban), *segera* (Iban).

Distribution. S India to S China, Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Borneo, known in Sabah from Keningau, Kinabatangan, Kota Belud, Kota Marudu, Kuala Penyu, Kudat, Lahad Datu, Papar, Penampang, Pitas, Ranau, Sandakan, Semporna, Tambunan, Tawau, Tenom and Tuaran districts (e.g., *Pennington 7927*, *SAN 32172*, *SAN 76481*, *SAN 84024* and *SAN 127288*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas and Miri districts (e.g., *S 21892*, *S 38399*, *S 40946*, *S 52306* and *Zainudin AZ 5596*). Also occurring in Brunei (e.g., *BRUN 5734*) and Kalimantan (e.g., *Kostermans 9885*).

Ecology. Rain forest, especially at the edge and in regenerating clearings, and along roadsides, at altitudes to 1250 m.

Uses. Long cultivated in Java (and Europe, under glass-house), this is a handsome tree suitable for town gardens. The leaves and bark are bitter and of medicinal value.

8. LANSIUM Corrêa

(from the Malay name, *langsat*)

Ann. Mus. Hist. Nat. Paris 10 (1807) 157; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 558, *p.p.*; King, J. As. Soc. Beng. 64, 1 (1895) 80, *p.p.*; Ridley, FMP 1 (1922) 410, *p.p.*; Backer & Bakhuizen *f.*, FJ 2 (1965) 125; Pennington & Styles, Blumea 22 (1975) 483; Mabberley, Blumea 31 (1985) 140, *in* Mabberley & Pannell, TFM 4 (1989) 246, PB 2nd. ed. (1997) 390; Corner, WSTM 3rd. ed., 2 (1988) 501, *p.p.*; Mabberley *et al.*, FM 1, 12 (1995) 314; Argent *et al.* (eds.), MNDT-CK 2 (1997) 419. **Synonym:** *Aglaia* Lour. sect. *Lansium* (Corrêa) Kosterm., Reinwardtia 7, 3 (1966) 221, *nom. illeg.* (*nom. superfl. pro* sect. *Neolansium* Harms), *p.p.*

Trees. **Indumentum** of simple hairs. **Bud scales** absent. **Leaves** spirally arranged, *paripinnate*, without *pseudogemmula*; leaflets subopposite to alternate, *the most distal on one side appearing terminal*; petiolules pulvinate at base. **Inflorescences** spikes, racemes or more rarely basally branched panicles with spicate or racemose branches, *borne on twigs, branches or bole*. **Flowers** unisexual (tree dioecious) or bisexual; female and bisexual flowers larger than male ones; calyx deeply 5-lobed, the lobes imbricate; petals 5, free from each other but united with staminal tube in proximal third to half, aestivation imbricate; staminal tube globose to cyathiform (= cup-shaped), margin more or less undulate, *anthers (8–)10 in one whorl* inside the throat of the staminal tube, their tips not or slightly exerted,

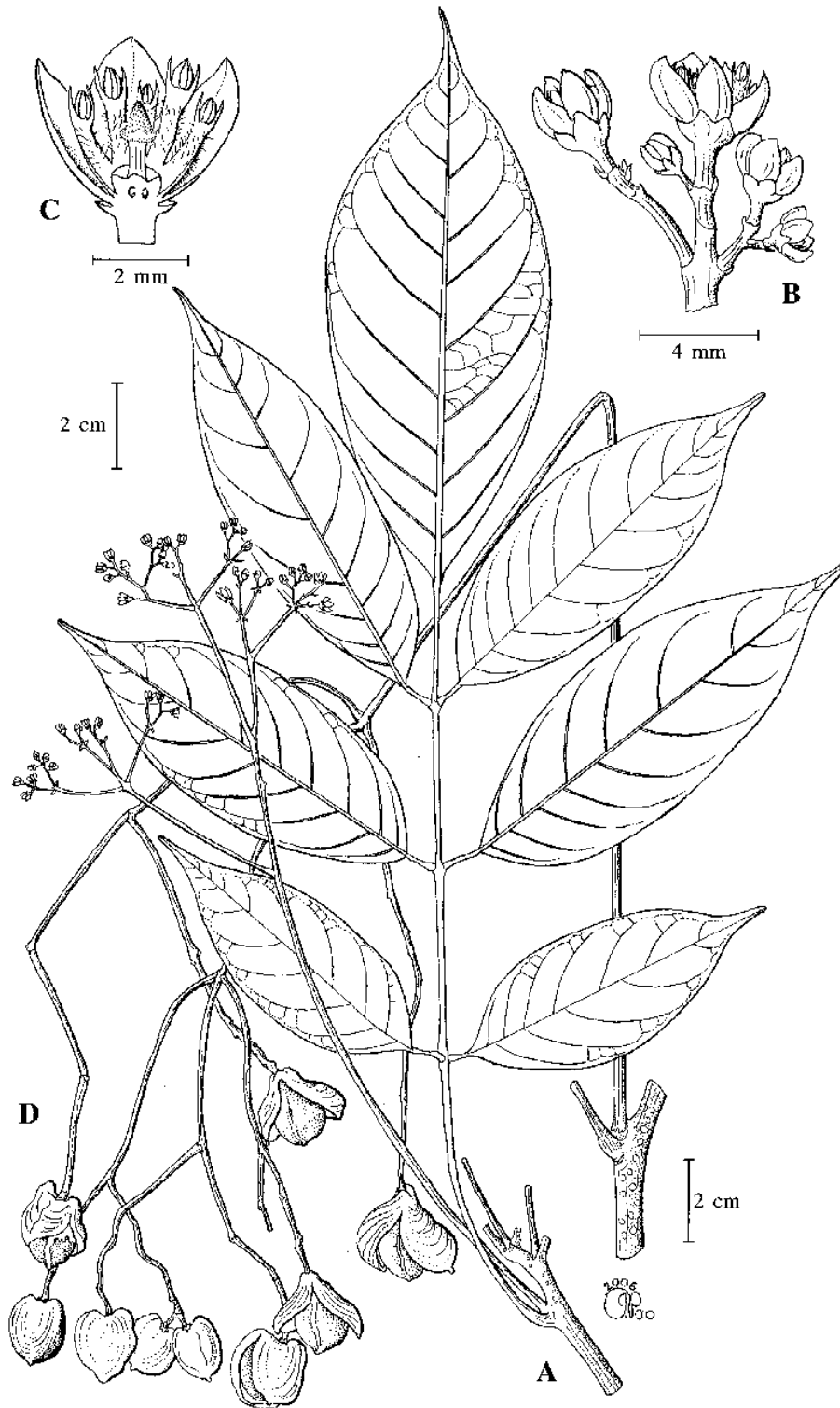


Fig. 24. *Heynea trijuga*. A, flowering leafy twig; B, distal part of inflorescence; C, longitudinal section of flower; D, infructescence. (A–C from *Forman* 2700, D from *S* 38399.)

without appendages; *disc absent*; ovary 3–5-locular, each locule with one ovule, style long and broad-columnar, its flanks ribbed with the impressions of the surrounding anthers, *stigma unlobed*. **Fruit** a 1–5-seeded berry. **Seeds** usually arillate; aril completely enveloping seed; embryo with thick planoconvex, superposed free cotyledons; radicle included. Germination cryptocotylar; eophylls simple, opposite.

Distribution. Three species, the genus possibly being the only one restricted to Malesia, but planting of *Lansium domesticum*, which may be native in southern Thailand in any case, elsewhere has obscured this. In Borneo, only *L. domesticum* is found; the other two, *L. membranaceum* (Kosterm.) Mabb. and *L. breviracemosum* Kosterm. occur only in Sumatra and the Lesser Sunda Islands (Sumbawa and Flores), respectively.

Ecology. Rain forest, including *kerangas*, at altitudes to 1360 m.

Notes. The venation of the leaflets closely resembles that of many Sapindaceae, notably *Lepisanthes* spp. and is also seen in *Aglaia* spp., particularly *A. oligophylla*, *Chisocheton lansifolius* and *Dysoxylum rigidum*.

Lansium domesticum Corrêa
(Latin, *domesticus* = cultivated)

Fig. 25, Plate 6C.

Ann. Mus. Hist. Nat. Paris 10 (1807) 157; Hiern *op. cit.* 558; King *op. cit.* 81; Merrill, EB (1921) 320, Enum. Philip. Pl. 2 (1923) 368, PEB (1929) 123; Ridley *op. cit.* (1922) 411; Masamune, EPB (1942) 376; Backer & Bakhuizen *f. op. cit.* (1965) 125; Mabberley, Blumea 31 (1985) 141, *op. cit.* (1989) 246; Corner *op. cit.* (1988) 501; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 233; Mabberley *et al. op. cit.* 315; PROSEA 2 (1991) 186; Turner, Gard. Bull. Sing. 47 (1995) 342; Coode *et al.* (eds.) *op. cit.* 206; Argent *et al.* (eds.) *op. cit.* 420; Beaman & Anderson *op. cit.* 132. **Neotype** (Kostermans, 1966): *Kostermans s.n.*, cult. Java (BO). **Synonyms:** *Lansium domesticum* Corrêa var. *aqueum* Jack, Trans. Linn. Soc., London 14, 1 (1823) 116; *Lansium aqueum* (Jack) M.J.Roem., Fam. Nat. Syn. Monogr. 1 (1846) 99; *Aglaia aquea* (Jack) Kosterm. *op. cit.* (1966) 234; *Aglaia dookoo* Griff., Not. 4 (1854) 505, Kostermans *op. cit.* (1966) 238; *Aglaia domestica* (Corrêa) Pellegr., F1. Gén. Indoch. 1 (1911) 766, *nom. illeg.*, Kostermans *op. cit.* (1966) 244. (For complete synonymy *cf.* Mabberley *op. cit.*, 1985.)

Tree to 30 m tall and 75 cm diameter but usually much less; bole irregularly fluted; buttresses short, concave, to 2 m out. **Bark** light reddish brown or fawn mottled, slightly scaling and with tubercles of old infructescences. **Twigs** subglabrous to subtomentellous when young. **Leaves** 30–50 cm long; petioles 5–8 cm long, often flattened adaxially, pulvinate; leaflets coriaceous, glabrous above, subglabrous to fawn-tomentose below, especially on venation, 2–4 (or 5) on each side of rachis, alternate or subopposite; blades elliptical-ovate to oblong, 9–25(–45) × 5–10(–15) cm, the most apical usually the largest, base somewhat asymmetrical, acute to cuneate, apex shortly acuminate, acumen 10–15(–25) mm long; lateral veins (7–)10–14 on each side of midrib, arcuate; intercostal venation reticulate to scalariform, conspicuous on both surfaces when dry; petiolules 5–10 mm long, more or less pubescent. **Inflorescences** racemose, 4–20 cm long, solitary or usually in fascicles of 2–10 on branches and bole, rarely on twigs, more or less pubescent; bracts ovate, *c.* 1 mm, acute. **Flowers** sweetly scented; pedicels 0–2 mm long; calyx lobes suborbicular, 1–2 mm across, margin ciliate; petals ovate to suborbicular, 2–3 mm long, creamy-white; staminal tube glabrous or almost so, margin undulate to crenate, anthers 1–2 mm long, within or slightly protruding from staminal tube; ovary and style densely pilose.

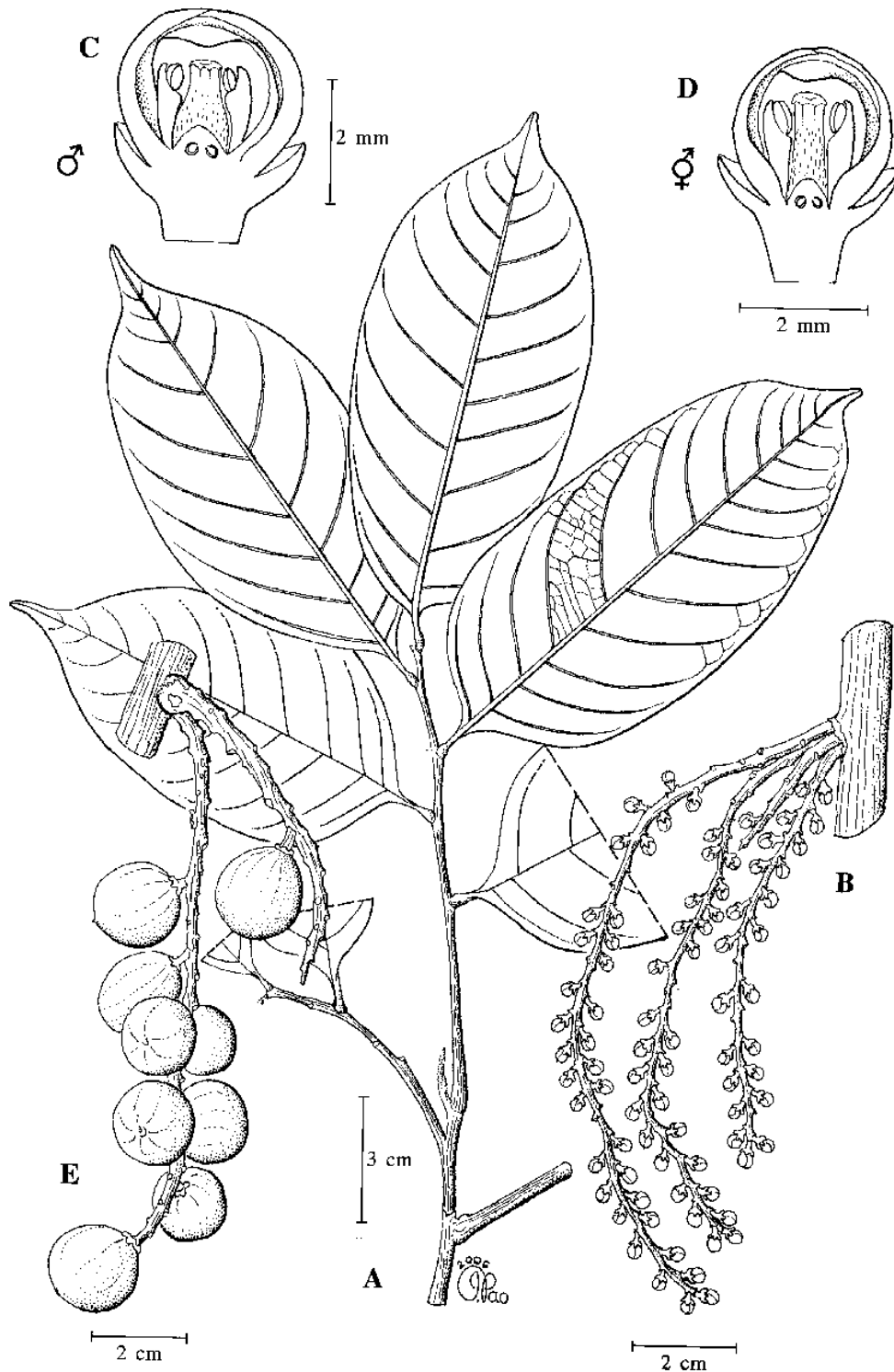


Fig. 25. *Lansium domesticum*. A, leafy twig; B, inflorescences; C, longitudinal section of male flower; D, longitudinal section of bisexual flower; E, infructescence. (A from *S* 49293, B–D from *S* 25711, E from *SAN* 21541.)

Fruits ellipsoid-globose, 2–4 × 1.5–2(–4) cm, pale yellow or brownish, often becoming glabrous; pericarp sometimes with white latex, white inside; the locules with undeveloped seeds filled with arillate tissue. **Seeds** 1–5, more or less flattened ellipsoid, *c.* 13 × 7 mm; aril completely enveloping seed, *c.* 25 × 15 mm, perichalazal and pachychalazal, developing from funicle and exostome. Seedlings with simple leaves.

Vernacular names. Known throughout Malaysia and Indonesia as *langsat*. Different cultivars are known locally as *duku*, *duku-langsat*, *kokosan* or *pisitan*.

Distribution. Peninsular Thailand; ‘wild’, cultivated and naturalized in Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Maluku and Irian Jaya (W New Guinea). In Borneo, known in Sabah from Beaufort, Kinabatangan, Kota Kinabalu, Kuala Penyu, Lahad Datu, Ranau, Sandakan and Tenom districts (e.g., *Pennington 7885*, *SAN 21541*, *SAN 39451*, *SAN 126699* and *SAN 134927*) and in Sarawak from Bau, Belaga, Betong, Bintulu, Kapit, Kuching, Limbang, Lubok Antu, Lundu, Marudi, Miri, Simunjan and Sri Aman districts (e.g., *Mabberley 1602*, *S 35639*, *S 48298*, *S 58182* and *S 68673*). Also occurring in Brunei (e.g., *BRUN 16841*) and Kalimantan (e.g., *Kostermans 6223*).

Ecology. Rain forest including *kerangas* and on limestone, at altitudes to 110 m. Fruits said to be dispersed by bats.

Uses. *Lansium domesticum* is one of the important native fruit trees of Malaysia but it is scarcely grown on a plantation scale. Most of the fruits seen in markets are harvested from village trees. Although refreshing, the arils have one of the lowest vitamin C contents of any fruit grown in Borneo. The fruits in Malay markets are called *duku* and *langsat* and, more recently has appeared the more appreciated *duku-langsat*. The name *duku* is used for a larger round form, which is borne in infructescences of about 8–12. The pericarp is always *c.* 5 mm thick without latex. Usually there are no developed seeds and the aril is sweetly flavoured. By contrast the *langsat* has smaller ellipsoid bitter-sweet fruits with thin pericarp and much latex, borne in infructescences of about 20 or more. The *duku-langsat* has features of both. The *duku* is a tree with a densely leafy wide crown, reminiscent of *rambai*; the *langsat* is more scruffy in appearance with a more open crown. The *duku* and *langsat* are apomictic, the different forms thus being clones, their cultivar status now confirmed by AFLP analysis (Kiew *et al.*, *Telopea* 10 (2003) 225). Wild trees in Peninsular Malaysia at least have sourer, smaller fruits with latex: they are not readily grown outside the forest. Trees are propagated by budding, cleft and side grafting and from seed, in which case they flower after about 15 years. Interesting details of trading the fruits and of folklore associated with them is provided by Kostermans (*op.cit.* (1966) 241) and information on production, propagation and planting as well as diseases and pests is given in PROSEA (*op.cit.* (1991) 186).

The wood is light-coloured and has been used for toolhandles, houseposts and rafters. Formerly, it was one of the woods used for ‘baja’, a teeth-blackening agent used by Malays. The bark is astringent and is of possible medical value, particularly in treating dysentery. An extract has been used as an arrow poison, for which the seeds, which are said to be anthelmintic, have also been used. The pericarp has been burnt as an insect repellent in Java and, like the bark, used dried or boiled and drunk in the treatment of stomach ache, diarrhoea and intestinal spasms, as well as tooth-ache, high blood pressure, measles, malaria and other fevers. (PROSEA *op. cit.* (1991) 186).

9. PSEUDOCLOUSENA T.Clark

(Greek, *pseudo* = false, *Clausena* (Rutaceae), to which genus the sole species was first referred)

Blumea 38 (1994) 291, in Mabblerley *et al.*, FM 1, 12 (1995) 55; Beaman & Anderson, PMK 5 (2004) 133. **Synonym:** *Walsura* sect. *Neowalsura* Harms in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 119.

Trees. **Indumentum** of simple hairs. **Bud scales** absent. **Leaves** spirally arranged, imparipinnate, without pseudogemma; rachis not swollen at insertion of leaflets. **Inflorescences** thyrses of bisexual or male flowers. **Flowers:** calyx deeply 5-lobed; petals more than 4, free, aestivation imbricate; staminal tube more or less cylindrical, each filament linear with bifid apex; disc absent; ovary 4- or 5-locular, each locule with 1 ovule. **Fruit** a 1- or 2-seeded berry, asymmetrical, shortly beaked. **Seeds** ellipsoid, non-arillate, possibly pachychalazal.

Distribution. One variable species of rain forest, distributed from Indo-China to Irian Jaya.

Pseudoclausena chrysogyne (Miq.) T.Clark

Fig. 26.

(Greek, *chryso-* = gold-, *gyne* = woman; referring to the colour of the trichomes covering the ovary)

Blumea 38 (1994) 291, *op. cit.* (1995) 55; Turner, Gard. Bull. Sing. 47 (1995) 342; Beaman & Anderson, FMK 5 (2004) 133. **Basionym:** *Clausena chrysogyne* Miq., Fl. Ind. Bat., Suppl. (1861) 502. **Type:** *Teijsmann s.n.* [= *HB 3805*], Sumatra, Palembang (holotype L [*Acc. No. 9082021006*]; isotype U [*Acc. No. 43005*]). **Synonyms:** *Cipadessa borneensis* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 6; *Walsura multijuga* King, J. As. Soc. Beng. 64, 1 (1895) 85, Ridley, FMP 1 (1922) 412, Bull. Misc. Inform., Kew (1930) 370, Merrill, Enum. Philip. Pl. 2 (1923) 379; *Walsura glabra* Merr., Phil. J. Sci. 13 (1918) 76, EB (1921) 323, Masamune, EPB (1942) 377; *Walsura borneensis* Merr., PEB (1929) 132, Masamune *op. cit.* 377; *Walsura hosei* Ridl. *op. cit.* (1930) 371; *Walsura velutina* Ridl., *op. cit.* (1930) 371; *Walsura chrysogyne* (Miq.) Bakhuisen *f.*, Blumea 16 (1968) 359, Anderson, CLTS (1980) 253, Mabblerley in Mabblerley & Pannell, TFM 4 (1989) 254, Coode *et al.* (eds.), CLBD (1996) 206; *Pseudoclausena chrysogyne* (Miq.) T.Clark forma *velutina* (Ridl.) T.Clark *op. cit.* (1994) 294.

Tree to 25 m tall; bole to 15 m tall, to 60 cm diameter. **Bark** *c.* 2 mm thick, pale brown to grey-brown; inner bark 2–4 mm thick, red-brown. **Sapwood** whitish with red or pink tinge. **Twigs** 1–3.5 mm diameter apically, glabrous or puberulous or velvety, sometimes sparsely lenticellate. **Leaves** 18–42 cm long; petioles 2.5–8.5 cm long, 0.8–2.1 mm thick, terete or slightly flattened adaxially, glabrous or puberulous or velvety; leaflets subcoriaceous, lateral ones (1–)2–4(–7) on each side of rachis; blades ovate, elliptical or lanceolate, that of lateral leaflets (5.3–)7.2–14(–18.5) × 2.3–5(–6.5) cm, of terminal leaflets (6.4–)7.2–16.5(–19.5) × 2.4–5(–6.8), and of basal leaflets 4–12.5 × 1.9–5.5 cm, base attenuate and slightly asymmetrical, apex shortly acuminate; midrib and lateral veins prominent below; lateral veins 6–10(–15) on each side of midrib; petiolules (of distal leaflets) *c.* 10 mm long, 0.4–0.9 mm thick. **Inflorescences** clustered around shoot apex or in the axils of fully expanded leaves, 1–6(–10) cm long, branched to second (or third) order. **Flowers:** buds cylindrical to barrel-shaped, 3–3.6 × 1.4–2.6 mm; calyx 1.5–1.8 mm tall, lobes 0.8–1.2 mm long with a

blunt apex; petals 5, free or imbricate, narrowly elliptical-oblong, 2.8–4.8 × 1.5–1.8 mm; staminal tube 1.5–3.3 mm tall, 0.9–1.8 mm diameter, tubular for 1/4–1/2 of its length, anthers 0.4–0.5 mm long, glabrous or with a short tuft of trichomes at apex; ovary densely pubescent with short stiff hairs, each locule with one ovule, style more or less cylindrical, 0.4–0.6 mm long, 0.2–0.3 diameter, stigma subcapitate and shallowly 2-lobed on top. **Fruits** subglobose, 1.3–1.8 cm diameter with a short, asymmetrically positioned beak 3–5 mm long. **Seeds** subellipsoid, 0.8–1.3 cm long, dark brown and shining but lacking an aril.

Vernacular name. Sarawak—*bunya* (Iban).

Distribution. Indo-China, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi, Maluku and Irian Jaya. In Borneo, recorded in Sabah from Keningau, Labuk Sugut, Sandakan and Tawau districts (e.g., *Pennington 7899*, *SAN 16479*, *SAN 66696*, *SAN 84007* and *SAN 107255*) and in Sarawak from Bintulu, Kapit, Limbang, Lundu, Marudi and Miri districts (e.g., *Pennington 7983*, *S 24268*, *S 24459*, *S 32163* and *S 77219*). Also occurring in Brunei (e.g., *Awong Kaya 20*) and Kalimantan (e.g., *Ambriansyah et al. 1302*).

Notes. Specimens with young parts velutinous have been recognised as forma *velutina*. Although restricted to Borneo and the Philippines (Mindanao), its occurrence is sporadic and there are intermediate less hairy forms (see *Dysoxylum cauliformum* and *Toona* spp. for similar examples).

10. REINWARDTIODENDRON Koord.

(Caspar Georg Carl Reinwardt, 1773–1854, sometime Director of the Botanic Gardens at Bogor, Java; Greek, *dendron* = tree)

Meded. s'Lands Pl. Buitenz. 19 (1898) 389; Merrill, Enum. Philip. Pl. 2 (1923) 369; Pennington & Styles, Blumea 22 (1975) 486; Mabberley, Blumea 31 (1985) 144, in Mabberley & Pannell, TFM 4 (1989) 247, PB 2nd. ed. (1997) 609; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 233; Mabberley *et al.*, FM 1, 12 (1995) 322; Argent *et al.* (eds.), MNDR-CK 2 (1997) 420; PROSEA 5, 3 (1998) 490; Beaman & Anderson, PMK 5 (2004) 133. **Synonyms:** *Lansium* Corrêa sect. *Neolansium* Harms in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b (1940) 124; *Aglaiia* Lour. sect. *Lansium* (Corrêa) Kosterm., Reinwardtia 7, 3 (1966) 221, *nom. illeg.*, *p.p.*

Trees. **Indumentum** of simple hairs. **Bud scales** absent. **Leaves** spirally arranged, without pseudogemma, pinnate or trifoliolate; leaflets alternate, the most distal on one side appearing terminal; petiolules often swollen; domatia frequently present. **Inflorescences** axillary spikes or basally branched panicles of spikes. **Flowers** bisexual, yellow; calyx deeply 5-lobed, lobes orbicular, imbricate; petals 5, free from each other but united with staminal tube at base; staminal tube globose to ovoid, with an undulate to toothed margin, anthers 10 in 2 whorls of 5, glabrous, the upper ones partly exerted, the lower ones alternating with the upper ones and completely included, their connectives extended to form a short acute appendage; *disc absent*; ovary 5-locular, each locule with one ovule, style very short, with a small capitate (= head-shaped) or pileate (= cap-shaped), obscurely lobed apex. **Fruit** a 1–5-seeded berry. **Seeds** apparently sarcotestal; embryo with thick planoconvex, superposed, free cotyledons; radicle included.

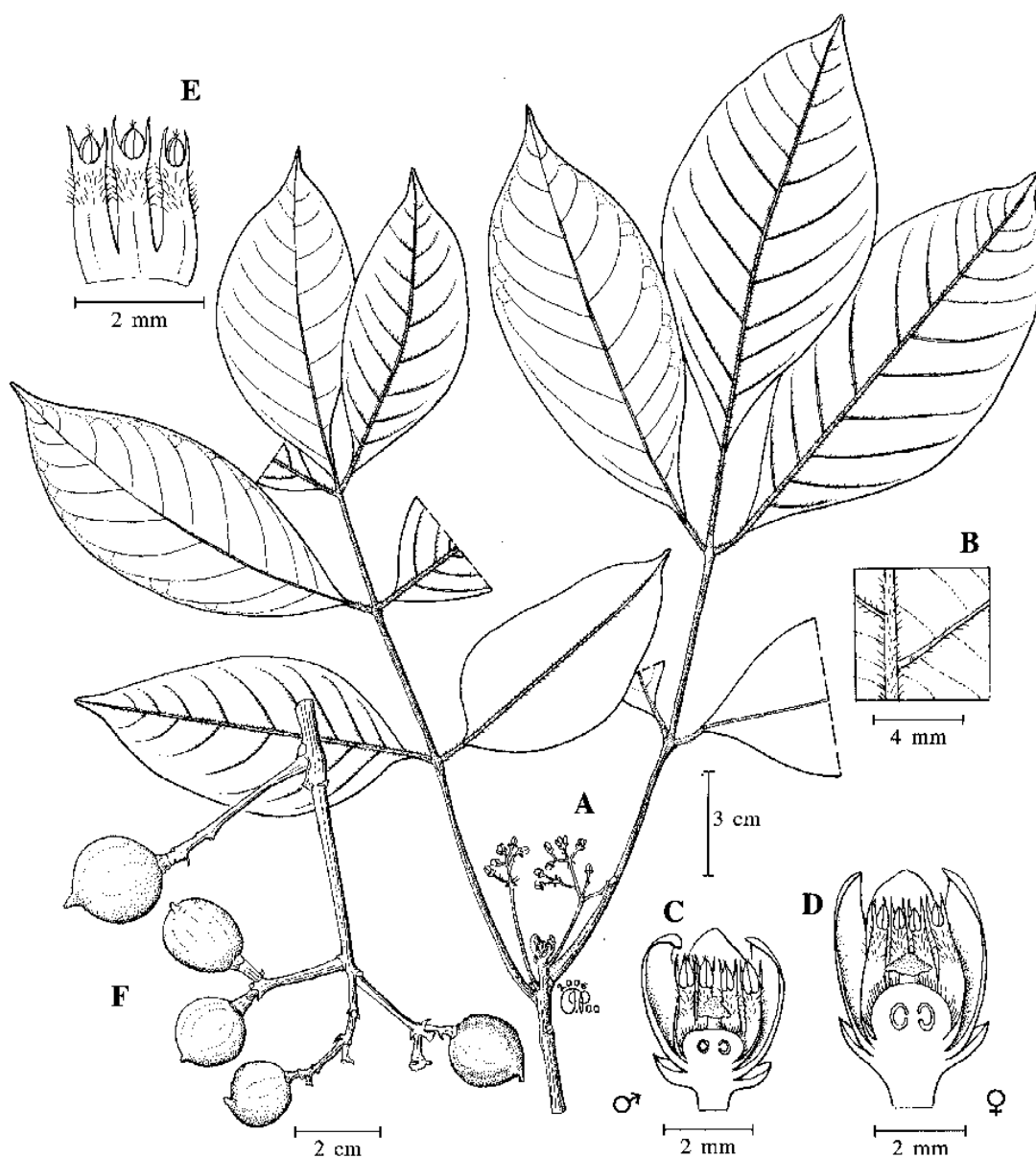


Fig. 26. *Pseudoclausena chrysogyne*. A, flowering leafy twig; B, detail of part of lower leaf surface showing fine venation and indumentum; C, longitudinal section of male flower; D, longitudinal section of female flower; E, adaxial view of stamens; F, infructescence. (A–E from SAN 119062, F from ITTO/BA 1055.)

Distribution. Probably seven species restricted to Indo-Malesia, from the W Ghats of India (*R. anaimalaiense* (Bedd.) Mabb.) to Irian Jaya. Of these, three species occur in Sabah and Sarawak.

Ecology. Rain forest at altitudes to about 900 m.

Uses. The wood of *Reinwardtiidendron* is used for making high grade furniture, panels, doors and window frames.

Notes. The genus consists of very closely related but clearcut, distinct species, some of which are very little known. It closely resembles *Aglaia* in pollen and secondary xylem as well as overall facies but it differs in its simple indumentum, the two whorls of anthers with appendages and the 5-locular ovary. It is perhaps closest to *Lansium* that shares the indumentum type and the leaflet form and venation but the latter differs in its single whorl of 10 stamens without appendages, the inflorescences borne on branches and bole and the seeds, which are arillate and pachychalazal.

Key to *Reinwardtiidendron* species

1. Secondary lateral veins of leaflets almost as prominent as the primary ones, at least on upper surface.....**2. R. humile**
Secondary lateral veins of leaflets not so prominent.....2
2. Petiole densely and lower surface of leaflet sparsely brown-tomentose. Leaflets 2–4 (or 5) on each side of rachis; blades elliptical, 4–5.5(–8) × 1.5–2.5(–3.5) cm, acumen 6–8 mm long. Fruits glabrous, globose, to 2 cm diameter.....**1. R. cinereum**
Petiole sparsely pubescent to glabrous, lower surface of leaflet glabrous. Leaflets 1 or 2 on each side of rachis; blades oblong-elliptical, 8–15 × 3–6.5 cm, acumen to 18 mm long. Fruits sericeous, depressed globose to obovoid with apical depression and 5 ribs, to 5 cm diameter.....**3. R. kinabaluense**

1. *Reinwardtiidendron cinereum* (Hiern) Mabb.

(Latin, *cinereus* = ashen; referring to the colour of dried leaves)

Mal. For. 45 (1982) 452, *op. cit.* (1985) 144, *op. cit.* (1989) 247; Whitmore, Tantra & Sutisna *op. cit.* 233; Mabberley *et al. op. cit.* 324; Turner, Gard. Bull. Sing. 47 (1995) 342; Argent *et al.* (eds.) *op. cit.* 420. **Basionym:** *Lansium cinereum* Hiern in Hooker *f.*, Fl. Brit. Ind. 1 (1875) 558, King, J. As. Soc. Beng. 64, 1 (1875) 81, Ridley, FMP 1 (1922) 411. **Type:** *Maingay 1908* [= *Kew Distr.* 339], Peninsular Malaysia, Malacca (holotype K). **Synonym:** *Aglaia pseudolansium* Kosterm. *op. cit.* (1966) 252.

Tree to 27 m tall; clear bole to 18 m tall, to 70 cm diameter. **Buttresses** to 1 m tall, extending out to 3 m, snake-like at extremities. **Bark** smooth with scaly patches and conspicuous knobby tubercles; inner bark white. **Sapwood** yellow. **Twigs** rather angular, with conspicuous petiole scars and dense indumentum when young, aluminium grey later. **Leaves** 10–15 cm long; *petioles* 1.5–2 cm long, *densely brown-tomentose*; *leaflets* chartaceous to subcoriaceous, *very sparsely pubescent below, lateral ones 2–4 (or 5) on each side of rachis; blades elliptical, 4–5.5(–8) × 1.5–2.5(–3.5) cm*, the most apical ones larger (to 11.5 × 4.5 cm), base weakly asymmetrical, cuneate, apex acuminate, *acumen 6–8*

mm long; midrib bristly brown-pilose on both surfaces; primary lateral veins 6–8 on each side of midrib, brown-pilose below, arcuate, with pilose domatia in their axils, *secondary ones inconspicuous*; petiolules *c.* 5 mm long, densely brown-tomentose, weakly swollen at base. **Inflorescences** spicate, to 10 cm long; peduncles densely pilose; bracts to 4 mm long, acute, often with smaller bracteoles. **Flowers:** calyx lobes *c.* 1 mm long, fawn-sericeous, margin ciliate; petals 4 mm long, ovate. **Fruits** globose, 1.5–2 cm diameter, glabrous, yellow.

Vernacular name. Sabah—*maliadoh* (Ladad Datu).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known only in Sabah from Lahad Datu and Sandakan districts (e.g., *BNB FD 4659* and *SAN 29328*).

Ecology. Rain forest at altitudes to 700 m. Rarely collected.

Use. The sarcotesta is edible.

Notes. The leaflets are very similar to those of *Aglaia oligophylla* (*q.v.*) but are more-or-less alternate and have no stellate indumentum.

2. *Reinwardtiodendron humile* (Hassk.) Mabb. (Latin, *humilis* = lowly; referring to the first tree described)

Fig. 27.

Mal. For. 45 (1982) 452, *op. cit.* (1985) 145, *op. cit.* (1989) 249; Whitmore, Tantra & Sutisna *op. cit.* 233; Mabblerley *et al. op. cit.* 326; Turner *op. cit.* 342; Argent *et al.* (eds.) *op. cit.* 422; Beaman & Anderson *op. cit.* 133. **Basionym:** *Lansium humile* Hassk., *Retzia*, ed. nov. 1 (1858) 121, Backer & Bakhuizen *f.*, FJ 2 (1965) 125. **Lectotype** (Mabblerley, 1982): *Hort. Bogor. III-B-47* ('417'), Java, Bogor, cultivated [ex Sumatra] (K). **Synonym:** *Aphanamixis humilis* (Hassk.) Kosterm. *op. cit.* (1966) 263, Backer & Bakhuizen *f.*, FJ 3 (1968) 654, [*'humile'*].

Tree to 27 m tall; bole to 40 cm diameter, fluted at base; flowering when small; buttresses to 4 m tall, to 5 m out. **Bark** smooth with scaly patches, fawn; inner bark yellow to reddish brown. **Sapwood** yellowish. **Twigs** with indistinct petiole scars, subglabrous except minutely pubescent apices, dark brown when dry. **Leaves** 15–20 cm long; petioles 2–4 cm long; leaflets chartaceous to subcoriaceous, glossy on both surfaces, more or less glabrous, lateral ones 2 or 3 on each side of rachis; blades elliptical to elliptical-obovate, (6–)8.5–10 × 1.8–3.5 cm, the most apical one larger (to 18 × 6.5 cm), base weakly asymmetrical, cuneate, apex markedly acuminate, acumen to 1.5 cm long; *primary lateral veins not clearly distinct from secondary ones*, particularly on the upper surface of leaflets, together some 20–30 on each side of midrib, parallel, straight, forming an angle of about 60° to midrib, anastomosing at margin, *prominent on both surfaces*, rarely with domatia in the axils above; petiolules 4–6 mm long, weakly swollen and channelled. **Inflorescences** spikes or panicles, to 15 cm long; peduncles very sparsely pubescent; bracts *c.* 2 mm long, acute, usually with a pair of smaller bracteoles, all sparsely pubescent. **Flowers:** calyx lobes orbicular, 1–2 mm long, margin ciliate; petals ovate to obovate, to 2.5 mm long, yellow. **Fruits** fig-shaped or obovoid, especially when immature, to 5 cm diameter, with apical depression and five sutures, densely but very shortly pilose, yellow. **Seed** 1 with white, sweet-tasting aril.

Vernacular name. Sabah—*langsar munyit* (Malay).

Distribution. S China (Hainan), Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines and Sulawesi. In Borneo, recorded in Sabah from Beaufort, Keningau, Kinabatangan, Lahad Datu, Ranau, Sandakan, Semporna and Tawau districts (e.g., *FRI 40274*, *Mabberley 1672*, *SAN 26311*, *SAN 31284*, *SAN 76046* and *SAN 89320*) and in Sarawak from Kuching, Lundu and Serian districts (e.g., *S 14628*, *S 73281* and *S 78355*). Also occurring in Brunei (e.g., *Wong WKM 1097*) and Kalimantan (e.g., *Kostermans 8944* and *Kostermans 9574*).

Ecology. Rain forest at altitudes to 800 m.

3. *Reinwardtiodendron kinabaluense* (Kosterm.) Mabb.

(from Mt. Kinabalu)

Blumea 31 (1985) 145; Mabberley *et al. op. cit.* (1995) 325; Beaman & Anderson *op. cit.* 133.

Basionym: *Aglaia kinabaluensis* Kosterm. *op. cit.* (1966) 253. **Type:** Chew *et al. RSNB 122*, Borneo, Sabah, Mt. Kinabalu, eastern shoulder (holotype BO; isotypes CANB, K, L, SAN, SAR, SING).

Tree to 20(–35) m tall, to 25(–30) cm diameter and clear buttressed bole to 15 m tall. **Bark** smooth; inner bark yellow to white. **Sapwood** yellow. **Twigs** soon glabrous, appressed pilose at apices. **Leaves** to 27 cm long; *petioles* 4–5 cm long, *sparse pubescent to glabrous*; *leaflets* chartaceous to subcoriaceous, *glabrous*, *lateral ones 1 or 2 on each side of rachis* (the leaves thus largely trifoliolate); *blades oblong-elliptical*, 8–15 × 3–6.5 cm, the most apical one usually the largest (to 18 × 7 cm), base cuneate, apex acuminate, *acumen to 18 mm long*; primary lateral veins *c. 7* on each side of midrib, arcuate, frequently with small domatia in their axils, *secondary ones less conspicuous*; *petiolules c. 5 mm long*, sulcate, swollen at base. **Inflorescences** spicate, to 8 cm long or basally branched panicles with 2 or 3 branches to 8 cm long; peduncles more or less pilose especially in high altitude specimens; bracts triangular, *c. 1 mm long*, pilose. **Flowers:** calyx lobes *c. 1.5 mm long*, more or less pilose, margin ciliate; petals ovate, 4–5 mm long. **Fruits** *depressed globose when young, obovoid with apical depression and 5 ribs when mature, to 5 cm long, sericeous*, yellow.

Distribution. Endemic in Borneo. Known in Sabah from Keningau, Ranau, Sandakan, Tawau and Tenom districts (e.g., *SAN 44863*, *SAN 53864*, *SAN 81492* and *SAN 92166*) and in Sarawak from G. Gading, Lundu district (e.g., *SFN 36099*). Also occurring in Kalimantan (e.g., *Leighton 756*). Not yet recorded from Brunei.

Ecology. Rain forest at altitudes to 900 m. Rarely collected.

Notes. This species is remarkably similar in overall facies to *Aglaia oligophylla*, though the leaflets are larger in that species and its indumentum of stellate hairs, best seen in the fruit, distinguishes it at once. Furthermore, domatia are absent.

11. SANDORICUM Cav.

(from the Moluccan name, *sandori*, for *S. koetjape*)

kelampu (preferred name in Sabah and Sarawak), *sentul* (ASEAN trade name)

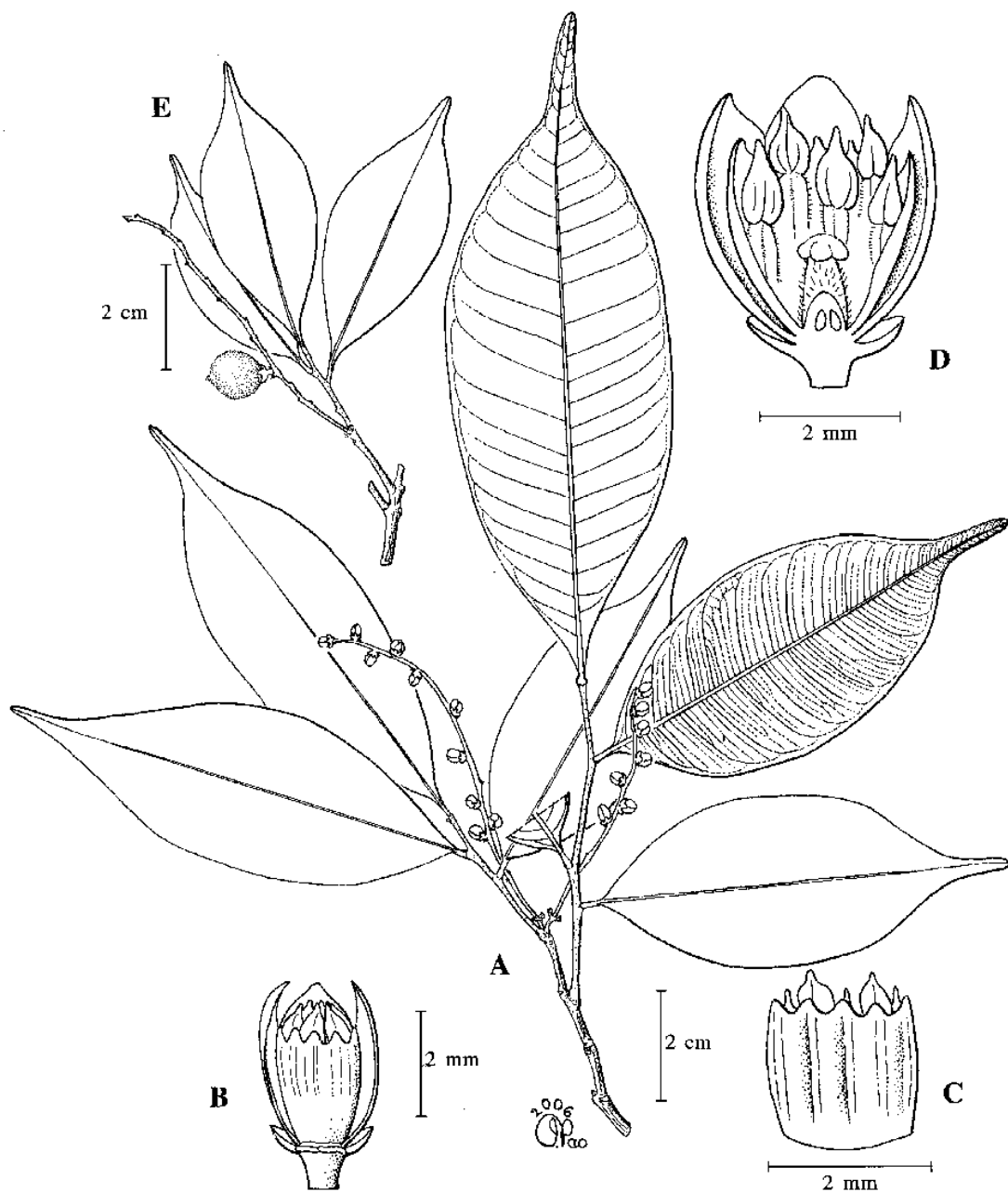


Fig. 27. *Reinwardtiodendron humile*. A, flowering leafy twig; B, flower with two petals removed; C, abaxial view of staminal tube; D, longitudinal section of flower; E, fruiting leafy twig. (A from Pennington 7876, B–D from SAN 84793, E from FRI 40274.)

Diss. 7 (1789) 359; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 553; King, J. As. Soc. Beng. 64, 1 (1895) 21; Ridley, FMP 1 (1922) 384; Merrill, Enum. Philip. Pl. 2 (1923) 381; Backer & Bakhuizen *f.*, FJ 2 (1965) 121; Pennington & Styles, Blumea 22 (1975) 507; Anderson, CLTS (1980) 252; Mabberley, Blumea 31 (1985) 146, *in* Mabberley & Pannell, TFM 4 (1989) 249, PB 2nd. ed. (1997) 636; Corner, WSTM 3rd. ed., 2 (1988) 504; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 234; Mabberley *et al.*, FM 1, 12 (1995) 344; Coode *et al.* (eds.), CLBD (1996) 206; Argent *et al.* (eds.), MNDT-CK 2 (1997) 422; PROSEA 5, 3 (1998) 497; Beaman & Anderson, PMK 5 (2004) 133.

Trees. **Indumentum** of simple hairs. **Bud scales** absent. **Leaves** spirally arranged, trifoliolate, without pseudogemma. **Inflorescences** axillary thyrses. **Flowers** bisexual; calyx more or less truncate to shallowly 4- or 5-lobed; petals (4 or) 5, free, aestivation imbricate; staminal tube cylindrical, ribbed distally, margin with 5 or 10 short lobes, anthers 10, glabrous, included; disc tubular, free, margin coarsely toothed; ovary slightly sunk in receptacle, 4- or 5-locular, each locule with 2 collateral ovules, stylehead with 4- or 5-lobed stigma. **Fruits** drupaceous, 1–5-locular, pyrenes 1(or 2)-seeded; outer mesocarp rather dry-fleshy or soft and fibrous, inner mesocarp fleshy or spongy-fibrous; endocarp thin, cartilaginous. **Seeds** kidney-shaped, laterally compressed, non-arillate, pachychalazal with thin sarcotesta; endosperm absent; embryo with thick, planoconvex, collateral cotyledons; radicle apical, extending to surface or slightly exerted. Germination phanerocotylar; eophylls trifoliolate, opposite.

Distribution. Five species, all but one, *Sandoricum koetjape*, restricted to W Malasia, where the cultivated forms of *S. koetjape* (q.v.) may have arisen, though wild plants appear to be native as far east as New Guinea. All five are wild in Borneo, to which three are restricted.

Ecology. Mixed dipterocarp, *kerangas* and other forest types. *Sandoricum beccarianum* is restricted to peatswamp forest, *S. borneense* to riparian forest.

Uses. The fruit (where known as mature) of all species is edible and the timber is locally used for house construction and for making furniture, cabinets, joineries, planks, packing cases, wood-carving items, and agricultural and household implements. The wood is also suitable for manufacturing veneer, plywood, blockboard, pulp and paper (PROSEA *op. cit.* (1998) 206).

Key to *Sandoricum* species

1. Leaflets obovate (to elliptical), apex rounded or emarginate. Tree of peatswamp forests.....**1. S. beccarianum**
 Leaflets lanceolate, ovate (or elliptical), apex acuminate to caudate. Trees of other habitats.....2
2. Leaflets glabrous, lanceolate-ovate or elliptical, base obtuse to rounded.....**2. S. borneense**
 Leaflets pubescent to subglabrous (or glabrous), ovate, base cuneate to rounded.....3
3. Leaflets caudate (acumen to 24 mm long), base cuneate.....**3. S. caudatum**
 Leaflets acute to acuminate (acumen never more than 15 mm long), base rounded, obtuse to acute (or subcuneate).....4

4. Calyx 4–4.5 mm tall, dark purplish brown; petals glabrous; staminal tube with 5 erose (= irregularly splitting) lobes; petiolule of apical leaflet 4–10 cm long.....**4. *S. dasyneuron***
 Calyx *c.* 3.5 mm tall, yellow-green; petals more or less pubescent; staminal tube with 10 bifid lobes; petiolule of apical leaflet 3–5.5 cm long.....**5. *S. koetjape***

1. *Sandoricum beccarianum* Baill.

Fig. 28.

(Odoardo Beccari, 1843–1920, traveller in Borneo, Director of the Botanic Garden and Herbarium in Firenze, Italy)

Adansonia 11 (1874) 264; Mabberley *op. cit.* (1985) 151, *op. cit.* (1989) 249; Mabberley *et al. op. cit.* 353; Turner, *Gard. Bull. Sing.* 47 (1995) 342; Argent *et al. (eds.) op. cit.* 422; PROSEA *op. cit.* (1998) 500. **Type:** *Beccari 3111*, Borneo, Sarawak, (holotype P; isotypes FI, G-DC, K). **Synonym:** *Sandoricum emarginatum* Hiern *op. cit.* 264, King *op. cit.* 22, Merrill, EB (1921) 319, Ridley *op. cit.* (1922) 385, Masamune, EPB (1942) 376, Anderson *op. cit.* (1980) 253.

Tree to 35 m tall; bole to 25 m tall and 70 cm diameter. **Bark** smooth with minute cracks to deeply fissured; inner bark red-brown, to 10 mm thick. **Sapwood** whitish to pale brown; heartwood pink to red-brown. **Twigs** 3–5 mm diameter apically. **Indumentum** restricted to innovations. **Leaves** 11–25 cm long; petioles 3–7 cm long, weakly swollen and flattened adaxially at base; *leaflets obovate (to elliptical)*, apical ones 5.5–14 × 3.5–9 cm, lateral ones 4–12 × 2.5–7 cm, base acute to subcuneate, *apex emarginate or rounded (to obtuse)*, sometimes mucronate; lateral veins 6–8 on each side of midrib, weakly arcuate and rather obscurely looped near margin; petiolules 3.5–10 mm long on lateral leaflets, 4–6 cm long on apical leaflets, all somewhat swollen at junctions with leaflet blade and when dry grooved adaxially. **Inflorescences** 1–5.5 cm long, produced with new leaves and from axils of fallen leaves up to at least ten nodes from apex, fasciculate (apparently arising in the axils of undeveloped leaves in axillary buds); primary branches to 2 cm long, bearing fascicles of 1–4 flowers; axes minutely puberulous to glabrous; bracts narrowly triangular, *c.* 1 mm long, pubescent, caducous. **Flowers:** bracteoles 1–3, narrowly triangular, *c.* 0.5 mm long, pubescent, borne half way up pedicel to articulation with pseudopedicel; pedicels 4–6 mm long, conspicuously articulated with pseudopedicel *c.* 1 mm long, continuous with calyx; calyx shallowly cup-shaped, 2–2.5 mm tall, subpuberulous, red-brown, margin truncate to irregularly (4 or)5-lobed, the lobes to 1 mm deep, obtuse, margin more or less ciliate; petals (4 or) 5, oblanceolate, 6–7 × 2.5 mm, yellow-green to white, glabrous; staminal tube fleshy, deeply (16–)20-ribbed, cream, subpilose inside, margin with (8–)10 emarginate lobes, anthers (8–)10, ovate, apiculate, *c.* 1 mm long, in one rank, inserted opposite lobes, very weakly exerted; disc *c.* 2 mm tall, membranous, glabrous, margin irregularly lacinate (= incised); ovary and style glabrous, stigmatic lobes *c.* 1 mm long. **Fruits** (immature) subglobose, *c.* 3 × 2.5 cm, stipitate, stipe to 5 mm long, densely minutely tomentellous, orange-red or pinkish yellow; pericarp with white latex. **Seeds** 2, *c.* 2 × 1 cm.

Vernacular names. Sabah—*langsar-langsar* (Malay), *lantupak mata kuching* (preferred name), *mata kuching ambok* (Malay), *mata kuching hutan* (Malay). Sarawak—*apau* or *ubah apau* (Melanau), *dual merah* (Bisayah), *kelampu paya* (Iban).

Distribution. Thailand, coastal regions of Sumatra, Peninsular Malaysia and Borneo. In Borneo, recorded in Sabah from Beaufort and Papar districts (e.g., *SAN 56053* and *SAN 78019*) and in Sarawak from Bintulu, Daro, Kuching, Lundu, Sarikei and Sri Aman districts

(e.g., *S 12418*, *S 20868* and *S 30262*). Also occurring in Brunei (e.g., *FD FMS 34486*) and Kalimantan (e.g., *Kostermans 6059* and *Kostermans 8149*).

Ecology. Peat swamp forests, where it can be co-dominant locally, at altitudes to 30 m. In Sarawak, generally found only where *ramin* is common.

2. *Sandoricum borneense* Miq.

(from Borneo)

Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 33; Merrill *op. cit.* (1921) 319; Masamune *op. cit.* 376; Anderson *op. cit.* (1980) 252; Mabberley *op. cit.* (1985) 150; Whitmore, Tantra & Sutisna *op. cit.* 234; Mabberley *et al. op. cit.* 351; Coode *et al.* (eds.) *op. cit.* 206; Argent *et al.* (eds.) *op. cit.* 422; PROSEA 5, 3 (1998) 500. **Type:** *Korthals s.n.*, Borneo, Kalimantan, Sg. Tewe, Sept. 1836 (holotype L [*Acc. No. 908133605*]).

Tree, 7–20 m tall; bole to 15 m tall and 20–40(–60) cm diameter, unbuttressed. **Bark** smooth, pale brown, with small lenticels; inner bark light brown or pinkish. **Sapwood** white. **Twigs** 3–4(–5) mm diameter apically, smooth, often pale when dry. **Indumentum** restricted to innovations. **Leaves** 22–38 cm long, red when young; petioles 4–10 cm long, terete to somewhat flattened adaxially near base; *leaflets glabrous*; *blades elliptical to lanceolate-ovate*, 8–22 × 3.5–8.5 cm, apical leaflet not conspicuously larger than lateral ones, *base obtuse to rounded*, those of lateral leaflets often markedly asymmetrical, *apex acuminate*; lateral veins 9–12 on each side of midrib, arising almost at right angles from midrib, very weakly arcuate and looped at margin; petiolules 3–5(–10) mm long on lateral leaflets, 20–45 mm on apical leaflets. **Inflorescences** 10–16 cm long, more or less erect, narrow, fragrant; primary branches to 6 cm long, subsquarrose to weakly ascending, the secondaries *c.* 1.5 cm long, bearing cymes of 1–5 flowers; bracts narrowly triangular, *c.* 8 mm long, to foliaceous, when lanceolate to oblanceolate, *c.* 2 cm long and petiolate, caducous. **Flowers:** bracteoles narrowly triangular, *c.* 4 mm long, caducous; pedicels 3–7 mm long, glabrous to subpuberulous; calyx shallowly cup-shaped, 1.5–2 mm tall, more or less puberulous, pale green, splitting irregularly into 5 obtuse lobes *c.* 0.5 mm deep; petals 5, linear-oblong, 6–8 mm long, glabrous, creamy-green to pinkish, apex acute; staminal tube creamy-green to pinkish, glabrous and with *c.* 20 ribs outside, villous inside, margin 10-lobed, each lobe more or less bifid, anthers *c.* 0.5 mm long in two ranks, alternating with the lobes, apiculate, weakly exerted; disc *c.* 2 mm tall, glabrous, margin 5-lobed, the lobes more or less bifid; ovary and style glabrous, stigmatic lobes *c.* 1 mm long. **Fruits** subglobose to pyriform, 2.5–4 cm diameter, velutinous, buff-yellow to orangeish, obscurely longitudinally ribbed, usually solitary; pericarp with milky latex; mesocarp sweet but mealy; endocarp tough; pyrenes 2–5. **Seeds** *c.* 14 × 9 mm.

Vernacular names. Sarawak—*apoh* (Berawan, Kayan), *apok* (Kenyah), *kelampu* (Iban).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort, Kota Belud, Papar, Sandakan, Sipitang and Tawau districts (e.g., *SAN 27996*, *SAN 32159*, *SAN 72288* and *SAN 78172*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Kuching, Lubok Antu, Lundu, Marudi, Miri and Tatau districts (e.g., *S 19929*, *S 29970*, *S 39662*, *S 45140* and *S 50094*). Also occurring in Brunei (e.g., *BRUN 152* and *SAN 17051*) and Kalimantan (e.g., *Veldkamp 8377*).

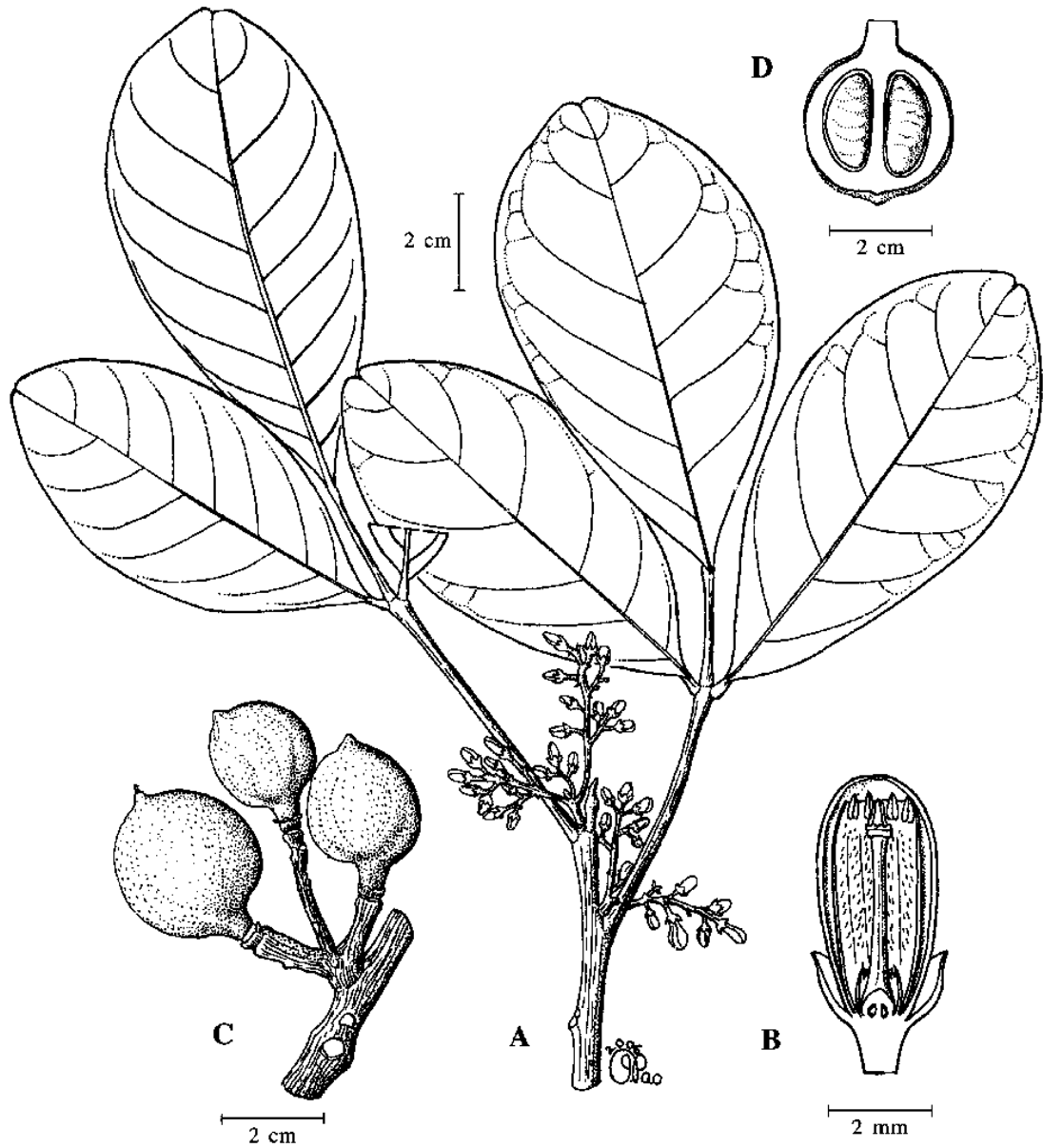


Fig. 28. *Sandoricum beccarianum*. A, flowering leafy twig; B, longitudinal section of flower; C, infructescence; D, longitudinal section of fruit. (A–B from *Kostermans 8149*, C–D from *S 12418*.)

Ecology. Riverbanks, subject to inundation, from 330 m down to just above tidal influence. The fruits fall into the water and are devoured by fish, which appear to spit out the pyrenes: whether or not such leads to effective dispersal is unrecorded.

Uses. In Sarawak, the wood is used for making *sape*, an Iban musical instrument.

3. *Sandoricum caudatum* Mabb.

Fig. 29.

(Latin, *caudatus* = ending with a tail-like appendage; referring to the elongated leaflet tip)

Blumea 31 (1985) 150; Whitmore, Tantra & Sutisna *op. cit.* 234; Mabberley *et al. op. cit.* 352; Coode *et al. (eds.) op. cit.* 206. **Type:** *Haviland 2851*, Borneo, Sarawak, Kuching district (holotype K; isotype SAR).

Small tree to 10 m tall; bole to 15 cm diameter. **Bark** smooth, grey-green. **Twigs** 3–4 mm diameter apically. **Indumentum** fulvous, restricted to innovations. **Leaves** 20–25 cm long; petioles 5–9 cm, wrinkled, base swollen and flattened adaxially; *leaflets subglabrous*; *blades ovate*, apical leaflets 14–15.5 × 6–7 cm, lateral ones 10–13 × 4–6 cm, *base cuneate*, more or less asymmetrical on lateral leaflets, *apex caudate*, *acumen to 24 mm long*; lateral veins 8–10 on each side of midrib, arcuate, looped well clear of margin; petiolules wrinkled when dry, 6–9 mm long on lateral leaflets, 4–5 mm long on apical ones. **Inflorescences** 4–7 cm long, sparsely branched, borne in axils of undeveloped leaves; primary branches to 2 cm long, squarrose, bearing fascicles of 2 or 3 flowers; axes minutely puberulous; bracts subtending primary branches narrowly lanceolate, 5–7 mm long, puberulous, caducous. **Flowers:** bracteoles at base of pedicels smaller, often with 1 or 2 more, smaller ones half way to articulation with pseudopedicel; pedicels 5–6 mm long; pseudopedicels 1–2 mm long continuous with calyx; calyx shallowly campanulate, *c.* 2.5 mm tall, more or less puberulous, pale green, splitting into 5 irregular obtuse lobes *c.* 0.75 mm deep, margin ciliate; petals 5, elliptical, *c.* 4.5 × 2 mm (immature), apex rounded, creamy-white; staminal tube glabrous outside, villous inside, margin with 10 irregular lobes, creamy-white, anthers 10, more or less in two ranks, alternating with lobes, oblong, *c.* 0.75 mm long, weakly exerted; disc *c.* 1.5 mm tall, glabrous, membranous, clasping ovary, margin lacinate; ovary and style glabrous, stigmatic lobes *c.* 1 mm long. **Fruits** solitary, at least 5 × 3.5 cm, stipitate, rostrate, stipe to 1 cm long, beak to 6 mm long, densely yellow-brown velutinous, somewhat ribbed longitudinally, calyx accrescent; pyrenes 3 or 4. **Seeds** *c.* 16 × 9 mm (immature).

Distribution. Endemic in Borneo, known only in Sarawak from Belaga, Betong, Kuching, Miri, Serian, Sri Aman and Tatau districts (e.g., *Purseglove 4990*, *S 20298*, *S 26874*, *S 41782*, *S 47156* and *S 59691*) and in Brunei (e.g., *Dransfield JD 7308* and *FD FMS 30440*).

Ecology. Lowland dipterocarp forest and *kerangas* forest at altitudes to 350 m.

Notes. Neither mature flowers nor mature fruits collected.

4. *Sandoricum dasyneuron* Baill.

(Greek, *dasy-* = shaggy, *neuron* = nerve; referring to the bristly veins on the underside of the leaflet)

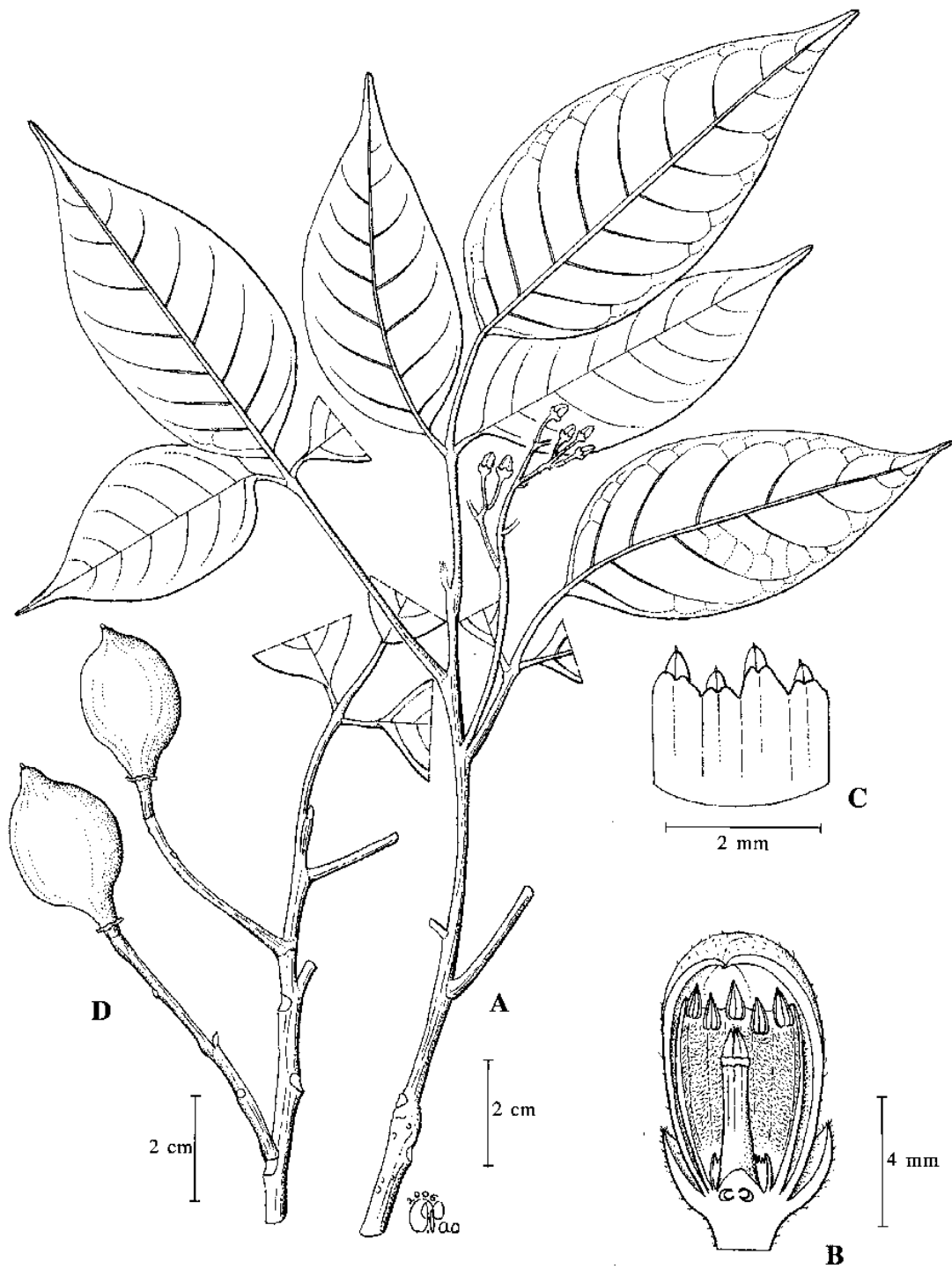


Fig. 29. *Sandoricum caudatum*. A, flowering leafy twig; B, longitudinal section of flower; C, abaxial view of staminal tube; D, fruiting leafy twig. (A–C from *Ong* 730, D from *S* 44932.)

Adans. 11 (1874) 265; Beccari, Nelle For. Born. (1902) 602; Merrill *op. cit.* (1921) 319; Masamune *op. cit.* 376; Anderson *op. cit.* (1980) 252; Mabberley *op. cit.* (1985) 147; Whitmore, Tantra & Sutisna *op. cit.* 234; Mabberley *et al. op. cit.* 345; Coode *et al. (eds.) op. cit.* 206. **Type:** Beccari 299, Borneo, Sarawak (holotype P; isotypes BP, G-DC, M).

Tree, 8–10(–25) m tall; bole 10–25 cm diameter. **Bark** smooth. **Sapwood** light red. **Twigs** 6–8 mm diameter apically. **Indumentum** ferruginous. **Leaves** 25–52 cm long; petioles 10–20.5 cm long, more or less pilose, base somewhat swollen; *leaflets glabrous above, more or less pilose below especially on veins; blades broadly ovate*, apical leaflets 17–24 × 12–16 cm, lateral ones 16–20 × 10–11 cm, *base acute to subcuneate, apex acuminate, acumen to 15 mm long*; lateral veins (10 or) 12 or 13 on each side of midrib, inarched only near margin; *petiolules* 3–15 mm long on lateral leaflets, *4–10 mm long on apical ones*. **Inflorescences** 2–13 cm long, produced with new leaves over at least 6 nodes, sparsely branched often from very close to base; primary branches to 6 cm long, squarrose, bearing fascicles of 1–3 flowers; axes densely short-tomentose; bracts narrowly triangular, *c.* 7 mm long, densely pubescent, caducous. **Flowers** weakly scented; bracteoles narrowly triangular, 1–2 mm long, densely pubescent, caducous; pedicels 5–7 mm long, articulated with pseudopedicel 1(–2) mm long, continuous with calyx; *calyx* campanulate, *4–4.5 × 4–5 mm*, glabrous, *dark purplish brown*, splitting into 5 irregular obtuse lobes to 1 mm deep, margin ciliate; *petals* 5, spatulate, 8–9 × 3 mm, *glabrous*, greenish white, apex acute; *staminal tube* fleshy, white, swollen at mouth, subpubescent outside, pilose inside, *margin with 5 erose lobes*, anthers 10, *c.* 1.5 mm long, in two ranks, the more distal ones opposite lobes, the more proximal ones inserted between them, all weakly exerted; disc *c.* 2 mm tall, narrowing towards mouth, membranous, glabrous, margin irregularly lacinate; ovary and style glabrous, stigmatic lobes *c.* 1.5 mm long. **Fruits** globose-pyriform, when mature 10 cm diameter, densely and minutely fulvous-tomentellous, multi-ribbed longitudinally; pyrenes at least 3, bean-shaped. **Seeds** 2.5 cm long.

Vernacular names. Sarawak—*atap bojig* (Land Dayak), *kelampu* (Iban, Malay), *krunkok* (Iban).

Distribution. Endemic in Borneo, known only in Sarawak from Bau, Bintulu, Kapit, Kuching, Marudi and Sri Aman districts (e.g., *S 14361*, *S 24649*, *S 28999* and *S 44047*) and in Brunei (e.g., *Niga NN 337*) and Kalimantan (e.g., *Burley et al. 785*).

Ecology. Hill-sides and ridges in mixed dipterocarp forest and ecotone to *kerangas* (Sarawak), *Agathis* forest on acid sands (E Kalimantan), at 50–600 m altitude.

5. *Sandoricum koetjape* (Burm.f.) Merr.

(from an Indonesian plant name—*ketjapi*)

Phil. J. Sci. Bot. 7 (1912) 237, *op. cit.* (1921) 319, *op. cit.* (1923) 361; Masamune *op. cit.* 377; Backer & Bakhuizen *f. op. cit.* (1965) 121; Mabberley *op. cit.* (1985) 147, *op. cit.* (1989) 249; Corner *op. cit.* (1988) 504; Whitmore, Tantra & Sutisna *op. cit.* 234; Mabberley *et al. op. cit.* 345; PROSEA 2 (1991) 284, *op. cit.* (1998) 500; Turner *op. cit.* 342; Argent *et al. (eds.) op. cit.* 422; Beaman & Anderson *op. cit.* 133. **Basionym:** *Melia koetjape* Burm.f., Fl. Ind. (1786) 101. **Type:** Anon. s.n. in *Herb. Burman*, Java (holotype G). **Synonyms:** *Sandoricum indicum* Cav., *op. cit.* 359, Hiern *op. cit.* 553, King *op. cit.* 23, Ridley *op. cit.* (1922) 385; *Sandoricum nervosum* Blume, Bijdr. Fl. Ned. Ind. (1825) 163, Ridley *op. cit.* (1922) 385; *Sandoricum maingayi* Hiern *op. cit.* 554, Merrill *op. cit.* (1921) 319,

Ridley *op. cit.* (1922) 385, Anderson *op. cit.* (1980) 253; *Sandoricum maingayi* Hiern var. *quadripetalum* C.DC. in A.P. de Candolle, Mon. Phan. 1 (1878) 462, Merrill *op. cit.* (1921) 319; Masamune *op. cit.* 377; *Sandoricum radiatum* King *op. cit.* 21, Ridley, Agr. Bull. Str. Fed. Malay St. 1 (1902) 429; *Sandoricum vidalii* Merr., Philip. Govt. Lab. Bur. Bull. 6 (1904) 8, *op. cit.* (1923) 361; Anderson *op. cit.* (1980) 353.

Tree to 45(–50) m tall; bole to 1 m diameter, fluted and sometimes with buttresses to 3 m tall. **Bark** pale pinkish brown, smooth, lenticellate to peeling with round flakes; inner bark pink. **Sapwood** pale yellow; heartwood pink or reddish. **Twigs** with distinct petiole scars, lenticellate, rough, grey-brown, 4–7 mm diameter apically, subglabrous to fulvous-tomentose. **Leaves** 18–40 cm long; petioles 7.5–16 cm long, flattened (or even winged when dry) adaxially towards the more or less swollen base, subglabrous to fulvous-pubescent; *leaflets glabrous or with a few brown hairs on midrib above, subglabrous to densely brown-pubescent below*, pink when young, withering yellow or reddish; *blades ovate*, apical ones 8–20 × 5–14 cm, lateral ones usually smaller and narrower, *base acute to rounded*, more or less asymmetrical on lateral leaflets, *apex acuminate, acumen less than 15 mm long*; lateral veins 7–14 (–20 in cultivated forms) on each side of midrib, looped near margin; *petiolules* 4–9 mm long on lateral leaflets, *3–5.5 cm long on apical ones*. **Inflorescences** 2.5–24 cm long, produced in up to 8 of the most apical leaf axils, erect or weakly drooping; axes more or less fulvous-pubescent; primary branches to 8 cm long, squarrose, bearing secondary branches of glomerules of 1–5 flowers; bracts narrowly triangular, *c.* 7 mm long, densely pubescent, caducous. **Flowers** fragrant; bracteoles somewhat smaller than bracts, subopposite; pedicels 3–5 mm long, articulated with pseudopedicels 1–1.5 cm long, continuous with calyx; *calyx* campanulate to cup-shaped, *c.* 3.5 mm tall, splitting into 5 irregular obtuse or rounded lobes to 0.75 mm deep, pubescent, margin ciliate, *yellow-green*; *petals* (4 or) 5, linear-lanceolate to oblanceolate, 6–9 mm long, yellowish green or pinkish, *more or less pubescent outside*, reflexed at anthesis, apex rounded to emarginate; *staminal tube* more or less pubescent outside, pilose inside, pale yellow to orangeish, *margin with 10 acute to bifid lobes*, somewhat reflexed at anthesis, anthers (8 or) 10, narrowly oblong, 1–1.5 mm long, apiculate, more or less in 2 ranks, weakly exerted; disc *c.* 1.5 mm tall, membranous, glabrous, margin irregularly lacinate; ovary and style glabrous, stigmatic lobes *c.* 1.5 mm long. **Fruits** depressed globose, 5–8 cm diameter, velvety, yellow or brownish when ripe, smooth to longitudinally wrinkled; pericarp with milky latex; mesocarp white, translucent, juicy sweet to very sour; endocarp tough with 1 or 2 seeds. **Seeds** 20–35 × 12–21 × 9–16 mm.

Vernacular names. Throughout Malesia and beyond, different forms are known variously as *sentul* (or variants) and *kechapi* (or variants) though apparently not consistently, even within an island.

Distribution. Planted widely in tropical Asia but the wild form probably extending from Peninsular Malaysia and Sumatra to New Guinea (Madang). In Borneo, recorded in Sabah from Beaufort, Kinabatangan, Lahad Datu, Penampang, Sandakan and Tawau districts (e.g., *SAN 32841*, *SAN 97075*, *SAN 105172*, *SAN 108515* and *SAN 139760*) and in Sarawak from Bau, Belaga, Bintulu, Kanowit, Kapit, Kuching, Lundu, Marudi, Miri, Serian and Simunjan districts (e.g., *Mabberley 1588*, *S 4037*, *S 28891*, *S 48161* and *S 79121*). Also occurs in Brunei (e.g., *Forman 1121*) and Kalimantan (e.g., *Burley et al. 785*).

Ecology. Native and naturalised in different types of forests at altitudes to 1200 m or more.

Uses. Grown, largely as village trees, for shade as well as fruit. The mesocarp is the part eaten: it is derived from the inner pericarp walls and as outgrowths from the endocarp. In

some forms it is exceedingly sweet but the sour ones may be ‘excruciating’. The tree is fast-growing when young: it is recommended as an avenue tree. The timber is red, moderately hard and takes a fine polish. It has been used for barrels, boats, carts and butchers’ blocks. The bark has been used in tanning fishing nets. Bark and also, particularly, the roots are claimed as effective in the treatment of a number of medical conditions. Some of the triterpenoids extracted from the stems have been shown to have significant cytotoxic activity against cultured cancer cells and to be insect antifeedants: extracts are promising as anti-inflammatories (*FRIM in Focus* Jan-Mar 2003: 7), though the effective agents have yet to be characterised.

Notes. The form known as *kechapi* in the narrow sense, i.e. that with robust pubescent twigs, a brown pubescent upper surface to the leaves, which are large, wither red, and have many lateral veins in the leaflets, is that most frequently encountered in the Philippines and elsewhere in the tropics (Sarawak – *S* 35985 from G. Santubong): planted in Sabah (*SAV* 97075). Wild trees in Peninsular Malaysia to New Guinea, beyond the range of cultivation of *kechapi*, have more delicate twigs, smaller subglabrous leaves, withering yellow, the leaflets with fewer veins and pinkish petals in rather shorter inflorescences, the fruits sweet-tasting with thinner smoother pericarp and falling when ripe. In the Philippines and from Sulawesi eastwards, the two forms seem perfectly distinct, but in Borneo and westwards it becomes impossible to draw a clear line between them, where the array of forms apparently spans the range from the wild form found elsewhere to something more approaching *S. dasyneuron*, with the cultivated *sentul* nearer the first, *kechapi* the second. Careful analysis of ‘wild’ populations might shed light on the origins of the various cultivars, of which one, at least, is tetraploid. Very rarely the apical leaflet is deeply trilobed (e.g., *S* 43449).

12. TOONA (Endl.) M.Roem.

(from *toon*, the Indian name for *T. ciliata*)

surian (preferred trade name)

Jennifer M. Edmonds & David J. Mabberley

Fam. Nat. Syn. Monogr. 1 (1846) 131, 139; Merrill, Enum. Philip. Pl. 2 (1923) 357; Backer & Bakhuizen *f.*, FJ 2 (1965) 117; Pennington & Styles, Blumea 22 (1975) 512; Anderson CLTS (1980) 253; Mabberley *in* Mabberley & Pannell, TFM 4 (1989) 256, PB 2nd. ed. (1997) 718; Edmonds, Commonw. For. Rev. 72 (1993) 181, *in* Mabberley *et al.*, FM 1, 12 (1995) 358; PROSEA 5, 2 (1995) 492; Argent *et al.* (eds.), MNDT-CK 2 (1997) 424; Beaman & Anderson, PMK 5 (2004) 134. **Basionym:** *Cedrela* L. sect. *Toona* Endl., Gen. Pl. 2 (1840) 1055. **Synonym:** *Cedrela* L., *p.p.*, Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 568, King, J. As. Soc. Beng. 64, 1 (1895) 89, Ridley, FMP 1 (1922) 415, Symington, Mal. For. 4 (1935) 119.

Deciduous or semi-evergreen, monoecious trees. **Indumentum** of simple hairs. **Bud scales** present. **Leaves** spirally arranged, usually *paripinnate*, without *pseudogemmula*; leaflets more than 8 on each side of rachis, opposite or subopposite, not strongly asymmetrical, margin entire to serrate, domatia usually present. **Inflorescences** much-branched thyrses. **Flowers** unisexual, rarely bisexual; calyx 5(or 6)-lobed or 5 (or 6) sepals free, imbricate to cup-shaped in bud; petals 5 (or 6), much less than 12 mm long, free, aestivation imbricate

(quincuncial), usually adnate to the *pulvinate, cushion-shaped androgynophore* (disc); *stamens* 5 (or 6), *free*, arising from androgynophore, sometimes alternating with 1–5 filamentous staminodes; ovary 5-locular, each locule with 6–10 ovules, stylehead discoid, usually 5-rayed. **Fruit** a woody septifragal capsule, valves opening from apex; columella softly woody, 5-angled, extending to capsule apex. **Seeds** *winged at both ends, when attached distally, or at one end, when attached by seed-end to proximal part of the columella*; endosperm residual; embryo with collateral, flattened, leaf-like cotyledons; radicle laterally exerted. Germination phanerocotylar; eophylls opposite, trifoliate, the leaflets deeply lobed or dentate.

Distribution. Four or five species from E Pakistan to S China and E Australia, with *T. ciliata* M.J.Roem. (*toon*) almost throughout the range. In Sabah and Sarawak, two species are known.

Ecology. In Sabah and Sarawak species of *Toona* occur in lowland to lower montane forests at altitudes to 1300 m. The trees are frequently associated with riverine habitats.

Uses. Valuable timbers especially *T. ciliata*, which, as red cedar, was the most important cabinet timber in Australia. In SE Asia, the *surian* timber is widely used for light construction work, furniture, joinery, cabinet work, packing cases and boxes, decorative panelling, musical instruments, wood-carvings, veneer and plywood.

Notes. Seriously under-recorded in the Flora area, partly due to their tall smoothish, straight boles making specimen collection difficult, and because the fruits mature several months after flowering. The descriptions have therefore had to be based, at least in part, on materials from outside the Flora area. *Toona sinensis* (A.Juss.) M.Roem, a high-altitude species in Peninsular Malaysia, recognisable by its serrate leaflets, completely glabrous flowers and unpleasant-smelling shoots has been recorded from Borneo in error.

Key to *Toona* species

Twigs inconspicuously lenticellate with minute lenticels. Leaflets usually glabrescent on midrib above. Flower buds with inconspicuous shortly ciliate fringe to petal margins, not forming bands; styles glabrous. Fruit valves smooth to lenticellate with small inconspicuous lenticels, red or light to reddish brown.....**1. T. ciliata**
 Twigs prominently lenticellate with warty lenticels. Leaflets usually conspicuously pilose on midrib above. Flower buds usually with dense ciliate bands of long hairs on petal margins; styles pilose. Fruit valves verrucose with conspicuous rusty lenticels, darkish or blackish brown.....**2. T. sureni**

1. *Toona ciliata* M.Roem.

Fig. 30.

(Latin, *ciliatus* = with fine hairs, resembling an eyelash; referring to the margins of petals and sepals)

Fam. Nat. Syn. Monogr. 1 (1846) 139; Edmonds *op. cit.* (1995) 366; PROSEA 5, 2 (1995) 497; Turner, Gard. Bull. Sing. 47 (1995) 342; Beaman & Anderson *op. cit.* 134. **Basionym:** *Cedrela toona*

Roxb. *ex* Rottl. *apud* Willd., Neue Schrif. Naturf. Freunde Berlin 4 (1803) 198; Hiern *op. cit.* 568. **Type:** *Klein s.n. in Herb. Willd.* 4828¹, India, Madras, 1799 (holotype B-WILLD; isotypes K, LIV [microfiche seen]). **Synonyms:** *Toona hexandra* M.Roem. *op. cit.* 139; *Surenus toona* (Rottl.) Kuntze, Rev. Gen. Pl. 1 (1891) 111; *Toona ciliata* M.Roem. var. *hexandra* (M.Roem.) Bahadur, Monogr. *Toona* (1988) 93. (For complete synonymy *cf.* Edmonds *op. cit.* 1995.)

Tree to 35 m tall; bole to 22 m tall, with or without buttresses (to 3.5 m); crown usually rounded, spreading to 21 m across, occasionally dense. **Bark** white, greyish white to brown, usually fissured and flaking; inner bark brown to reddish, fibrous. **Sapwood** white, pink or red; heartwood pinkish red; sweetly aromatic when cut. **Twigs** glabrescent to pilose, *inconspicuously lenticellate with small lenticels*. **Leaves** (15–)26–35(–69) cm long; rachises glabrous to sparsely pilose, often reddish; petioles 6–9(–11) cm long, glabrous to pilose; *leaflets* (5–)8–10(–15) on each side of rachis, *glabrescent with scattered hairs on upper surface of midribs*, glabrescent to pilose on lower surfaces, rarely velutinous on both surfaces; blades lanceolate to ovate-lanceolate, (7)9–13.5(–16) × (2.2–)3.6–4.8(–6) cm, base usually asymmetrical, margins entire, apex acute to acuminate; petiolules 0.5–0.9(–1.4) cm long, glabrescent to pilose, rarely velutinous. **Inflorescences** to 44 cm long, pendent, sweetly scented; axes often lenticellate, pilose to pilose-villous with short to long, spreading or appressed hairs. **Flowers** 3.5–4.6(–6) mm long; pedicels 0.5–0.75(–1) mm long, usually pilose, occasionally villous; calyx 0.75–1(–1.25) mm tall, glabrescent or pilose outside, lobes imbricate, sepals spatulate, (0.5–)0.75–1 × (0.5–)0.75–1(–1.25) mm, margins shortly ciliate; *petals* white to creamy-white, 3.5–4.9(–5.8) × (1.3–)2–2.6(–3.1) mm, usually glabrescent occasionally pilose outside, *margins shortly ciliate*; androgynophore (1.75–)3.0–4.5(–5.5) mm long; filaments 1.25–2.5 mm long (male flowers), 0.75–1.25(–1.75) mm long (female flowers), glabrous to pilose-villous, anthers 0.5–1.1 × 0.3–0.7(–0.9) mm, apices usually apiculate, often with long appendage, antherodes usually sagittate, 0.5–0.75(–0.9) × 0.3–0.5 mm, often with long apiculate appendage; disc 1.25–1.75(–2.5) mm diameter, reddish orange, pilose; ovary 1.25–1.8 mm diameter, sparsely to moderately pilose, each locule with 5–8 ovules, *style* 1–2.5(–3) mm long, 0.2–0.4 mm diameter (in male flowers), 0.3–1.5 mm long, 0.3–0.5 mm diameter (in female flowers), *glabrous*, stylehead 0.75–1.1(–1.25) mm diameter. **Fruits** 15–20(–28) mm long; columella 13–17(–28) × 6–10 mm, concave with apical scarring; *valves red to reddish brown, smooth to lenticellate with many small* (0.1–0.6 mm diameter) *scattered lenticels*. **Seeds** winged at both ends, 11–19 × 2.5–4.0(–5.8) mm, wings unequal, apices narrowly obtuse; seed body 5–8 mm × 1.1–2.4(–3) mm.

Vernacular names. Sabah—*limpaga* (preferred name), *ranggu* (Dusun).

Distribution. Pakistan, India, Bangladesh, S China, Myanmar, Thailand, Sumatra, Peninsular Malaysia (Kedah, Langkawi, Penang, Perak), Java, Borneo, the Philippines, Sulawesi, Nusa Tenggara, Maluku, New Guinea and New Britain to E Australia. In Borneo, known only in Sabah from Keningau, Kota Kinabalu, Ranau and Sandakan districts (e.g., *SAN 20212*, *SAN 25518*, *SAN 49242*, *SAN 56902* and *SAN 73475*) and in Kalimantan (e.g., *bb. 29226*).

Ecology. It has been planted in some areas of Sabah, but is reported as common to scarce in primary and disturbed, often riparian, rainforests from sea-level to 1000 m altitude.

¹ Note that copies of the IDC microfiche edition seen (K, L, P) are defective in including neither this sheet nor those near it in Herb. Willd.

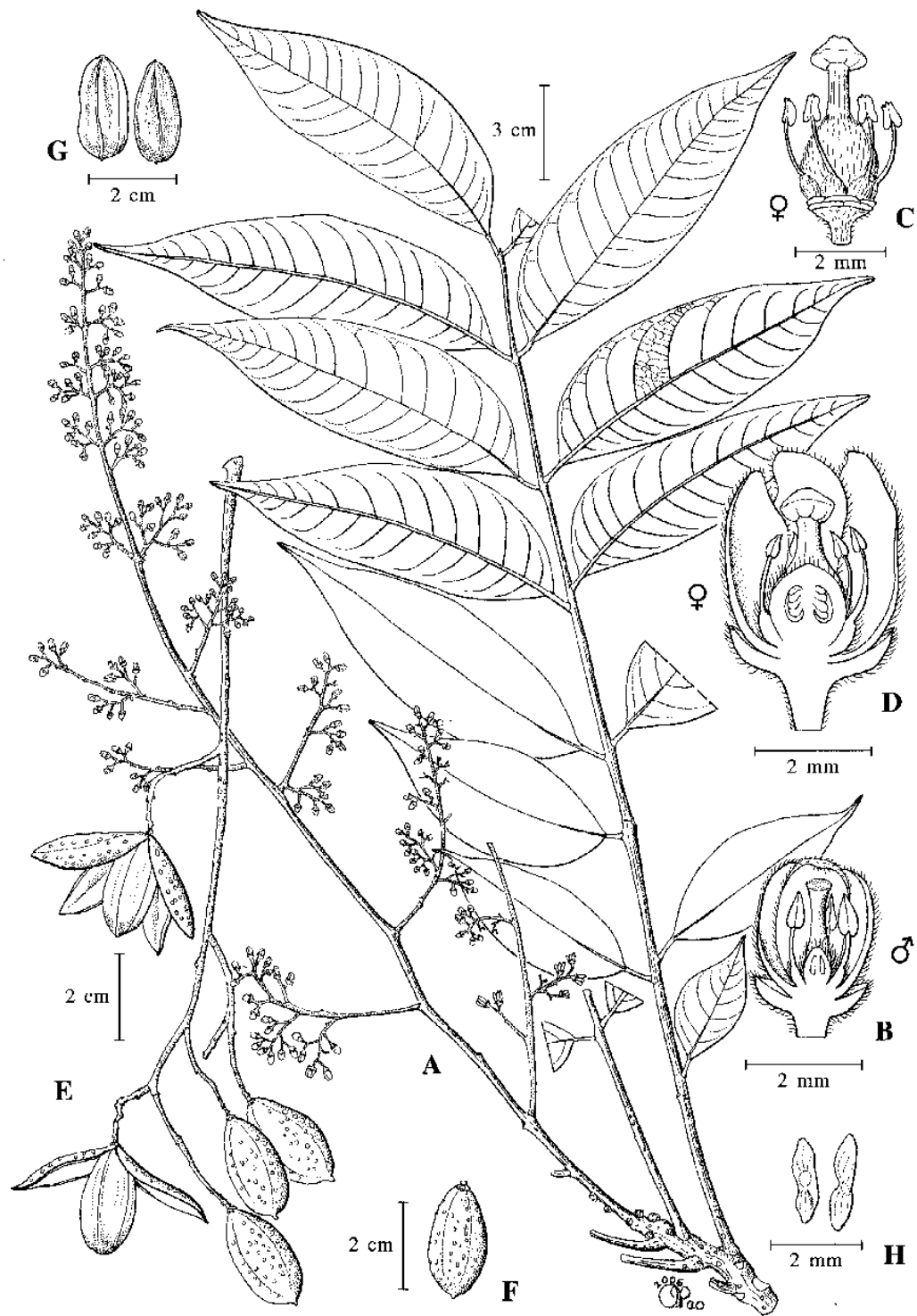


Fig. 30. *Toona ciliata*. A, flowering leafy twig; B, longitudinal section of male flower; C, female flower with sepals and petals removed; D, longitudinal section of female flower; E, infructescence; F, fruit; G, columella; H, seeds. (A–D from SAN 58856; E–H from SAN 20212.)

Uses. The timber is highly valued, especially in India and Australia; it is used in house and boat construction, for high grade furniture and carvings, and to make tea-chests, oil casks, pencils and musical instruments. The flowers are used as a source of red and yellow dyes for silk. Various parts are used medicinally throughout its range; the bark is a powerful astringent, a tonic and an anti-periodic, and is also used to treat dysentery and wounds.

Notes. The recent attempt (Almeida & Almeida, *J. Bombay Nat. Hist. Soc.* 91 [1995] 473) to push aside the well known name *Toona ciliata* in favour of '*T. hexandra* (Wall.) M. Roem.') fails because the epithet '*hexandra*' was not validated until 1846 and *T. hexandra* was first put in the synonymy of *T. ciliata* and not *vice versa*; the supposed basionym, *Cedrela hexandra* Wall. in Roxb., *Fl. Ind.* 2 (1824) 425, was a *nomen provisorium* and all the new infraspecific names proposed by the Almeidas (*op. cit.*) under '*T. hexandra* (Wall.) M. Roem.' are illegitimate.

This is the most wide-ranging *Toona* species and it exhibits considerable variation in filament pubescence. The type has glabrous filaments and this form extends to Hainan. With a more restricted distribution within this range, are trees with glabrescent or sparsely pilose-villous filaments; extending the range to E Australia are trees with conspicuously villous filaments. Whether the eastern variants should be recognised infraspecifically has yet to be determined. The name '*Toona (Cedrela) velutina* (DC.) M. Roem.' has often been given to specimens that have a dense velutinous pubescence on the vegetative organs. Such a variation in pubescence occurs in nearly all *Toona* species, and can occur within the same population of trees or sometimes even on different parts of the same tree, particularly represented by specimens collected at different seasons.

An important timber tree in the Philippines, occurring at low to medium altitudes in primary forests and commonly known as *T. calantas* Merr. & Rolfe (*Philipp. J. Sci. C. Bot.* 3 (1908) 105), is morphologically similar to *T. ciliata*. It may be a distinct species or merely a large-fruited geographical variant of *T. ciliata*. The fruits are usually (2-)2.8-4 cm long, with the columellas 2.4-4 × 0.7-1.5 cm; the valves are dark red or reddish brown, smooth, 2.4-4.1 × 0.4-1.4 cm, and lenticellate with numerous smallish lenticels (0.1-1 mm diameter), which are often even smaller and denser towards the base of the capsule. The seeds are (14-)20-32 × 3-6 mm with unequal wings broadly obtuse apically and with the seed body 4.2-10 × 1.5-3 mm. Some *Toona* specimens from Sabah might be referable to this large-fruited taxon.

2. *Toona sureni* (Blume) Merr.

(Latinized form of Javanese plant name, *suren*)

Interpr. Rumph. *Herb. Amb.* (1917) 305, Merrill *op. cit.* (1923) 357; Backer & Bakhuizen *f. op. cit.* 117; Mabblerley *op. cit.* (1989) 258; Edmonds *op. cit.* (1995) 363; PROSEA 5, 2 (1995) 498; Turner *op. cit.* 342; Argent *et al.* (eds.) *op. cit.* 424. **Basionym:** *Swietenia sureni* Blume, *Cat. Gew. Buitenz.* (1823) 72. **Lectotype** (selected here): *Reinwardt s.n.*, Java (L [Acc. No. 903257725]). **Synonyms:** *Cedrela febrifuga* Blume, *Verh. Bat. Gen.* 9 (1823) 135, Ridley *op. cit.* (1922) 415; *Cedrela sureni* (Blume) Burkill, *Gard. Bull. Str. Settl.* 5 (1930) 122, Symington *op. cit.* 122.

Tree to 40 m tall; bole to 25 m tall, with or without buttresses (up to 1 m); crown spreading, occasionally dense. **Bark** grey-brown, grey, light- or dark-brown, usually vertically fissured and flaking; inner bark pinkish white, brown, reddish or orange, fibrous. **Sapwood** cream,

pink or pale red; with cedar-aroma when cut. **Twigs** pilose and often *densely and prominently lenticellate with large fuscous* (= greyish brown), *verrucose* (= warty) *lenticels*. **Leaves** 29–52(–84) cm long; rachises glabrescent to moderately pilose or densely villous/velutinous; petioles 6–10 cm long, glabrescent to pilose, often lenticellate; *leaflets* 7–10(–12) on each side of rachis, *upper surface glabrescent to moderately pilose, (usually with short hairs and club-shaped glands) on the midribs and lateral veins*, lower surface occasionally glabrescent though usually pilose to densely villous/velutinous and fuscous; blades lanceolate to ovate-lanceolate, 6–15.5(–19.5) × 3–5.5(–7) cm, base symmetrical to asymmetrical, margin entire, apex acuminate, occasionally acute; petiolules 0.2–0.5(–1.2) cm long, glabrescent to pilose/villous. **Inflorescences** to 32 cm long, pendent; axes pilose to villous with medium to long spreading hairs, occasionally glabrescent. **Flowers** sweetly aromatic, 4.2–5 mm long; pedicels (0.3)0.75–1(–1.25) mm long, pilose to villous; calyx 1–1.3 mm tall, glabrescent to pilose outside, lobes imbricate, sepals usually shallowly triangular, especially in bud, 0.6–1 × 0.8–1.5 mm, glabrescent to villous outside, apices usually acute, margins ciliate; *petals* white or creamy-white, 3.5–4(–5) × 1.6–2(–3.2) mm, glabrescent to villous outside, but *usually with conspicuous long appressed hairs forming ciliate bands on petal margins* in bud; androgynophore 2.5–3.5(–4.7) mm long; filaments 1–1.75(–2.5) mm long (in male flowers), 1–1.3 mm long (in female flowers), pilose to villous with scattered to dense long hairs, anthers 0.75–1.25 × 0.3–0.4(–0.8) mm, apices often apiculate, antherodes 0.5–0.9 × 0.25–0.6 mm, sagittate; disc 1.25–1.75(–2.5) mm diameter, reddish, densely pilose; ovary 1.6–2.75 mm diameter, moderately to densely pilose, each locule with up to 6-ovules, *style* 0.6–1.5(–3) × 0.25–0.5 mm (in male flowers), 0.5–1 × 0.3 mm (in female flowers), *pilose with scattered usually appressed hairs especially on the lower half*, stylehead 0.6–0.9(–1.25) mm diameter. **Fruits** 14–20(–24) mm long; columella 14–20(–24) × 5–8(–10) mm, concave with apical scarring; *valves dark to blackish brown, rough, verrucose with conspicuous, often ovoid rusty lenticels*, 0.3–2 × 0.4–1.25 mm. **Seeds** winged at both ends, 11–20(–22) × (3–)4–4.8 mm, wings unequal with broadly obtuse apices; seed body 5–8 × 1.5–2 mm.

Vernacular names. Sabah—*limpaga* (Dusun Tambunan), *ranggoh* or *ranggo* (Dusun). Sarawak—*tarak* (Kelabit); Kalimantan—*suren*.

Distribution. India, Nepal, Bhutan, Myanmar, S China, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Lesser Sunda Islands, Maluku and New Guinea. In Borneo uncommon (rarely collected); so far known only from two records from the Kelabit Highlands (teste Noraini photographs) and Bario, Marudi districts (*R. Lian I*) in Sarawak. This species has been much confused with *T. ciliata* to which all Sabah specimens thus named (see above) are here referred. No indigenous Sabah specimen can confidently be placed here.

Ecology. Said to be common to rare in different types of forests, often in logged and disturbed areas, usually on hillsides or slopes often associated with streams or rivers, from sealevel to 1300 m.

Uses. The trees are fast-growing and the timber is favoured for house- and boat-building in Sarawak due to its lightweight properties. Medicinally, the bark is used as a powerful astringent and a purgative throughout its range; in Indonesia it is used as an astringent and a tonic for treating diarrhoea, dysentery and other intestinal infections. Leaf extracts have an antibiotic activity against *Staphylococcus*.

Notes. The original description refers to a fruiting tree and notes the form of the inflorescence, but not the flowers. In Blume's herbarium, there is no fruiting material of the

right date and, indeed, only one sheet bearing his name ‘*Swietenia surenis* [sic]’: this flowering specimen is here chosen as lectotype.

Across its range, this species exhibits a number of large-fruited variants, of which the most striking was described as *Cedrela celebica* Koord. (Med. s'Lands Plant. Batav. 19 (1898) 636) from NE Sulawesi. Its capsules are larger, generally 35–42 mm long, with columellas 29–38 × 13–18 mm; the verrucose valves are 36–41 × 9–11 mm and covered with large rusty lenticels 0.75–1.25 mm diameter; the seeds are 18–29 × 6–9 mm. Whether this is merely a large-fruited variant of *T. sureni* or a distinct taxon remains to be resolved.

13. VAVAEA Benth.

(Vava'u, Tonga)

In Hooker, Lond. J. Bot. 2 (1843) 212; Merrill, Enum. Philip. Fl. Pl. 2 (1923) 359; Backer & Bakhuizen *f.*, FJ 2 (1965) 119; Pennington, Blumea 17 (1969) 351; Pennington & Styles, Blumea 22 (1975) 464; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 234; Mabberley *et al.*, FM 1, 12 (1995) 34; Mabberley, PB 2nd. ed. (1997) 742; Argent *et al.* (eds.), MNDT-CK 2 (1997) 424; PROSEA 5, 3 (1998) 573; Beaman & Anderson, PMK 5 (2004) 134.

Trees or treelets with *Terminalia*-branching. **Indumentum** of simple hairs. **Bud scales absent.** **Leaves** simple. **Inflorescences** axillary or sometimes extra-axillary panicles of cymose branches, rarely subtended by a few subulate reduced leaves. **Flowers** mostly bisexual; calyx 4- or 5(–7)-lobed, with open rarely imbricate aestivation; petals (3 or) 4–6, free, imbricate, rarely contorted; staminal tube cylindrical or cup-shaped; filaments partly free, anthers 9–23, attached at ends of filaments; disc patelliform (= kneecap-shaped) or cup-shaped, united to base of staminal tube, or forming androecial ribbing, or absent; ovary 2–6-locular, each locule with 1 or 2 (rarely 3) collateral ovules or with 4–10 ovules in 2 rows. **Fruit** a berry with fleshy to woody pericarp. **Seeds** 1–3(–7), ovoid or planoconvex, with thin sarcotesta; thin endosperm sometimes present; embryo with planoconvex, collateral cotyledons; radicle superior, small, included or extending to the surface. Germination cryptocotylar; eophylls opposite, simple.

Distribution. Four species from Sumatra to tropical Australia and Polynesia, one restricted to Fiji and two to New Guinea. In Sabah and Sarawak the genus is represented by one species.

Vavaea amicorum Benth.

Fig. 31.

(Latin, *amicorum* = of friends; alluding to Tonga [Friendly Islands])

In Hooker, Lond. J. Bot. 2 (1843) 212; Merrill *op. cit.* (1923) 359; Pennington *op. cit.* 358; Whitmore, Tantra & Sutisna *op. cit.* 234; Mabberley *et al. op. cit.* 35; Argent *et al.* (eds.) *op. cit.* 426; Beaman & Anderson *op. cit.* 134. **Type:** *Barclay s.n.*, Tonga, Vava'u, May 1840 (holotype K). **Synonyms:** *Vitex bantamensis* Koord. & Valeton, Bijdr. Booms. Java 7 (1900) 210; *Vavaea bantamensis* (Koord. & Valeton) Koord. & Merr. *in* Koorders & Valeton, Atl. Baum. Java 2 (1914) err. slip t. 298, Backer & Bakhuizen *f. op. cit.* (1965) 120.

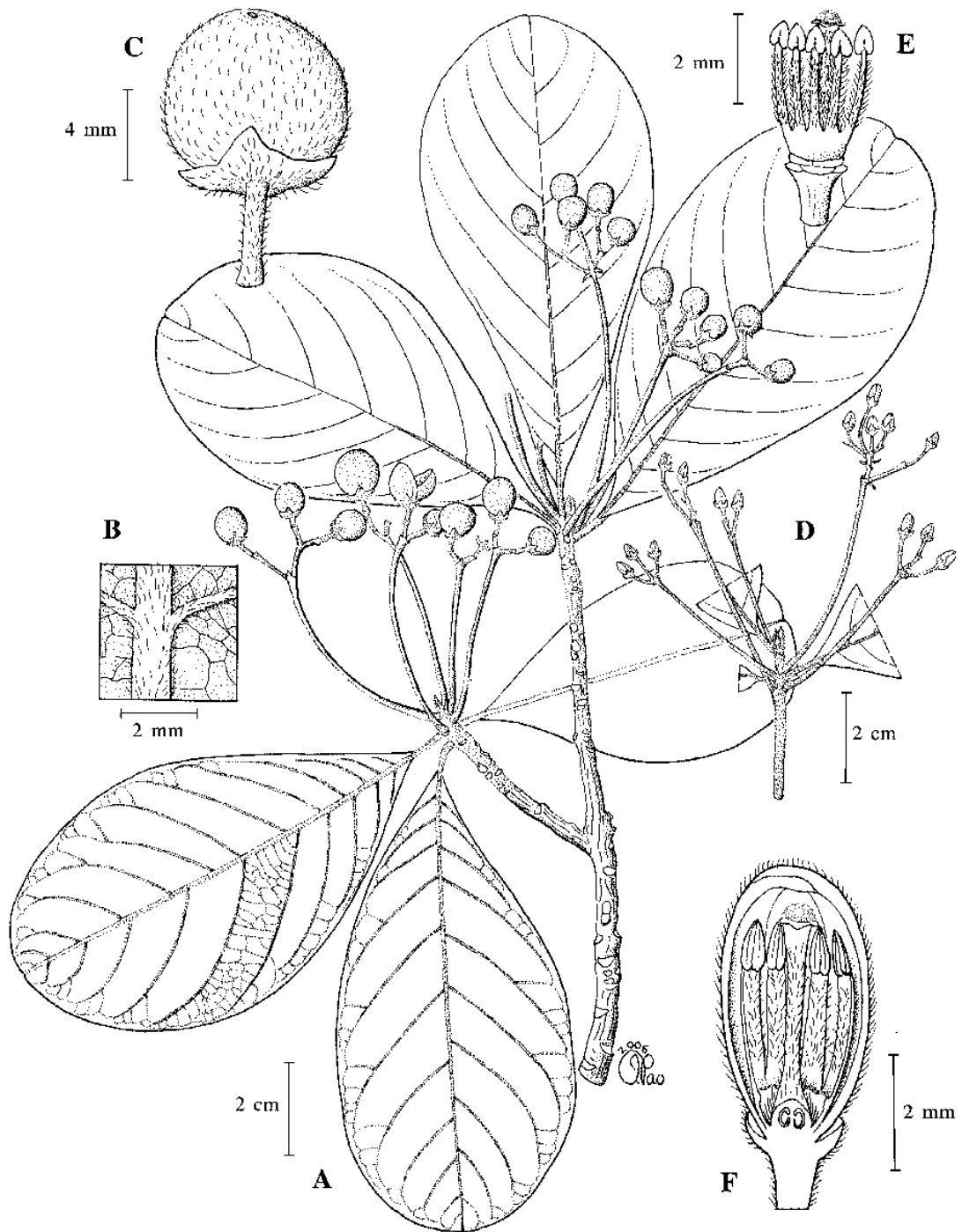


Fig. 31. *Vavaea amicorum*. A, fruiting leafy twig; B, detail of part of lower leaf surface showing fine venation and indumentum; C, fruit; D, flowering leafy twig; E, flower with sepals and petals removed; F, longitudinal section of flower. (A–C from Keith 6212, D–F from FD FMS 41260 [= Orolfo 7125].)

Treelet or tree to 30 m tall, usually much less; bole to 30 cm diameter; buttresses absent, rarely to 3 m tall, 2 m out. **Bark** brown, smooth, lenticellate to scaling, scales 5–10 × 5 mm; inner bark off white. **Sapwood** off white, darkening on exposure. **Twigs** 2–5(–10) mm diameter apically. **Leaves** in terminal rosettes, subglabrous to densely hispid; blades oblanceolate to obovate, rarely orbicular, (2.2–)3–22(–27) × (2–)5–9(–13) cm, base cuneate to attenuate, rarely truncate, apex obtuse, with or without an acute to obtuse acumen, less often more or less truncate; lateral veins 6–11(–16) on each side of midrib; intercostal venation sometimes conspicuously reticulate; petioles (2–)3–22.5(–45) mm long. **Inflorescences** (1.5–)2–13(–15) cm long; axes more or less pubescent; bracts linear-lanceolate, rarely foliaceous 1–4(–40) mm long. **Flowers:** pseudopedicels 1–5 mm long; calyx 1–3.5(–5) mm long, 4–6(–7)-lobed, the lobes deltate, ovate or oblong, with open aestivation, rarely foliaceous and somewhat imbricate at base; petals (3 or) 4–6, oblong to oblanceolate or rarely spatulate, 4–9.5 mm long, rather fleshy, imbricate or rarely contorted; filaments white or pinkish becoming yellow with age, united for 1/5 to almost their entire length, rarely with an apical pair of small lobes; staminal tube cup-shaped or short-tubular, 2–5.5 mm tall, 2.5–3 mm diameter, hirsute distally outside, densely barbate (= with tufts of long weak hairs) at throat, often purplish, anthers 9–17, ovoid or subspherical, rarely elongate, 0.3–1.2 mm long, glabrous or with a few hairs on connective; disc patelliform, cup-shaped or (short-tubular), 0.5–2 mm tall, glabrous to pubescent; ovary 2–4-locular, each locule with 1 or 2 (or 3) collateral ovules, stylehead depressed-capitate **Fruits** globose, rarely apiculate, 0.8–2 cm diameter, purplish black when ripe; pericarp usually thin and fleshy, rarely thickened and woody. **Seeds** 1–4.

Vernacular names. Sabah—*chendana* (preferred name), *sendana* (Bajau).

Distribution. Sumatra to the Philippines, tropical Australia and Tonga. In Borneo, known only in Sabah from Kuala Penyu, Lahad Datu, Sandakan and Semporna districts (e.g., *FD FMS 41260*, *SAN 26307*, *SAN 97012*, *SAN 126255* and *SAN A 1537*) and in Kalimantan (e.g., *Kostermans 5958* and *de Vogel 1802*).

Ecology. In forests at altitudes to 1250 m, frequently on limestone.

Uses. In Sabah, the timber is used as incense wood and in local burial rites. Considered a substitute for sandalwood in Fiji and the Caroline Islands, the wood is used for house construction, furniture, cabinet work, joinery and interior finishing in the Philippines and Papua New Guinea (*cf. PROSEA op. cit.* 1998).

14. WALSURA Roxb.

(from *wallurse* or *walsura*, the Tamil name for *W. trifoliolata* (A. Juss.) Harms of India)

Hort Beng. (1814) 32, *nom. nud.*; Fl. Ind. ed. Carey, 3 (1832) 386; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 563, *p.p.*; King, J. As. Soc. Beng. 64, 1 (1895) 82, *p.p.*; Ridley, FMP 1 (1922) 412, *p.p.*; Merrill, Enum. Philip. Fl. Pl. 2 (1923) 399, *p.p.*; PEB (1929) 131, *p.p.*; Backer & Bakhuizen *f.*, FJ 2 (1965) 129; Pennington & Styles, Blumea 22 (1975) 472; Anderson, CLTS (1980) 253, *p.p.*; Mabberley *in* Mabberley & Pannell, TFM 4 (1989) 252, *p.p.*, PB 2nd. ed. (1997) 752, Gard. Bull. Sing. 55 (2003) 195; Clark, Blumea 38 (1994) 257, *in* Mabberley *et al.*, FM 1, 12 (1995) 45; Coode *et al.* (eds.), CLBD (1996) 206, *p.p.*; Argent *et al.* (eds.), MNMT-CK 2 (1997) 426; PROSEA 5, 3 (1998) 578; Beaman & Anderson, PMK 5 (2004) 134.

Pachycaul to leptocaul trees. **Indumentum** of simple and/or bifid hairs. **Bud scales** absent. **Leaves** imparipinnate with 2–5 opposite lateral leaflets on each side of rachis or unifoliolate; pseudogemma absent; rachis swollen at insertion of leaflets. **Inflorescences** axillary thyrses. **Flowers** bisexual or male; calyx 5-lobed; petals 5, free, aestivation imbricate to valvate; androecium of discrete filaments or a 10-lobed tube with truncate to weakly bifid lobes; disc annular; ovary 2(or incompletely 4?)-locular, each locule with 2 collateral ovules, stylehead capitate to cylindrical, sometimes with 2 apical lobes. **Fruit** a 1- or 2(–?4)-seeded berry or 1- or 2-seeded weakly dehiscent capsule; pericarp with thin layer of sclerenchyma, the locules separated by a thin septum. **Seeds** with pre-raphé-funicular aril; endosperm absent; embryo with planoconvex, collateral cotyledons; radicle superior, included or extending to the surface. Germination cryptocotylar; eophylls spirally arranged, simple, entire.

Distribution. Sixteen species from Sri Lanka to the Himalaya and Indo-China through Malesia to New Guinea. In Sabah and Sarawak, the genus is represented by six species and one incompletely known taxon.

Ecology. Lowland and hill forests at altitudes to 1000 m with one species, *W. grandifolia* confined to limestone habitats.

Uses. The timber is used locally for general construction and interior work. In the Philippines, the wood of *W. pinnata* is considered a substitute for ‘guijo’ (*Shorea guiso* (Blanco) Blume) timber.

Key to *Walsura* species (excluding *Walsura* sp. A)

1. Leaflets strongly rugose, to 21(–28) × 10 cm. Filaments almost free...**3. W. grandifolia**
Leaflets not rugose, usually smaller, if not, staminal tube present.....2
2. Twigs 8–15 mm diameter apically. Leaves with 4 (or 5) leaflets on each side of rachis.....**4. W. pachycaulon**
Twigs 2.5–8 mm diameter apically. Leaves with 1–3 leaflets on each side of rachis.....3
3. Leaflet apex with an acumen (2–)2.5–5 cm long.....**6. W. sarawakensis**
Leaflet apex acute or with an acumen to 1.5 cm long.....4
4. Leaflet puberulent to densely pubescent below. Inflorescence a tightly condensed thyrses to 1.7 cm long. Fruits 4-winged to rhomboidal in cross-section, dehiscent.....**2. W. dehiscens**
Leaflet glabrous below. Inflorescence subcorymbose cymes or open thyrses with up to third order branching, 8–35 cm long. Fruits round in cross-section, indehiscent.....5
5. Leaves to 25 cm long; petioles 3–5 cm long; leaflets ovate, lateral ones 5.5–14.5 × 2–4.5 cm. Inflorescences subcorymbose cymes. Fruits brownish green tomentellous, ellipsoid.....**1. W. decipiens**
Leaves to 50 cm long; petioles *c.* 9 cm long; leaflets narrowly oblanceolate or elliptical-oblong, lateral ones 5.5–25 × 2–11.5 cm. Inflorescences an open thyrses with up to third order branching. Fruits glabrous to finely puberulent, spherical to

ovoid.....5. *W. pinnata*

1. *Walsura decipiens* Mabb.

Fig. 32.

(Latin, *decipiens* = deceiving; an allusion to collectors being led to believe it belonged to Burseraceae, Leguminosae, or Sapindaceae)

Gard. Bull. Sing. 55 (2003) 195. **Type:** *Meijer SAN 36201*, Sabah, Labuk Rd. mile 25.5 (holotype SAN; isotypes K, KEP, L, SAR, SING). **Synonym:** *Walsura pinnata* auct. non Hasskarl (1855): Clark *op. cit.* (1994) 276, *p.p.*, *op. cit.* (1995) 48, *p.p.*

Tree to 28 m tall; bole to 6 m tall, to 30 cm diameter. **Bark** scaly, dark red-brown; inner bark pinkish red. **Young twigs** pale brown, finely sericeous, lenticellate, *older ones 4–5 mm diameter apically*. **Apical buds** strongly fulvous-hairy. **Leaves** to 25 cm long; *petioles 3–5 cm long*, terete; *leaflets glabrous and somewhat glaucous below when dry, lateral ones 2 on each side of rachis; blades ovate, that of lateral leaflets 5.5–14.5 × 2–4.5 cm*, the apicals larger than laterals, articulated at petiolule apices, base acute, *apex acuminate, acumen to 1.5 cm long*; lateral veins 8–12 on each side of midrib, arising almost at right angles to midrib but strongly arcuate, looping together but not reaching margin; petiolules 8–18 mm long, that of apical leaflet to 25 mm long, conspicuously swollen at both ends. **Inflorescences** *subcorymbose cymes to 20 cm long*, in axils of current flush of which apical leaves scarcely developed; axes densely fulvous-pilose; peduncles to 7 cm long, with branches to 9 cm long, bearing apical head of branchlets, each branched once or twice more and bearing cymules of 1–5 flowers; bracts triangular, to 2 mm long, usually much less, densely hairy, caducous. **Flowers:** pedicels *c.* 1 mm long; bracteoles triangular, 0.5–1 mm, densely hairy, persistent; calyx *c.* 0.8 mm tall, green, lobes broadly triangular, apices rounded to acuminate, very hairy outside; petals oblong, *c.* 3 × 1 mm, white, hairy outside, apex obtuse; filaments 10, alternately long and short, the longer ones almost as long as petals, weakly bifid, apically strigose, pale green, anthers ovate, *c.* 0.7 mm long, apiculate, sparsely hairy, bright yellow, inserted between 2 apical lobes; disc fleshy, annular; ovary glabrous, style to 1.2 mm long, stylehead flattened with apical papilla and peripheral flange. **Fruits** *ellipsoid, 2.5–3 cm long, indehiscent, round in cross-section, brownish green tomentellous*, apex usually apiculate. **Seed** 1, ellipsoid.

Distribution. Endemic in Borneo, known only in Sabah from Keningau, Sandakan and Tawau districts (e.g., *SAN 30552, SAN 31560, SAN 35017, SAN 118523* and *SAN 118575*) and in Sarawak from Baram district (e.g., *S 35017*).

Ecology. Rain forest at altitudes to 150 m.

2. *Walsura dehiscens* T.Clark

(Latin, *dehiscens* = splitting open; the fruit)

Blumea 38 (1994) 287, *op. cit.* (1995) 53. **Type:** *Clark 78*, Sarawak, Simunjan district, Sabal FR (holotype L; isotypes FHO [not found], SAR [not found]).

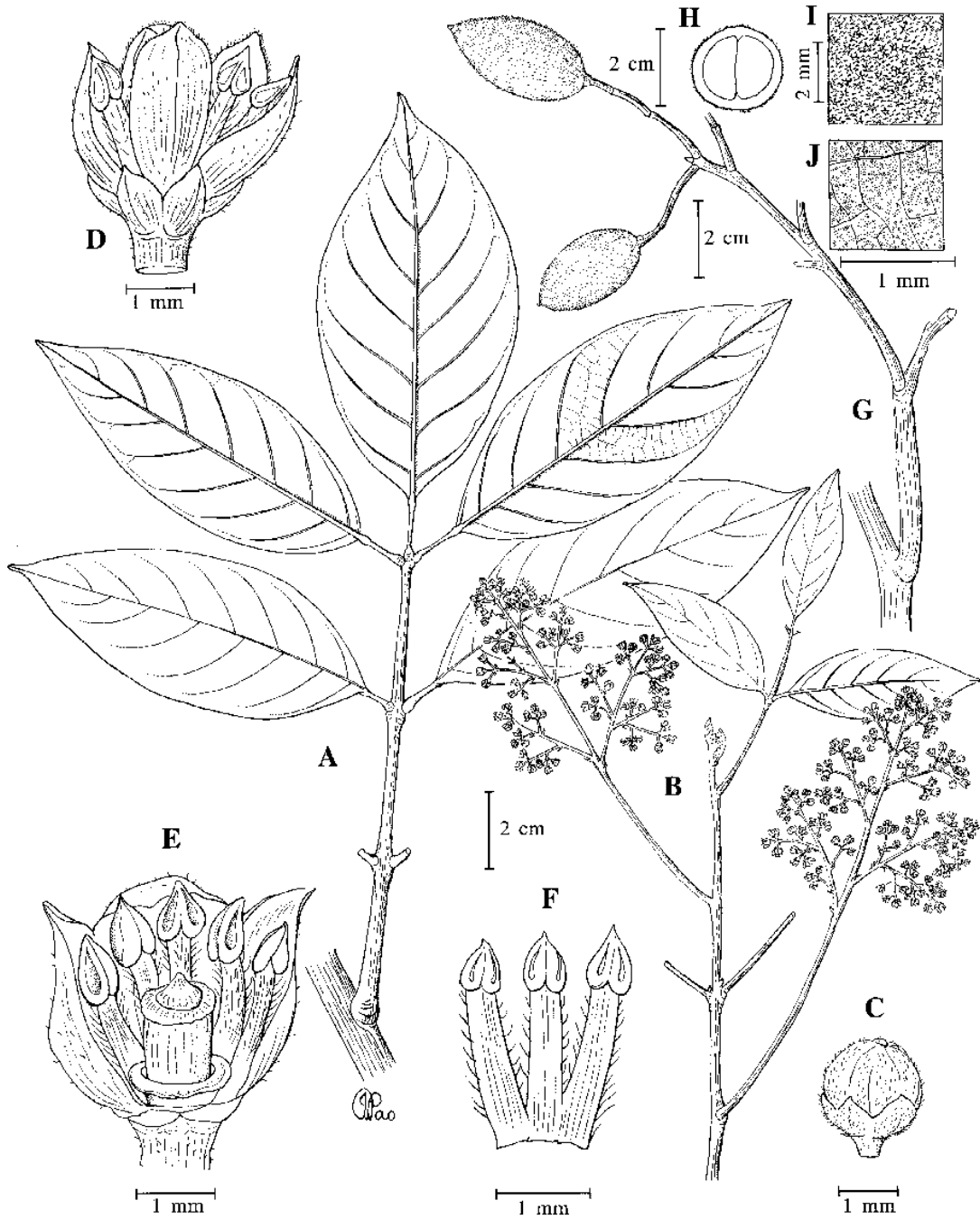


Fig. 32. *Walsura decipiens*. A, leafy twig; B, flowering leafy twig; C, flower bud; D, open flower; E, open flower with some sepals and petals removed; F, adaxial view of stamens; G, fruiting twig; H, cross section of fruit; I, indumentum on fruit wall; J, indumentum on lower leaflet surface. (A from SAN 31560, B-F from SAN 36201, G-J from S 35017.)

Tree to 9(–13) m tall; bole to 8(–12) cm diameter. **Bark** smooth, grey; inner bark pale yellow or pinkish. **Twigs** 1.5–3.5 mm diameter apically, glabrous to puberulous, densely lenticellate, dark brown to blackish. **Leaves** 25–30(–35) cm long; petioles 4.5–9.5 cm long, 1.5–2(–2.5) mm thick, more or less terete, lenticellate; lower surface of leaflets glaucous except on the veins, puberulent to densely pubescent, lateral ones 2 on each side of rachis; blades of terminal and upper lateral leaflets elliptical (to obovate), basal ones ovate to elliptical, (9–)11–16(–19) × 4–6(–8) cm, apex acute with acumen to 1.5 cm long; lateral veins 6–9 on each side midrib; petiolules 0.7–2(–2.5) × 0.6–1.2 mm. **Inflorescences** tightly compact thyrses, 1–1.7 cm long, 1(or 2)-branched, branches to 4 mm long, all densely hairy. **Flowers:** buds cylindrical, 1.5–1.6 × 1.2–1.3 mm; calyx 1–1.4 mm tall, lobes c. 0.6 mm; petals 2.2–2.5 × 1–1.8 mm, glabrous inside; androecium c. 1.5 mm tall, cylindrical to barrel-shaped, tubular in the lower 1/5, filaments pubescent on edges, apically bifid, teeth c. 0.2 mm long, anthers c. 0.5 mm long, shortly beaked; disc c. 0.4 mm tall; style c. 0.5 mm long, 0.5 mm diameter, below bilobed stigmatic surface c. 0.9 mm diameter. **Fruit** a 1- or 2-seeded capsule, 4-winged when immature, rhomboidal to subterete in cross-section, 1.7–1.5 × 0.6–0.9 cm, subglaucous when fresh, brown when dry, puberulous, weakly septically dehiscent into 2(–?4) valves. **Seeds** with white fleshy coat.

Vernacular names. Sarawak—*penyan-ketidoh* (Punan).

Distribution. Endemic in Borneo and known in Sabah from Beaufort, Kota Kinabalu and Papar districts (e.g., *SAN* 33572, *SAN* 47852 and *SAN* 78228) and in Sarawak from Belaga, Limbang, Lubok Antu, Miri, Serian, Sibul, Simunjan and Sri Aman districts (e.g., *Geh & Samsuri* 1105, *S* 16648, *S* 40128, *S* 43064, *S* 63391 and *S* 83356). Also occurring in Kalimantan (e.g., *Hallier* 355, *Kostermans* 10324 and *Winkler* 2414) but not yet recorded from Brunei.

3. *Walsura grandifolia* Ridl.

(Latin, *grandis* = large, *folium* = leaf; large-leaved)

Bull. Misc. Inform. Kew (1930) 370; Anderson *op. cit.* (1980) 253; Mabberley, Gard. Bull. Sing. 55 (2003) 198. **Type:** *Haviland* 1635, Sarawak, near Kuching, 5 Oct 1892 (holotype K; isotype SAR). **Synonym:** *Walsura pinnata* auct. non Hasskarl (1855): Clark *op. cit.* (1994) 276, *p.p.*, *op. cit.* (1995) 48, *p.p.*

Treelet to 7 m tall; trunk to 10 cm diameter. **Bark** smooth, greyish white; inner bark brown. **Twigs** 7–8 mm diameter apically, lenticellate. **Leaves** c. 40 cm long, glabrous; petioles 10–15 cm long, flattened adaxially; leaflets coriaceous, strongly rugose, lateral ones 2 on each side of rachis; blades elliptical to elliptical-oblong (apical one obovate), to 28 × 10 cm, base cuneate, apex shortly acuminate; lateral veins 12–15 on each side of midrib, impressed above, prominent below; petiolules 2–2.3 cm long (of apical leaflet to 5.5 cm long), stout. **Inflorescences** to 35 cm long, lax; peduncles c. 15 cm long, branches remote, basal ones c. 8 cm long, apical ones c. 2.5 cm long, few-flowered, puberulous; bracts small, lanceolate, pubescent, caducous. **Flowers:** pedicels c. 2 mm long, pubescent; calyx c. 1 mm tall, pubescent, green, 5-lobed, the lobes subtriangular, acute; petals oblong-ovate, 3.5–4 × 1–1.5 mm, pubescent outside, fleshy, green; filaments almost free, c. 0.5 mm wide, unlobed, pubescent especially on margins, anthers c. 0.8 mm long, strongly apiculate, apically hairy, inserted apically; disc torus-shaped, c. 0.5 mm tall, glabrous; ovary densely pilose, style swollen towards apex, stylehead cylindrical, c. 0.6 mm across, glabrous. **Fruits** (immature) yellow-orange, covered with very fine brownish hairs. Aril juicy, transparent.

Distribution. Endemic in Borneo and restricted to Bau and Kuching districts, Sarawak (e.g., *S* 32633, *S* 41069, *S* 50390 and *S* 74985).

Ecology. Forest on limestone at altitudes to 200 m. Rarely collected.

Notes. Recently confused with *W. pinnata* from which it differs in its very large leaflets and flowers, its androecium of almost free filaments without apical teeth, its larger disc and its longer cylindrical stylehead.

4. *Walsura pachycaulon* Mabb. *ex* T. Clark

Fig. 33.

(Greek, *pachy-* = thick, *caulos* = stem; referring to the thick leafy shoots)

Blumea 38 (1994) 280, *op. cit.* (1995) 51; Coode *et al.* (eds.) *op. cit.* 207. **Type:** *Meijer SAN 53580*, Borneo, Sabah, Sandakan district, Lungmanis FR (holotype L; isotypes K, SAN, SAR, SING).

Tree to 29 m tall; bole to 25 cm diameter. **Bark** grey-brown to blackish; inner bark pink. **Twigs** 8–15 mm diameter apically, lenticellate, glabrous. **Leaves** to 60 cm long; petioles to 22 cm long, 7 mm thick, flattened to channelled adaxially; *leaflets* subcoriaceous, sparsely pubescent or glabrous below, *lateral ones* 4 (or 5) on each side of rachis; *blades* narrowly oblanceolate to elliptical or oblong, 13–19.5 × 3.5–6.5 cm (distal pairs), basal pairs smaller, terminal pairs larger, base somewhat cuneate, apex acuminate; venation prominent on both surfaces; lateral veins 10–19 on each side midrib (terminal leaflets), 9–14 (lateral leaflets); petiolules to 2.3 cm long, to 2 mm thick. **Inflorescences** to 45 cm long, in axils of caducous undeveloped leaves, puberulous, branched to three orders, first order to 15 cm long. **Flowers:** pedicels 1–2.5 mm long; buds *c.* 3 mm diameter before anthesis; calyx *c.* 1.3 mm tall, lobes *c.* 0.5 mm; petals *c.* 4.2 × 2.2, imbricate; *androecium cylindrical*, *c.* 2.4 mm tall, *forming glabrous tube in lowermost 1/4*, filaments pubescent on inner surface, apex bifid, anthers *c.* 0.6 mm long, apex shortly beaked and pubescent; disc *c.* 0.7 mm tall, glabrous, style narrowly obconical, glabrous, stylehead *c.* 0.4 × 0.9 mm, apex domed. **Fruits** spherical, to 4.2 cm diameter, brown. **Seeds** to 2.8 × 1.6 cm, with sweet-tasting aril.

Distribution. Endemic in Borneo. In Sabah, known from Kinabatangan, Lahad Datu and Tawau districts (e.g., *SAN 65826*, *SAN 69355*, *SAN 113497* and *SAN A 4050*) and in Sarawak from Kapit district (e.g., *S 28266*). Also occurs in Brunei (e.g., *Hansen 1566*) and Kalimantan (e.g., *Kostermans 4421*).

Notes. Specimens *SAN 142584* (from Tawau) and *SAN 143514* (from Lahad Datu) key out here, though these collections have small leaflets and the buds are fulvous-tomentose. Clark (*op. cit.* 1994), included specimens *S 21733*, *S 21920*, *S 29617* and *S 43853* (all collected from small trees to 4 m tall, some on basalt, from Kapit district, Sarawak) in this species. They are, however, not canopy trees and do not have the thick stems typical of the species. They resemble some forms of *W. pinnata* and need further study. Likewise, the correct identity of other specimens (e.g., *SAN 96172* and *SAN 100304*) collected from small trees (with large leaflets to 30 cm long) in Tawau, Sabah and referred to *W. pinnata* by Clark (*op. cit.* 1994), also need further investigation.

5. *Walsura pinnata* Hassk.

(Latin, *pinnatus* = feather-like; the leaf)

Retzia 1 (1855) 147; Backer & Bakhuizen *f. op. cit.* 129; Anderson *op. cit.* (1980) 253; Mabberley *op. cit.* (1989) 254; Clark *op. cit.* (1994) 276, *p.p.*, *op. cit.* (1995) 48, *p.p.*; Turner, Gard. Bull. Sing. 47 (1995) 343; PROSEA 5, 3 (1998) 579; Beaman & Anderson *op. cit.* 134. **Neotype** (Clark, 1994): *Koorders 971*, Java, Bogor, tree no. III b 20 [grown from material collected by Hasskarl, Java, south Bantam, 1841], 26 June 1892 (BO; 'clonotype' *Anon. s.n., idem*, L [Acc. 926258685]). **Synonym:** *Walsura neurodes* Hiern *op. cit.* 564, King *op. cit.* 84, Ridley *op. cit.* (1922) 412; *Walsura villamilii* Merr., Phil. J. Sci. 9, Bot. (1914) 308, *op. cit.* (1923) 380, *op. cit.* (1929) 132, Masamune, EPB (1942) 377.

Tree, 12–37 m tall; bole 11–24 m tall, 24–38 cm diameter. **Bark** smooth, pale, scaling; inner bark pink-brown. **Twigs** 2.5–8 mm diameter apically, glabrous, usually lenticellate. **Leaves** to 50 cm long; petioles to 9 cm long, 1–4 mm thick, flattened adaxially, usually glabrous; leaflets subcoriaceous, lower surface glabrous or almost so and glaucous (when fresh), lateral ones 2 or 3 on each side of rachis; blades narrowly oblanceolate, elliptical to oblong, lateral ones 5.5–25 × 2–11.5 cm, terminal ones slightly larger, base somewhat cuneate, apex acute to shortly acuminate, acumen to 1.5 cm long; lateral veins 7–12(–20) on each side of midrib, sometimes with shorter veins in between not reaching margin; petiolules 0.4–1.4 cm long. **Inflorescences** thyrsoid, 8–20(–35) cm long, usually in axils of caducous, undeveloped leaves, branched to three orders; primary branches to 10 cm long, puberulous. **Flowers:** pedicels to 2 mm long; buds cylindrical prior to anthesis; calyx 1.2–1.5 (1–9) mm tall, puberulous outside; petals 3–3.8(–4) × 1.5–1.8 mm, imbricate; androecium subcylindrical, with subglabrous tube for about half its length, filaments densely pubescent especially inside, apex bifid with teeth c. 0.2 mm long, anthers 0.6–0.8 mm long; disc 0.2–0.4 mm tall; ovary usually hairy, style more or less cylindrical, glabrous, stylehead c. 0.4 × 0.7–1 mm. **Fruit** a 1- or 2-seeded, indehiscent berry, spherical to ovoid, 1.2–2.4(–2.8) × 1.2–2.4 cm, round in cross-section, glabrous to finely puberulous, reddish when fresh. **Seed** ellipsoid, 1.3–2.3 × 0.9–1.3 cm; aril sweet-tasting, colourless.

Vernacular name. Sabah—*lantupak mata kucing* (preferred name).

Distribution. From S China (Yunnan), Vietnam, Myanmar and Thailand to Peninsular Malaysia, Java, Borneo, the Philippines, Maluku (Halmahera, Aru) and Irian Jaya. In Borneo, recorded in Sabah (but see below) from Beaufort, Keningau, Kinabatangan, Kota Belud, Lahad Datu, Ranau, Sandakan, Semporna, Sipitang and Tawau districts (e.g., *SAN 17583*, *SAN 35188*, *SAN 72681*, *SAN 84004* and *SAN 95758*) and in Sarawak from Kapit and Lundu districts (e.g., *S 23939* and *S 23959*). Also occurring in Brunei (e.g., *FD FMS 34472*) and Kalimantan (e.g., *Mogea 4163*).

Ecology. Lowland rain forest though precise range unclear (see below).

Notes. Clark (1994: 249, 279) discusses the variation in this species and has informal entities for the major variants he recognises. In Sabah, there are typical 'pinnata' (e.g., *SAN 86994*) and also 'villamilii' (e.g., *SAN 57288*), which has leaves with three or four as opposed to two leaflets on each side of rachis with some lateral veins failing to reach the leaf margin, but otherwise, according to Clark, they intergrade. Although there is a wide range of lateral vein number in the leaflets of Sabah specimens, the great majority fall into his broadly circumscribed *W. pinnata*, though specimens with a very small number of lateral

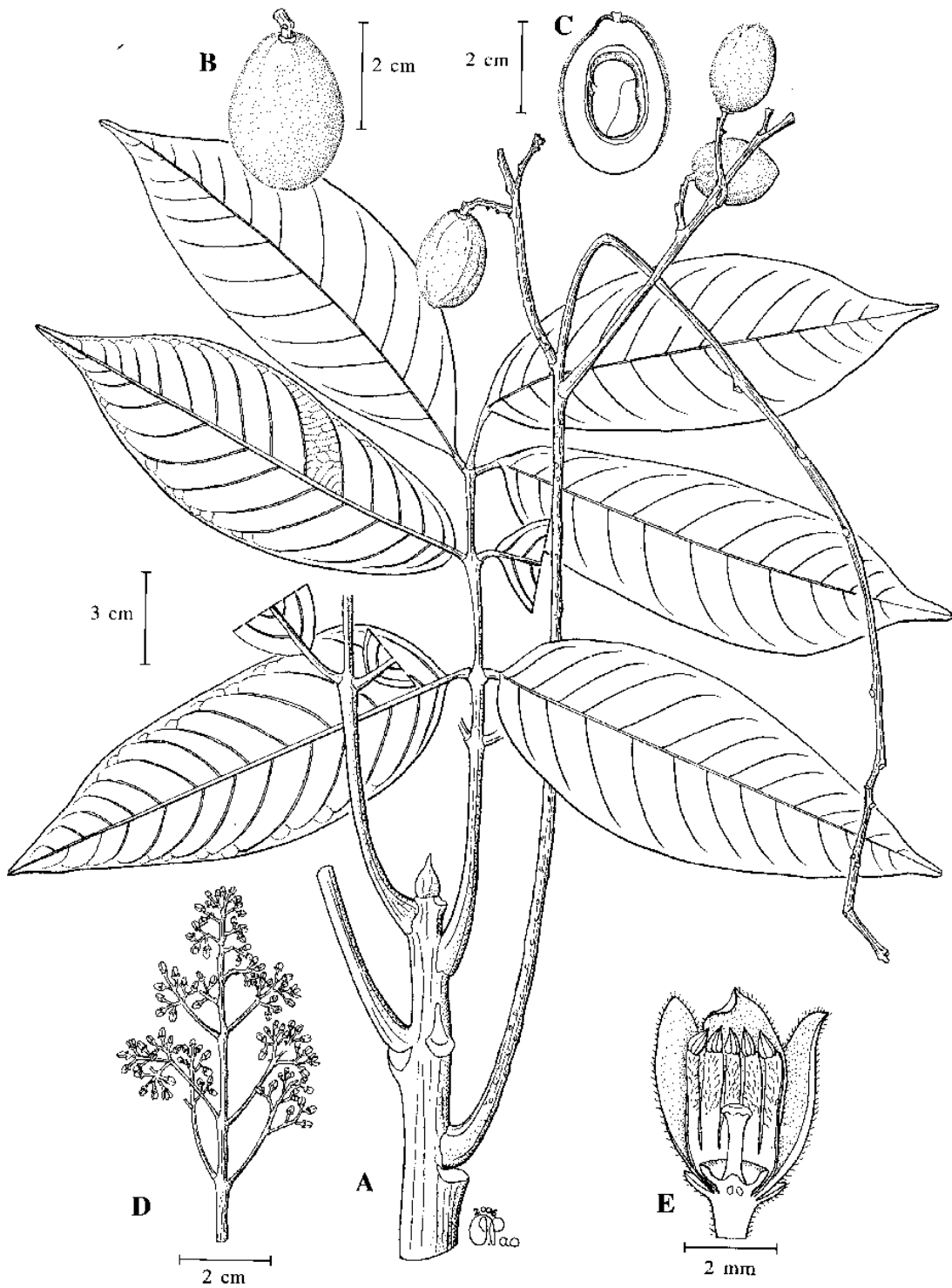


Fig. 33. *Walsura pachycaulon*. A, fruiting leafy twig; B, fruit; C, longitudinal section of fruit; D, distal part of inflorescence; E, longitudinal section of flower. (A–C from SAN 69355, D–E from SAN A 4050.)

veins (6 or 7 on each side of midrib as opposed to 14–19) and short inflorescences and infructescences (e.g., *Mabberley 1664*, *SAN 30551*, *SAN 31339*, *SAN 35168* and *SAN 44553*) seem very distinctive. In Sarawak, ‘typical’ *W. pinnata* has rarely been collected (e.g., *Pennington 8000* with 6–8 lateral veins on each side of midrib and *S 64519* with 18–19 lateral veins). Some of the specimens referred to *W. pinnata* by Clark are now referred to *W. decipiens* and *W. grandifolia* (see above). Nonetheless, even shorn of these and other extraneous materials (see *Mabberley op. cit.* 2003), *W. pinnata* seems to me still to be heterogeneous, more so when the Kalimantan and Peninsular Malaysian materials included herein by Clark are taken into consideration (see also discussion under *W. pachycaulon* above). This perplexing complex still needs further collecting and analysis in the field across its supposed range.

6. *Walsura sarawakensis* T.Clark (from Sarawak)

Blumea 38 (1994) 283, *op. cit.* (1995) 52. **Type:** *Purseglove P 5204*, Borneo, Sarawak, Bt. Mayeng (holotype SING; isotype L).

Treelet, 2–6 m tall. **Twigs** 6–8 mm thick apically, glabrous, pale brown, sparsely lenticellate. **Leaves** 52–80 cm long; petioles 15–21 cm long, flattened adaxially, subglabrous; leaflets subcoriaceous, sparsely pubescent below, lateral ones 3 on each side of rachis; blades lanceolate, to 36(–41) × 12 cm, terminal largest, base shortly attenuate, apex acuminate with acumen to 5 cm long; lateral veins 14–18 on each side of midrib, prominent on both surfaces. **Inflorescences** 7.5–8 cm long, in axils of undeveloped leaves, branched to second order, lower branches to 1.3 cm long, puberulous. **Flower buds** cup-shaped before anthesis; calyx c. 1.1 mm tall, lobes c. 0.8 mm long; petals 3.2–3.5 × 1.7–1.8 mm, imbricate, green; androecium cylindrical forming a tube in the lower ½ to ¾, alternate filaments slightly shorter, apices bifid, the teeth c. 0.3 mm long, anthers c. 0.8 mm long, apex acute to beaked; disc c. 0.3 mm tall; style cylindrical, glabrous, stylehead subcapitate, c. 0.7 × 1.1 mm. **Fruit** a berry, ellipsoid, 2–3 × 1.7–2.5 cm, glabrous, purplish brown. **Seeds** 1–4, 1.8–2.3 × 1.4 cm; aril white, sticky.

Distribution. Endemic in Borneo and restricted to Bt. Mersing and Tau Range, Kapit district, Sarawak (e.g., *Purseglove P 5143* and *Purseglove P 5219*). Rarely collected.

Ecology. Lowland forest, at altitudes to 300 m.

Incompletely known species

Walsura sp. A

Clark, *Blumea* 38 (1994) 290, *op. cit.* (1995) 55.

Tree to 35 m tall; bole to 75 cm diameter; buttressed to 1.2 m tall. **Bark** smooth to flaking, reddish. **Twigs** 2.5–4 mm diameter apically, glabrous, lenticellate. **Leaves** 13–24 cm long; petioles 2.5–5 cm long, slightly flattened adaxially near base, densely puberulous with simple and 2-armed trichomes; leaflets subcoriaceous, lateral ones 2 on each side of rachis; blades elliptical, 7.5–14 × 3.5–5.5 cm, the apical ones the largest, base acute, apex shortly acuminate; midrib and lateral veins prominent below, sparsely pubescent (simple and 2-armed trichomes); lateral veins 7–10 on each side of midrib; petiolules to 1.2 cm long.

Flowers unknown. **Fruit** a 1- or 2-seeded berry, ellipsoid, 2.2–2.6 × 1.5–1.8 cm, puberulous with simple and 2-armed trichomes. **Seeds** 1–1.5 cm long; aril sweet-tasting, fleshy.

Distribution. Endemic in Borneo and known only in Sarawak from Bintulu and Kuching districts (e.g., *S 27213*, *S 27982*, *S 30670* and *S 37776*).

Notes. The indumentum comprising simple and 2-armed trichomes is distinctive.

15. XYLOCARPUS J.König

(Greek, *xulon* = wood, *karpon* = fruit; referring to the woody fruit)
nyireh (ASEAN standard trade name)

Naturf. 20 (1784) 2; Merrill, Enum. Philip. Fl. Pl. 2 (1923) 258; Backer & Bakhuizen *f.*, FJ 2 (1965) 118; Pennington & Styles, Blumea 22 (1975) 525; Anderson, CLTS (1980) 253; Mabblerley, Mal. For. 45 (1982) 448, in Mabblerley & Pannell, TFM 4 (1989) 258; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 235; Mabblerley *et al.*, FM 1, 12 (1995) 371; Coode *et al.* (eds.), CLBD (1996) 207; Argent *et al.* (eds.), MNDT-CK 2 (1997) 426; PROSEA 5, 3 (1998) 591. **Synonym:** *Carapa auctt. non-Aublet* (1775): Hiern in Hooker *f.*, Fl. Brit. Ind. 1 (1875) 566, King, J. As. Soc. Beng. 64, 1 (1895) 87, Ridley, FMP 1 (1922) 414, Corner, WSTM 3rd. ed., 2 (1988) 497.

Semi-evergreen coastal trees. **Twigs** lenticellate, marked with distinct petiole scars. **Indumentum** of simple hairs. **Bud scales** present. **Leaves** paripinnate, without pseudogemmula; leaflets opposite, entire, glabrous, 1–5 on each side of rachis. **Inflorescences** thyrsoid, axillary. **Flowers** unisexual; calyx 4-lobed to about the middle, valvate; petals 4, contorted and much longer than the calyx in bud; staminal tube margin with 8 suborbicular, retuse or shallowly and irregularly divided lobes, anthers 8, included; disc cushion-shaped, substanding or surrounding and united with ovary, red; ovary 4- or 5-locular, each locule with 3 or 4(–6) ovules, style short, stylehead discoid, its margin crenellate (= finely crenate) and its upper surface with four radiating stigmatic grooves. **Fruit** a large pendulous subspherical capsule, tardily dehiscent by 4 (or 5) leathery valves from apex. **Seeds** 5–20, large, irregularly tetrahedral or pyramidal, outermost surface convex, attached to central columella, with aerenchymatous (?sarcotestal) coat; endosperm absent; embryo with the large cotyledons fused together; radicle lying above the hilum. Germination cryptocotylar; eophylls simple, entire, becoming trifoliolate later.

Distribution. Three species throughout the coastal regions of the Old World tropics from E Africa to the W Pacific. Two species occurring in Sabah and Sarawak, though there is a single sterile specimen of *Xylocarpus rumphii* (Kostel.) Mabb. (*FD FMS 35386*), collected from Timbun Mata Island, Semporna district, Sabah in 1938. *Xylocarpus rumphii* is not a mangrove tree but grows on beaches and rocky headlands; it has fissured rather than peeling bark and it has more (and more acute) leaflets and larger inflorescences than either of the other two species. If the record is confirmed, it is a first for Borneo.

Ecology. In mangrove swamps and coastal forests on rock and other substrates.

Uses. The wood of *Xylocarpus* spp. is used mainly for high quality furniture, cabinet work, carving and the manufacture of artistic articles. Other common uses include light

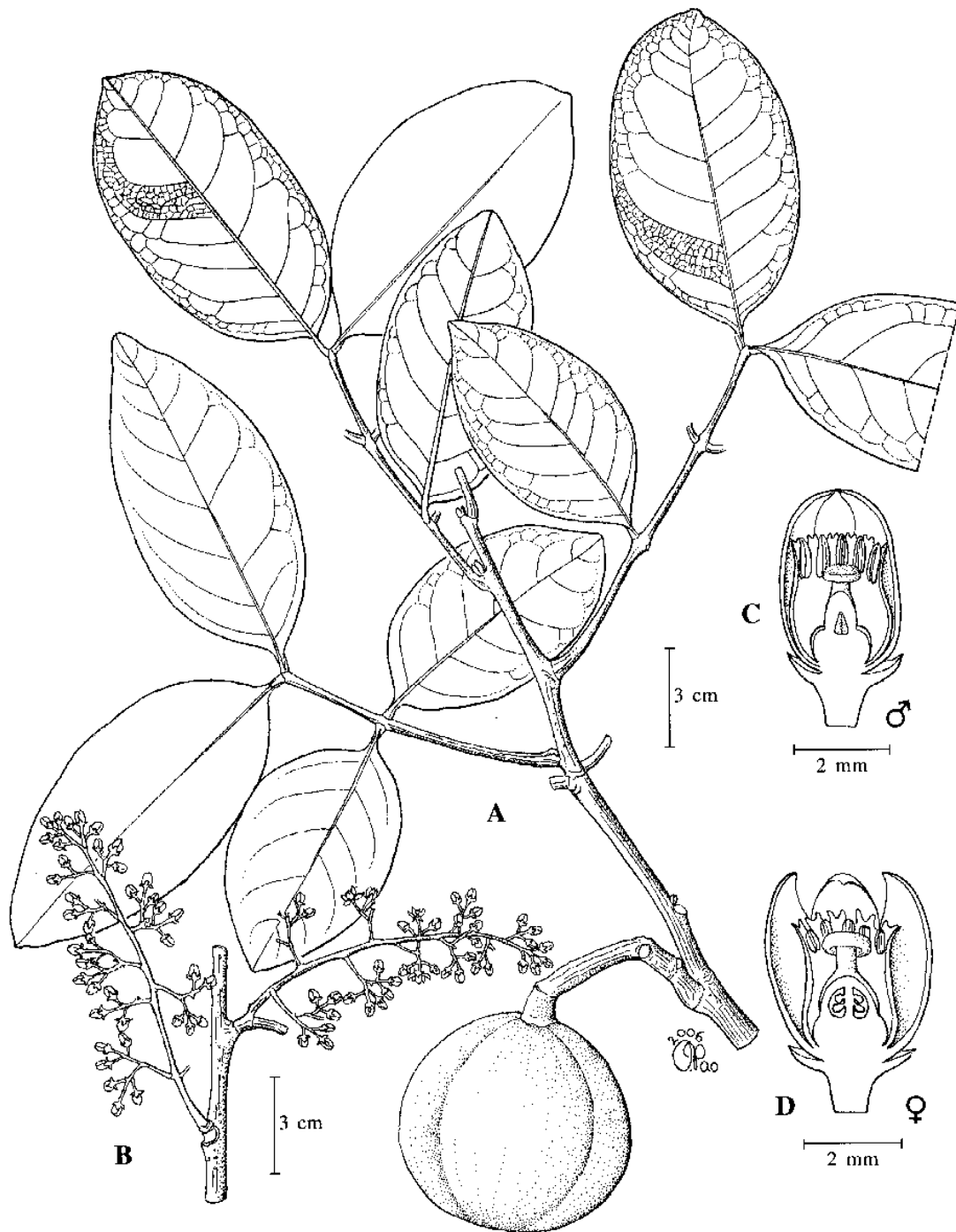


Fig. 34. *Xylocarpus moluccensis*. A, fruiting leafy twig; B, part of inflorescence; C, longitudinal section of male flower; D, longitudinal section of female flower. (A from SAN 84119, B–D from S 36068.)

construction, interior finishing, panelling, flooring and decorative veneer. The bark yields tannin, which has been extensively used to tan fishing nets and hides. Oil extracted from seeds is used as illuminant and for treating insect bites. Decoction of the bark is used in traditional medicine for the treatment of cholera, dysentery, diarrhoea and other abdominal pains. (PROSEA 5, 3 (1998) 591). The antifilarial activity of *Xylocarpus* extracts is discussed by Abdullah *et al.*, J. Trop. For. Prod. 3 (1997) 216–9 and Zaridah *et al.*, J. Ethnopharm. 78 (2001) 79–84.

Notes. The two species definitely occurring in Sabah and Sarawak are most readily distinguished in the field and collectors have so far reported no intermediate specimens. In Peninsular Malaysia, moreover, the local people have separate names for the two, which are frequently confused by herbarium workers. Indeed, in the absence of ecological information, ripe fruit, details of the bark, buttresses and pneumatophores, all of which are distinguishing field characters, the herbarium worker may well be at a loss to pigeon-hole specimens, particularly sterile material, and those from young plants may be almost impossible to determine.

Key to *Xylocarpus* species

Leaflets ovate-elliptical, usually rounded at apex. Inflorescences 1–6 cm long, often with indistinct main axis; pedicels conspicuously swollen near calyx. Fruits 12–25 cm diameter. Buttresses flattened, ribbon-like spreading across mud; pneumatophores absent..... **1. *X. granatum***

Leaflets elliptical-oblong, lanceolate or oblanceolate, apex acute to obtuse. Inflorescences 3–8(–13) cm long, usually with distinct main axis; pedicels not conspicuously swollen near calyx. Fruits 6–11 cm diameter. Buttresses not ribbon-like; pneumatophores erect, pointed..... **2. *X. moluccensis***

1. *Xylocarpus granatum* J.König

Plates 5D & E.

(Latin, pomegranate (*Punica granatum* L., Lythraceae); alluding to the fruit shape)

Naturf. 20 (1784) 2; Merrill, EB (1921) 318, *op. cit.* (1923) 358, PEB (1929) 120; Masamune, EPB (1942) 377; Backer & Bakhuizen *f. op. cit.* 118; Anderson *op. cit.* (1980) 253; Mabberley *op. cit.* (1982) 450, *op. cit.* (1989) 260; Whitmore, Tantra & Sutisna *op. cit.* 235; Mabberley *et al. op. cit.* 378; Turner, Gard. Bull. Sing. 47 (1995) 343; Coode *et al.* (eds.) *op. cit.* 207; Argent *et al.* (eds.) *op. cit.* 426; PROSEA 5, 3 (1998) 594. **Type:** not traced. **Synonyms:** *Carapa moluccensis* auct. non Lam. (1785); Ridley *op. cit.* (1922) 414, *p.p.*; *Carapa obovata* Blume, Bijdr. Fl. Ned. Ind. 1 (1825) 179, King *op. cit.* 87, Ridley *op. cit.* (1922) 414, *p.p.*; *Granatum obovatum* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 110; *Carapa granatum* (Koenig) Alston in Trimen, Handb. Fl. Ceylon 6 (1931) 45 '*granata*', Corner *op. cit.* (1988) 497; *Xylocarpus minor* Ridl., Bull. Misc. Inform. Kew (1938) 289, Masamune *op. cit.* 377.

Tree or shrub, (1–)6–15(–20) m tall; bole to 90 cm diameter, often of poor form; *buttresses thin, branched, ribbon-like, spreading out from base; pneumatophores absent.* **Bark** thin, smooth, scaling as irregular flakes, whitish to yellow-brown; inner bark reddish or pink. **Leaves** to 9(–12) cm long, usually much less; petioles to 4 cm long; leaflets coriaceous, 1–3 on each side of rachis; *blades ovate or elliptical*, (3.5–)5–12 × (2–)3–6 cm, base cuneate, *apex rounded or obtuse*; venation prominent on both surfaces; petiolules (2–)5–6(–11) mm long, swollen. **Inflorescences** (1–)3–6 cm long, more or less squarrose, borne on new and older twigs, *frequently forked with indistinct main axis*; bracts and bracteoles *c.* 0.5 mm,

caducous. **Flowers:** *pedicels* 3–9 mm long, *conspicuously swollen towards the calyx*; calyx lobes 1–3 mm long; petals oblong, 3.5–5.5(–6.5) × 2–3 mm, creamy-white or pinkish; staminal tube 2–3.5 mm diameter, lobes apiculate or bifid to retuse. **Fruits** depressed globose, 12–25 cm diameter. **Seeds** 8–16(–20), 4–6 cm long.

Vernacular name. Sarawak—*nyireh bunga* (Iban, Malay).

Distribution. Old World Tropics from E Africa and continental Asia throughout Malesia to Tonga. In Borneo, known in Sabah from Beaufort, Kinabatangan, Kota Kinabalu, Kuala Penyu, Kudat, Labuk Sugut, Lahad Datu, Sandakan, Semporna, Sipitang and Tawau districts (e.g., *Mabberley 1674*, *Pennington 7892*, *SAN 86409*, *SAN 105235* and *SAN 145862*) and in Sarawak from Kuching, Lawas, Sarikei and Sibiu districts (e.g., *S 2012*, *S 7744*, *S 26706* and *S 26817*). Also occurring in Brunei (e.g., *BRUN 5058*) and Kalimantan (e.g., *Ambriansyah 2320*).

Ecology. Mangroves, usually estuarine and often associated with *Nypa* and *Sonneratia*.

2. *Xylocarpus moluccensis* (Lam.) M.J.Roem.

Fig. 34.

(from the Moluccas = Maluku)

Syn. Hesp. 1 (1846) 124; Merrill *op. cit.* (1921) 318, *op. cit.* (1923) 358; Backer & Bakhuizen *f., op. cit.* 118, *p.p.*; Anderson *op. cit.* (1980) 253; Mabberley *op. cit.* (1982) 450, *op. cit.* (1989) 260; Whitmore, Tantra & Sutisna *op. cit.* 235; Mabberley *et al. op. cit.* 376; Turner *op. cit.* 343; Argent *et al.* (eds.) *op. cit.* 426; PROSEA 5, 3 (1998) 594. **Basionym:** *Carapa moluccensis* Lam., Enc. Méth. 1 (1785) 621, Hiern *op. cit.* 567, King *op. cit.* 87, Ridley *op. cit.* (1922) 414, *p.p.*, Corner *op. cit.* (1988) 498. **Type** [icon]; Rumphius, *Herb. Amboin. 3 (1743) t. 61*. **Synonyms:** *Granatum moluccense* (Lam.) Kuntze *op. cit.* 110; *Carapa obovata auct. non* Blume (1825); King *op. cit.* 87, *p.p.*, Ridley *op. cit.* (1922) 414, *p.p.*; *Carapa borneensis* Becc., Nelle For. Borneo (1902) 574.

Tree, 6–18(–30) m tall, *with small, not ribbon-like buttresses and many pointed pneumatophores*; bole usually solitary, to 70 cm diameter. **Bark** rough with longitudinal fissures, falling as oblong flakes. **Leaves** to 10 cm long, sometimes with persistent apical spike to 1 mm long; *leaflets* 1–4 on each side of rachis; *blades elliptical-oblong or lanceolate to oblanceolate*, (5–) 7–10(–17) × (2.5)4–6.5(–7) cm, base cuneate, more or less asymmetrical, *apex acute to obtuse*; venation prominent on both surfaces; petiolules (0–)2–5 mm long, sometimes swollen. **Inflorescences** 3–8(–13) cm long, often produced with the new leaves, somewhat lax, *main axis distinct*; lateral branches to 4 cm long; bracts and bracteoles *c.* 0.5 mm, more or less persistent. **Flowers:** *pedicels* 3–8 mm long, *not conspicuously swollen near calyx*; calyx lobes 1–1.7 mm long; petals oblong to obovate, 3.5–4 × 2–3 mm, creamy-white; staminal tube 2–3 mm diameter, lobes acute to apiculate or bifid to retuse. **Fruits** depressed globose, 6–11 cm diameter. **Seeds** 5–10, 4–6.5 cm long.

Vernacular name. Sarawak—*nyireh-peti* (Iban), *nyireh batu* (Malay).

Distribution. Tropical Asia from India (Sundarbans) to tropical Australia. In Borneo, known in Sabah from Sandakan district (e.g., *SAN 81797* and *SAN 84119*) and in Sarawak from Kuching, Sarikei and Sibiu districts (e.g., *S 7741*, *S 26721* and *S 30655*). Also occurring in Brunei and Kalimantan, but no specimens were seen at KEP.

Ecology. Mangrove swamps, most commonly in the upper reaches, often in only slightly brackish water. This species has been widely confused with the previous species, the first clear distinction being made by Beccari (*op. cit.*).

POLYGALACEAE

W.J.J.O. De Wilde & Brigitta E.E. Duyfjes

National Herbarium of the Netherlands, University Leiden Branch,
Leiden, The Netherlands

A.W. Bennett *in* Hooker *f.*, Fl. Br. Ind. 1 (1872) 200; King, J. As. Soc. Beng. 59, 2 (1890) 129; Chodat, Monogr. Polygalacearum I, Mém. Soc. Phys. Hist. Nat. Genève, Suppl. (1891) 1, *ibid.* II (1893) 1, *in* Engler & Prantl, Nat. Pflanz. Fam. III, 4 (1896) 343; Merrill, EB (1921) 324; Ridley, FMP 1 (1922) 137; Masamune, EPB (1942) 378; Backer & Bakhuizen *f.*, FJ 1 (1964) 196; Ng, TFM 1 (1972) 351; Anderson, CLTS (1980) 286; Meijden, Leiden Bot. Ser. 7 (1982) 1, FM 1, 10 (1988) 455; Eriksen, Pl. Syst. Evol. 186 (1993) 33; Turner, Gard. Bull. Sing. 47 (1995) 404; Coode *et al.* (eds.), CLBD (1996) 253; Argent *et al.* (eds.), MNDT-CK 2 (1997) 503; Pendry, Fl. Thailand 7, 3 (2001) 498; Beaman & Anderson, PMK 5 (2004) 261.

Trees, shrubs, woody climbers, autotrophic green-leaved or saprophytic herbs. **Stipules** absent. **Leaves** simple, entire, spirally arranged or sometimes (sub)opposite or whorled, sometimes small, scale-like and without chlorophyll. **Inflorescences** usually raceme-like, branched or unbranched, or flowers solitary; bracts present; bracteoles basal, rarely absent. **Flowers** bisexual, mostly bilaterally symmetrical; sepals 5, free, overlapping, or the lower 2 (rarely all) fused, subequal or the two lateral ones enlarged and petaloid (petal-like); petals 3 or 5, free or at base variously fused, also fused with the sepals or with the staminal tube, or with the filaments, equal or unequal, the lower ones often forming a carina (keel); stamens (2–)8(–10), filaments usually more or less united, or free, anthers basifixed, 1- or 2-locular, opening by a single apical pore or (longitudinal) introrse slit(s); disc present or absent; ovary superior, 1–8-locular, with 1 ovule per locule, or in *Xanthophyllum*, 1-locular (2-carpellate) with 4 or more ovules, style simple, stigma simple or lobed, ovules anatropous, with two integuments and a thick nucellus. **Fruit** berry-like, or a capsule, samara (winged nutlet) or drupe. **Seed** 1 or more, usually with endosperm.

Distribution. Worldwide about 15 genera with over 1000 species, in tropical and temperate regions; especially well developed in South America and South Africa. In Sabah and Sarawak 5 genera with about 69 species, of which the SE Asian genus *Xanthophyllum* Roxb. is woody, all species being trees, treelets or shrubs, and well represented (52 species and 3 incompletely known taxa) in the Flora area.

Ecology. As the genera represent a wide range of life forms in temperate and tropical regions, also in Borneo, members of the family can be found almost everywhere. The large worldwide genus *Polygala* L. consists mainly of heliophilous herbs, of which the originally American species *P. paniculata* L. is a common pantropical weed; *Salomonina* Lour. (few species in Sabah and Sarawak) are weedy herbs; *Epirixanthes* Blume (few species in Sabah and Sarawak) are tiny saprophytic shade plants; members of *Securidaca* L. (two species in Sabah and Sarawak) are woody climbers; *Xanthophyllum* is in Asia the largest genus of forest shrubs and trees.

Cross-pollination by insects is regarded as common in the family, because the flowers frequently look adapted for this in shape and colour. However, self-pollination was proved

effective in several cases, and possibly the rule, also in *Xanthophyllum*, although in this genus the flowers particularly seem to be constructed for pollination by insects.

Almost all modes of dispersal are represented in the family, corresponding to the great diversity in fruit and seed types. In *Xanthophyllum* dispersal by birds and small mammals, even monkeys, is possible.

Notes. Polygalaceae is a well defined family. Features of wood anatomy and pollen are diverse, but characteristic for the family, giving little evidence for relationship with other families. The genus *Xanthophyllum* has been regarded as a family of its own, but Meijden *op. cit.* (1982) convincingly proved that it should remain in the family as one of three tribes based on differences in floral structure (*Polygaleae*, *Moutabeae* and *Xanthophylleae*) as already recognised since Chodat *op. cit.* (1896). Relationship through the general resemblance of *Xanthophyllum* flowers to those of the Fabaceae (Caesalpinioideae and Faboideae) is spurious, although recent molecular research points to ties with Fabaceae (<http://www.MOBOT/research/APweb/orders/fabalesweb.htm>; 1st Sept. 2006).

Uses. None of the genera has significant economic value. The roots of the weedy *Polygala paniculata* are locally sold as they release a pleasant perfume (coumarins). The largest woody representatives are found in *Xanthophyllum*, but have as yet no commercial value in the timber trade.

Key to genera

1. Herbs, exceptionally with woody stem. Ovary 2-locular.....2
 Trees, shrubs or lianas. Ovary 1-locular.....4
2. Sepals unequal, the lateral ones larger than other sepals and petaloid, about as long as the petals. Lower petals (keel) appendiculate at apex. Stamens 8. Fruits often with low wing all round.....3

Polygala L.

(Greek, *polus* = much, *gala* = milk; referring to the supposed property of the plant in stimulating milk secretion)

Sp. Pl. 2 (1753) 701; Merrill, EB (1921) 324; Masamune, EPB (1942) 378; Adema, Blumea 4 (1966) 256; Anderson, CLTS (1980) 286; Meijden, FM 1, 10 (1988) 459; Coode *et al.* (eds.), CLBD (1996) 254; Beaman & Anderson, PMK 5 (2004) 262.

Annual or perennial herbs, rarely shrubs or low climbers. Lateral sepals large, petaloid, about as long as petals; keel with appendages. Stamens 8, variously fused. Ovary 2-locular. Capsule dehiscent, usually with low wing around. Seed with a lobed aril or long hairs (coma).

A large genus of more than 500 species, all over the world. In Sabah and Sarawak five species but only one, *P. venenosa* Poir., is a stout herb or a low shrub, which exceptionally may attain the stature of a small tree.

Sepals all subequal, not petaloid, much shorter than the petals. Lower petal without apical appendages. Stamens 2-6. Fruits not winged.....3

3. Plant with green leaves. Fruits leathery, dehiscent, exceeding the sepals.....

Salomonina Lour., *nom. cons.*

(King Salomo, 971-931 A.D.)

Fl. Cochin. 1 (1790) 14; Merrill, EB (1921) 324; Masamune, EPB (1942) 378; Meijden, FM 1, 10 (1988) 486; Coode *et al.* (eds.), CLBD (1996) 254; Beaman & Anderson, PMK 5 (2004) 263.

About three species distributed from India, Sri Lanka and Nepal to China, Japan, S Korea, Taiwan, Indo-China, Thailand, Malesia and N Australia. In Sabah and Sarawak two species, *S. cantonensis* Lour. and *S. ciliata* L., are small weedy herbs. Plant saprophytic, pale, with scale-like brownish leaves. Fruits fleshy, indehiscent, enclosed by the sepals.....

Epirixanthes Blume

(Greek, *epi* = on, *rhiza* = root, *anthos* = flower; referring to the plant which grows on the root of a host, but the plant is saprophytic)

Cat. Gew. Buitenzorg (1823) 25, 82; Endlicher, Gen. Pl. (1839) 728 (*'Epirhizanthus'*); Merrill, EB (1921) 325; Masamune, EPB (1942) 378; Meijden, FM 1, 10 (1988) 488; Coode *et al.* (eds.), CLBD (1996) 253; Beaman & Anderson, PMK 5 (2004) 261.

Erect, little-branched, saprophytic herbs with small, bract-like erect leaves.

Five species distributed from India to China, Malesia and Solomon Islands. All five species occur in Borneo.

4. Lianas. Petals 3. Ovary with 1 ovule. Fruits with a long coriaceous wing.

Securidaca L., *nom. cons.*

(Latin, *securis* = axe; referring to the shape of the fruit)

Syst. Nat. ed. 10 (1759) 1155; A.W. Bennett *in* Hooker *f.*, Fl. Br. India 1 (1872) 207; Chodat *in* Engler & Prantl, Nat. Pflanz. Fam. III, 4 (1896) 340; Meijden, FM 1, 10 (1988) 483; Coode *et al.* (eds.), CLBD (1996) 254; Beaman & Anderson, PMK 5 (2004) 263.

Woody climbers, without tendrils. Inflorescences (racemes or) panicle-like; sepals 5, unequal; petals 3, halfway adnate to staminal tube, lower one keel-like; stamens 8, monadelphous; ovary 1-locular, with 1 ovule. *Fruit a winged nutlet* (samara). Seed glabrous, not arillate.

About 80 species mainly in S and C tropical America; four species in SE Asia, with two species, *S. inappendiculata* Hassk. and *S. philippinensis* Chodat, in Sabah and Sarawak.

Trees (or shrubs). Petals 5. Ovary 1-locular, with 4 or more ovules. Fruit (sub)globose, not winged.....**Xanthophyllum**

XANTHOPHYLLUM Roxb., *nom. cons.*

(Greek, *xanthos* = yellow, *phullon* = leaf; referring to the leaves, often yellow when dry)

minyak berok (Malay), *nyalin* (Iban; preferred name in Sarawak)

Pl. Corom. 3 (1820, '1819') 81; A.W. Bennett *in* Hooker *f.*, Fl. Br. Ind. 1 (1872) 208; King, J. As. Soc. Beng. 59, 2 (1890) 134; Chodat, Bull. Herb. Boiss. 4 (1896) 254, *in* Engler & Prantl, Nat. Pflanz. Fam. III, 4 (1896) 343, *in* Merrill, PEB (1929) 133; Ridley, FMP 1 (1922) 137; Masamune, EPB (1942) 378; Ng, TFM 1 (1972) 352; Anderson, CLTS (1980) 286; Meijden, Leiden Bot. Ser. 7 (1982) 60, FM 1, 10 (1988) 493; Kessler & Sidiyasa, TBSA-EK (1994) 192; Turner, Gard. Bull. Sing. 47 (1995) 405; Coode *et al.* (eds.), CLBD (1996) 253; Argent *et al.* (eds.), MNDT-CK 2 (1997) 503; Pendry, Fl. Thailand 7, 3 (2001) 525; Beaman & Anderson, PMK 5 (2004) 263. **Synonyms:** *Jakkia* Blume, Cat. Gew. Buitenzorg (1823) 17, Bijdr. Fl. Ned. Ind. (1825) 60 (*'Jackia'*), *non Jackia* Wallich, *nec Jackia* Sprengel; *Skaphium* Miq., Fl. Ind. Bat., Suppl. (1861) 357.

Trees, large or small, *or shrubs*. **Twigs** terete, often smooth, green or yellow, sometimes with nodal glands. Growth always sympodial; in each flush the terminal bud aborts, and growth is continued through the axillary bud of the uppermost leaf. **Axillary buds** solitary or in clusters of 2–8, each with 2 bud scales. **Leaves** alternate (or spiral), sometimes partly shifted-decussate (subopposite), stalked, nearly always with glands beneath, drying yellowish (*X. flavescens*, mostly), green or (dark) brown; *petiole* often finely transversely wrinkled when fresh. **Inflorescences** axillary (and terminal), branched or unbranched. **Flowers** mostly bilaterally symmetrical, solitary or with 3 (rarely more) together; *sepals* 5, free, slightly unequal, sometimes persistent; *petals* 5, usually unequal, free, lower petal usually boat-shaped (keel), unguiculate (contracted at the base into a claw), inappendiculate (subequal without keel in *X. ecarinatum*, *X. stipitatum*); *stamens* (7–)8(–10), 4 epipetalous, 2 placed at the base of the keel and adnate with it or not, and two alternipetalous and opposite the lateral sepals, filaments free or partly united basally (up to halfway), sometimes triadelphous, anthers opening introrsely with longitudinal slits; *disc* annular; *ovary* usually short stipitate, composed of 2 median carpels, *1-locular*, style terminal, curved, about as long as stamens, stigma small, slightly 2-lobed or peltate, *ovules* 4 or (6–)18 (rarely more). **Fruits** indehiscent, not winged, (*sub*)globose, 1–15 cm diameter, usually with a firm pericarp. **Seeds** 1 or 4 or more, inappendiculate, glabrous; embryo large, cotyledons flat or thick, albumen copious to nearly absent.

Distribution. About 100 species, in tropical Asia, including S India, Sri Lanka, northwards to S China and Hainan, mainly in Malesia, east to N Australia. In Sabah and Sarawak, 55 species (including 3 incompletely known taxa and 1 shrub species) are recognised; 41 species are endemic in Borneo with 23 species occurring only in Sabah and Sarawak. Borneo is the main centre of *Xanthophyllum* species diversity in W Malesia, but the origin of the genus is believed to be in E Malesia (New Guinea, Australia). None of the Bornean species cross Wallace's Line to E Malesia.

Ecology. All species are confined to primary (or degraded primary) forest vegetation types; the majority in lowland rain forest, where often recorded as found along rivers, below 500 m altitude. Some species grow in hill and montane forest at altitudes between 500–1200(–2000) m, and others occur in (peat)swamp forest or *kerangas* forest.

Uses. The fruit of some species (e.g., *X. ecarinatum*, *X. obscurum*, *X. stipitatum*) with pulp around the seeds has been recorded as edible. The trees generally do not reach timber size, and thus are not of commercial value. *Xanthophyllum brevipes*, with drooping branches, is potentially an ornamental roadside tree. Locally, the wood is frequently used for making knife handles and sheaths.

Notes. *Xanthophyllum* seems the most primitive genus in the family, with subequal sepals and sometimes a rather weak asymmetrical corolla, but Meijden (*op. cit.* 1982) pointed out that this is mainly deceptive. He distinguished 7 subgenera of which 5 are represented in the Flora area. The criteria for this division are derived from a fairly large set of often complicated and not readily seen characters, mainly concerning the following: axillary buds; glands on leaves and inflorescences; mode of leaf venation; hairiness of sepals; shape, size and indumentum of petals; mode of fusion of stamens; details of the ovary, style and stigma; number of ovules (generally 4 versus 8 or more); size of fruit and number of seeds; and especially characters of the seeds, albumen present or absent, and the embryo. This subdivision, with accompanying descriptions, is not directly useful for recognizing the species, and most of the 'difficult' characters are left out in the two keys to the species and the descriptions. Unfortunately, the number of ovules has to be used in some cases.

Key to *Xanthophyllum* subgenera and sections

1. Fruit 1-seeded (exceptionally 2-seeded).....2
Fruit 4- or more-seeded.....5
2. Stamens triadelphous. Embryo flat, covered by copious endosperm. Twigs with nodal glands.....
Subgen. **Triadelphum** Meijden
Species in Sabah and Sarawak included in this subgenus are: 9. *X. contractum* [flowers unknown], 12. *X. ellipticum*, 18. *X. hildebrandii* and 24. *X. montanum*.
Stamens monadelphous or free. Embryo thick, without or with little endosperm. Twigs mostly without nodal glands.....3
3. Stamens monadelphous. Stigma peltate. Twigs with a pair of annular nodal glands.....
Subgen. **Coriaceum** Meijden
In Sabah and Sarawak represented by: 38. *X. ramiflorum*.
Stamens free, *i.e.* filaments free or to 0.5–1.5(–2.5) mm connate. Stigma slightly 2-lobed. Twigs without nodal glands.....4
4. Intercostal venation scalariform. Testa sticking to the inner side of the fruit wall on drying. Albumen absent.....
Subgen. **Xanthophyllum** sect. **Xanthophyllum**
In Sabah and Sarawak represented by: 13. *X. ferrugineum*, 14. *X. flavescens*, 16. *X. havilandii*, 23. *X. macrophyllum*, 41. *X. resupinatum*, 43. *X. rufum*, 44. *X. schizocarpon* and 50. *X. velutinum*.
Intercostal venation reticulate. Testa sticking to the rest of the seed on drying. Albumen present, though sometimes scarce.....
Subgen. **Xanthophyllum** sect. **Eystathes** (Lour.) Meijden
In Sabah and Sarawak represented by: 1. *X. adenotus*, 2. *X. beccarianum*, 3. *X. bicolor*, 4. *X. borneense*, 5. *X. brachystachyum*, 7. *X. ceraceifolium*, 8. *X. clovis*, *X. crassum*, 10. *X. discolor*, 15. *X. griffithii*, 17. *X. heterophyllum*, 19. *X. impressum*, 20. *X. korthalsianum*, 21. *X. lineare*, 22. *X. longum*, 25. *X. neglectum*, 26. *X. nigricans*, 27. *X. nitidum*, 29. *X. ovatifolium*, 30. *X. pachycarpon*, 31. *X. parvifolium*, 32. *X. pauciflorum*, 33. *X. pedicellatum*, 34. *X. penibukanense*, 35. *X. pseudoadenotus*, 36. *X. pulchrum*, 37. *X. purpureum*, 39. *X. rectum*, 40. *X. reflexum*, 42. *X. reticulatum*, 46. *X. subcoriaceum*, 47. *X. tardicrescens*, 48. *X. tenue*, 49. *X. trichocladum*, 51. *X. vitellinum*, 52. *Xanthophyllum* sp. A, 53. *Xanthophyllum* sp. B and 54. *Xanthophyllum* sp. C.
5. Embryo thick, covered with little endosperm.....
Subgen. **Brunophyllum** Meijden
In Sabah and Sarawak represented by: 6. *X. brevipes*, 11. *X. ecarinatum* and 28. *X. obscurum*.
Embryo flat, covered with copious endosperm.....
Subgen. **Exsertum** Meijden
In Sabah and Sarawak represented by: 45. *X. stipitatum*.

Key to *Xanthophyllum* species
(primarily using flower and fruit characters)

Notes: It could not be avoided to use occasionally two character states to be seen only with high magnification. Whether the leaves beneath are papillose or not papillose should be examined with a magnification of at least 25x. The number of ovules in the ovary must be ascertained in living or boiled material after longitudinally sectioning the ovary; the section to be started at the apex.

1. Leaves patently long-hairy below, at least on midrib; hairs 0.5 mm long or more. [Ovules 8–16].....2
 Leaves glabrous below, or minutely appressed or patently short-hairy, hairs *c.* 0.2 mm long or less. [Ovules 4, 8 or more].....9
2. Intercostal venation scalariform, at least (partly) between lower lateral veins. Inflorescences (normally) branched.....3
 Intercostal venation all reticulate. Inflorescences unbranched.....4
3. Leaves papillose below. Ovary and fruit hairy all round or in 4 rows in upper half.....**43. *X. rufum***
 Leaves not or indistinctly papillose below. Ovary and fruit glabrous or hairy in 2 rows in upper half.....**50. *X. velutinum***
4. Sepals and inflorescence axes with hairs *c.* 1 mm long.....**49. *X. trichocladum***
 Sepals and inflorescence axes with hairs 0.1–0.5 mm long.....5
5. Leaves bullate (blistered) between the intercostal veins.....**42. *X. reticulatum***
 Leaves not bullate (flat) between the intercostal veins.....6
6. Pedicels 2–5(–7) mm long. Longest petals 11–12 mm long. Anthers 0.5–1.5 mm long.....7
 Pedicels (5–)7–15 mm long. Longest petals 12–16 mm long. Anthers 1.5–2 mm long.....8
7. Twigs up to 1 mm diameter. Inflorescences *c.* 1 cm long or less. Anthers *c.* 0.5 mm long.....**5. *X. brachystachyum***
 Twigs 2–3 mm diameter. Inflorescences longer than 2 cm. Anthers 1–1.5 mm long.....**37. *X. purpureum***
8. Petioles 3–6 mm long. Pedicels 7–10 mm long. Petals 15–16 mm long. Anthers *c.* 2 mm long.....**2. *X. beccarianum***
 Petioles 1.5–3 mm long. Pedicels 9–15 mm long. Petals *c.* 12 mm long. Anthers *c.* 1.5 mm long.....**33. *X. pedicellatum***
9. Leaves papillose or indistinctly papillose and often more or less dull glaucous or whitish below.....10
 Leaves not papillose and usually not glaucous below.....24
10. Intercostal venation scalariform. Ovary glabrous or hairy on median ribs.....
**44. *X. schizocarpon***

- Intercostal venation reticulate. Ovary glabrous or hairy, not especially on median ribs.....11
11. Ovary (fruit) glabrous.....12
 Ovary (fruit) hairy (glabrescent), at least towards apex and base.....14
12. Ovules 4. Anthers up to 0.4 mm long.....**4. X. borneense** (in part)
 Ovules 8–18. Anthers at least 0.7 mm long.....13
13. Petioles (5–)8–12 mm long. Longest petals *c.* 8 mm long. Fruit 1(or 2)-seeded, *c.* 1 cm diameter. Flowering on the older wood. Exclusively in peatswamp forest.....
**38. X. ramiflorum**
 Petioles 1.5–3 mm long. Longest petals 15–16 mm long. Fruit 10- or more-seeded, *c.* 4 cm diameter. Flowering among the leaves.....**6. X. brevipes**
14. Ovules 8–16 (occasionally 4 in *X. discolor*).....15
 Ovules 4.....19
15. Petioles 20–30 mm long.....**3. X. bicolor**
 Petioles (3–)6–15 mm long.....16
16. Petioles transversely wrinkled, at apex passing into the narrowly attenuate leaf base. Lower pair of lateral veins usually reaching beyond the middle of the blade.....
**34. X. penibukanense**
 Petioles transversely or longitudinally wrinkled, not passing into a narrowly attenuate leaf base (base cordate, rounded or attenuate). Lower pair of lateral veins not usually reaching the middle of the blade.....17
17. Leaves *c.* 10 cm long or less. Twigs slender, at apex 1–2 mm diameter. Ovules 4 or 8.....**10. X. discolor**
 Leaves generally more than 10 cm long. Twigs stouter, at apex 2–4 mm diameter. Ovules 8–15.....18
18. Petioles 4–8 mm long. Leaf base (sub)cordate.....**36. X. pulchrum**
 Petioles 10–15 mm long. Leaf base attenuate.....**35. X. pseudoadenotus**
19. Axillary buds mostly more than (1.5–)4 mm long.....20
 Axillary buds at most 1.5 mm long.....22
20. Axillary buds situated (1.5–)3–15 mm above the leaf axil and placed on a 0.5–1.5 mm long stalk.....**20. X. korthalsianum**
 Axillary buds situated in the leaf axil, sessile.....21
21. Scales of axillary bud at apex with 2 distinct thickenings, rendering the bud clove-shaped.....**8. X. clovis**
 Scales of axillary bud not thickened at apex.....**15. X. griffithii** (in part)
22. Leaves 2–5(–6) cm long. Flowers solitary or in up to 3-flowered inflorescences. Pedicels 7–11 mm long.....**31. X. parvifolium**
 Leaves, at least on the average, more than 5 cm long. Inflorescences either with more than 6 flowers, or when less, then flowers on 2–4 mm long pedicels.....23

23. Inflorescences shorter than 5 cm, unbranched.....**32. X. pauciflorum**
 Inflorescences longer, to 20 cm long, branched (sometimes seemingly unbranched if
 lower bracts resemble leaves).....**19. X. impressum**
24. Ovary (fruit) hairy all round, not glabrous laterally.....25
 Ovary (fruit) glabrous, at least laterally, or hairy only on ribs.....43
25. Axillary buds (2–)3 mm long or longer.....26
 Axillary buds up to 2 mm long.....33
26. Axillary buds 10–20(–30) × 6–12(–14) mm, flat and leaf-like, at base attenuate and not
 thickened, at apex rounded to obtuse.....**17. X. heterophyllum**
 Axillary buds 2–11 mm long, not leaf-like.....27
27. Axillary buds erect, flattened against the twig, very densely short-hairy.....
**40. X. reflexum**
 Axillary buds half-patent to patent, glabrous or sparsely short-hairy.....28
28. Inflorescences unbranched or hardly branched.....29
 Inflorescences branched.....30
29. Petioles slender, 4–7 mm long. Leaves membranous or chartaceous, with 3–5 pairs of
 lateral veins.....**25. X. neglectum** (in part)
 Petioles thick, 8–10 mm long. Leaves thickly coriaceous, with 4–7 pairs of lateral
 veins.....

X. crassum W.J.de Wilde & Duyfjes

(Latin, *crassus* = thick; referring to the thick leaves)

(subgen. **Xanthophyllum**, sect. **Eystathes**)

Gard. Bull. Sing. 57 (2005) 50. Type: *Sugau SAN 134307*, Borneo, Sabah, Kinabatangan district, Bt. Tawai (holotype SAN).

Shrub or treelet *c.* 2 m tall, *c.* 3 cm diameter. Bark blackish brown. Twigs *without nodal glands*, black, glabrous, 4–5 mm thick. Axillary buds *solitary*, long-conical, (2–)4–5 mm long, *patent, glabrous*. Leaves *glabrous, thickly coriaceous, flat*, dark brown above, *not papillose below*; blade (shortly) ovate-elliptical, 6–10(–12) × 4–6(–7) cm, base broadly rounded, apex rounded with short, broad, blunt tip; midrib slightly raised above; *lateral veins 4–7 pairs, not forming an intramarginal vein; intercostal venation reticulate*, flat and indistinct below; *glands few, scattered, less than 0.5 mm diameter; petioles 8–10 mm long*, stout, black on drying, glabrous, without glands, *smooth*. Inflorescences *stout, erect*, (almost) *unbranched*, finely yellow-brown appressed hairy; axes 5–7 cm long, 3–4 mm thick, 10–15-flowered. Flowers solitary or 2–3 together; pedicels short, stout, *4–5 mm long*; sepals 5–6 mm long, densely appressed yellow-brown hairy; petals 14–15 mm long, purple-black on drying, partly grey-yellow appressed hairy; stamens and pistil not seen; *ovary* subglobose, *c.* 2.5 mm diameter, *densely yellow-brown subpatently hairy all around*, hairs *c.* 0.5 mm long, *ovules 4*. Fruits unknown.

Endemic in Borneo and confined to Bt. Tawai in Sabah, where it is known only by the type specimen.

Stunted montane forest over ultrabasic rock, at *c.* 1250 m altitude.

30. Petioles (20–)25–30 mm long. Leaves 22–42 cm long; intercostal venation indistinct below..... **7. X. ceraceifolium**
 Petioles 4–20 mm long. Leaves shorter than 20 cm, when larger, then intercostal venation distinct and prominent below..... 31
31. Leaves *c.* 4 times as long as wide. Petioles 8–20 mm long. Lateral veins 10–20 pairs. Anthers 0.6–1.2 mm long..... **1. X. adenotus**
 Leaves to 3 times as long as wide. Petioles 4–16 mm long. Lateral veins (4–)6–9 pairs. Anthers 0.4–0.7 mm long..... 32
32. Twigs slender, 1(–2) mm diameter. Leaves (usually) pale below.....
 **15. X. griffithii** (in part)
 Twigs stouter, 2–3 mm diameter. Leaves dull brownish, not pale below.....
 **51. X. vitellinum** (in part)
33. Midrib sunken above. Ovules 8–12. Fruits large, 4–6 cm diameter.....
 **45. X. stipitatum** (in part)
 Midrib flat or prominent above. Ovules 4. Fruits much smaller (less than 2 cm diameter)..... 34
34. Inflorescences (infructescences) branched..... 35
 Inflorescences (infructescences) unbranched or sometimes with a side-branch at the base..... 38
35. Leaves 4–6 times as long as wide; lateral veins 9–14 pairs..... **21. X. lineare**
 Leaves to *c.* 3 times as long as wide; lateral veins 4–10 pairs..... 36
36. Petioles 30–40 mm long..... **22. X. longum**
 Petioles 8–14(–16) mm long..... 37
37. Intercostal venation coarsely reticulate; areoles subequal or unequal in size, 1–5 mm diameter..... **51. X. vitellinum** (in part; including **58. Xanthophyllum sp. B**)
 Intercostal venation sharply very finely reticulate; areoles of equal size, *c.* 0.5 mm diameter..... **27. X. nitidum**
38. Ovary and fruit appressed hairy. Petioles 3.5–5 mm long..... **47. X. tardicrescens**
 Ovary and fruit patently or half-patently hairy. Petioles more than 5 mm long..... 39
39. Inflorescences stout, straight, erect, many-flowered..... **39. X. rectum**
 Inflorescences slender, small, subpatent, mostly less than 10-flowered..... 40
40. Leaves coriaceous, apex (sub)obtuse..... **52. Xanthophyllum sp. A**
 Leaves membranous or subcoriaceous, apex acute-acuminate..... 41
41. Axis of inflorescence less than 1 mm diameter. Fruits *c.* 1 cm diameter.....
 **25. X. neglectum** (in part)
 Axis of inflorescence 1–2 mm diameter. Fruits 1.5–2 cm diameter..... 42
42. Fruits black, not wrinkled on drying..... **54. Xanthophyllum sp. C**
 Fruits light brown, wrinkled on drying..... **4. X. borneense** (in part)

43. Intercostal venation at least on parts of the leaf scalariform.....	44
Intercostal venation reticulate.....	49
44. Flowering on the older wood.....	9. X. contractum
Flowering at apex of twigs.....	45
45. Ovary and fruit hairy on 4 ribs in apical half, hairs brown.....	23. X. macrophyllum
Ovary and fruit glabrous or hairy on 2 (or 4) ribs, hairs greyish.....	46
46. Midrib flat below, prominent above; leaf base attenuating into a narrow petiole-like part.....	41. X. resupinatum
Midrib prominent below, prominent to sunken above; leaf base not so.....	47
47. Inflorescences branched or unbranched, axes or branches more or less thickened, with spaced and conspicuously raised scars of pedicels, or axes (branches) very densely set with flowers or scars of pedicels.....	16. X. havilandii
Inflorescence axes branched, branches not thickened, except in upper part not densely set with flowers or scars of pedicels, scars not or but little raised.....	48
48. Pedicels 1–1.5(–6) mm long. Sepals often persistent in fruit, medium brown with light coloured margin when dry; outer sepals sparsely minutely hairy.....	13. X. ferrugineum (in part)
Pedicels (2–)3–10 mm long. Sepals not persistent in fruit, without a lighter coloured margin when dry; outer sepals more densely hairy.....	14. X. flavescens (in part)
49. Ovules 4.....	50
Ovules 8 or more.....	54
50. Petioles finely transversely wrinkled, 3–4(–6) mm long. Lateral veins 3–4 pairs. Inflorescences and pedicels (sub)glabrous, with <i>c.</i> 5 flowers.....	29. X. ovatifolium
Petioles transversely wrinkled or not, (5–)6–11 mm long. Lateral veins 4–6 pairs. Inflorescences and pedicels hairy, mostly with 6 or more flowers.....	51
51. Leaves (dark) brown on drying. Axillary buds densely short-hairy.....	26. X. nigricans
Leaves green or light brown on drying. Axillary buds glabrous or sparsely short-hairy.....	52
52. Fruits 2–3 cm diameter, with <i>c.</i> 7 mm thick spongy or solid pericarp.....	30. X. pachycarpon
Fruits 1–1.5(–1.8) cm diameter, with thin pericarp.....	53
53. Style early caducous. Fruits dull, more or less wrinkled.....	48. X. tenue
Style initially persistent on fruit. Fruits smooth, more or less shiny.....	46. X. subcoriaceum
54. Leaves greenish yellow on drying.....	55
Leaves green(–brown) or dark brown on drying.....	56
55. Pedicels 1–1.5(–6) mm long. Sepals often persistent in fruit, on drying medium brown with light coloured margin; outer sepals minutely hairy.....	13. X. ferrugineum (in part)

- Pedicels (2–)3–10 mm long. Sepals not persistent in fruit, without a lighter coloured margin; outer sepals more or less hairy.....**14. X. flavescens** (in part)
56. Leaf glands rather numerous and distinct, 0.5–1 mm diameter, nearly all situated in the axils of lateral veins and midrib.....**18. X. hildebrandii**
 Leaf glands scattered or situated at the margins, not in the axils of lateral veins and midrib.....57
57. Fruits smaller, ovoid or globose, 1–2.2 cm across.....58
 Fruits larger, globose or subellipsoid, 4–14 cm across.....59
58. Leaf glands sometimes located near the margins of the blade but never on the margin itself. Anthers glabrous. Flowers bright brown when dry. Fruits yellowish to greenish brown when dry.....**24. X. montanum**
 Leaf glands located in upper half of the blade, with at least 6 glands on the margins. Anthers short-hairy along slits and at base. Flowers (sepals) often black when dry. Fruits black when dry.....**12. X. ellipticum**
59. Petals unequal, the lower middle one (keel) boat-shaped, distinct from the upper ones.....**28. X. obscurum**
 Petals nearly subequal in size and form.....60
60. Pedicels 1.5–5(–6) mm long. Stamens shorter than petals. Fruits subellipsoid; pericarp coarsely wrinkled when dry.....**11. X. ecarinatum**
 Pedicels at least 8 mm long. Stamens longer than petals. Fruits globose; pericarp smooth, not wrinkled when dry.....**45. X. stipitatum** (in part)

Key to *Xanthophyllum* species

(based on vegetative characters; excluding 52. *Xanthophyllum* sp. A, 53. *Xanthophyllum* sp. B and 54. *Xanthophyllum* sp. C)

Notes. To ascertain whether the leaf lower surface is papillose or not papillose, examination under 25x (at least) is needed.

1. Leaf intercostal venation scalariform or subscalariform.....2
 Leaf intercostal venation reticulate.....13
2. Leaves densely patently long-hairy below (at least on the midrib), the hairs 0.3–2 mm long.....3
 Leaves glabrous or appressedly or subpatently short-hairy below, the hairs to 0.2(–0.3) mm long.....4
3. Indumentum reddish brown. Leaves elliptical-oblong, papillose below; lateral veins 5–9 pairs; glands minute *c.* 0.1 mm diameter; upper part of petioles often with large glands.....**43. X. rufum**
 Indumentum grey or brown. Leaves narrowly elliptical to elliptical, smooth or indistinctly papillose below; lateral veins 8–11(–12) pairs; glands 0.2–0.6 mm diameter; petioles without glands.....**50. X. velutinum**
4. Leaves papillose below.....**44. X. schizocarpon**

Leaves not papillose below	5
5. Leaf intramarginal vein absent	9. X. contractum
Leaf intramarginal vein distinct or indistinct	6
6. Leaves bullate (blistered) between lateral and/or intercostals veins	7
Leaves not bullate (flat) between lateral and/or intercostals veins	9
7. Leaf intramarginal vein indistinct; glands located near the midrib	
.....	48. X. tenue (in part)
Leaf intramarginal vein distinct; glands scattered on the leaf blade	8
8. Leaves elliptical-oblong, base rounded or short-cuneate, apex acuminate-cuspidate; glands few to numerous; petioles 7–12 mm long, smooth, appressed short-hairy, without glands	16. X. havilandii
Leaves narrowly elliptical, base attenuate, apex acute-acuminate; glands few; petioles 10–18 mm long, longitudinally wrinkled, glabrous, often with 2–4 glands	
.....	23. X. macrophyllum
9. Axillary buds in clusters of 2–3	10
Axillary buds solitary, absent or inconspicuous	11
10. Leaves elliptical, oblong or rarely lanceolate, intramarginal vein distinct, base attenuate-rounded, apex acute(-acuminate); glands absent or if present few and scattered	14. X. flavescens (in part)
Leaves narrowly elliptical, intramarginal vein indistinct, base cuneate, apex long-acuminate; glands absent or it present few to numerous and located mostly near the midrib	
.....	48. X. tenue (in part)
11. Petioles smooth, with two glands. Leaf intramarginal vein distinct; laminar glands absent or few and scattered	14. X. flavescens (in part)
Petioles (finely) transversely wrinkled or smooth, without glands. Leaf intramarginal vein indistinct; laminar glands few, mainly located near leaf margin or confined to the upper half of leaf blade	12
12. Petioles 9–14 mm long; leaf base cuneate	13. X. ferrugineum (in part)
Petioles 4.5–7 mm long; leaf base attenuating into a narrow petiole-like part	
.....	41. X. resupinatum
13. Leaves bullate (at least sometimes) above	14
Leaves flat above	18
14. Axillary buds in clusters of 2–3(–4). Leaf apex acuminate-cuspidate	15
Axillary buds solitary. Leaf apex acutish	16
15. Leaves elliptical, margins sometime curved; intramarginal vein distinct; glands located at some distance from the midrib, basal glands absent	46. X. subcoriaceum
Leaves narrowly elliptical, margin always flat; intramarginal vein indistinct; glands located near the midrib, basal glands often present	48. X. tenue (in part)

16. Leaves oblong-lanceolate, 20–50 × 5–10(–15) cm, base cordate with the margins curved upwards and connate above the apex of petiole or flat and rounded or (broadly) cuneate; intramarginal vein distinct; glands located near the midrib; petioles 10–20 mm long, usually with 2 small prominent glands..... **1. X. adenotus**
 Leaves narrowly ovate-elliptical, 7–19(–30) × 2–6(–11) cm, base cuneate, obtuse or rounded-cordate, always flat; intramarginal vein distinct or indistinct; glands scattered; petioles 4–8 mm long, without glands..... 17
17. Leaves papillose below; intramarginal vein indistinct; petioles 4–8 mm long, appressed short-hairy, longitudinally or transversely wrinkled..... **36. X. pulchrum**
 Leaves not papillose or only indistinctly papillose below; intramarginal vein distinct; petioles to 5 mm long, patently long-hairy, smooth..... **42. X. reticulatum**
18. Petioles smooth (glabrous or hairy)..... 19
 Petioles longitudinally or transversely wrinkled..... 29
19. Leaves not papillose below; twigs, petioles, lower leaf surface glabrous or patently short-hairy..... 20
 Leaves papillose below; twigs, petioles, lower leaf surface densely patently long-hairy..... 25
20. Twigs with distinct nodal glands. Axillary buds solitary. Petioles to 6 mm long.....
 **18. X. hildebrandii**
 Twigs without nodal glands. Axillary buds in clusters of 2–3 or solitary. Petioles (5–)6–30(–40) mm long..... 21
21. Petioles (20–)30–40 mm long..... **22. X. longum**
 Petioles 5–15 mm long..... 22
22. Leaves ovate-elliptical, thick coriaceous, apex rounded with short, broad blunt tip; intramarginal vein absent..... **X. crassum** (see above)
 Leaves elliptical, oblong, lanceolate, or narrowly elliptical, not thick coriaceous, apex acute-acuminate or long-acuminate; intramarginal vein distinct or indistinct..... 23
23. Leaves drying yellowish, elliptical, oblong, rarely lanceolate, base attenuate-rounded..... **14. X. flavescens** (in part)
 Leaves drying brownish, (narrowly) elliptical, base cuneate..... 24
24. Petioles 6–11 mm long, glands absent or inconspicuous (small). Lateral veins 4–6 pairs..... **48. X. tenue** (in part)
 Petioles 8–14(–16) mm long, often with a pair of glands at the apical half. Lateral veins (6–)7–9(–11) pairs..... **51. X. vitellinum** (in part)
25. Leaves narrow, oblong-linear, apex long-acute; petioles to 2 mm long.....
 **5. X. brachystachyum**
 Leaves narrowly elliptic or elliptical, apex acutish; petioles (1.5–)3–7 mm long..... 26
26. Leaves smaller, 5–11 × 1.5–4 cm; petioles to 3 mm long..... **33. X. pedicellatum**
 Leaves larger, 8–31 × 2–9 cm; petioles 3–7 mm long..... 27

27. Axillary buds ovate-oblong, not thickened at base. Leaf base cordate, sometimes covering the upper side of petiole; intramarginal vein distinct; lateral veins 9–12 pairs..... **49. X. trichocladum**
 Axillary buds triangular, basally thickened. Leaf base otherwise, if cordate never covering the upper side of petiole; intramarginal vein absent, indistinct or distinct; lateral veins 5–8 pairs.....28
28. Leaves narrowly elliptical, base cordate; midrib slightly raised above; intramarginal vein indistinct. Flowers (petals) orange red; pedicels 7–15 mm long.....
 **2. X. beccarianum**
 Leaves elliptical or narrowly elliptical, base cordate, rounded-attenuate or cuneate; midrib slightly sunken or flat above; intramarginal vein, if present, distinct at least in the apical half of leaf blade. Flowers (petals) purple; pedicels 2–7 mm long.....
 **purpureum**
29. Leaves papillose below.....30
 Leaves not papillose below.....42
30. Leaf base long-attenuate, merging and forming part of petiole.....31
 Leaf base not so.....32
31. Petioles 20–30 mm long. Leaves oblong, 14–35 × 4.5–10 cm, apex rounded or bluntly acute; lateral veins 8–12 pairs; glands inconspicuous..... **3. X. bicolor**
 Petioles 8–15 mm long. Leaves ovate-elliptical, 7–18 × 2.5–7 cm, apex acute-acuminate; lateral veins 4–6 pairs; glands numerous, scattered on the leaf blade.....
 **34. X. penibukanense**
32. Leaves smaller, 1.5–9 × 0.5–3.5 cm; petioles 1.5–4.5 mm long.....33
 Leaves larger, (4–)7–20(–30) × 3–10 cm; petioles 5–30 mm long.....35
33. Twigs pendent; axillary buds absent or minute (less than 0.5 mm long). Leaves narrowly elliptical; lateral veins *c.* 10 pairs..... **6. X. brevipes**
 Twigs not pendent; axillary buds 0.5–1.5 mm long. Leaves elliptical-oblong, oblong or lanceolate; lateral veins 1–6 pairs.....34
34. Leaves elliptical-oblong, 1.5–5(–6) × 0.5–2 cm, base rounded or cuneate, apex long-acuminate with rounded tip; lateral veins 1–3 pairs, intramarginal vein indistinct; petioles 2–2.5 mm long..... **31. X. parvifolium**
 Leaves oblong or lanceolate, 5–8(–9) × 1.2–2.5(–3.5) cm, base acute, apex acuminate-cuspidate; lateral vein 4–6 pairs, intramarginal vein absent; petioles 3.5–4.5 mm long..... **32. X. pauciflorum**
35. Twigs with a pair of annular nodal glands..... **38. X. ramiflorum**
 Twigs without nodal glands.....36
36. Axillary buds clove-shaped. Petioles 9–20(–30) mm long..... **8. X. clovis**
 Axillary buds not clove-shaped. Petioles 4–15 mm long.....37
37. Twigs reticulately wrinkled. Axillary buds in clusters of 2 or 3.....
 **4. X. borneense** (in part)
 Twigs smooth. Axillary buds solitary.....38

38. Leaves 18–35 × 5.5–10 cm, base attenuate; lateral veins 12–14 pairs.....
**35. X. pseudoadenotus**
 Leaves 4–20 × 1–5(–9) cm, base cuneate or rounded; lateral veins 4–9 pairs.....39
39. Axillary buds arising at (1.5–)3–15 mm above the leaf axils, 1–2 mm stalked; scales leaf-like, 6–18 × 1.5–8 mm.....**20. X. korthalsianum**
 Axillary buds appearing at the leaf axils, sessile; scales not leaf-like.....40
40. Leaves narrowly ovate; petioles without glands.....**10. X. discolor**
 Leaves ovate-oblong, elliptical-oblong or narrowly elliptical; petioles sometimes with 1 or 2 glands at the apical part.....41
41. Leaves ovate-oblong or elliptical-oblong, 4–10 × 1–5 cm; lateral veins 4–6 pairs. Axillary buds not hidden between petiole base and low ridge of twig.....
**15. X. griffithii** (in part)
 Leaves narrowly elliptical, 10–20 × 3.5–9 cm; lateral veins 8–9 pairs. Axillary buds mostly hidden between petiole base and low ridge of twig.....**19. X. impressum**
42. Leaves larger, 22–50 × 7–18 cm; petioles at least 18 mm long.....**7. X. ceraceifolium**
 Leaves smaller, (2.5–)5–20(–38) × (1–)2–7(–11) cm; petioles much shorter than 18 mm long.....43
43. Axillary buds longer than 5 mm.....44
 Axillary buds to 4 mm long.....47
44. Axillary buds (8–)10–20(–35) mm long, flat; scales leaf-like, wrinkled, sometime with 1–4 glands.....**17. X. heterophyllum**
 Axillary buds 5–7(–11) mm long, not flat; scales not leaf-like, smooth, without glands.....45
45. Twigs stout 2–3 mm diameter. Axillary buds not patent (erect). Petioles 8–14(–16) mm long. Leaf lateral veins (6–)7–9(–11) pairs.....**51. X. vitellinum** (in part)
 Twigs slender. Axillary buds half-patent. Petioles 4–7(–12) mm long. Leaf lateral veins 3–6 pairs.....46
46. Petioles without glands, 4–7 mm long. Leaves narrowly elliptical, margin undulate; intramarginal vein distinct.....**25. X. neglectum** (in part)
 Petioles sometimes with 1 or 2 glands at the apical part, 5–12 mm long. Leaves ovate-oblong or elliptical-oblong, margin plane; intramarginal vein indistinct.....
**15. X. griffithii** (in part)
47. Axillary buds in clusters of 2, 3 or 4.....48
 Axillary buds solitary (or 2).....52
48. Twigs reticulately or finely longitudinally wrinkled.....49
 Twigs smooth.....50
49. Twigs reticulately wrinkled. Axillary buds glabrescent. Leaves elliptical-oblong larger, 8–16 × 3.5–7 cm, base attenuate; glands scattered.....**4. X. borneense** (in part)

- Twigs finely longitudinally wrinkled. Axillary buds densely patently short-hairy. Leaves elliptical to narrowly elliptical, smaller, 3.5–12 × 1.2–5.5 cm, base cuneate; glands inconspicuous, mostly located near midrib..... **26. X. nigricans**
50. Lateral veins 5–7 pairs..... **45. X. stipitatum**
 Lateral veins 3–5 pairs.....51
51. Leaves ovate-elliptical, smaller, 3.5–9.5 × 1.4–6 cm; intramarginal vein absent. Axillary buds 1–1.8 mm long..... **29. X. ovatifolium**
 Leaves narrowly elliptical, larger, 7–16 × 2–5(–7) cm; intramarginal vein distinct. Axillary buds less than 1 mm long..... **47. X. tardicrescens**
52. Petioles (1.5–)3–7 mm long.....53
 Petioles (5–)7–12(–18) mm long.....56
53. Lateral veins 3–5 pairs. Axillary buds half-patent, 1.5–4 mm long.....
 **25. X. neglectum** (in part)
 Lateral veins 5–9 pairs. Axillary buds not half-patent, minute and inconspicuous, to 1 mm long.....54
54. Leaves ovate-oblong, base rounded or attenuate; intramarginal vein indistinct; nodal glands absent..... **11. X. ecarinatum**
 Leaves ovate-elliptical or oblong, base cuneate; intramarginal vein distinct; nodal glands present.....55
55. Leaves ovate-elliptical, larger, 5–20 × 2–7 cm, margin sometimes crenulated with at least 6 glands..... **12. X. ellipticum**
 Leaves oblong, smaller, (4–)6–9 × 1–2.5(–3.5) cm, margin plane without glands..... **24. X. montanum**
56. Twigs with distinct nodal glands..... **28. X. obscurum**
 Twigs without nodal glands.....57
57. Twigs lengthwise finely grooved, patently short-hairy. Axillary buds appressed against twig. Petioles patently short-hairy. Laminar glands few, located near leaf base.....
 **40. X. reflexum**
 Twigs smooth, usually glabrous. Axillary buds not so. Petioles glabrous. Laminar glands absent, inconspicuous or if present not or rarely located near leaf base.....58
58. Lateral veins (6–)7–14 pairs.....59
 Lateral veins 4–7 pairs.....60
59. Leaves linear or linear-lanceolate, parallel-sided; petioles coarsely wrinkled, without glands..... **21. X. lineare**
 Leaves (narrowly) elliptical, not parallel-sided; petioles finely wrinkled, often with a pair of glands at the apical part..... **51. X. vitellinum** (in part)
60. Laminar glands, few to numerous, scattered or located near midrib or leaf margin.....61
 Laminar glands absent or inconspicuous.....62

61. Axillary buds inconspicuous. Leaves larger, 8–20 × 3–7 cm; glands few, located near leaf margin; petioles without glands..... **13. X. ferrugineum** (in part)
 Axillary buds distinct, half-patent. Leaves smaller, 4–10 × 1–5 cm; glands few to numerous, scattered or located near midrib; petioles sometimes with 1 or 2 glands at the apical part..... **14. X. griffithii** (in part)
62. Twigs stout, *c.* 5 mm diameter, black. Axillary buds minute, less than 0.5 mm long. Leaf intramarginal vein absent..... **39. X. rectum**
 Twigs slender, not black. Axillary buds 1–1.5 mm long. Leaf intramarginal vein distinct or indistinct.....63
63. Axillary buds short-hairy. Leaves oblong-lanceolate; intramarginal vein indistinct.....
 **27. X. nitidum**
 Axillary buds glabrous. Leaves oblong; intramarginal vein distinct.....
 **30. X. pachycarpon**

1. *Xanthophyllum adenotus* Miq.

Fig. 1.

(Greek, *adenos* = gland; referring to glands on the leaves)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Fl. Ind. Bat., Suppl. (1861) 393; Meijden *op. cit.* (1982) 100, *op. cit.* (1988) 515; Coode *et al.* (eds.) *op. cit.* 255; Beaman & Anderson *op. cit.* 263. **Lectotype** (Meijden, 1982): *Teijsmann HB 509*, Sumatra, Padang, Pulau Pisang (BO; isolectotype U [*Acc. No. 40600*]). **Synonyms:** *X. cordatum* Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 274; *X. cordatum* Miq. f. *aequale* Chodat *op. cit.* (1929) 133; *X. arsatii* C.E.F.Fisch., Bull. Misc. Inform. Kew (1932) 176.

Shrub or tree, to 15 m tall and 25 cm diameter. **Bark** smooth. **Sapwood** white, yellow or pale orange. **Twigs** green, *smooth, without nodal glands*, glabrous or patently short-hairy. **Axillary buds** *solitary, half-patent to patent*, ovate-oblong to lanceolate, (2–)3–6(–10) mm long, *glabrous or sparsely short-hairy*, hairs to 0.2 mm long. **Leaves** chartaceous, *somewhat bullate between lateral veins*, greyish green or brown above, brownish, *glabrous or patently short-hairy and not papillose below; blades oblong-lanceolate, 20–50 × 5–10(–15) cm, base cordate with the margins curved upwards and connate above the apex of the petiole, or flat and rounded, or (broadly) cuneate, apex acutish*; midrib slightly raised above; *lateral veins 10–20 pairs, forming an intramarginal vein; intercostal venation reticulate, distinct and prominent below; glands 2–6(–20), usually located near the midrib* (if few, only present in basal part), 0.3–0.4 mm diameter; *petioles 10–20 mm long, glabrous or short-hairy, usually with 2 small, prominent glands, wrinkled*. **Inflorescences** sometimes on the older nodes, stout, *branched*; axes angular, sparsely or densely short-hairy; flowers solitary (or in a cluster of 2); lower bracts opposite. **Flowers:** pedicels 1–3.5 mm long, densely short-hairy; sepals often with minute glands, outer sepals 2–4 mm long, inner sepals 3–5.5 mm long; petals pinkish to pale violet, the upper petals with a yellow spot, drying dark red, the longest one 9–14 mm long, keel unguiculate (clawed), hairy outside, other petals hairy above base and near apex; *filaments free or 1(–2) mm connate*, widened above base and with a hairy knob-like thickening at inner side, for the rest glabrous, *anthers 0.6–1.2 mm long, ciliate along slits; ovary (half-)patently hairy all around, style glabrous near apex, stigma slightly 2-lobed, ovules 4*. **Fruits** globose, 1.5–1.8 cm diameter, dull, pale or reddish brown, *hairy*; pericarp thin, brittle; fruiting pedicels 2–5 mm long. **Seed** 1.

Vernacular names. Sabah—*burangkuk* (Dusun Kinabatangan), *kurapit* (Murut), *sintotobou* (Tenggara). Sarawak—*manok indu* (Engkari Iban).

Distribution. Sumatra and Borneo.

Notes. The stout petioles of large-leaved specimens are somewhat swollen, transversely wrinkled and (green-)brown in the fresh state, reminiscent of *Xanthophyllum ceraceifolium*, in which the petiole is still stouter and black. Two varieties are recognised in Borneo.

Key to varieties

Leaf base cordate or narrowly cordate, margins usually curved upwards.....

var. **adenotus**

Synonyms: *X. cordatum* Miq. *op. cit.* (1864) 274; Merrill, EB (1921) 325, Ridley, Bull. Misc. Inform. Kew (1925) 77; Chodat *op. cit.* (1929) 133; Masamune *op. cit.* 379; Anderson *op. cit.* (1980) 287; Beaman & Anderson *op. cit.* (2004) 263; *X. cordatum* Miq. f. *aequale* Chodat *op. cit.* (1929) 133, for the type only.

Sumatra and Borneo (Sabah, Sarawak, Brunei). In Sabah, common and widespread (e.g., *SAN 54118*, *SAN 73453*, *SAN 74178*, *SAN 95386*, *SAN 96533*, *SAN 126404* and *SAN 132039*) and in Sarawak recorded from Belaga, Bintulu, Kapit, Kuching, Lundu, Marudi, Miri, Song and Tatau districts (e.g., *Hansen 679*, *Jacobs 5450*, *S 22908*, *S 35070* and *S 64926*). Also known from Brunei (e.g., *BRUN 16253*, *BRUN 16592*, *BRUN 91176* and *Kirkup 357*). Lowland and hill mixed dipterocarp forest, frequently along river banks, on sandy soil or limestone-derived alluvial soil, from sea level to 700 m altitude.

Leaf base (rounded or) cuneate, margin flat.....

var. **arsatii** (C.E.C.Fisch.) W.J.de Wilde & Duyfjes

(After Arsat, a forest guard in Sabah)

Gard. Bull. Sing. 57 (2005) 47. Basionym: *X. arsatii* C.E.C.Fisch. *op. cit.* 176; Masamune *op. cit.* 379. **Type:** *Arsat BNBFD 1213*, Borneo, Sabah (holotype K).

Endemic in Borneo (Sabah, Sarawak, Brunei, Kalimantan). In Sabah, recorded from Kinabatangan, Labuk Sugut, Sandakan, Sipitang and Tawau districts (e.g., *SAN 37456*, *SAN 79073*, *SAN 91117*, *SAN 95970* and *SAN 130719*) and in Sarawak, from Kapit, Kuching, Lawas, Limbang, Lubok Antu, Lundu, Marudi and Miri districts (e.g., *Brooke 10035*, *S 29155*, *S 33564*, *S 34490* and *S 59969*). Also occurring in Brunei (e.g., *BRUN 15060*, *Hotta 13182*, *Niga NN 94*, *Ogata 142* and *Sands 5673*) and Kalimantan (e.g., *Church et al. 159*, *Endert 5078*, *Jarvie 5668*, *Mogea et al. 4036* and *Wiradinata 3566*). Mixed dipterocarp forest, along streams, on flat land or on ridges, on sandy soil, sandstone, shale or silty clay, at altitudes to 400 m.

2. *Xanthophyllum beccarianum* Chodat

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Mém. Soc. Phys. Hist. Nat. Genève, Suppl. (1891) t. 9, f. 3 ('*beccarinum*'), Bull. Herb. Boiss. 4 (1896) 257; Merrill *op. cit.* (1921) 325; Masamune *op. cit.* 325; Anderson *op. cit.* (1980) 286; Meijden *op. cit.* (1982) 112, *op. cit.* (1988) 522; Coode *et al.* (eds.) *op. cit.* 255. **Lectotype** (Meijden, 1982): *Beccari 2230*, Borneo, Sarawak (G; isolecotypes K, M, SAR, W).

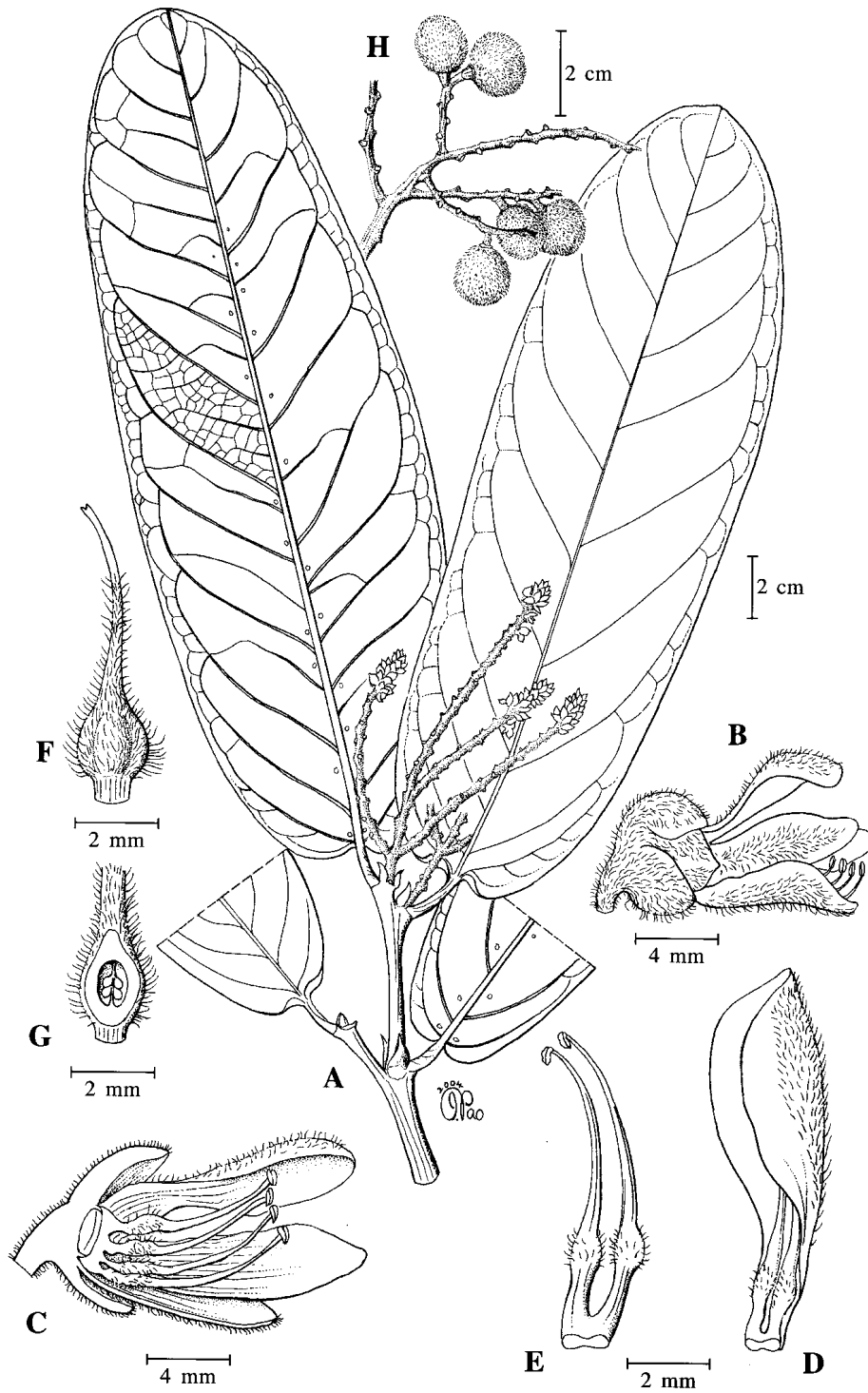


Fig. 1. *Xanthophyllum adenotus*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoecium removed; D, lower petal with 2 stamens; E, stamens; F, gynoecium; G, longitudinal section of ovary; H, part of infructescence. (A–G from SAN 107296, H from SAN 81178.)

Tree, to 12 m tall, to 17 cm diameter. **Bark** grey (green), smooth. **Twigs**, without nodal glands, 2–3 mm diameter, densely patently hairy (hairs up to 1 mm long). **Axillary buds** solitary, long-hairy, triangular, 0.5–5 mm long, basally strongly thickened. **Leaves** discolorous, flat above, sparsely patently long-hairy and papillose below; blades narrowly elliptical, 9–19 × 4–8 cm, base cordate, apex acutish; midrib densely hairy below, slightly raised above; lateral veins 6–8 pairs, forming an indistinct intramarginal vein in apical part; intercostal venation reticulate; glands numerous, scattered, c. 0.1 mm diameter; petioles 3–6 mm long, smooth, densely long-hairy, without glands. **Inflorescences** unbranched, shorter than the leaves, densely minutely hairy (hairs to 0.4 mm long), flowers sometimes turned upside-down, basal part of axis bearing clustered flowers (to 3 together). **Flowers:** pedicels 7–10(–15) mm long; sepals glabrous or short-hairy; outer sepals c. 2.5 mm long, with glandular spots, inner sepals 3–4 mm long; petals 15–16 mm long, orange-red when dry, glabrous except for the ciliate base, the longest one c. 16 mm long; filaments free, anthers c. 2 mm long; ovary patently hairy, style glabrous in apical half, stigma slightly 2-lobed, ovules 13. **Fruits** globose, c. 1.5 cm diameter, finely hairy, apically pointed when immature; fruiting pedicels 10–12 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, known by 1 collection from Labuk Sugut district, Bt. Masasau (*SAN 107390*) and in Sarawak from Bako NP, G. Gading NP, Sampadi FR, Samunsam WS, G. Santubong and Semengoh FR, all in Kuching district (e.g., *S 12781*, *S 14903*, *S 32986*, *S 34392*, *S 43446* and *S 69066*). In Brunei, recorded by one collection (*Wong WKM 1380*) from Temburong district and in Kalimantan known by 2 collections, one from Berau (*Ambriansyah et al. AA 665*) and the other from Ulu Barito (*Ridsdale PBU 7*).

Ecology. Mixed dipterocarp forest on ridges or along rivers, at altitudes to 200 m.

Notes. *Xanthophyllum beccarianum* is closely related to *X. brachystachyum*, *X. pedicellatum*, *X. purpureum*, *X. reticulatum* and *X. trichocladum*, forming the ‘beccarianum-group’, of which species delimitation needs further study.

3. *Xanthophyllum bicolor* W.J.de Wilde & Duyfjes

(Latin, *bi* = two, *color* = colour; referring to the different colour of the petiole and leaf surfaces)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 48. **Type:** *Niga NN 182*, Borneo, Brunei, Belait district, Sg. Mau (holotype KEP; isotypes BRUN, L, SAN, SAR, SING).

Tree, to 30 m tall and 32 cm diameter. **Bark** dark brown, smooth; inner bark pale yellow. **Twigs** smooth, glabrous, grey, without nodal glands. **Axillary buds** solitary or in clusters of up to 3, conical, 2–4 mm long, glabrous, with corky thickenings at the base. **Leaves** discolorous, glabrous, flat, green and shiny above, contrastingly pale cinnamon and papillose below; blades oblong, 14–35 × 4.5–10 cm, base long-attenuate and forming part of the petiole, apex rounded to bluntly acute; midrib somewhat raised above; lateral veins 8–12 pairs, indistinct, basal veins hardly reaching the middle of the leaf, intramarginal vein faint; intercostal venation coarsely reticulate, faint; glands inconspicuous; petioles 20–30 mm long, glabrous, consisting of a grey-brown, transversely or longitudinally furrowed or wrinkled basal half and a smooth distal part, yellowish like the midrib, without glands.

Inflorescences nearly half as long as the leaves, 6–11 cm long, *unbranched*; *axes minutely sparsely appressed hairy, hairs 0.1–0.5 mm long*, 15–25-flowered; bracts minute. **Flowers:** 1–3 per bract; *pedicels 5–10 mm long*, appressed fine-hairy or subglabrous; sepals *c.* 4 mm long, subglabrous; petals glabrous, yellowish orange when fresh, brown-orange on drying; *filaments free*; *ovary ovoid, c.* 4 mm diameter, *sparsely appressed short-hairy, c.* 2 mm stipitate, style caducous, *stigma slightly 2-lobed, ovules 8(?)*. **Fruits** globose, 1.5–2 cm diameter, 2 mm stipitate, light brown (blue when fresh), glabrous; pericarp thin; fruiting pedicels *c.* 10 mm long. **Seed 1.**

Vernacular name. Brunei—*bait musang* (Iban).

Distribution. Endemic in Borneo (Sabah and Brunei). In Sabah, recorded from Beaufort and Ranau districts (e.g., *SAN 43595*, *SAN 77790* and *SAN 86129*). In Brunei, known from Belait district (e.g., *BRUN 17868*, *BRUN 17936*, *Joffre JJA 10*, *Niga NN 182* and *Niga NN 369*).

Ecology. Mixed dipterocarp forest, riverside forest or hills, on peaty or (yellow) sandy clay soil, at low altitude.

Notes. *Xanthophyllum bicolor* is close to *X. penibukanense* but the latter differs from the former in having smaller leaves with much shorter transversely wrinkled petioles.

4. *Xanthophyllum borneense* Miq.

(of Borneo)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Ann. Mus. Bot. Lugd.-Bat. (1864) 277; Merrill *op. cit.* (1921) 325; Masamune *op. cit.* 379; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 82, *op. cit.* (1988) 508. **Lectotype** (Meijden, 1982): *Korthals s.n.*, Borneo, Kalimantan (L [*Acc. No. 9081711927*]; isolectotypes G, K, L [*Acc. Nos. 944354123 & 9081711939*], U [*Acc. No. 40587*], W). **Synonym:** *X. glabrescens* Ridl., Bull. Misc. Inform. Kew (1938) 113, Masamune *op. cit.* 380.

Small tree, to 5(–8) m tall. **Twigs** *reticulately wrinkled, without nodal glands*. **Axillary buds** *in clusters of 2 (or 3), 1–2(–3) mm long, glabrescent*. **Leaves** *subcoriaceous, concolorous or discolorous, glabrous, flat or slightly bullate and green(-brown) above, pale, not or (indistinctly) papillose below; blades elliptical-oblong, 8–16 × 3.5–7 cm, base attenuate, apex acutish or acute-acuminate, margin sometimes undulate; midrib flat or prominent above; lateral veins 4–6(–8) pairs, forming an intramarginal vein; intercostal venation reticulate; glands few or numerous, scattered, c.* 0.2 mm diameter; *petioles 5–11 mm long, glabrous, finely transversely wrinkled, without glands*. **Inflorescences** *slender, axes 1–2 mm diameter, with less than 10 flowers*, shorter or longer than the leaves, 4–9 cm long, *unbranched*, glabrous. **Flowers:** *pedicels c.* 2 mm long; sepals glabrous outside, outer sepals *c.* 3 mm long, inner sepals *c.* 4 mm long; petals pale brownish or orange when dry, minutely ciliate apically, the longest petal 10–11 mm long, keel sparsely appressed minutely hairy outside; *filaments free, anthers c.* 0.3 mm long, (sub)glabrous; *ovary glabrous or hairy all around*, style sparsely more or less appressed hairy, *stigma slightly 2-lobed, ovules 4*. **Fruits** globose to broadly ovoid, 1.5–1.8 cm diameter, *pale brown, on drying smooth or coarsely wrinkled, glabrous or sparsely appressed hairy all around*; fruiting pedicels *c.* 5 mm long. **Seed 1.**

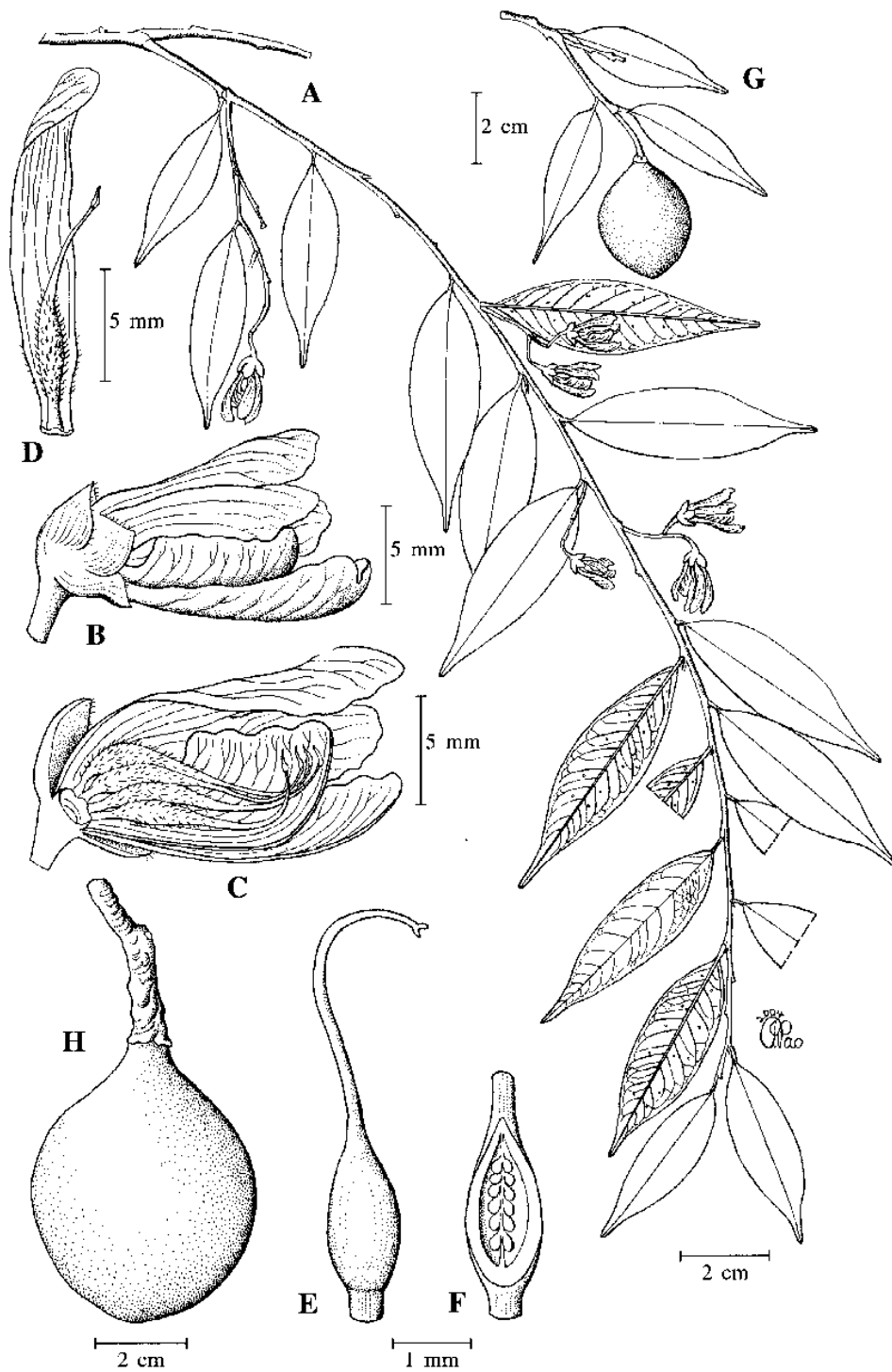


Fig. 2. *Xanthophyllum brevipes*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoecium removed; D, adaxial view of stamen and petal; E, gynoecium; F, longitudinal section of ovary; G, part of leafy twig with immature fruit; H, mature fruit. (A–F from S 26838, G from S 32989, H from S 91156.)

Distribution. Endemic in Borneo (Sabah, Sarawak and SE Kalimantan) and known from few collections only. In Sabah, known by two rather doubtful collections, one from Beaufort district (*SAN 115308*) and the other from Lamag, Kinabatangan district (*SAN 53303*); and in Sarawak, recorded from Kapit and Kuching districts (e.g., *Hose 38* and *S 8451*). In SE Kalimantan, known only from the type.

Ecology. Forest along riverbanks, and on hillslopes, at altitudes below 300 m.

Notes. The circumscription of this species, comprising only few specimens collected from distant localities, needs further study.

5. *Xanthophyllum brachystachyum* W.J.de Wilde & Duyfjes

(Greek, *brachus* = short; *stachus* = spike; referring to the short inflorescences)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 49. **Type:** *Normaya & Sirukit S 91521*, Borneo, Sarawak, Marudi district, Sg. Silat Basin, Bt. Palutan (holotype SAR; isotypes KEP, L, SAN, SING).

Tree, to 12 m tall and 9 cm diameter. **Bark** smooth, grey-green or whitish, slash bark yellow, tough. **Sapwood** yellow, hard. **Twigs** smooth, without nodal glands, 0.5–1 mm diameter, brown patently long-hairy, hairs *c.* 0.5 mm long, later glabrescent. **Axillary buds** solitary, less than 1 mm long, hairy. **Leaves** more or less discolorous, flat, green and glabrous above, patently long-hairy mainly on midrib and papillose below; blades narrowly oblong, 3–7(–9.5) × 0.5–1(–2) cm, base narrowly rounded or cuneate, apex long-acute; midrib flat above; lateral veins 4–7 pairs, forming a faint intramarginal vein; intercostal venation reticulate; glands numerous, scattered, minute, *c.* 0.1 mm diameter; petioles *c.* 2 mm long, long-hairy, smooth, without glands. **Inflorescences** much shorter than the leaves, *c.* 0.5 cm long, unbranched, 2–4-flowered; axes glabrescent, hairs *c.* 0.5 mm long. **Flowers:** pedicels 2–4 mm long, subglabrous; sepals sparsely appressed hairy or subglabrous, hairs *c.* 1 mm long, outer sepals 1.5–2 mm long, inner sepals *c.* 2.5 mm long; petals pale purplish, drying orange brown, (sub)glabrous, *c.* 12 mm long; filaments free, subglabrous, anthers *c.* 0.5 mm long, with some hairs at base; ovary *c.* 1 mm stipitate, densely light brown half-patently hairy, hairs 0.5–1 mm long, style glabrous in apical part, stigma slightly 2-lobed, ovules (presumably) 8 or more. **Fruits** globose, 1–1.5 cm diameter, pale brown, hairy; fruiting pedicels *c.* 5 mm long. **Seed** 1.

Vernacular names. Sarawak—*bagok* (Iban), *bila* (Kenyah), *nyalin daun kecil* (Malay).

Distribution. Endemic in Borneo (Sabah and Sarawak). In Sabah, known by one collection from Bt. Sunggau, Beaufort district (*SAN 77425*, which is intermediate with delicate forms of *X. purpureum*). In Sarawak, known from Marudi and Miri districts, (e.g., *S 3735*, *S 91521* and *S 91825*).

Ecology. Mixed dipterocarp forest, at 500–900 m altitudes.

6. *Xanthophyllum brevipes* Meijden

Fig. 2, Plate 7A.

(Latin, *brevis* = short, *pes* = foot or stalk; referring to the short-petioled leaves)

(subgen. **Brunophyllum**)

Bot. J. Linn. Soc. 67 (1973) 117, *op. cit.* (1982) 144, *op. cit.* (1988) 536; Anderson *op. cit.* (1980) 287; Argent *et al.* (eds.) *op. cit.* 505. **Type:** Anderson S 26838, Borneo, Sarawak, Kuching district, Semengoh FR (holotype L; isotypes KEP, L, SAN, SAR).

Tree, 20(–30) m tall, to 40 cm diameter. **Bark** smooth or slightly fissured, yellowish brown. **Twigs and branches** smooth, glabrous, green, pendent; nodal glands sometimes distinct. **Axillary buds** absent or if present minute, less than 0.5 mm long. **Leaves** glabrous, flat and (green-)brown above, hardly paler and papillose below; blades narrowly elliptical, 2.5–7.5 × 0.7–2.5 cm, base rounded or attenuate, apex acuminate to cuspidate; midrib sunken above; lateral veins c. 10 pairs, little more distinct than finer veins, forming an indistinct intramarginal vein; intercostal venation reticulate; glands more than 10, in a row between margin and midrib, c. 0.1 mm diameter; petioles 1.5–3 mm long, glabrous, finely transversely wrinkled, without glands. **Inflorescences** short, unbranched, 2–5-flowered; axes hardly thicker than pedicels, glabrous. **Flowers:** pedicels c. 7 mm long; sepals minutely ciliate at margin, for the rest glabrous, outer sepals c. 3.5 mm long, inner sepals c. 4 mm long; petals unequal, white, drying orange-brown, faintly ciliate, longest one 15–16 mm long, keel clawed, boat-shaped, ciliate at base; filaments c. 0.5 mm connate, hairy in basal part, anthers c. 1 mm long, glabrous; ovary orange-brown, glabrous, style glabrous, stigma peltate, ovules 18. **Fruits** glabrous, pear-shaped (to broadly ovoid), 4–5 cm diameter, strongly finely wrinkled when dry, shiny, (reddish) brown or blackish; pericarp firm; fruiting pedicels 10–15 mm long, blackish. **Seeds** more than 10, flattened-ovoid, c. 1 cm long.

Distribution. Endemic in Borneo (Sarawak and Brunei). In Sarawak, recorded from Bintulu, Kuching, Miri and Serian districts (e.g., S 15107, S 15748, S 16643, S 38492 and S 91155). In Brunei, known from Bt. Puan and Sg. Liang, Belait district (e.g., BRUN 631 and Ogata Og-B 404).

Ecology. Mixed dipterocarp forest, on slopes or near streams, at altitudes below 100 m.

Uses. *Xanthophyllum brevipes*, with sharply drooping branches, is potentially an ornamental roadside tree.

7. **Xanthophyllum ceraceifolium** Meijden

Fig. 3, Plate 7B.

(Latin, *ceraseus* = waxy, *folium* = leaf; referring to the waxy appearance of the leaves)

(subgen. **Xanthophyllum**, sect. **Eystathes**)

Bot. J. Linn. Soc. 67 (1973) 117, *op. cit.* (1982) 102, *op. cit.* (1988) 517, Anderson *op. cit.* (1980) 287. **Type:** Galau S 14822, Borneo, Sarawak, Kuching district, Semengoh FR (holotype L; isotypes K, SAN, SAR, SING).

Small tree, to 16 m tall, to 16 cm diameter. **Bark** greyish brown with numerous brown lenticels on lower trunk. **Twigs** smooth, without nodal glands, glabrous, greenish. **Axillary buds** solitary, half-patent, elliptical to oblong, 5–7 mm long, glabrous. **Leaves** coriaceous, glabrous, flat, dull greenish and rather glossy above, not papillose below; blades lanceolate-oblong, 22–50 × 7–18 cm, base broadly cuneate, apex acute-acuminate; midrib raised above; lateral veins 8–10 pairs, slightly prominent, in apical part forming an indistinct intramarginal vein; intercostal venation reticulate, obscure; glands 2–8, of which two at the

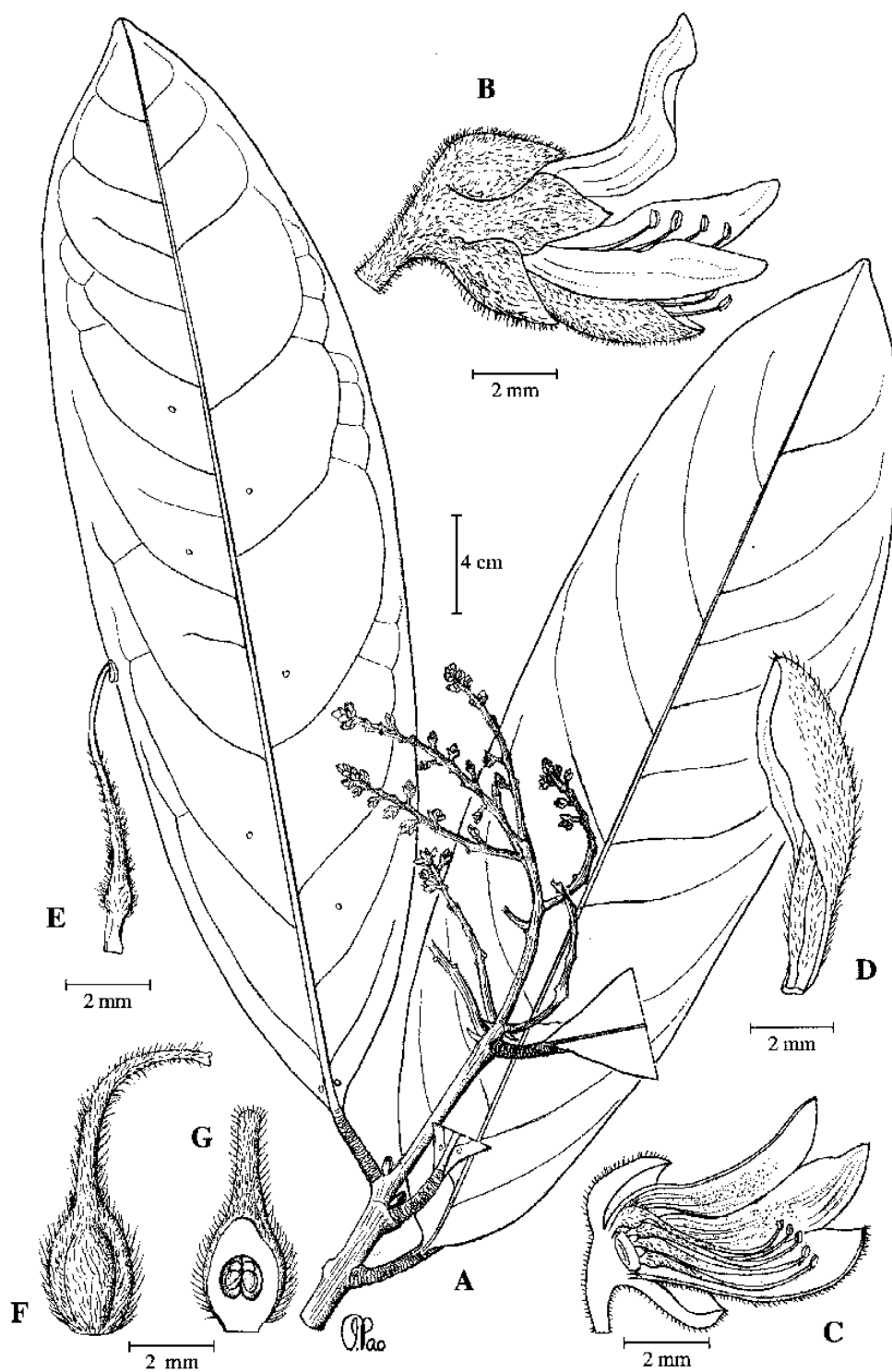


Fig. 3. *Xanthophyllum ceraceifolium*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoecium removed; D, lower petal; E, stamen; F, gynoecium; G, longitudinal section of ovary. (All from S 32405.)

very base, 0.5–1 mm diameter, the other ones (if present) scattered, sometimes close to midrib; *petioles* (18–)25–30 mm long, *glabrous, black, stout, transversely wrinkled, without glands*. **Inflorescences** shorter than the leaves, *branched*; axes flattened basally, brown, minutely hairy; lower bracts (sub)opposite. **Flowers:** pedicels 2.5–3.5 mm long; outer sepals 3–3.5 mm long, inner sepals 4.5–5 mm long; petals yellowish, drying dark red, glabrous inside, the longest one 9–11 mm long, keel appressed hairy outside; *filaments free*, widened above base and with an appressed hairy knob-like thickening at inner side, anthers 0.5–1 mm long; *ovary* nearly sessile, *appressed long-hairy all around, stigma slightly 2-lobed, ovules 4*. **Fruits** unknown.

Distribution. Endemic in Borneo. Confined to Sarawak; known only from few collections from Semengoh FR (e.g., *S 14822, S 32449, S 37757, S 38742 and S 91157*).

Ecology. Lowland mixed dipterocarp forest, on hillslopes, on sandy loamy soils.

Notes. In living as well as in dried specimens, the stout petiole is conspicuously black and transversely wrinkled.

8. *Xanthophyllum clovis* (Meijden) Meijden

Fig. 4.

(French, *clou* = nail; referring to the clove-like axillary buds)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Leiden Bot. Ser. 7 (1982) 103, *op. cit.* (1988) 517; Coode *et al.* (eds.) *op. cit.* 255. **Basionym:** *X. vitellinum* var. *clovis* Meijden *op. cit.* (1973) 120. **Type:** *Wood SAN 15156*, Borneo, Sabah, Sipitang district, Sibubu (holotype L; isotypes BRI, K, SING).

Tree, to 16 m tall, to 19 cm diameter. **Bark** greyish, with scattered lenticels, flaky. **Sapwood** yellow to reddish. **Twigs** (young) *smooth, glabrous, yellowish green, without nodal glands*. **Axillary buds** *solitary, clove-shaped, sessile, 6.5–12 mm long, at base slightly enlarged and convex, enlarged at the rounded or emarginate apex, and there with 2 knob-like appendages*. **Leaves** *glabrous, concolorous or discolorous, flat and greenish to brownish above, papillose below; blades elliptical, 8.5–18 × 3.5–6.5 cm, base broadly cuneate, apex short acute-acuminate; midrib flat above; lateral veins 7–8 pairs, forming an indistinct intramarginal vein in apical half; intercostal venation reticulate; glands few to numerous, mostly near the midrib, 0.2–0.5 mm diameter; petioles 9–20(–30) mm long, glabrous, finely transversely wrinkled, without glands*. **Inflorescences** to 20 cm long, *branched*; axes dark, minutely patently hairy, in basal part flowers in clusters of up to 7; lower bracts opposite. **Flowers:** pedicels 4–5 mm long, densely shortly more or less appressed hairy; outer sepals *c.* 3 mm long, inner sepals *c.* 4 mm long, with tiny glandular spots at apex; petals dark red when dry, the longest one 8.5 mm long, keel appressed hairy outside, other petals glabrous or sparsely ciliate; *filaments (almost) free*, widened above base and with appressed hairy, knob-like appendage at inner side, anthers *c.* 0.5 mm long; *ovary* subsessile, *half-patently hairy all around*, style hairy in two rows to near apex, *stigma slightly 2-lobed, ovules 4*. **Fruits** globose, 1.5–2 cm diameter, *glabrescent*; fruiting pedicels *c.* 5 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and E Kalimantan). In Sabah uncommon, known only by 2 collections from Labuk Sugut and Sipitang districts (i.e., *SAN 15156 and SAN 99867*) and in Sarawak from Lundu and Miri districts (e.g., *S 49888 and S*

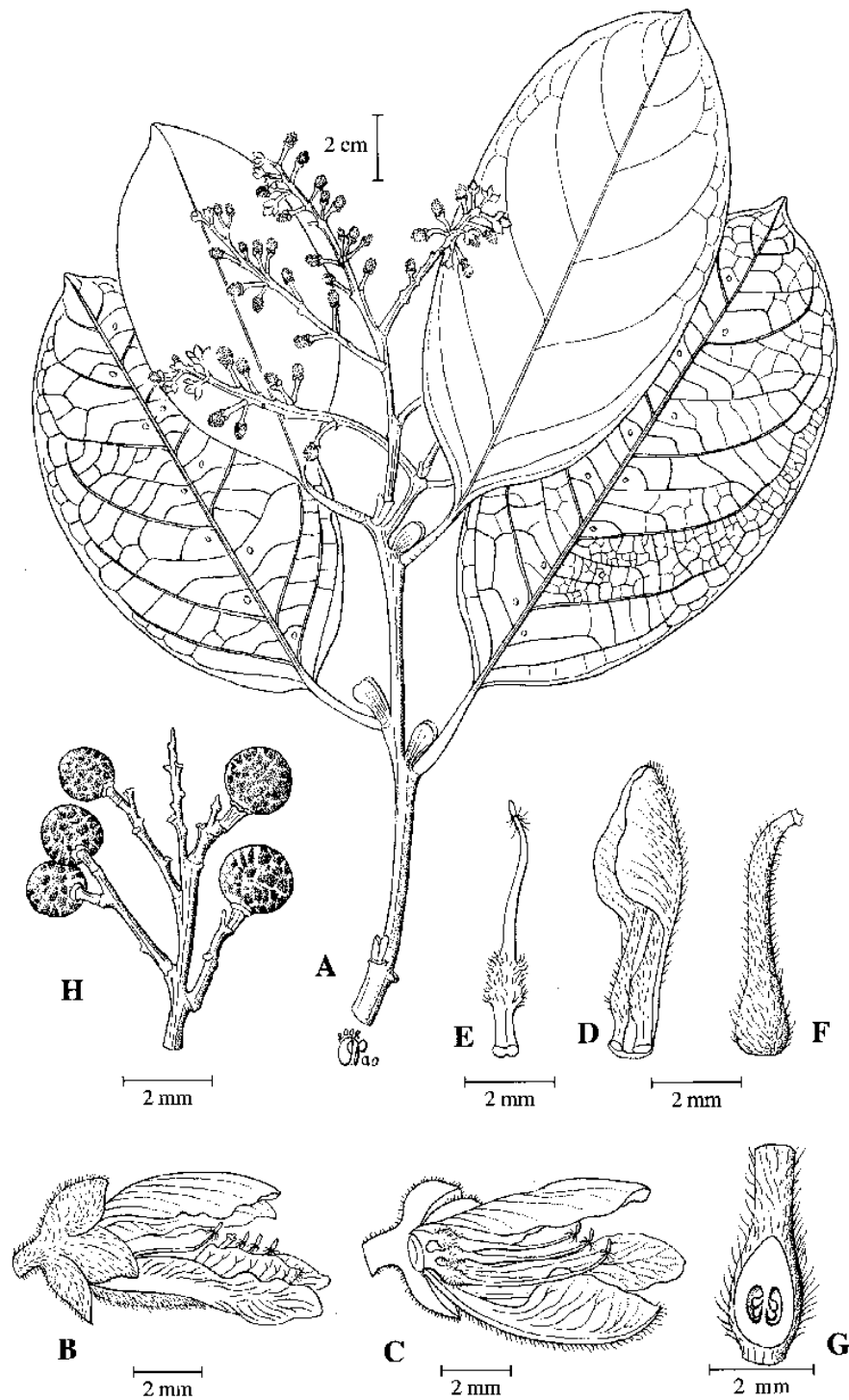


Fig. 4. *Xanthophyllum clovis*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoecium removed; D, lower petal with 2 stamens; E, stamen; F, gynoecium; G, longitudinal section of ovary; H, infructescence. (A–G from *S* 49888, H from *BRUN* 16523.)

46563). Also occurring in Brunei, Tutong district (e.g., *Ariffin et al. ARK 18, BRUN 16523* and *Forman 868A*) and E Kalimantan (e.g., *Arifin Berau 1004*).

Ecology. Lowland mixed dipterocarp forest on hillsides or ridges and in Brunei in swamp forest.

Uses. Fruits are recorded as edible (*Ariffin et al. ARK 18*).

9. *Xanthophyllum contractum* Meijden

(Latin, *contractus* = contracted; referring to the short inflorescences and short stipitate fruits)

(subgen. **Triadelphum**)

Leiden Bot. Ser. 7 (1982) 138, *op. cit.* (1988) 532. **Type:** *Clemens 21664*, Borneo, Sarawak, Batang Rejang (holotype A; isotypes K, NY, SAR, Z).

Tree, *c.* 18 m tall, *c.* 30 cm diameter. **Twigs** smooth, pale yellowish, glabrous, with nodal glands. **Axillary buds** solitary, minute, obtuse, *c.* 1 mm long or smaller, glabrous. **Leaves** chartaceous, glabrous, flat and yellowish green above, not papillose below; blades elliptical-oblong, 14–20 × 6.5–8 cm, base acute, apex obtuse to very shortly acuminate; midrib raised above; lateral veins 8–9 pairs, not forming an intramarginal vein; intercostal venation scalariform; glands 12–18, located at 2–5 mm from the margin, some scattered, 0.2–0.3 mm diameter; petioles 9–10 mm long, glabrous, smooth, without glands. **Inflorescences** to 6 cm long, unbranched, appearing on older twigs from adventitious buds; nodal glands indistinct. **Flowers** unknown. **Fruits** *c.* 3 mm stipitate, ovoid, 1.5–2 × 1–1.5 cm, more or less fleshy, finely pustulate, dark reddish, glabrous; pericarp hard; fruiting pedicels 2–6 mm long, glabrous. **Seed** 1, (sub)apical, developing from one of the 12 opposite ovules in the apical half as seen in the young fruit.

Distribution. Endemic in Borneo. In Sarawak known by the type from Upper Rejang R., Belaga district (*Clemens 21664*), and another collection from Ulu Katibas, Song district (*S 64876*). In Brunei, represented by one collection (*Hotta 13348*) from Temburong district.

Ecology. Lowland riparian forest.

Notes. Fruits purple when ripe.

10. *Xanthophyllum discolor* Chodat

Plate 7C.

(Latin, *discolor* = of different colour; the upper and lower leaf surface)

(subgen. **Xanthophyllum**, sect. **Eystathes**)

Bull. Herb. Boiss. 4 (1896) 257; Ridley *op. cit.* (1922) 147; Ng *op. cit.* 356; Meijden *op. cit.* (1982) 108, *p.p.* (*excl. syn. X. hypoleucum*), *op. cit.* (1988) 520, *p.p.* (*excl. syn. X. hypoleucum*); Turner *op. cit.* 405; Coode *et al.* (eds.) *op. cit.* 255; Beaman & Anderson *op. cit.* 264. **Type:** Ridley 6199, Singapore (holotype K; isotypes BM, K). **Synonyms:** *X. discolor* Chodat subsp. *macranthum* Meijden *op. cit.* (1973) 118.

Distribution. Peninsular Malaysia, Borneo and the Philippines.

Notes. Two subspecies, subsp. *discolor* and subsp. *macranthum* Meijden, are recognised, with the latter occurring only in the Philippines.

subsp. **discolor**

Shrub or small tree, to 5 m tall, to 5 cm diameter. **Bark** whitish green. **Twigs** *smooth, without nodal glands, at apex 1–1.5 mm thick*, pale, whitish or yellowish, early glabrescent (hairs *c.* 0.1 mm long). **Axillary buds** *solitary*, ovate, 1–2 mm long, subacute or obtuse, pale brown, subglabrous. **Leaves** *discolorous, flat and* (brown-)green above, *glabrous or sometimes with minute hairs on midrib, pale and papillose below; blades narrowly ovate, 5–14 × 1.5–5 cm, base rounded or cuneate*, apex subobtuse, acute, or acute-acuminate (or short-caudate); midrib almost flat; *lateral veins 5–8 pairs, not forming an intramarginal vein* (or only a faint one in apical leaf half); *intracostal venation reticulate*; glands numerous, scattered, 0.1–0.2 mm diameter; *petioles (4–)8–12 mm long, transversely wrinkled, glabrous, without glands*. **Inflorescences** shorter than the leaves, 1.5–4.5 cm long, bearing 6–15 solitary flowers, *unbranched*; axes minutely hairy; bracts minute, caducous. **Flowers:** pedicels 2–4 mm long, subglabrous; sepals *c.* 2 mm long, partly minutely grey-hairy; petals 10–11 mm long, subglabrous, drying pink-orange; *filaments free*, slightly protruding, anthers not seen; *ovary c.* 1.5 mm stipitate, *densely appressed hairy*, style densely or sparsely more or less patently hairy, remaining on the growing ovary, *stigma slightly 2-lobed, ovules 4 or 8*. **Fruits** globose, 1–1.2 cm diameter, (sparsely) appressed hairy; pericarp thin, pale brown; fruiting pedicels *c.* 5 mm long. **Seed** 1.

Distribution. Peninsular Malaysia and Borneo (Sabah, Sarawak and Kalimantan). In Sabah, recorded from Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan and Tawau districts (e.g., *FRI 41254, SAN 60113, SAN 82408, SAN 94028 and SAN 129708*) and in Sarawak from Bau, Bintulu, Kapit, Lundu, Song and Sri Aman districts (e.g., *S 4694, S 46344, S 47342, S 50058 and S 77595*). In Kalimantan, known from W and E parts (e.g., *ANU 26774, Enderi 3271, Kato et al. B 6115, Kostermans 7122 and Wiradinata ITTO/BB 136*).

Ecology. Mixed dipterocarp forest, lower montane forest and *padang* forest, on hill summit and hill ridge, at 180–1100 m altitudes.

Uses. For Sarawak, *Awa et al. S 50058* reported: ‘for driving away padi pests burn the twigs into ashes and scatter it around the padi field’.

Notes. First developing leaves, when still dangling, are purple. Specimens from Peninsular Malaysia are recorded as having ovaries with 6–15 ovules (Ng *op. cit.* 1972, Meijden *op. cit.* 1982, *op. cit.* 1988); in the few Bornean collections either 4 or 8 ovules were counted. The number of ovules per ovary, as a strong taxonomic character needs, at least in certain species-groups, reconsideration.

11. **Xanthophyllum ecarinatum** Chodat

Plate 7D.

(Latin, *e* = without, *carinatum* = keeled; referring to the lack of a boat-shaped carina)

(subgen. **Brunophyllum**)

Bull. Herb. Boiss. 4 (1896) 254, in Engler & Prantl, Nat. Pflanz. Fam. III, 4 (1896) 344; Merrill *op. cit.* (1921) 325; Masamune *op. cit.* 379; Meijden *op. cit.* (1982) 148, *op. cit.* (1988) 539; Coode *et al.* (eds.) *op. cit.* 255; Argent *et al.* (eds.) *op. cit.* 505; Beaman & Anderson *op. cit.* 264. **Type:** *Haviland 1768*, Borneo, Sarawak (holotype K; isotype SAR). **Synonym:** *X. kalimantanum* Meijden *op. cit.* (1973) 118, *op. cit.* (1982) 148, *op. cit.* (1988) 539 (see notes).

Tree, 3–25 m tall, to 16 cm diameter. **Bark** pale grey (brown), smooth. **Sapwood** pale yellow. **Twigs** smooth, without nodal glands, glabrous. **Axillary buds** solitary, minute, less than 0.5 mm long, or absent. **Leaves** glabrous, flat, glossy and brown above, not papillose below; blades (ovate-)oblong, (3–)7–17 × (1–)2.5–7 cm, base rounded or attenuate, apex acuminate to cuspidate; midrib slightly prominent to flat, or sunken in basal part; lateral veins 5–7 pairs, forming a rather indistinct intramarginal vein; intercostal venation coarsely reticulate; glands 0–8, scattered in middle and apical parts of the leaf blade, 0.2–0.4 mm diameter; petioles (1.5–)4–6.5 mm long, glabrous, transversely wrinkled, without glands. **Inflorescences** (much) shorter than the leaves, unbranched; axes lanate (woolly hairy); flowers solitary or in basal part in clusters of up to 3. **Flowers** drying black; pedicels 2–6 mm long, sparsely lanate; outer sepals (3–)4–5 mm long, inner sepals (3.5–)6–7 mm long; petals subequal, 9.5–12 mm long, when fresh white, the upper ones with a yellow spot, ciliate towards apex, inside hairy above insertion of filaments; stamens 8(–10), shorter than petals, filaments for 5–6 mm connate, towards apex lanate, anthers c. 0.6 mm long, glabrous or sparsely lanate at base; ovary stipitate for 2.5–4 mm, drying black, glabrous or with few long hairs on the ribs, style glabrous or sparsely lanate, stigma peltate, ovules 12–18(–23). **Fruits** (sub)ellipsoid, 7–11 × 6 cm, attenuate at base and apex, orange to dark brown, glabrous; pericarp soft, c. 0.5 cm thick and coarsely wrinkled when dry; fruiting pedicels 5–10 mm long, 5 mm thick or more. **Seeds** 8 or more.

Vernacular names. Sarawak—*apolah* (Kayan), *buah kong* (Iban, Ulu Engkari).

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah common, known from Keningau, Kinabatangan, Ranau, Tambunan, Tawau and Tenom districts (e.g. *KEP 80476*, *Pereira JTP 154*, *SAN 84003*, *SAN 97683*, *SAN 100129*, *SAN 135858* and *SAN 139755*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lubok Antu, Lundu and Miri districts (e.g., *S 8288*, *S 43917*, *S 46687*, *S 57679* and *S 80899*). Also occurring in Brunei (e.g., *Dransfield JD 7410*) and Kalimantan (e.g., *bb. 17946*, *Church et al. 2728*, *Wiradinata 3586* and *Winkler 2464*).

Ecology. Lowland mixed dipterocarp and lower montane forest, along rivers, on hillsides or steep slopes, also in *kerangas* forest, at altitudes to 1250 m. Occasionally occurs on ultrabasic soil.

Uses. The fruit, yellow or bright orange when ripe with white sweet pulp, is reported as edible.

Notes. The status of *Xanthophyllum kalimantanum* Meijden (*op. cit.* 1982, *op. cit.* 1988) from SE Kalimantan as a synonym needs further study, because its type is rather reminiscent of *X. parvifolium*.

12. *Xanthophyllum ellipticum* Miq.
(Latin, *ellipticus* = elliptical; the leaves)

Fig. 5.

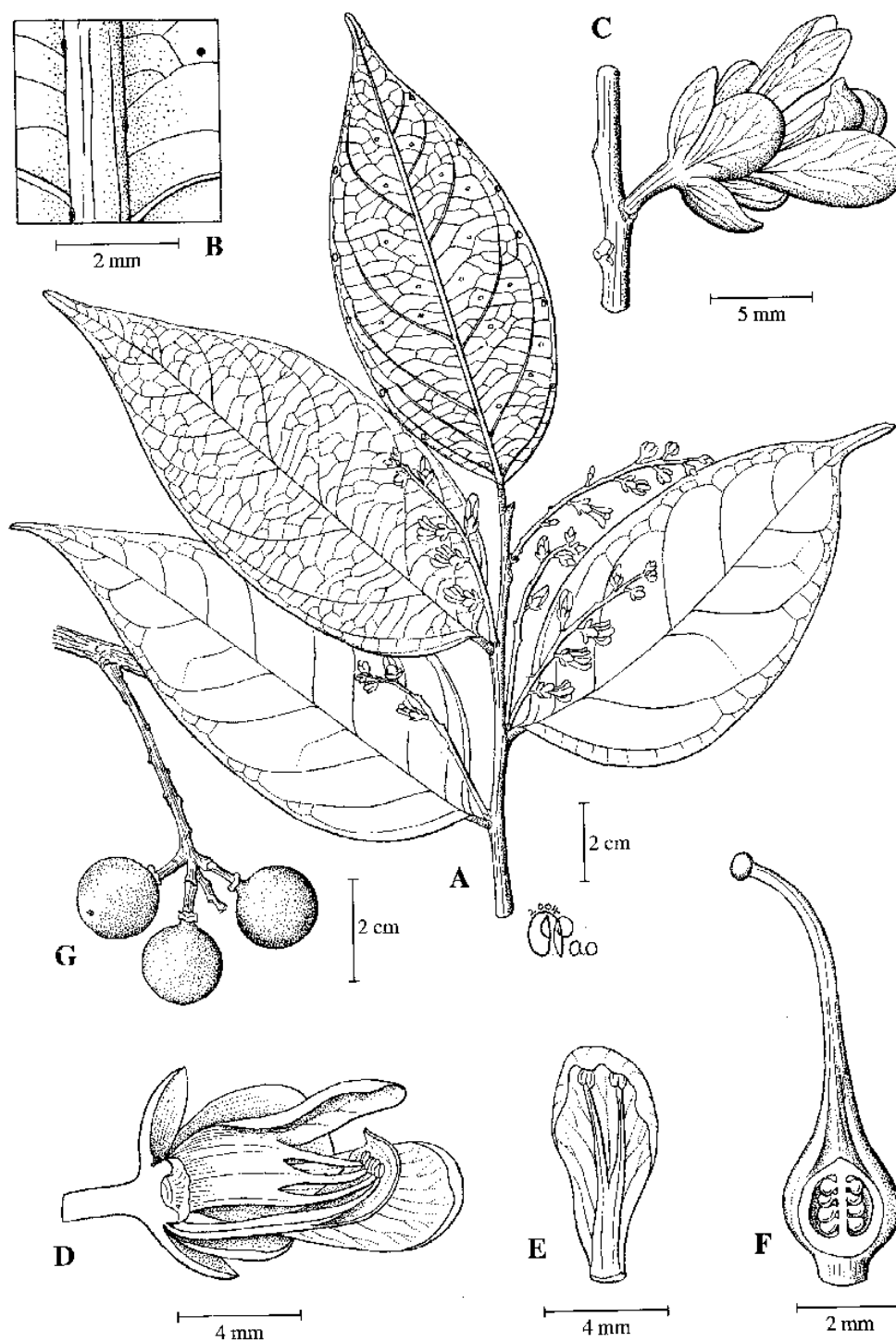


Fig. 5. *Xanthophyllum ellipticum*. A, flowering leafy twig; B, detail of lower leaf surface with glands; C, open flower; D, longitudinal section of open flower with the gynoecium removed; E, adaxial view of petal and stamens; F, gynoecium with longitudinal section of ovary; G, infructescence. (A–F from S 25564, G from S 53089.)

(subgen. **Triadelphum**)

Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 276; King *op. cit.* 140; Chodat *in* Engler & Prantl, Nat. Pflanz. Fam. III, 4 (1896) 344, *op. cit.* (1929) 133 (excluding var. *subcoriaceum*); Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 379; Ng *op. cit.* (1972) 357; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 135, *op. cit.* (1988) 530; Turner *op. cit.* 405; Coode *et al.* (eds.) *op. cit.* 255; Argent *et al.* (eds.) *op. cit.* 505; Pendry, *op. cit.* 526. **Lectotype** (Meijden, 1982): *Korthals s.n.*, Borneo, Kalimantan (L [Acc. No. 9081711971]; isolectotypes AMD [Acc. Nos. 036920 & 036919], G, L [Acc. No. 9081711909]). **Synonyms:** *X. citrifolium* Chodat, Bull. Herb. Boiss. 4 (1896) 255, *in* Engler & Prantl (1896) 345, Merrill *op. cit.* (1921) 325, Masamune *op. cit.* 379, Anderson, Gard. Bull. Sing. 20 (1963) 152; *X. kingii* Chodat, Bull. Herb. Boiss. 4 (1896) 255; Ridley *op. cit.* (1922) 143.

Shrub or tree, to 30 m tall, to 40 cm diameter. **Bark** grey or reddish brown, smooth. **Sapwood** (white-)yellow. **Twigs** glabrous or minutely short-hairy, *smooth, with distinct nodal glands*. **Axillary buds** solitary, *c. 1 mm long*, inconspicuous. **Leaves** glabrous, flat and green or pale brownish *above, not papillose below; blades ovate-elliptical, 5–20 × 2–7 cm, base cuneate, apex acute-acuminate, margin sometimes shallowly crenate because of glands*; midrib narrow and sunken above; *lateral veins 5–9 pairs, forming a distinct intramarginal vein; intercostal venation reticulate; glands numerous, 0.4–0.8 mm diameter, scattered but at least 6 present on the leaf margin itself; petioles 4–7 mm long, glabrous or minutely hairy, longitudinally or transversely wrinkled, without glands*. **Inflorescences** sometimes several together, shorter than the leaves, *unbranched*. **Flowers:** *pedicels 3–4 mm long, sparsely to densely minutely (woolly) hairy; sepals often drying black, glabrous or minutely hairy inside, outer sepals 3–4 mm long, inner sepals 4–5(–6) mm long; petals white or pale yellow, drying brown or dark orange, inside minutely hairy above base, keel 6–7(–8) mm long, other petals 8–9 mm long, lateral petals 3–4 mm wide, upper petals 1.5–2 mm wide; stamens triadelphous, glabrous, anthers c. 0.5 mm long, short hairy at base, ciliate along slits, often cohering around the stigma; ovary subsessile, glabrous, black when dry, style glabrous, stigma peltate, ovules 8–14. Fruits globose, 1.5–2.2 cm diameter, smooth, (brown or) blackish when dry (orange when fresh), somewhat shiny, glabrous; pericarp thin, brittle, inside purplish red; fruiting pedicel 3–6(–8) mm long. Seed 1.*

Vernacular names. Sarawak—*nyalin tikus* (preferred name), *apolah* (Kayan), *kayu paya* (Kenyah). Brunei—*bait, menjalin* (Iban).

Distribution. S Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah common, recorded from Beaufort, Keningau, Kuala Penyu, Papar, Penampang, Ranau, Sandakan, Tambunan, Tawau and Tenom districts (e.g., SAN 27321, SAN 49361, SAN 63183, SAN 66028, SAN 70024, SAN 79313 and SAN 132249) and in Sarawak also common and known from Betong, Bintulu, Julau, Kuching, Marudi, Miri, Sarikei, Sibu and Sri Aman districts (e.g., S 11974, S 29857, S 35777, S 51759 and S 65118). Also occurring in Brunei (e.g., BRUN 15138, BRUN 15224, BRUN 16280 and Dransfield JD 7437) and Kalimantan (e.g., Church *et al.* 1582, Endert 1806, Kartawinata 1405 and Kostermans 10358).

Ecology. Lowland forest, mainly in (peat) swamp forest and along rivers, at altitudes to 650 m. Occasionally also in *kerangas* forest (e.g., S 11974).

13. **Xanthophyllum ferrugineum** Meijden

(Latin, *ferrugineus* = rusty coloured; the inflorescences)

(subgen. **Xanthophyllum**, sect. **Xanthophyllum**)

Bot. J. Linn. Soc. 67 (1973) 118, *op. cit.* (1982) 69, *op. cit.* (1988) 503; Anderson *op. cit.* (1980) 287; Coode *et al.* (eds.) *op. cit.* 257; Argent *et al.* (eds.) *op. cit.* 508. **Type:** *Au S 23906*, Borneo, Sarawak (holotype L; isotypes K, KEP, L, SAN, SAR, SING).

Tree, to 25 m tall, to 40(–60) cm diameter. **Bark** grey or greenish, smooth. **Sapwood** yellow. **Twigs** smooth, without nodal glands, glabrous. **Axillary buds** solitary, inconspicuous. **Leaves** coriaceous, glabrous, flat and bright yellow(–green) above, not papillose below; blades elliptical-oblong, 8–20 × 3–7 cm, base cuneate, apex acute-acuminate; midrib prominent to sunken above, not very prominent below; lateral veins 5–7 pairs, forming indistinct intramarginal vein; intercostal venation scalariform (exceptionally more or less reticulate), fine, obscure; glands few, mainly near the margin, 0.4–0.6 mm diameter, basal glands similar; petioles 9–14 mm long, glabrous, finely transversely wrinkled or smooth, without glands. **Inflorescences** shorter than the leaves, at the apex of twigs, branched; axes densely to sparsely yellow-brown short-hairy. **Flowers:** pedicels 1–2(–6) mm long, densely minutely greyish hairy; sepals brown with pale margin when dry, 4–5 mm long, (sub)glabrous outside, often with (minute) glandular spots, outer sepals sparsely minutely hairy, inner sepals thickened in middle basal part, minutely appressed hairy, but glabrous along the margin; petals yellow or white, the upper petals with a yellow spot, drying yellowish, the longest one 8.5–10 mm long, keel densely hairy outside and in apical part inside, other petals (sub)glabrous; filaments free, anthers 0.5–0.7 mm long, minutely hairy; ovary sometimes ribbed, glabrous (or sparsely hairy), apically often greyish hairy in 4 short rows, stigma slightly 2-lobed, ovules 8–14. **Fruits** subglobose, 1–2 cm diameter, finely tuberculate, dull, yellowish brown, glabrous (immature fruits with persistent sepals); fruiting pedicel c. 3 mm long. **Seed** 1.

Vernacular name. Sarawak—*senumpol* (Iban).

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, known from Kinabatangan, Kota Kinabalu and Tawau districts (e.g., *FRI 41304*, *SAN 42002*, *SAN 62907*, *SAN 62921* and *SAN 64058*) and in Sarawak from Kanowit, Kapit, Kuching and Limbang districts (e.g., *S 14975*, *S 23987*, *S 27054*, *S 29556* and *S 32263*). Also occurring in Brunei (e.g., *BRUN 3038*) and Kalimantan (e.g., *Nooteboom 4350*).

Ecology. Mixed dipterocarp forest, on ridges, on sandy clay soil, often on soil over ultrabasic bedrock, at altitudes to 500 m.

Notes. *Xanthophyllum ferrugineum* resembles *X. flavescens* (see below) but the latter differs from the former by its longer pedicels and more hairy sepals.

14. **Xanthophyllum flavescens** Roxb.

Fig. 6.

(Latin, *flavescere* = becoming yellowish; the leaves).

(subgen. **Xanthophyllum**, sect. **Xanthophyllum**)

Pl. Corom. 3 (1820) 82, t. 284, f. 2; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 64, *op. cit.* (1988) 500; Turner *op. cit.* 405; Coode *et al.* (eds.) *op. cit.* 256; Argent *et al.* (eds.) *op. cit.* 508. **Lectotype** (Meijden, 1982): *Roxburgh s.n.* [‘May, 1811; Sp. N. 363–p. 3034, *Xanthophylla flavescens*, this is a large tree, found on Thothoree hill, flowers all yellow’], India (BM). **Synonyms:**

Jakkia excelsa Blume, Bijdr. Fl. Ned. Ind. (1825) 62 ('*Jackia*'); *X. excelsum* (Blume) Miq., Fl. Ind. Bat. 1, 2 (1858) 129, Merrill *op. cit.* (1921) 326, Enum. Philip. Fl. Pl. 2 (1923) 386; Ridley *op. cit.* (1922) 143; Masamune *op. cit.* 380, Backer & Bakhuizen *f. op. cit.* 201, Ng *op. cit.* (1972) 354; *X. affine* Miq. *op. cit.* (1864) 271, King *op. cit.* 142, Ridley *op. cit.* (1922) 143, Merrill *op. cit.* (1923) 386, Chodat *op. cit.* (1929) 133, Masamune *op. cit.* 379, Ng *op. cit.* (1972) 354, Anderson *op. cit.* (1980) 286, Meijden *op. cit.* (1982) 70, *op. cit.* (1988) 503, Kessler & Sidiyasa *op. cit.* 193, Turner *op. cit.* 405, Coode *et al.* (eds.) *op. cit.* 255, Argent *et al.* (eds.) *op. cit.* 505, Beaman & Anderson *op. cit.* 264, **syn. nov. Lectotype** (Meijden, 1982): *Korthals s.n.*, Borneo (L [Acc. No. 9081711714]; isolectotypes AMD [Acc. Nos. 036923 & 036924]); *X. sarawakense* Chodat, Bull. Herb. Boiss. 4 (1896) 262, Merrill *op. cit.* (1921) 326, Masamune *op. cit.* 381, **syn. nov. Type**: *Beccari 3459*, Borneo (holotype K; isotypes FI, K, P); *X. pallidum* Ridl., Bull. Misc. Inform. Kew (1938) 113, Masamune *op. cit.* 380. (For complete synonymy *cf.* Meijden *op. cit.* 1982).

Shrub, treelet, understory or canopy tree, to 30 m tall and 50(–80) cm diameter. **Bark** grey or (greenish) brown, smooth. **Sapwood** (pale) yellow. **Twigs** smooth, without nodal glands, glabrous or minutely greyish hairy, glabrescent. **Axillary buds** solitary or in clusters of 2 or 3, conical, 0.5–4 mm long, glabrous or hairy, the upper one sometimes stalked or slightly supra-axillary. **Leaves** flat, yellowish or greyish green, often lighter along midrib and base of veins above, not papillose, glabrous or sometimes minutely hairy in basal part below; blades elliptical or oblong, rarely lanceolate, 5–18(–35) × 2–8(–13) cm, base attenuate to nearly rounded, apex acute (acuminate); midrib sunken or raised above, prominent below; lateral veins 4–10(–16) pairs, usually forming (incomplete or distinct) intramarginal vein; intercostal venation (sub)scalariform, exceptionally reticulate; glands absent or (1–)2–10, scattered, variable in size; petioles 5–15 mm long, glabrous, smooth, sometimes at apex or in apical half with two glands. **Inflorescences** at the upper part of twigs, shorter or longer than the leaves, single or few together, mostly branched, minutely greyish hairy, nodes or bracts sometimes with glands. **Flowers** single or 2 or 3 together; pedicels (2–)3–11 mm long; sepals persistent in fruit or not, hairy, sometimes with small glands, outer sepals 1.5–5.5 mm long, (sparsely or) densely hairy, inner sepals 2–7.5 mm long; petals yellow, or white (or rarely pink), the upper ones with or without a (orange-)yellow spot, drying yellowish, the longest one 6–17 mm long, keel and lateral petals mostly finely hairy outside, hairy or glabrous inside, upper petals reflexed, finely hairy sometimes only towards base; filaments free (or to 1 mm connate), glabrous or sparsely hairy towards base, anthers 0.5–1.5 mm long; ovary glabrous or greyish hairy on 2 or 4 ribs in apical part, often somewhat 2-locular, sometimes ribbed or tuberculate, style hairy, stigma slightly 2-lobed, ovules (5–)8–12(–16). **Fruits** globose or somewhat longer than wide, 1–2 cm diameter, sometimes sharply beaked, glabrous, smooth, sometimes ribbed, (pale) brown; pericarp not very thick, hard; fruiting pedicels 4–11 mm long. **Seeds** 1 (or 2).

Vernacular names. Sabah—*lahau* (Kadayan), *penatang* (Dusun Kinabatangan), *tampasak* (Ranau). Sarawak—*kabok* (Kayan), *lamie* (Kayan), *sabetong* (Punan). Brunei—*bait* (Iban).

Distribution. Continental SE Asia (E India, Bangladesh, Myanmar, Thailand, Laos, Cambodia, Vietnam) and W Malesia: Sumatra, Peninsular Malaysia, Java, Borneo (the most common species; Sabah, Sarawak, Brunei and Kalimantan) and the Philippines. In Sabah, recorded from most districts (e.g., *SAN 26071*, *SAN 30362*, *SAN 42805*, *SAN 95813* and *SAN 119229*) and in Sarawak also common and known from most districts (e.g., *S 29150*, *S 32945*, *S 47517*, *S 52777* and *S 77366*). Also occurring in Brunei (e.g., *BRUN 16229*, *BRUN 16860* and *Wong WKM 1372*) and Kalimantan (e.g., *bb. 18353*, *Burley 2477*, *Endert 3372*, *Kostermans 10142* and *Mogea et al. 4064*).

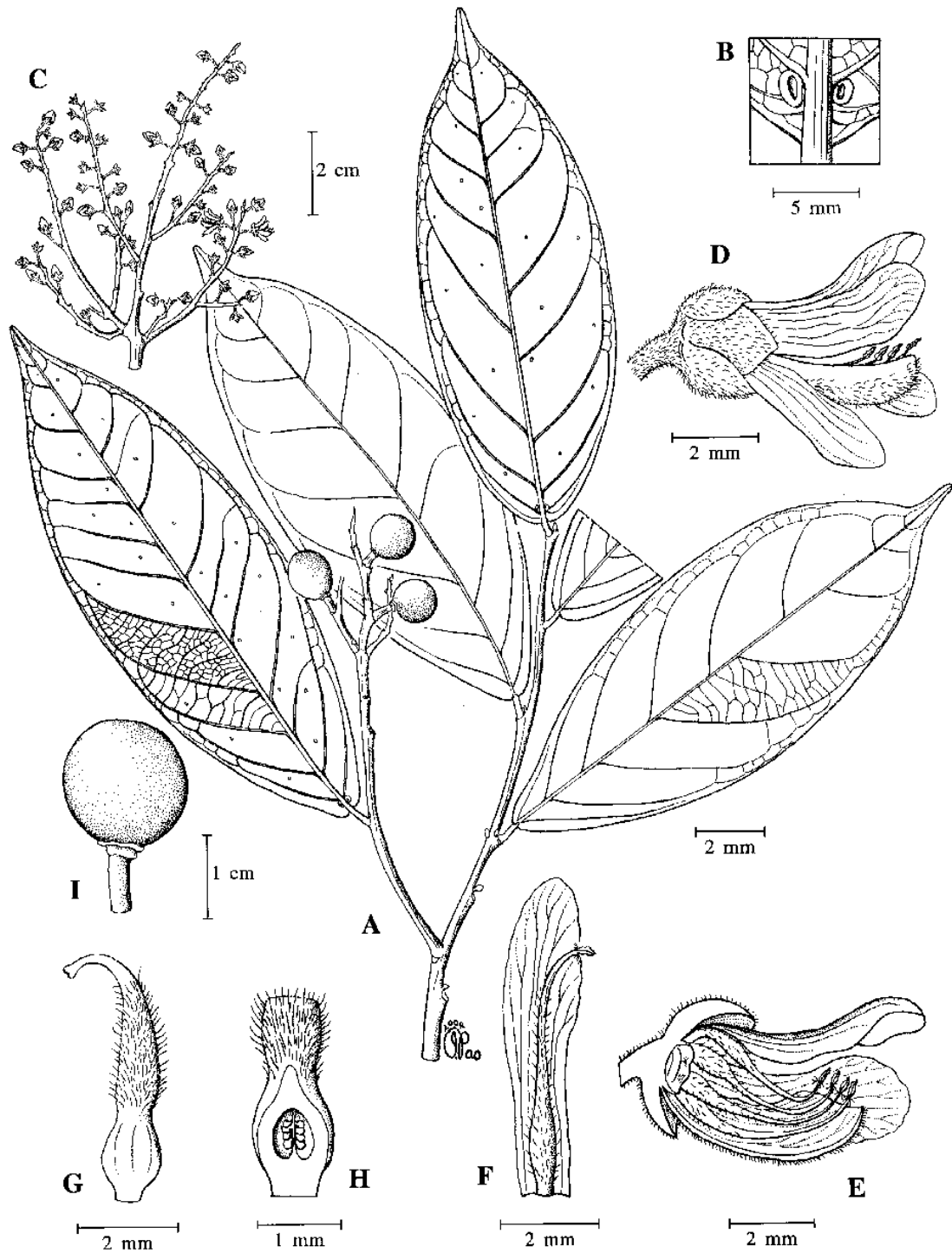


Fig. 6. *Xanthophyllum flavescens*. A, fruiting leafy twig; B, detail of lower leaf base with glands; C, inflorescence; D, open flower; E, longitudinal section of open flower with the gynoecium removed; F, adaxial view of petal and stamen; G, gynoecium; H, longitudinal section of ovary; I, fruit. (A–B from *S* 41080, C–H from *SAN* 30606, I from *S* 41080.)

Ecology. Mixed dipterocarp to montane forest at altitudes to 1500(–2000) m, on flat land, along streams or on ridges, on clay loam soil, sandy soils, sandstone, limestone, or soil over ultrabasic bedrock.

Uses. In Kalimantan the leaves are eaten as a vegetable (*Giessen 45*), and the wood for building houses (*Church et al. 93*).

Notes. *Xanthophyllum flavescens* is a very variable species, including specimens with leaves of variable shape and drying yellow or green. Some collections seem intermediate to related species, e.g., *X. ferrugineum*, *X. havilandii*, *X. macrophyllum* or *X. velutinum*.

15. *Xanthophyllum griffithii* A.W.Benn.

(W. Griffith, 1810–1845, British colonial physician and botanist in India and Malacca)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

In Hooker f., Fl. Br. Ind. 1 (1874) 210; King *op. cit.* 136; Ridley *op. cit.* (1922) 149; Ng *op. cit.* (1972) 357 (excl. var. *curtisii* and var. *montanum*), Mal. For. (1975) 85; Meijden *op. cit.* (1982) 92, *op. cit.* (1988) 513; Kessler & Sidiyasa *op. cit.* 194; Turner *op. cit.* 405; Coode *et al.* (eds.) *op. cit.* 256; Argent *et al.* (eds.) *op. cit.* 508; Pendry *op. cit.* 532; Beaman & Anderson *op. cit.* 265. **Lectotype** (Ng, 1972): *Griffith s.n.*, Myanmar, Mergui (K). **Synonyms:** *X. gracile* Chodat, Bull. Herb. Boiss. 4 (1896) 256; *X. parvum* Chodat, Bull. Herb. Boiss. 4 (1896) 264; *X. pseudostipulaceum* Merr., Philip. J. Sc. (1915) Bot. 316, *op. cit.* (1923) 387.

Tree, to 27 m tall and 40 cm diameter. **Bark** greyish or (blackish) brown, smooth. **Sapwood** (pale) yellow. **Twigs** smooth, slender, c. 1(–2) mm diameter, without nodal glands, glabrous or minutely patently short-hairy. **Axillary buds** solitary, sessile, half-patent, (1.5–)3–10 mm long, hairy, glabrous or glabrescent. **Leaves** glabrous, concolorous or discolorous, flat and dark green to brownish above, lighter coloured, glaucous or (sometimes) not glaucous and papillose or not papillose below; blades ovate, ovate-oblong or elliptical-oblong, 4–10 × 1–5 cm, base (broadly) cuneate, apex acute-acuminate, sometimes cuspidate; midrib flat or slightly raised above; lateral veins 4–6 pairs, usually forming an indistinct intramarginal vein in apical half; intercostal venation reticulate; glands 4–20, scattered but often located near midrib, 0.2–0.3 mm diameter; petioles 5–12 mm long, glabrous, finely transversely wrinkled, sometimes with 1 or 2 glands in apical part. **Inflorescences** up to 10 cm long, mostly branched; axes (reddish) brown, sparsely or densely minutely short-hairy, glabrescent or not; lower bracts opposite. **Flowers:** pedicels 1.5–4.5 mm long; sepals sometimes with 2 glands in apical part, outer sepals 1.5–2.5 mm long, inner sepals 2.5–3.3 mm long; petals white, the upper ones with a yellow spot, drying dark (orange-)red, the longest one 6.5–10 mm long, keel clawed, densely hairy outside, other petals glabrous or hairy outside in apical part; filaments free, widened above base and with a knob-like hairy appendage on inner side, anthers c. 0.4 mm long; ovary 0.5–2 mm stipitate, appressed hairy all around, stigma slightly 2-lobed, ovules 4. **Fruits** globose, 1–1.2 cm diameter, smooth, brown, hairy all around (sometimes glabrescent); fruiting pedicels 2–4 mm long. **Seed** 1.

Distribution. SE Asia and Malesia. A widespread species, of which in Sabah and Sarawak two varieties occur.

Key to varieties

Twigs at apex slender, c. 1 mm diameter or less, glabrous. Branches of inflorescences finely hairy, glabrescent.....

var. **angustifolium** Ng

(Latin, *angustus* = narrow, *folium* = leaf; with narrowed leaves)

Fed. Mus. J., N. S. 13 (1970 [for 1968]) 137. **Type:** *Osman KEP 23692*, Peninsular Malaysia (holotype SING; isotype KEP). **Synonym:** *X. griffithii* A.W.Benn. subsp. *angustifolium* (Ng) Meijden *op. cit.* (1982) 94, *p.p.*, *op. cit.* (1988) 513, *p.p.*, Beaman & Anderson *op. cit.* 265.

Twigs early glabrescent or glabrous, towards apex c. 1 mm diameter or less. *Axillary buds* long-triangular, acute, 1.5–5 mm long, glabrous or early glabrescent. *Leaf blades* ovate-oblong or elliptical-oblong, 4–9 × 1–4(–5) cm, apex sometimes long-acuminate, usually paler, (indistinctly) papillose or not papillose below; petioles 5–10 mm long, glabrous. *Branches of inflorescences* slender, 1 mm thick or less, glabrescent. *Fruits sparsely (more or less appressed) hairy* (sometimes glabrescent); fruiting pedicels 3–4 mm long, glabrescent.

Peninsular Malaysia and Borneo. In Borneo, known in Sabah from Kinabatangan, Penampang, Ranau, Tambunan and Tawau districts (e.g., *SAN 21929*, *SAN 44739*, *SAN 63066* and *SAN 77483*) and in Sarawak from Belaga, Kapit, Kuching, Limbang, Lundu and Mukah districts (e.g., *S 29198*, *S 36705*, *S 48819*, *S 69812* and *S 81817*). Also occurring in Brunei (e.g., *Prance et al. 30688*). Usually in lower montane forest, occasionally also in lowland mixed dipterocarp forest on slopes and ridges, riparian forest and *kerangas* forest, at 200–1400 m altitudes.

Twigs towards apex 1–2 mm diameter, hairy. Branches of inflorescences hairy.....

var. **papillosum** W.J.de Wilde & Duyfjes

(Latin, *papillosum* = papillose; the lower leaf surface)

Gard. Bull. Sing. 57 (2005) 52. **Type:** *Abang Mohtar S 54289*, Borneo, Sarawak, Lundu district (holotype SAR; isotypes K, KEP, L, MO, SAN). **Synonym:** *X. griffithii* A.W.Benn. subsp. *angustifolium* (Ng) Meijden *op. cit.* (1982) 94, *p.p.*

Twigs hairy, towards apex 1–2 mm thick. *Axillary buds* long-triangular or oblong-linear, 5–9(–10) mm long, hairy. *Leaf blades* (ovate or) elliptical-oblong, 5–10(–13) × 2–5 cm, apex acute-acuminate, dull, pale (grey-glaucous) and distinctly papillose below; petioles 6–12 mm long, hairy. *Branches of inflorescences* 1–2 mm thick, densely brown-hairy. *Fruits densely patently hairy*, sometimes glabrescent; fruiting pedicels c. 3 mm long, densely finely hairy.

Endemic in Borneo and known in Sarawak from Bintulu, Kuching and Lundu districts (e.g., *S 40567*, *S 47097*, *S 54289*, *S 59990* and *S 60111*). Also occurring in E Kalimantan (e.g., *Ambriansyah et al. 942* and *Kessler et al. 651*). In mixed lowland dipterocarp forest and heath forest, also in forest close to the sea.

16. **Xanthophyllum havilandii** Chodat

(G.D. Haviland, 1857–1901, surgeon and naturalist, Medical Officer and Director of Govt. Museum at Kuching, Sarawak)

(subgen. **Xanthophyllum**, sect. **Xanthophyllum**)

Bull. Herb. Boiss. 4 (1896) 260; Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 380; Anderson *op. cit.* (1980) 287. **Type:** *Haviland 1616*, Borneo, Sarawak, Kuching (holotype K, *n.v.*). **Synonym:** *X. hosei* Ridl., Bull. Misc. Inform. Kew (1938) 113; Masamune *op. cit.* 380; Meijden *op. cit.* (1982) 69; *op. cit.* (1988) 502, **syn. nov.** **Lectotype** (Meijden, 1982): *Hose 311*, Borneo, Sarawak (K; isolectotypes BM, L).

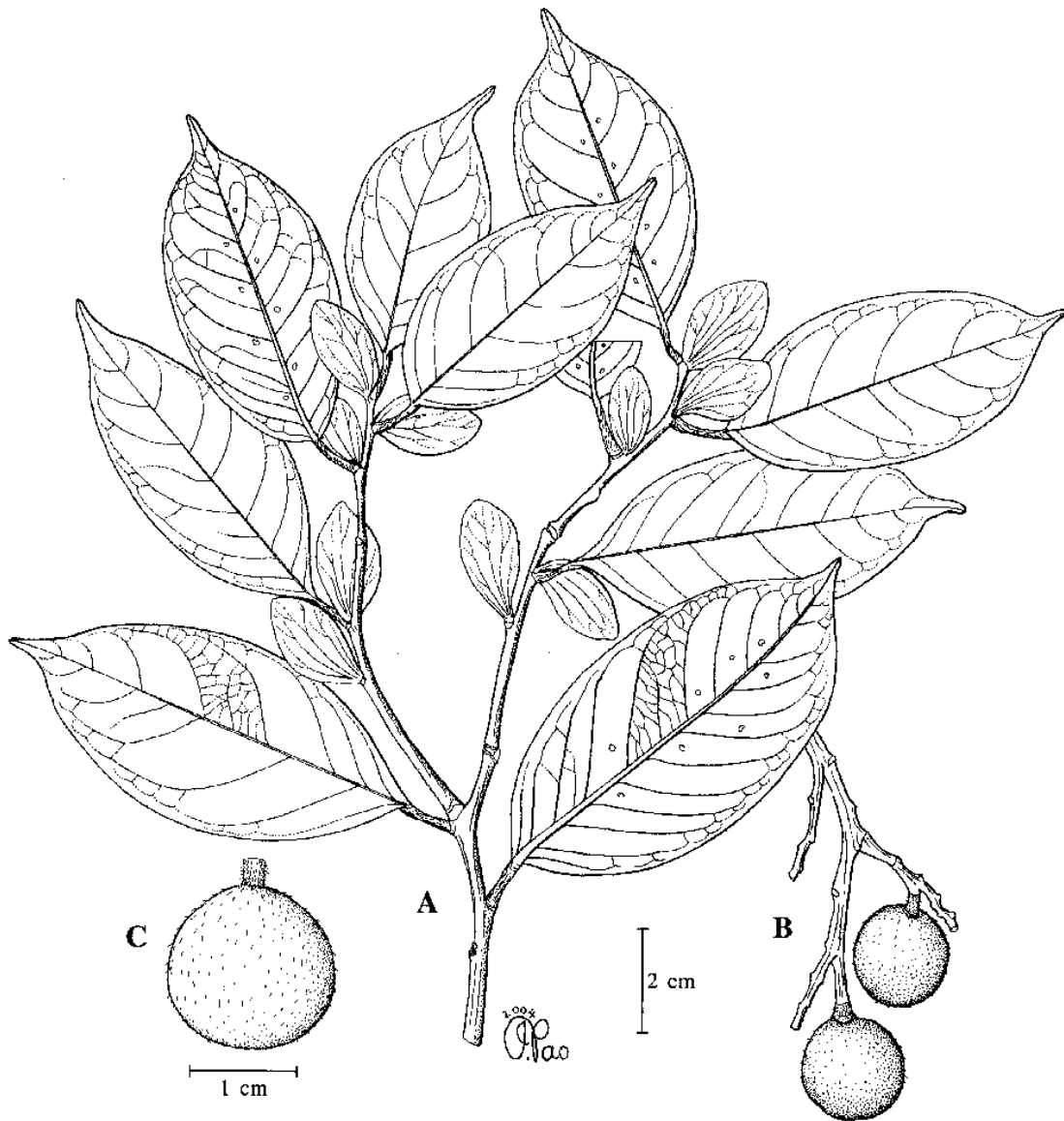


Fig. 7. *Xanthophyllum heterophyllum*. A, leafy twig; B, infructescence; C, fruit. (A from SAN 42728, B–C from SAN 25338.)

Shrub or small tree, to 5 m tall, to 6 cm diameter. **Bark** blackish. **Twigs** smooth, without nodal glands, glabrous or minutely appressed short-hairy, soon glabrescent. **Axillary buds** inconspicuous. **Leaves** slightly bullate between lateral veins, lower surface lighter coloured, not papillose, glabrous or sparsely minutely appressed short-hairy in basal part especially on the veins (hairs c. 0.2 mm long); blades elliptical-oblong, 12–21 × 4.5–10 cm, base rounded to short-cuneate, apex acuminate-cuspidate; midrib sunken above, prominent below; lateral veins 7–11 pairs, forming a distinct, (nearly) complete intramarginal vein; intercostal venation scalariform; glands 8 to numerous, scattered, 0.2–0.4 mm diameter, basal glands larger; petioles 7–12 mm long, minutely appressed short-hairy, smooth, without glands. **Inflorescences** borne on the upper parts of twigs, up to 12 cm long, branched or unbranched; axes often thickened, dull, minutely densely appressed short-hairy, internodes (except at base) very short, 0.5–1 mm long, resulting in the conspicuously dense-flowered inflorescence. **Flowers:** pedicels 2.5–4 mm long; sepals glabrous to sparsely minutely appressed hairy inside, outer sepals 2–2.5 mm long, with 2–4 glandular spots, appressed hairy outside, inner sepals 3.5–4 mm long, keeled and there densely appressed hairy, for the rest more or less glabrous outside; petals yellowish when dry, the longest one c. 8.5 mm long, keel clawed, sparsely hairy outside, glabrous inside, other petals glabrous but more or less ciliate; filaments free, wide at base, sparsely hairy to halfway, anthers c. 1 mm long, ciliate along slits; ovary subsessile, glabrous, smooth or ribbed, style glabrous in basal 1/3, upwards appressed hairy, stigma slightly 2-lobed, ovules 7–10. **Fruits** globose, c. 1.5 cm diameter, smooth or finely pustulate, glabrous; style more or less persistent, recurved; fruiting pedicels 3–4 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sarawak and Brunei). In Sarawak known from Belaga, Bintulu, Kuching and Miri districts (e.g., *Haviland 1616*, *Hose 311*, *S 14783*, *S 24911* and *S 27999*). In Brunei, recorded from Belait district (e.g., *Coode et al. 7814* and *Dransfield et al. 6848*).

Ecology. Mixed dipterocarp forest on hillsides or on river banks, at low altitudes.

Notes. There has been confusion about the identity of the names *Xanthophyllum havilandii* and *X. hosei*, but more recent collections, e.g., *Dransfield et al. 6848*, *Coode et al. 7814*, both from Brunei, made it clear that the types of both names belong to one species. The type of *X. havilandii* (*Haviland 1616*) belongs to the form with a branched inflorescence with rather well-spaced flowers, whereas the lectotype of *X. hosei* (*Hose 311*) represents the form with mostly unbranched inflorescences with the flowers conspicuously densely packed.

17. *Xanthophyllum heterophyllum* Meijden Fig. 7, Plate 8A.
(Greek, *heteros* = different, *phullon* = leaf; referring to the leaf-like axillary buds)

(subgen. ***Xanthophyllum***, sect. ***Eystathes***)

Leiden Bot. Ser. 7 (1982) 107, *op. cit.* (1988) 519; Coode *et al.* (eds.) *op. cit.* 256; Argent *et al.* (eds.) 508; Beaman & Anderson *op. cit.* 265. **Type:** *Wood SAN 15371*, Borneo, Sabah (holotype L; isotypes BRI, KEP).

Tree, to 30 m tall and to 50 cm diameter. **Bark** greyish or yellowish, smooth, fissured or cracked. **Sapwood** white or (reddish) yellow, with large rays as of *Quercus*. **Twigs** smooth, 1–2 mm diameter, without nodal glands, glabrous. **Axillary buds** solitary, large, elliptical to oblong, (8–)10–20(–35) × 6–12(–14) mm; scales flat and leaf-like, wrinkled, indistinctly

veined, more or less shiny, sometimes in middle part with 1–4 indistinct glands, base shortly attenuate, apex rounded to obtuse. **Leaves** glabrous, flat, more or less shiny and brownish green above, yellowish brown, not papillose below; blades (narrowly) elliptical, 4–12(–19) × 2–5(–7.5) cm, base cuneate, apex shortly acuminate to cuspidate; midrib flat or raised above; lateral veins 7–10(–12) pairs, not forming an intramarginal vein; intercostals venation reticulate; glands few to many, mostly situated in the middle and apical parts of leaf blade, 0.2–0.4 mm diameter; petioles 7–15 mm long, glabrous, finely transversely wrinkled, without glands. **Inflorescences** branched, c. 5 cm long; axes densely short-hairy; lower bracts opposite. **Flowers** unknown (ovary appressed hairy all around, ovules 4). **Fruits** globose, c. 1.5 cm diameter, shiny or dull, brown, slightly hairy; pericarp soft; fruiting pedicels 1.5–3 mm long. **Seed** 1, and 3 abortive ovules.

Vernacular name. Sarawak—*nyalin bukit* (Iban).

Distribution. Endemic in Borneo (Sabah, Sarawak and Brunei). In Sabah, recorded from Beaufort, Kinabatangan, Kota Kinabalu, Labuk Sugut, Ranau and Sandakan districts (e.g., SAN 42011, SAN 62090, SAN 66624, SAN 69307, SAN 84133 and SAN 93048) and in Sarawak from Kuching district (e.g., Purseglove P4431 and S 8917). Also occurring in Brunei (e.g., BRUN 599).

Ecology. Lowland forest, hillsides and on ridges, at low altitudes (exceptionally to 1000 m).

18. *Xanthophyllum hildebrandii* Meijden

(F.H. Hildebrand, 1900–1975, Dutch forester and botanist)

(subgen. *Triadelphum*)

Leiden Bot. Ser. 7 (1982) 139, *op. cit.* (1988) 532; Beaman & Anderson *op. cit.* 265. **Type:** *Clemens 26048*, Borneo, Sabah, Mt. Kinabalu, Dallas (holotype L; isotype K).

Tree. **Twigs** smooth, with distinct nodal glands, glabrous. **Axillary buds** solitary, minute. **Leaves** membranous, glabrous, flat and dull above, reddish brown and not papillose below; blades (narrowly) elliptical, c. 15 × 5–7 cm, base attenuate, apex acute-acuminate; midrib sunken above; lateral veins c. 7 pairs, in apical half forming a rather indistinct intramarginal vein; intercostal venation coarsely reticulate; glands numerous, mostly located very close to midrib in the axils of the lateral veins, with a few scattered, 0.5–1 mm diameter; petioles c. 6 mm long, glabrous, smooth, without glands. **Inflorescences** 1 or 2 together, unbranched; nodal glands distinct; axes up to 10 cm long, sparsely shortly woolly hairy, basal bracts attenuate. **Flowers** unknown. **Fruits** (young) c. 2.5 mm stipitate, ovoid, apically with gland-like pustules, black, glabrous; fruiting pedicels 7–10 mm long, dark. **Seed** (immature) 1, (sub)apical, developing from one of c. 12 ovules situated in apical 2/3 of the fruit.

Distribution. Endemic in Borneo and known only from the type collection from Mt. Kinabalu, Sabah.

Ecology. Hill mixed dipterocarp forest, at c. 1000 m altitude.

Notes. The incompletely known *Xanthophyllum hildebrandii* is very similar to *X. ellipticum* in having some glands always present on the leaf margin.

19. *Xanthophyllum impressum* Meijden(Latin, *impressus* = impressed; referring to the enclosed axillary buds)(subgen. **Xanthophyllum**, sect. **Eystathes**)Leiden Bot. Ser. 7 (1982) 90, *op. cit.* (1988) 513; Argent *et al.* (eds.) *op. cit.* 508. **Type:** *Agam SAN 31500*, Borneo, Sabah, Lahad Datu district (holotype L; isotypes KEP, SAN, SAR).

Tree, to 23 m tall, to 70 cm diameter. **Bark** pale or dark grey, smooth. **Sapwood** white or yellowish. **Twigs** without nodal glands, yellowish, smooth, glabrous. **Axillary buds** solitary, mostly more or less enclosed between the base of the petiole and a low ridge of the twig, 1–2 × 1.5–2 mm, for c. 1 mm of its length uncovered; scales thickened, especially at base, but leaving a narrow scar. **Leaves** glabrous, mostly discolorous, flat and dull greyish green above, pale yellowish green and papillose below; blades narrowly elliptical, 10–20 × 3.5–9 cm, base cuneate, apex acutish to shortly acuminate; midrib prominent above; lateral veins 8–9 pairs, not forming an intermarginal vein; intercostal venation reticulate; glands scattered, inconspicuous, c. 0.3 mm diameter; petioles 10–14 mm long, glabrous, longitudinally or finely transversely wrinkled, sometimes with glands. **Inflorescences** to 20 cm long, branched, 6 (or more)-flowered; axes reddish brown, densely minutely appressed hairy; lower bracts (sub)opposite. **Flowers:** pedicels 1.5–4 mm long; outer sepals 2–2.5 mm long, inner sepals 3–4 mm long; petals white, the upper ones with a yellow spot, drying orange to dark red, the longest one 8.5–10.5 mm long, keel clawed, densely hairy outside, other petals glabrous; filaments free, widened above the base, there appressed hairy, for the rest glabrous, anthers c. 0.7 mm long, hairy or (sub)glabrous at base; ovary subsessile, half-patently hairy, stigma slightly 2-lobed, ovules 4. **Fruits** globose, c. 1.7 cm diameter, dull, smooth, pale brownish, appressed hairy; fruiting pedicels 3–4 mm long. **Seed** 1.

Distribution. Borneo (Sabah and E Kalimantan) and the Philippines. In Sabah, known from Beaufort, Kinabatangan, Lahad Datu and Ranau districts (e.g., *SAN 25091*, *SAN 39920*, *SAN 62958*, *SAN 77037* and *SAN 96580*). Also occurring in Kalimantan (e.g., *Kostermans 13665*).

Ecology. Forest on ridges or river banks, at low altitudes.

Notes. *Xanthophyllum impressum* resembles *X. vitellinum* but the latter differs from the former by its non-papillose lower leaf surface.

20. *Xanthophyllum korthalsianum* Miq.

(P.W. Korthals, 1807–1892, Dutch botanist)

(subgen. **Xanthophyllum**, sect. **Eystathes**)

Ann. Mus. Bot. Lugd.-Bat. (1864) 277; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 107, *op. cit.* (1988) 520; Argent *et al.* (eds.) *op. cit.* 510. **Lectotype** (Meijden, 1982): *Korthals s.n.*, Borneo, Kalimantan (L [*Acc. No. 9081711711*]); isolectotypes K, L [*Acc. No. 9081711706*], U [*Acc. No. 40577*]).

Tree, to 25 m tall, *c.* 30 cm diameter. **Twigs** glabrous, smooth, without nodal glands. **Axillary buds** solitary, inserted on the stem (1.5–)3–15 mm above the leaf axils, on 1–2 mm long stalks; scales leaf-like, elliptic to linear-lanceolate, 6–18 × 1.5–8 mm, faintly veined. **Leaves** glabrous, discolorous, flat and green above, papillose below; blades elliptical, 8–14 × 2.5–5 cm, base cuneate, apex acute-acuminate; midrib slightly raised above; lateral and intercostals veins prominent to obscure; lateral veins 6–8 pairs, forming a more or less distinct intramarginal vein; intercostal venation reticulate; glands few to numerous, located near the midrib or scattered, 0.1–0.3 mm diameter; petioles 7–10 mm long, glabrous, finely transversely wrinkled, glands present or absent. **Inflorescences** shorter to much longer than the leaves, branched, the lower branches distinctly supra-axillary, (sub)opposite; axes densely minutely hairy. **Flowers:** pedicels 1.5–2 mm long; sepals glabrous inside except for few hairs at base, outer sepals *c.* 2 mm long, inner sepals *c.* 3.5 mm long; petals incompletely known, upper petal *c.* 8.5 mm long, sparsely hairy at apex; stamens not seen; ovary patently whitish hairy (short and long fine hairs mixed), style and stigma not seen, ovules 4. **Fruits** unknown.

Distribution. A rare species, known from few collections from C Sumatra and Borneo (Sarawak and SE Kalimantan). In Sarawak, recorded from Bt. Raya, Kapit district (e.g., *S* 24806). Also occurring in SE Kalimantan (e.g., *Korthals s.n.*).

Ecology. Ridge forest, at *c.* 200 m altitude.

Notes. *Xanthophyllum korthalsianum* is similar to *X. heterophyllum* but the latter differs from the former by its non-papillose lower leaf surface and sessile, strictly axillary buds.

21. *Xanthophyllum lineare* (Meijden) W.J.de Wilde & Duyfjes

(Latin, *linea* = line; the linear leaves)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 55. **Basionym:** *X. adenotus* Miq. var. *lineare* Meijden *op. cit.* (1982) 101, *op. cit.* (1988) 516. **Type:** *Sinanggul SAN 57294*, Borneo, Sabah, Lahad Datu district, Bt. Silam (holotype K; isotype SAN).

Tree, to 7 m tall and 9 cm diameter. **Bark** smooth, brown or blackish. **Twigs** smooth, without nodal glands, greenish, glabrous. **Axillary buds** solitary, long-triangular, 1–2 mm long, acute, glabrous, sometimes enclosed by a low ridge of the twig. **Leaves** (thinly) coriaceous, glabrous, flat and grey-green or brown above, light brown and not papillose below; blades linear or lanceolate-linear, more or less parallel-sided, (9–)13–38 × (1.3–)2–5.5 cm, base narrowly rounded or short-cuneate, apex acute or (long) acuminate; midrib raised above; lateral veins 9–14 pairs, at *c.* 45° to the midrib, forming a weak irregular intramarginal vein; intercostal venation reticulate, distinct or indistinct above; glands several, less than 0.5 mm diameter, scattered; petioles (8–)10–12(–18) mm long, glabrous, without glands, coarsely transversely wrinkled. **Inflorescences** (sub)terminal, 6–12 cm long, branched, many-flowered, flowers solitary; axes angular or terete, *c.* 1.5 mm thick, sometimes thickened to 3 mm thick and then densely set with pedicel scars, sparsely minutely hairy. **Flowers:** pedicels *c.* 2 mm long, sparsely hairy; outer sepals *c.* 2 mm long, inner sepals *c.* 3.5 mm long, minutely appressed hairy, petals pinkish or red, subglabrous but keel hairy outside, upper petals pilose inside at base, longest petal *c.* 9 mm long; filaments free, somewhat widened above base, anthers *c.* 1 mm long; ovary densely hairy all

around, c. 1 mm long stipitate, style partly minutely hairy, stigma slightly 2-lobed, ovules 4. **Fruits** globose, 1.3–1.8 cm diameter, light brown, sparsely hairy, glabrescent; pericarp thin; fruiting pedicels c. 3 mm long, sparsely hairy. **Seed** 1.

Distribution. Endemic in Borneo and so far known only from Bt. Silam, Lahad Datu district, Sabah (e.g., *Repin et al. SP 6225, SAN 29652, SAN 57294, SAN 95535, SAN 144533* and *SAN A 4182*).

Ecology. Stunted forest on ultrabasic bedrock at 200–500 m altitude.

22. *Xanthophyllum longum* W.J.de Wilde & Duyfjes

(Latin, *longus* = long; the petioles)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 55. **Type:** *Sigin et al. SAN 107165*, Borneo, Sabah, Sandakan district, Ulu Sg. Pinangah (holotype SAN; isotypes KEP, L, SAR).

Tree, to 5 m tall and 10 cm diameter. **Bark** pale greenish or blackish. **Sapwood** white. **Twigs** smooth, without nodal glands, minutely hairy. **Axillary buds** solitary or in cluster of 2, less than 1 mm long, minutely hairy. **Leaves** glabrous except for the minutely patently hairy midrib and petiole, flat above, not papillose below; blades (narrowly) oblong, 15–20 × 6–7 cm, base rounded to short-attenuate, apex acute-acuminate; midrib raised above; lateral veins 8–10 pairs, forming an intramarginal vein; intercostal venation reticulate; glands inconspicuous; petioles (20–)30–40 mm long, 1–2 mm thick, the basal portion of c. 15 mm brown, the rest slightly narrower and drying as green as the midrib, glabrous, smooth, without glands. **Inflorescences** about half as long as the leaves, subapical, branched, axes minutely patently hairy. **Flowers** (after anthesis) single; pedicels 1–2 mm long; perianth, stamens and pistil unknown; ovary globose, densely grey(-brown) patently hairy all around (hairs c. 0.5 mm long), style caducous, stigma slightly 2-lobed, ovules 4. **Fruits** globose, 1.5–1.7 cm diameter, brownish, hairy; pericarp thin; fruiting pedicels c. 4 mm long. **Seed** 1.

Distribution. Endemic in Borneo and confined to Sabah, where it is known from Kinabatangan and Tawau districts (e.g., *SAN 81178, SAN 95970, SAN 107165, SAN 107277* and *SAN 107314*).

Ecology. Lowland forest, along streams, on undulating land and hillsides.

Notes. *Brunig LI 48*, from E Sarawak (sterile) keys out to *Xanthophyllum longum*, but represents an undescribed species.

23. *Xanthophyllum macrophyllum* Baker

(Greek, *makros* = large, *phullon* = leaf; the large leaves)

(subgen. *Xanthophyllum*, sect. *Xanthophyllum*)

Bull. Misc. Inform. Kew (1896) 21; Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 380; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 78; *op. cit.* (1988) 507; Coode *et al.* (eds.) *op. cit.* 256; Argent

et al. (eds.) *op. cit.* 510; Beaman & Anderson *op. cit.* 265. **Type:** *Creagh s.n.*, Borneo, Sabah (holotype K; isotype BM).

Shrub or tree, 3–25 m tall, 3–30 cm diameter. **Bark** pale brown, smooth. **Sapwood** white or pale yellow. **Twigs** smooth, without nodal glands, green, glabrous. **Axillary buds** 0.5–2 mm long. **Leaves** sometimes slightly bullate and greenish above, glabrous or minutely hairy on midrib, mostly brownish green and not papillose below; blades narrowly elliptical, (10–)14–28 × 4–10 cm, base attenuate, apex acute-acuminate; midrib prominent above, rarely slightly sunken; lateral veins 7–10 pairs, forming a nearly complete and rather prominent intramarginal vein; intercostal venation scalariform; glands mostly few, scattered, c. 0.5 mm diameter; petioles 10–18 mm long, glabrous, with (0–)2(–4) glands, longitudinally wrinkled. **Inflorescences** on the upper parts of twigs, shorter than the leaves, mostly branched; axes appressed brown velvety; bracts often opposite, with 2 small indistinct glands. **Flowers:** pedicels 2–12 mm long; sepals shortly appressed brown hairy outside, ribbed inside, outer sepals 5–6 mm long, inner sepals 6–7 mm long; petals yellow, or white and the upper ones with a yellow spot, drying (yellowish to) brown or blackish, the longest one 13–16 mm long, keel clawed, appressed velvety outside, at apex more or less densely hairy inside, other petals glabrous or hairy outside at apex; filaments free, anthers 0.5–0.8 mm long, short hairy; ovary sessile or short stipitate, creamish brown, often c. 8-ribbed when dry, the median ribs mostly prominent and hairy over 1/3–2/3 their length, the other ribs hairy in apical part only, stigma slightly 2-lobed, ovules 6–14. **Fruits** globose, c. 2 cm diameter, yellow-brown or blackish, faintly ribbed in apical part, glabrous or hairy on ribs only; fruiting pedicels 5–12 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and W Kalimantan). In Sabah common, recorded from Keningau, Kinabatangan, Lahad Datu, Penampang, Pensiangan, Ranau, Sandakan, Sipitang, Tawau and Tenom districts (e.g., *SAN 15427*, *SAN 28753*, *SAN 35891*, *SAN 66044*, *SAN 130878*, *SAN 132732* and *SAN 135348*). In Sarawak also common, known from Kapit, Kuching, Lawas, Lubok Antu, Lundu, Marudi, Miri, Mukah and Tatau districts (e.g., *S 21776*, *S 32812*, *S 36095*, *S 33999*, *S 46512* and *S 54738*). Also known in Brunei (e.g., *SAN 17503*). In W Kalimantan known by one doubtful collection from G. Benuang (*Wiradinata et al. ITTO/BB 310*).

Ecology. Lowland mixed dipterocarp forest and lower montane mossy forest, often near streams or on hillsides, from sea level to 1750 m altitudes.

Notes. *Xanthophyllum macrophyllum* resembles the highly variable *X. flavescens* but the latter differs from the former in having petals that are not blackish on drying. It is also reminiscent of *X. havilandii* but the latter differs by its thickish and densely flowered inflorescences.

24. *Xanthophyllum montanum* Meijden

(Latin, *mons* = mountain; growing in the mountains)

(subgen. **Triadelphum**)

Leiden Bot. Ser. 7 (1982) 137, *op. cit.* (1988) 532; Beaman & Anderson *op. cit.* 265. **Type:** *Mikil SAN 46765*, Borneo, Sabah, Ranau district, Mt. Kinabalu, Sosopodon FR (holotype L; isotypes K, SAN, SAR).

Tree, 10–30 m tall, 12–30 cm diameter. **Bark** orange-yellowish green, smooth, thinly flaky. **Sapwood** yellowish. **Twigs** smooth, slender, glabrous, with distinct nodal glands. **Axillary buds** solitary, inconspicuous. **Leaves** glabrous, flat and brownish green above, not papillose below; blades oblong, (4–)6–9 × 1–2.5(–3.5) cm, base cuneate, apex gradually acuminate; midrib sunken above; lateral veins 6–9 pairs, forming a distinct intramarginal vein; intercostal venation reticulate; glands 2–8(–15), scattered in the middle and apical parts of leaf blade, mostly closely together, not near the margin, 0.3–0.6 mm diameter; petioles 3.5–5 mm long, glabrous, indistinctly transversely wrinkled, without glands. **Inflorescences** to 3 cm long, (3–)5–7-flowered, minutely hairy, unbranched; nodal glands usually distinct, round or elongate, 0.3–0.6 mm long. **Flowers:** pedicels c. 5 mm long, sparsely minutely woolly hairy; sepals minutely hairy inside, outer sepals c. 3 mm long, inner sepals 3.5–4.5 mm long; petals yellowish brown when dry, the longest one 6–6.5 mm long, keel inside minutely hairy near base, upper petals hairy inside; stamens triadelphous, filaments hairy in basal part, anthers 0.6 mm long, glabrous; ovary 0.5(–1) mm stipitate, glabrous, style glabrous or minutely hairy at base, ovules 8–12. **Fruits** globose, c. 1 cm diameter, yellowish to greenish brown, smooth, dull, glabrous; pericarp thin; fruiting pedicels 4–6 mm long. **Seed** 1.

Distribution. Sumatra (doubtful) and Borneo (Sabah). In Sabah, confined to Mt. Kinabalu, Ranau district (e.g. *RSNB 4884*, *SAN 29232*, *SAN 46726* and *SAN 46765*).

Ecology. Lower montane forest on brownish soil, at 900–1600 m altitude.

25. *Xanthophyllum neglectum* Meijden

(Latin, *negligere* = neglected; for a long time overlooked)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bot. J. Linn. Soc. 67 (1973) 119, *op. cit.* (1982) 86, *op. cit.* (1988) 509; Anderson *op. cit.* (1980) 287; Argent *et al.* (eds.) *op. cit.* 510. **Type:** *Singh SAN 24222*, Borneo, Sabah (holotype L; isotypes K, KEP, L, SAN, SAR, SING).

Tree, 4–20 m tall, 5–20 cm diameter. **Bark** greyish or greenish brown or dark green, smooth. **Sapwood** pale yellow or brown. **Twigs** slender, c. 1 mm diameter, smooth, without nodal glands, green, glabrous. **Axillary buds** solitary or in pairs, half-patent, glabrous, elliptical to ovate-oblong, 1.5–4(–6) mm long, acute, yellowish. **Leaves** membranous or chartaceous, dull, glabrous, flat and greyish green above, sometimes slightly waxy, not papillose below; blades (narrowly) elliptical, 5–12 × 2–5.5 cm, base cuneate, margin often undulate, apex acute-acuminate; midrib prominent above; lateral veins 3–5 pairs, forming a distinct intramarginal vein; intercostal venation reticulate; glands 2–8, not in basal part, 0.2(–0.4) mm diameter; petioles 4–7 mm long, glabrous or sparsely short-hairy in the upper groove, without glands, hardly wrinkled or finely transversely wrinkled. **Inflorescences** slender, shorter than the leaves, 1.5–8 cm long, with 3–10 flowers (occasionally 2 per node), unbranched; axes c. 0.5 mm diameter, pale brown, sparsely patently short-hairy. **Flowers:** pedicels 2–4 mm long; outer sepals 2.2–2.5 mm long, inner sepals 3–3.5 mm long; petals white or yellowish, drying pale brownish, the longest one 7–10 mm long, keel nearly glabrous or hairy outside, short hairy inside basally, other petals glabrous except for some hairs at the base and apex; filaments free or to 0.5 mm connate, filaments of abaxial 4 stamens basally thickened, anthers c. 0.4 mm long; ovary (half-)patently hairy all around, c. 0.5 mm stipitate, style subglabrous, caducous, stigma slightly 2-lobed, ovules 4. **Fruits**

globose, *c.* 1 cm diameter, dull greyish green, slightly wrinkled, hairy all around; pericarp soft; fruiting pedicels slender, 2–4 mm long, pale brown. **Seed** 1.

Vernacular names. Sabah—*demining* (Dusun), *kemuning* (Dusun).

Distribution. Endemic in Borneo (Sabah, Sarawak, Kalimantan). In Sabah, known from Keningau, Kinabatangan, Lahad Datu and Sandakan districts (e.g., *SAN 17812*, *SAN 23509*, *SAN 27865*, *SAN 35262*, *SAN 111821* and *SAN 144332*) and in Sarawak from Gunung Buri, Samarahan district (e.g., *S 36666*). Also occurring in Kalimantan (e.g., *Ambriansyah AA 2156*, *Church et al. 1926*, *Kostermans 12630* and *de Vogel 854*).

Ecology. Mixed dipterocarp forest and lower montane forest, often along rivers, on sandstone or black and brown soil, at altitudes to *c.* 600 m.

Uses. In Kalimantan, the tough wood is used for axe handles.

Notes. *Xanthophyllum neglectum* is similar to *X. tenue* and *X. subcoriaceum*. See notes under *X. subcoriaceum*.

26. *Xanthophyllum nigricans* Meijden

(Latin, *nigricare* = becoming blackish; referring to drying plant parts)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bot. J. Linn. Soc. 67 (1973) 119, *op. cit.* (1982) 82, *op. cit.* (1988) 508; Anderson *op. cit.* (1980) 287; Coode *et al.* (eds.) *op. cit.* 256. **Type:** Singh & Nordin *SAN 48764* Borneo, Sabah, Tawau district, Baradaya FR (holotype KEP; isotypes K, SAN).

Tree, to 25 m tall and 20 cm diameter. **Bark** greyish or dark brown, smooth, rough or flaky. **Sapwood** whitish or yellowish, hard. **Twigs** finely longitudinally wrinkled, glabrous, without nodal glands. **Axillary buds** in cluster of 2 or 3 (or 4), 1.5–2.5 mm long, densely patently light-brown short-hairy. **Leaves** glabrous, flat and (dark) brown above, sometimes bluish (because of thin waxy layer), and not papillose (irrespective of very fine occasional papillation) below; blades elliptical to narrowly elliptical, 3.5–12 × 1.2–5.5 cm, base cuneate, apex acute-acuminate; midrib (slightly) prominent above; lateral veins 5–6(–7) pairs, forming a more or less distinct intramarginal vein; intercostal venation reticulate; glands scarce or inconspicuous, located on or near the midrib, *c.* 0.1 mm diameter, basal ones often larger; petioles 6–11(–14) mm long, glabrous, variously wrinkled, without glands. **Inflorescences** shorter than the leaves, unbranched, bearing more than 6 flowers; axes black, sparsely appressed hairy; flowers in clusters of 1–3. **Flowers:** pedicels 2–3 mm long, black when dry, nearly glabrous; sepals glabrous outside, patently hairy inside at base, outer sepals *c.* 1.8 mm long, inner sepals *c.* 2.5 mm long; petals white, drying dark (reddish), sparsely appressed hairy outside, ciliolate apically, the longest one *c.* 8 mm long; filaments free, anthers *c.* 0.3 mm long, hairy at base; ovary black, glabrous, style glabrous or basally sparsely appressed hairy, stigma slightly 2-lobed, ovules 4. **Fruits** globose, *c.* 1.4 cm diameter, dull, slightly wrinkled, brownish, glabrous; fruiting pedicels 2–4 mm long, *c.* 2 mm thick. **Seed** 1.

Distribution. Endemic in Borneo (Sabah and Sarawak). In Sabah known from Beaufort, Keningau, Kinabatangan, Lahad Datu, Labuk Sugut, Sandakan, Semporna and Tawau

districts (e.g., *SAN 16730*, *SAN 40914*, *SAN 43594*, *SAN 93581* and *SAN 95842*) and in Sarawak, known by one collection from Sg. Ebau, Bintulu district (*S 48871*).

Ecology. In ridge and hillside forest, on yellowish, brown or black soil, at altitudes to 600 m.

Notes. Meijden (*op. cit.* 1982, *op. cit.* 1988) described the lower leaf surface as papillose, but this character was not observed in the present study.

27. *Xanthophyllum nitidum* W.J.de Wilde & Duyfjes

(Latin, *nitidus* = shiny; referring to both leaf surfaces)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 56. **Type:** *Dewol et al. SAN 108778*, Borneo, Sabah, Kinabatangan district, Bt. Tawai FR (holotype SAN; isotypes A, BO, K, KEP, L, SAR, SING).

Tree, 20–30 m tall and 20–35 cm diameter. **Twigs** smooth, without nodal glands, yellow, glabrous. **Bark** smooth, black; inner bark yellowish. **Sapwood** white. **Axillary buds** solitary, c. 1 mm long, minutely short-hairy. **Leaves** glabrous, flat and green-yellow shiny above, not papillose below; blades oblong-lanceolate, 7–11 × 2–4 cm, base cuneate, apex acute-acuminate; midrib flat above; lateral veins 4–5 pairs, intramarginal vein indistinct; intercostal venation finely reticulate on both surfaces, areoles all of about the same size, small, c. 0.5 mm diameter; glands inconspicuous; petioles 8–12 mm long, glabrous, transversely wrinkled, without glands. **Inflorescences** 5–10 cm long, branched, minutely light brown hairy. **Flowers** 2 together at base, other flowers solitary; pedicels 2–3 mm long, hairy; perianth, stamens and pistil not seen; developing ovary and immature fruit sessile, globose, 4–6 mm diameter, (not densely) hairy all around, light green, ovules 4. **Fruits** unknown.

Distribution. Endemic in Borneo (Sabah and Kalimantan). In Sabah, known from Kinabatangan and Sandakan districts (e.g., *SAN 46624*, *SAN 71499* and *SAN 108778*) and in Kalimantan from Kutai (e.g., *Ariffin & Abriansyah AA 968* and *Sidiyasa 1118*).

Ecology. Lowland forest on brown soil over ultrabasic rock, at 100–400 m altitude.

28. *Xanthophyllum obscurum* A.W.Benn.

(Latin, *obscurus* = dark; referring to dark drying colour of the dried flower and fruit)

(subgen. *Brunophyllum*)

In Hooker f., Fl. Br. Ind. 1 (1874) 211; King *op. cit.* 141; Ridley *op. cit.* (1922) 144; Ng *op. cit.* (1972) 361, *op. cit.* (1975) 89; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 145, *op. cit.* (1988) 536; Kessler & Sidiyasa *op. cit.* 194; Turner *op. cit.* 406; Coode *et al.* (eds.) *op. cit.* 256; Argent *et al.* (eds.) 510; Pendry *op. cit.* 534. **Type:** *Maingay 144* (= *Kew Distr. 3115*), Singapore (holotype K). **Synonyms:** *X. insigne* A.W.Benn. *in* Hooker f. *op. cit.* 211, King *op. cit.* 144; *X. scortechinii* King *op. cit.* 140, Ridley *op. cit.* (1922) 143, Ng *op. cit.* (1972) 363, Anderson *op. cit.* (1980) 288.

Tree, 15–35 m tall and 20–55 cm diameter. **Bark** pale, brown-grey, smooth. **Sapwood** white or yellowish. **Twigs** glabrous, often thickened on the nodes and with adventitious

buds; nodal glands usually distinct, circular or elongate, c. 0.5 mm diameter. **Axillary buds** solitary, to 0.5 mm long. **Leaves** glabrous, flat and dark brown or greyish red-brown above, not papillose below; blades ovate to elliptical, (4-)7.5-17 × (1.5-)3.5-9 cm, base cuneate, apex rounded to obtuse or sometimes short-acuminate; midrib prominent or flat above; lateral veins (3-)6-9 pairs, sometimes in upper part forming an intramarginal vein; intercostal venation coarsely reticulate; glands 2-16, usually located near or on the margin, (0.2-)0.5-0.7(-1) mm diameter; petioles 5-11(-15) mm long, glabrous, without glands, transversely wrinkled. **Inflorescences** sometimes also on the older nodes, shorter than the leaves, unbranched; axes black, glabrous to sparsely short woolly hairy. **Flowers** black when dry; pedicels 3-11 mm long; outer sepals 3-5.5 mm long, inner sepals 4-7.5 mm long; petals unequal, white or purple, the upper ones with a yellow or green spot, inside glabrous or woolly hairy above insertion of filaments and at apex, the longest one 14-19 mm long, keel boat-shaped, 9.5-16 mm long, lateral petals spatulate, longer than upper petals and keel, upper petals more or less linear, flat to slightly channelled, curved upwards; stamens 7.5-12 mm long, filaments connate for (0.1-)1-3 mm, glabrous, free parts woolly hairy at base, the hairs often intertwined, forming a filamental 'tube', glabrous upwards, anthers 0.7-1.7 mm long, glabrous to minutely hairy, free or coherent around the stigma; ovary black, glabrous, style glabrous, stigma peltate, ovules 8-18. **Fruits** globose, (4-)5-7(-14) cm diameter, dull brown or blackish; pericarp 0.5-2 cm thick, not wrinkled, glabrous; fruiting pedicels 5-10 mm long, 5-15 mm thick. **Seeds** 8-16, sticking together like a ball on drying.

Vernacular names. Sarawak—*langir* (Malay), *mangkok* (Iban), *masa pinsang* (Iban), *ngilas* (Malay).

Distribution. S Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, common and found in almost all districts (e.g., SAN 40554, SAN 56887, SAN 66027, SAN 110636 and SAN 135910). In Sarawak, recorded from Bintulu, Kuching, Lundu, Marudi, Miri, Serian and Song districts (e.g., S 6391, S 17003, S 26991, S 38006 and S 70902). Also occurring in Brunei (e.g., BRUN 17696 and Coode *et al.* 7870) and Kalimantan (e.g., van Balgooy 6085, Burley 2473, Kostermans 10160, Nootboom 4409 and Sidiyasa 2182).

Ecology. Lowland mixed dipterocarp forest, on flat land and hillsides and in lower montane forest, at altitudes to 1800 m, on sandstone-derived, yellow clayey soil, brown soil, black soil or sandy loam soil. Occasionally also occurs in *kerangas* forest.

Uses. The fruit is reported as edible. In Kalimantan, the wood is used for making knife sheaths.

29. *Xanthophyllum ovatifolium* Chodat

(Latin, *ovatus* = ovate, *folium* = leaf; referring to the shape of the leaf)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bull. Herb. Boiss. 4 (1896) 258; Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 380; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 83; *op. cit.* (1988) 508. **Type:** *Haviland 2090*, Borneo, Sarawak, Kuching district (holotype K; isotypes BM, L, SAR, SING).

Tree. **Twigs** glabrous, slender, smooth, without nodal glands. **Axillary buds** in clusters of 2 (or 3), 1–1.8 mm long; glands present or not. **Leaves** glabrous, flat and rather dull, brownish to greenish above, dull and not papillose below; blades ovate-elliptical, 3.5–9.5 × 1.4–6 cm, base rounded or broadly cuneate, apex acute, mostly cuspidate; midrib above slightly prominent at base; lateral veins 3–4 pairs, not forming an intramarginal vein; intercostal venation finely reticulate; glands 8–20, usually located halfway between margin and midrib, 0.4–0.6 mm diameter, basal glands usually present; petioles 3–5(–6) mm long, glabrous, without glands, transversely wrinkled. **Inflorescences** shorter than the leaves, unbranched, 4–6-flowered; axes brownish, glabrous to sparsely appressed hairy. **Flowers:** pedicels 7–8 mm long; sepals glabrous outside, outer sepals c. 2.8 × 1.7 mm, inner sepals 3–3.5 × 1.8–2 mm; petals white, drying pale brownish, ciliate at apex and base, for the rest glabrous, the longest one 9–10 mm long; filaments free, anthers 0.3–0.4 mm long, glabrous; ovary glabrous, style sparsely appressed hairy basally, stigma slightly 2-lobed, ovules 4. **Fruits** unknown.

Distribution. Sumatra (doubtful) and Borneo (Sarawak). In Sarawak uncommon and known from Kuching and Lundu districts (e.g., Haviland 2090, Haviland 2087 and S 7433).

30. *Xanthophyllum pachycarpon* W.J.de Wilde & Duyfjes

(Greek, *pachus* = thick, *karpos* = fruit; referring to the thick-walled fruits)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 58. **Type:** *Lai et al.* S 69651, Borneo, Sarawak, Lubok Antu district, Nanga Segara, Sg. Engkari (holotype SAR; isotypes K, KEP, L, MO, SAN).

Tree, 12–30 m tall and to 30 cm diameter. **Bark** greyish or darkish green, smooth or with large warty lenticels. **Sapwood** orange-yellow. **Twigs** slender, glabrous, smooth, yellowish, without nodal glands. **Axillary buds** solitary, long-triangular, 1–1.5 mm long, glabrous. **Leaves** glabrous, flat and green-brown or light brown above, not papillose below; blades oblong, 8–16 × 2.5–6 cm, base cuneate, apex acute-acuminate; midrib slightly raised on both sides; lateral veins 4–6 pairs, forming an irregular intramarginal vein; intercostal venation finely and sharply reticulate on both surfaces; glands inconspicuous; petioles 6–12 mm long, longitudinally and transversely wrinkled, glabrous, without glands. **Inflorescences** much shorter than the leaves, unbranched, 7–10-flowered (flower-scars); axes short-hairy, glabrescent. **Flowers** unknown. **Fruits** globose, 2–3 cm diameter, light brown, coarsely (brain-like) wrinkled on drying, glabrous; pericarp 5–10 mm thick, solid or spongy by irregularly sized, scattered hollows; fruiting pedicels 3–4 mm long. **Seed** 1.

Vernacular names. Sarawak—*mangkok* (Iban), *sambubu* (Malay), *sabetong* (Kayan).

Distribution. Endemic in Borneo (Sabah, Sarawak and W Kalimantan). In Sabah, known from Keningau, Kinabatangan, Labuk Sugut, Ranau, Sandakan and Tenom districts (e.g., SAN 51297, SAN 52099, SAN 65263, SAN 78258 and SAN 97680) and in Sarawak from Belaga, Lubok Antu and Serian districts (e.g., S 3525, S 27397 and S 69651). In W Kalimantan, collected twice from Serawai area (*Church et al.* 1524 and *Church et al.* 5626).

Ecology. Mixed dipterocarp forest, on hillridges and hillsides, at altitudes to 650 m, occurs also in forest on brown soil over ultrabasic bedrock.

Notes. *Xanthophyllum pachycarpon* vegetatively resembles *X. nitidum* but the latter differs by its finer but sharper intercostal venation, branched inflorescences and hairy young fruits.

31. *Xanthophyllum parvifolium* Meijden

Fig. 8.

(Latin, *parvus* = small, *folium* = leaf; with small leaves)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bot. J. Linn. Soc. 67 (1973) 119, *op. cit.* (1982) 88, *op. cit.* (1988) 510; Anderson *op. cit.* (1980) 287.

Type: *Ilias S 5396*, Borneo, Sarawak, Samarahan district, Sabal FR (holotype L; isotypes KEP, SAN, SAR, SING).

Tree, 10–25 m tall and 15–30 cm diameter. **Bark** (yellowish) greyish, smooth. **Twigs** smooth, without nodal glands, glabrous, slender, c. 0.5 mm diameter, forming short shoots bearing 2 or 3 leaves. **Axillary buds** in clusters of two, c. 1 mm long. **Leaves** glabrous, more or less discolorous, flat, shiny and yellowish or greenish brown above, (indistinctly) papillose, yellowish to reddish brown below; blades elliptical-oblong, 1.5–5(–6) × 0.5–2 cm, base rounded or cuneate, apex long-acuminate with rounded tip; midrib flat or slightly prominent above; lateral veins 1–3 pairs, indistinct, forming an indistinct intramarginal vein; intercostal venation indistinct, reticulate; glands numerous, scattered, c. 0.1 mm diameter; petioles 2–2.5 mm long, glabrous, transversely wrinkled, without glands. **Inflorescences** (sub)apical, to 3.5 cm long, glabrous, unbranched; axes c. 0.5 mm diameter, 1–3-flowered. **Flowers:** pedicels 6–11 mm long; sepals purplish, (sub)glabrous outside, outer sepals c. 2 mm long, inner sepals 3–3.5 mm long; petals pale orange, drying orange brown, sparsely hairy at base and at apex, for the rest glabrous, the longest one 10–11 mm long; filaments free, filaments widened and thickened above the base and there densely patently short-hairy, for the rest glabrous, anthers c. 0.4 mm long, with few short hairs at base; ovary c. 1 mm stipitate, appressed hairy, style sparsely appressed hairy in lower half, stigma slightly 2-lobed, ovules 4. **Fruits** short stipitate, globose, 1–1.2 cm diameter, dull, pale brown, sparsely appressed short-hairy; pericarp thin; fruiting pedicels slender, 7–11 mm long, glabrous. **Seed** 1.

Distribution. Endemic in Borneo (Sarawak and Brunei). In Sarawak known from Limbang, Lundu, Miri, Mukah and Samarahan districts (e.g., *S 5396*, *S 38315*, *S 38418*, *S 43019*, *S 49968* and *S 79021*). In Brunei, represented by one collection (*Ashton 3332*) from Belait district.

Ecology. Mixed dipterocarp forest and *kerangas* forest, at 30–1200 m altitude.

Notes. *Xanthophyllum parvifolium* is close to *X. ovatifolium* but the latter differs from the former by its *non-papillose* lower leaf surface.

32. *Xanthophyllum pauciflorum* Meijden

(Latin, *paucis* = few, *flos* = flower; referring to the few-flowered inflorescence)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bot. J. Linn. Soc. 67 (1973) 119, *op. cit.* (1982) 87, *op. cit.* (1988) 509. **Type:** *Sibat S 21934*, Borneo, Sarawak, Tatau district, Bt. Mersing (holotype L; isotypes K, KEP, P, SAN, SAR, SING).

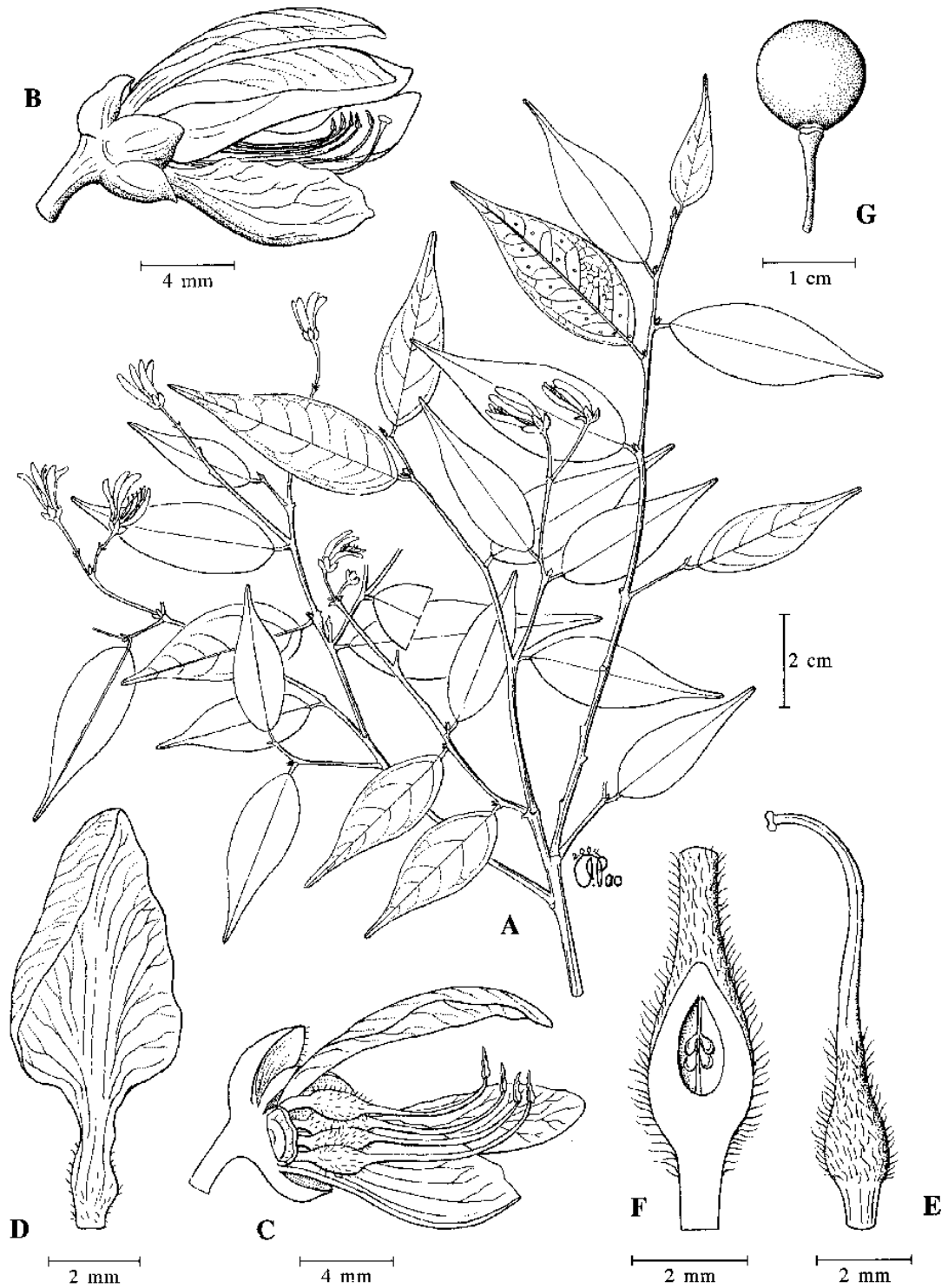


Fig. 8. *Xanthophyllum parvifolium*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoeceum removed; D, lower petal; E, gynoeceum; F, longitudinal section of ovary; G, fruit. (A–F from S 43019, G from S 38315.)

Tree, 7–25 m tall and 7–25 cm diameter. **Bark** greyish, smooth. **Sapwood** brown. **Twigs** smooth, without nodal glands, glabrous, slender, more or less as thick as petioles, flush only a few internodes long. **Axillary buds** in pairs, small, 0.5–1.5 mm long. **Leaves** glabrous, flat and (dull) green above, papillose below; blades oblong to lanceolate, 5–8(–9) × 1.2–2.5(–3.5) cm, base acute, apex acuminate or cuspidate; midrib flat or raised above; lateral veins 4–6 pairs, not forming an intramarginal vein; intercostal venation reticulate; glands 2–7, minute, c. 0.2 mm diameter; petioles 3.5–4.5 mm long, transversely wrinkled, glabrous, without glands. **Inflorescences** much shorter than the leaves, 3–6-flowered, unbranched; axes slender, to 5 cm long, glabrous or sparsely patently short hairy. **Flowers:** pedicels 1.5–3 mm long, sepals with a small apical tuft, outer sepals c. 2 mm long, sparsely short-hairy outside, inner sepals c. 2.7 mm long, glabrous outside; petals yellowish, drying yellowish orange, sparsely hairy or glabrous outside, ciliate and apically tufted, at base densely hairy at both sides, the longest one 7.5–8.5 mm long; filaments free, anthers c. 0.4 mm long, with few hairs at base; ovary patently or appressed hairy, stigma slightly 2-lobed, ovules 4. **Fruits** globose, 1–1.7 cm diameter, olive-brown, smooth, with a distinct remnant of style, roughly hairy, glabrescent or glabrous; fruiting pedicels 2–5 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sarawak and Brunei). In Sarawak, known from Sri Aman and Tatau districts (e.g., *Chai ITTO/BC 109*, *S 21887*, *S 21934*, *S 21965* and *S 22387*). In Brunei, recorded from Tutong district (e.g., *BRUN 15558*).

Ecology. Mixed dipterocarp forest on basalt ridges or hillsides, at 250–800 m altitudes.

33. *Xanthophyllum pedicellatum* Meijden

(referring to the long pedicel)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Leiden Bot. Ser. 7 (1982) 113, *op. cit.* (1988) 522; Argent *et al.* (eds.) *op. cit.* 510. **Type:** Wood SAN 15009, Borneo, Sabah, Lahad Datu district, Bt. Silam (holotype L; isotypes BRI, KEP, SAN, SING).

Shrub, treelet or tree, 5–20 m tall, 5–20 cm diameter. **Bark** greyish or greenish, smooth. **Sapwood** pale yellow. **Twigs** 1–2 mm diameter, densely brownish patently long-hairy (hairs 0.5–1 mm long), glabrescent, without nodal glands. **Axillary buds** solitary, narrowly triangular, 1.5–3.5 mm long, hairy. **Leaves** discolorous, flat, dark green and shiny above, patently long-hairy (mainly on midrib) and papillose below; blades narrowly elliptical, 5–11 × 1.5–4 cm, base cuneate to rounded or slightly cordate, apex usually acutish; lateral veins 7–8 pairs, forming an indistinct intramarginal vein or not; intercostal venation reticulate; glands numerous, scattered, c. 0.1 mm diameter; petioles 1.5–3 mm long, patently long-hairy, smooth, without glands. **Inflorescences** as long as the leaves, unbranched; axes densely patently hairy, with hairs to 0.5 mm long. **Flowers:** pedicels 10–15 mm long; sepals sparsely minutely hairy outside, glabrous inside except at base; outer sepals 2–2.5 mm long, inner sepals 3–3.5 mm long; petals pinkish, drying orange-red, glabrous except for the ciliate base, the longest one 12.5 mm long; filaments (almost) free, anthers c. 1.5 mm long, sparsely minutely hairy at base; ovary subsessile, brownish half-patently hairy, style glabrous in apical part, stigma slightly 2-lobed, ovules 9–11. **Fruits** globose, c. 2 cm diameter, pale brownish, hairy; pericarp thin; fruiting pedicels 11–15 mm long. **Seed** 1.

Vernacular name. Sabah—*kandis dahan* (Kedayan).

Distribution. Endemic in Borneo (Sabah and Sarawak). In Sabah, known from Kinabatangan, Lahad Datu, Pensiangan and Sandakan districts (e.g., *SAN 37155*, *SAN 54141*, *SAN 62417*, *SAN 97398* and *SAN 131701*) and in Sarawak, recorded by one collection (*Zainudin et al. AZ 5705*) from Sg. Berangan, Belaga district.

Ecology. Lowland forest on hillslopes or ridges, also in swampy areas, at altitudes to 500 m, on brown or black soil, sandy soil, sandstone-derived soil and black soil over ultrabasic bedrock.

Notes. *Xanthophyllum pedicellatum* is closely related to *X. beccarianum* and possibly representing a delicate-branched ecotype of the latter. The differences between these two species as well as with other related species (e.g., *X. brachystachyum*, *X. purpureum*, *X. reticulatum* and *X. trichocladum*) need further study.

34. *Xanthophyllum penibukanense* Heine

Fig. 9.

(After the village Penibukan, Sabah)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Mitt. Bot. Staatssamml. München 6 (1953) 215, Pflz. Clemens Kinab. (1953) 50; Meijden *op. cit.* (1982) 110, *op. cit.* (1988) 521; Argent *et al.* (eds.) *op. cit.* 510; Beaman & Anderson *op. cit.* 265. **Lectotype** (Meijden, 1982): *Clemens 40794*, Borneo, Sabah, Ranau district, Mt. Kinabalu (M; isolectotypes B, BM, G, K, L).

Shrub, treelet or tree, 3–12 m tall, 5–20 cm diameter. **Bark** grey(-green), smooth. **Sapwood** orange-yellow. **Twigs** smooth, without nodal glands, glabrous. **Axillary buds** solitary, ovate-oblong, 3–7 mm long, acute, flat but basally thickened, where often with exuberant cork-formation which may hide the scales completely, greyish to cream-coloured, more or less shiny. **Leaves** chartaceous, glabrous, discolorous, flat, dark green and shiny above, contrastingly paler and papillose below; blades ovate-(narrowly) elliptical, 7–18 × 2.5–7 cm, base long-attenuate, apex acute-acuminate; midrib slightly sunken or more or less prominent above; lateral veins and intercostal venation distinct; lateral veins 4–6 pairs, forming a distinct intramarginal vein in apical part, lowermost veins reaching to or over halfway up the blade; intercostal venation reticulate; glands numerous, scattered, 0.1–0.2 mm diameter; petioles 8–15 mm long, merging into the long-attenuate leaf base, blackish, glabrous, often transversely wrinkled, without glands. **Inflorescences** as long as or shorter than the leaves, unbranched; axes minutely sparsely appressed hairy or (sub)glabrous, on basal part flowers in clusters of up to 3. **Flowers:** pedicels 2–6 mm long, minutely appressed hairy; sepals sparsely hairy along the midrib or (sub)glabrous outside, often some with glandular spots, outer sepals c. 3 mm long, inner sepals 3–3.5 mm long; petals creamy white to pale purplish, the upper ones with a yellow spot, drying orange, glabrous outside, apically and basally ciliate, the longest one 11–13 mm long; filaments up to 2.5 mm connate, anthers c. 1.5 mm long, often minutely hairy all over; ovary 1–2 mm stipitate, densely hairy or partly glabrous, style thinly appressed hairy in basal part, stigma slightly 2-lobed, ovules 8–12. **Fruits** globose, c. 1.5 cm diameter, more or less shiny, brownish, glabrous or nearly so; pericarp thin; fruiting pedicels 4–10 mm long. **Seed** 1.

Vernacular names. Sarawak—*blutai* (Kenyah), *sigarangan* (Kelabit).

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and E Kalimantan). In Sabah, known from Keningau, Kota Belud, Penampang and Ranau districts (e.g., *Kokawa 5369*, *RSNB 1264*, *SAN 53972*, *SAN 85444* and *SAN 113012*) and in Sarawak from Bau, Belaga, Bintulu, Kuching, Limbang, Marudi, Miri and Samarahan districts (e.g., *S 24001*, *S 29205*, *S 43614*, *S 55223*, *S 74388* and *S 80873*). In Brunei recorded by one collection (*Kessler 424*) from Belait district and in Kalimantan from Sekatak and Sanggau (e.g., *Murata et al. s.n.* and *de Jong 308*).

Ecology. Mixed dipterocarp forest and lower montane forest, at altitudes to 1500 m, near streams, on hills or ridges, on limestone rock or sandy (loam) soil. Occasionally also in *kerangas* forest.

Notes. A species with variable indumentum of the ovary.

Uses. In Sarawak, the wood is used for making knife handles.

35. *Xanthophyllum pseudoadenotus* Meijden

(Greek, *pseudein* = deceive; referring to the similarity to *X. adenotus*)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Leiden Bot. Ser. 7 (1982) 110, *p.p. (excl. syn.)*, *op. cit.* (1988) 521, *p.p. (excl. syn.)*. **Type:** *Haviland 2113*, Borneo, Sarawak (holotype K; isotypes SAR, SING).

Treelet or small tree, 3–12 m tall. **Twigs** smooth, grey-brown, early glabrescent, 2–4 mm diameter, without nodal glands. **Axillary buds** solitary, long-triangular, 4–6 mm long, grey-brown, glabrous. **Leaves** glabrous, discolorous, flat and dark green above, pale cinnamon yellowish and papillose below; blades narrowly (ovate-)elliptical, 18–35 × 5.5–10 cm, base attenuate, apex acute-acuminate; midrib pale, raised above; lateral veins 12–14 pairs, rather patent, lower pairs not reaching the middle of blade, forming a faint intramarginal vein; intercostal venation reticulate; glands numerous, minute, less than 0.1 mm diameter, scattered; petioles 10–15 mm long, glabrous, longitudinally or transversely wrinkled, without glands. **Inflorescences** 5–7 cm long, unbranched, with 10–15 flowers; axes subglabrous. **Flowers:** pedicels 5–6 mm long, minutely appressed hairy, hairs *c.* 0.1 mm long; sepals 2–3.2 mm long; petals subglabrous, brownish orange on drying, the longest one *c.* 15 mm long; filaments *c.* 1.5 mm connate, anthers *c.* 2 mm long, ciliate along slits; ovary with appressed hairs 0.1–0.2 mm long, style glabrous in apical part, stigma slightly 2-lobed, ovules 9–11. **Fruits** globose, *c.* 1.5 cm diameter, greenish or brown, minutely appressed hairy, glabrescent; pericarp thin, brittle; fruiting pedicels 5–7 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sarawak and Kalimantan). In Sarawak, known from Belaga, Kuching and Miri districts (e.g., *Chew CWL 1153*, *Haviland 2113*, *S 35295* and *S 45496*). In W Kalimantan, known from Ngira (e.g., *de Jong 851*).

Ecology. Forest on stream banks, on sandy loam soil, at *c.* 200 m altitude.

Notes. The present circumscription of the species is different from the original one, leaving out specimens now included in *X. bicolor*, a species with longer petioles and a much narrowed leaf base, and in *X. pulchrum*, a species with shorter petioles and a cordate or rounded leaf base. *Xanthophyllum pseudoadenotus* resembles *X. adenotus*, a species with

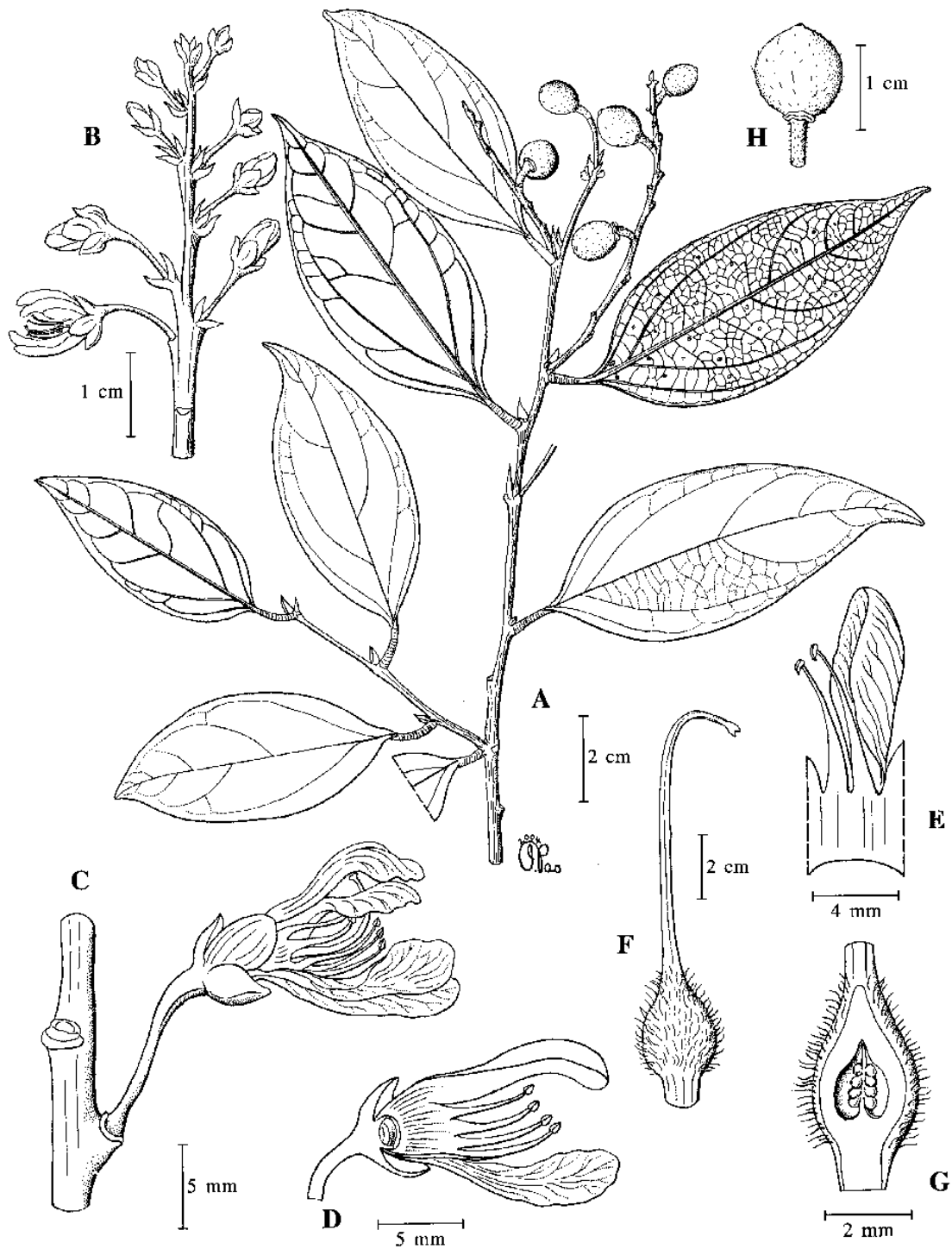


Fig. 9. *Xanthophyllum penibukanense*. A, fruiting leafy twig; B, inflorescence; C, open flower; D, longitudinal section of open flower with the gynoecium removed; E, adaxial view of petal and stamens; F, gynoecium; G, longitudinal section of ovary; H, fruit. (A from S 20112, B–G from S 36889, H from S 20112.)

branched inflorescences and a more or less concolourous, brown, *non-papillose* lower leaf surface.

36. *Xanthophyllum pulchrum* King

(Latin, *pulcher* = beautiful; referring to the tree)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

J. As. Soc. Beng. 59, 2 (1890) 141; Ridley *op. cit.* (1922) 146; Ng *op. cit.* (1972) 361; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 111, *op. cit.* (1988) 521; Turner *op. cit.* 406. **Lectotype** (Meijden, 1982): *King's Collector 2859*, Peninsular Malaysia, Perak (L; isolectotypes FI, G, K, L, P, Z). **Synonyms:** *X. densiflorum* Chodat, Bull. Herb. Boiss. 4 (1896) 256, Merrill *op. cit.* (1921) 325, Masamune *op. cit.* 379; *X. stapfii* Chodat, Bull. Herb. Boiss. 4 (1896) 260, *p.p.* (*excl. specim. Haviland 1620* [= *X. adenotus* Miq. var. *adenotus*]), Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 381; *X. hypoleucum* Merr. *op. cit.* (1929) 135, Masamune *op. cit.* 380; *X. pulchrum* King subsp. *stapfii* (Chodat) Meijden *op. cit.* (1982) 112, *op. cit.* (1988) 522.

Shrub, treelet or small tree, 2–11(–30) m tall, 3–20(–30) cm diameter. **Bark** grey, brown or pale greenish, smooth, lenticellate. **Sapwood** white, yellowish orange or brown. **Twigs** smooth, glabrous or patently short-hairy, at apex 2–4 mm diameter, without nodal glands. **Axillary buds** solitary, half-patent, ovate or oblong, 2–6 mm long, thickened in lower half, obtuse or acute, pale brown or reddish, often irregular because of cork-forming, adventitious buds often present. **Leaves** chartaceous, glabrous, discolourous, sometimes bullate between lateral veins and green above, papillose below; blade narrowly (ovate-)elliptical, 7–30 × 2–11 cm, base rounded-cordate, obtuse, or short cuneate, apex acutish; midrib flat or (indistinctly) prominent above; lateral veins 5–14 pairs, forming mostly an (indistinct) intramarginal vein in apical half; intercostal venation reticulate; glands numerous, scattered, 0.1–0.2 mm diameter; petioles 4–8 mm long, longitudinally or transversely wrinkled, glabrous or appressed short-hairy all round, the older ones transversely cracked and more or less corky, without glands. **Inflorescences** shorter than the leaves, few to many-flowered, at the ends of young twigs but also axillary, not rarely on old nodes, unbranched; axes (sparsely) short-hairy, on its basal part flowers in clusters of up to 3; bracts with glands, subsistent, lower ones (sub)opposite. **Flowers:** pedicels 2–8 mm long, glabrous or hairy; sepals often with glands, glabrous or hairy, outer sepals 2–5 mm long, inner sepals 3–6 mm long; petals pink or whitish, drying red or brownish orange, slightly hairy apically and basally inside, the longest one 11–18 mm long; filaments free or to 2 mm connate, anthers 2–2.5(–3.5) mm long, hairy at base or all over, ciliate along slits; ovary sessile or to 2 mm stipitate, whitish or pale brown hairy, style glabrous in apical part, stigma slightly 2-lobed, ovules 8–16. **Fruits** globose, 1–2 cm diameter, (sparsely) appressed hairy; pericarp thin, brittle, pale brown; fruiting pedicels 5–8 mm long. **Seed** 1.

Vernacular names. Sarawak—*menjalin* (Iban), *bait musang* (Iban), *penapan* (Iban).

Distribution. Peninsular Malaysia and Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, recorded from Keningau, Kinabatangan, Labuk Sugut, Lahat Datu, Pensiangan, Pitas, Ranau, Sandakan and Tawau districts (e.g., *SAN 21397*, *SAN 30359*, *SAN 44523*, *SAN 96510* and *SAN 108737*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Lundu, Marudi and Tatau districts (e.g., *S 21711*, *S 48606*, *S 69332* and *S 79474*). Also occurring in Brunei (e.g., *Flemmich FMS 34415*) and Kalimantan (e.g., *Kostermans 4673* and *Shea ANU 26377*).

Ecology. Mixed dipterocarp forest near streams, on hillsides, hilltops, slopes or ridges, or in swampy areas, on sandy clay soil or on limestone, also on ultrabasic bedrock, at altitudes to 1000 m.

Notes. Pending a detailed (field) study, we have disregarded the ambiguous character of the mode of wrinkling of the petiole to distinguish *Xanthophyllum pulchrum* subsp. *stapfii*, *X. pseudoadenotus* and Bornean specimens of *X. discolor* (partly), as applied by Meijden (*op. cit.* 1982, *op. cit.* 1988). Instead, we accepted *X. pulchrum* as a variable species, characterized by the petiole length and the shape of the leaf base. The species also resembles *X. bicolor* and *X. penibukanense* in many respects, and the differences need further investigation. *Xanthophyllum discolor* is regarded as a distinct species differing from *X. pulchrum* in the number of ovules per ovary (4–8 in the former and 8–16 in the latter), thinner twigs (1–1.5 vs. 2–4 mm diameter), smaller leaves (5–14 × 1.5–5 vs. 7–30 × 2–11 cm), longer petioles (8–12 vs. 4–8 mm) and shorter longest petals (10–11 vs. 11–18 mm). Most Bornean specimens previously identified by Meijden (1982) as *X. discolor* subsp. *discolor* (e.g., SAN 21397, SAN 30359, SAN 32718, SAN 35564 and SAN 36059) belong to *X. pulchrum*.

37. *Xanthophyllum purpureum* Ridl.

Fig. 10.

(Latin, *purpureus* = purple; referring to the purple flowers)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bull. Misc. Inform. Kew (1938) 114; Masamune *op. cit.* 381; Meijden *op. cit.* (1982) 114, *op. cit.* (1988) 522; Coode *et al.* (eds.) *op. cit.* 256; Beaman & Anderson *op. cit.* 266. **Type:** Moulton 174, Borneo, Sarawak (holotype K; isotype SING). **Synonym:** *X. molle* Ridl. *op. cit.* (1938) 114, Masamune *op. cit.* 380.

Shrub or small tree, 3–6 m tall, 2–20 cm diameter. **Bark** whitish or (dark) brown, smooth. **Sapwood** white, pale yellow or orange, hard. **Twigs** smooth, mostly densely dark rusty patently long-hairy, (1–)2–3 mm thick, without nodal glands. **Axillary buds** solitary, narrowly triangular, (1.5–)3–5 mm long, basally thickened. **Leaves** more or less densely patently long-hairy (hairs c. 0.5 mm long) all over or only on midrib and veins, more or less discolorous, flat and green above, papillose below; blades elliptical or narrowly elliptical, 8–20 × 2–9 cm, base cordate to rounded-attenuate, rarely cuneate, apex acutish; midrib slightly sunken to flat above; lateral veins (5–)6–7 pairs, not or only in apical part forming an intramarginal vein; intercostal venation reticulate; glands numerous, scattered, c. 0.1 mm diameter; petioles c. 5 mm long, smooth, densely patently long-hairy, without glands. **Inflorescences** shorter than the leaves, more than 1 cm long, unbranched; axes with sparse hairs to 0.2 mm long, few- to many-flowered, on its basal part the flowers often in clusters of 3. **Flowers:** pedicels 2–7 mm long; sepals minutely hairy outside (hairs 0.1 mm long), subglabrous inside, often with tiny, glandular spots, outer sepals 2–3 mm long, inner sepals 2.5–4 mm long; petals (light) purple to rose-violet, drying orange-red, ciliate at base and apex, for the rest glabrous, the longest one 11–12(–14) mm long; filaments free or 0.4 mm connate, anthers 1–1.5 mm long, glabrous or short hairy at base; ovary subsessile or c. 1.5 mm stipitate, patently hairy, style glabrous in apical half, stigma slightly 2-lobed, ovules 8–14. **Fruits** globose, 1–1.5 cm diameter, pale yellow-brown, hairy; pericarp thin; fruiting pedicels 3–7 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah common and recorded from most districts (e.g., *SAN 50479*, *SAN 72369*, *SAN 89392*, *SAN 92954* and *SAN 110469*). In Sarawak also common, known from Bintulu, Kapit, Kuching, Limbang, Marudi and Song districts (e.g., *S 26031*, *S 32237*, *S 40317*, *S 50302* and *S 65072*). Also occurring in Brunei (e.g., *Wong WKM 1235*) and in Kalimantan (e.g., *Church et al. 1586*, *Endert 3589*, *Nooteboom 4707* and *Peters 1033*).

Ecology. Mixed dipterocarp forest and lower montane forest, on hillsides, along ridges or streams, on yellow sandy loam soil, clay soil or on ultrabasic bedrock, at low altitudes to c. 1100 m. Occasionally occurs in *kerangas* forest.

Uses. In Kalimantan, the wood is used for general construction.

38. *Xanthophyllum ramiflorum* Meijden
(Latin *ramiflorus* = flowering on the older branches)

Fig. 11.

(subgen. **Coriaceum**)

Blumea 18 (1970), *op. cit.* (1982) 133, *op. cit.* (1988) 530; Anderson *op. cit.* (1980) 288; Coode *et al.* (eds.) *op. cit.* 256. **Type:** Anderson *S 16051*, Borneo, Sarawak, Kuching district, Bako NP (holotype L; isotypes SAR [not located], SING).

Shrub or tree, 5–30 m tall, to 40 cm diameter. **Bark** pale brown. **Twigs** smooth, nodes with a pair of annular glands, glabrous. **Axillary buds** in pairs, very indistinct when dormant, sunken into the tissue of the twig, the upper one when fully developed produces 2 broadly ovate 1–1.5 mm long persistent scales. **Leaves** coriaceous, glabrous, more or less discolorous, flat and brownish above, paler and papillose below; blades elliptical, 7–20 × 3–8 cm, base cuneate, apex blunt (obtuse to subacute); midrib slightly sunken to flat above; lateral veins c. 8 pairs, not forming an intramarginal vein; intercostal venation coarsely reticulate; glands numerous, scattered, c. 0.3 mm diameter; petioles (5–)8–12 mm long, glabrous, coarsely longitudinally and finely transversely wrinkled, without glands. **Inflorescences** solitary or up to 9 together in the axils of the lower leaves or lower down on the older twigs, unbranched, 1–10-flowered; axes to 1.5 cm long, thin, glabrous; nodal glands indistinct; bracts small, scale-like. **Flowers:** pedicels 8–10 mm long; sepals dark (reddish) when dry, glabrous except for ciliate margin, outer sepals c. 4 mm long, inner sepals 4.5–5 mm long; petals white, the upper ones with a purple mark, drying yellowish, minutely hairy in basal half on both sides, keel like the lateral petals but shorter, lateral petals 7.5–8.5 × 7 mm, upper petals up to 7 × 2 mm; stamens 8, exceptionally 7, monadelphous, filaments c. 5 mm long, 1.5–2 mm connate, densely short-hairy to about halfway, anthers 0.7–0.8 mm long, minutely ciliate and short hairy at base; ovary pale brownish, glabrous, style c. 5 mm long, glabrous, stigma peltate, oblique, ovules 8–12. **Fruits** 1–4 on the branches, glabrous, more or less globose, c. 1.2 cm diameter, pustulate, dull, reddish brown, the style-scar more or less protruding and excentric; fruiting pedicels c. 15 mm long. **Seeds** 1 or 2.

Vernacular name. Sarawak—*nyalin padang* (preferred name).

Distribution. Endemic in Borneo (Sarawak, Brunei and Kalimantan). In Sarawak, known from Julau, Kuching, Sibuan and Simunjan districts (e.g., *S 2614*, *S 12894*, *S 16051*, *S 27802*).

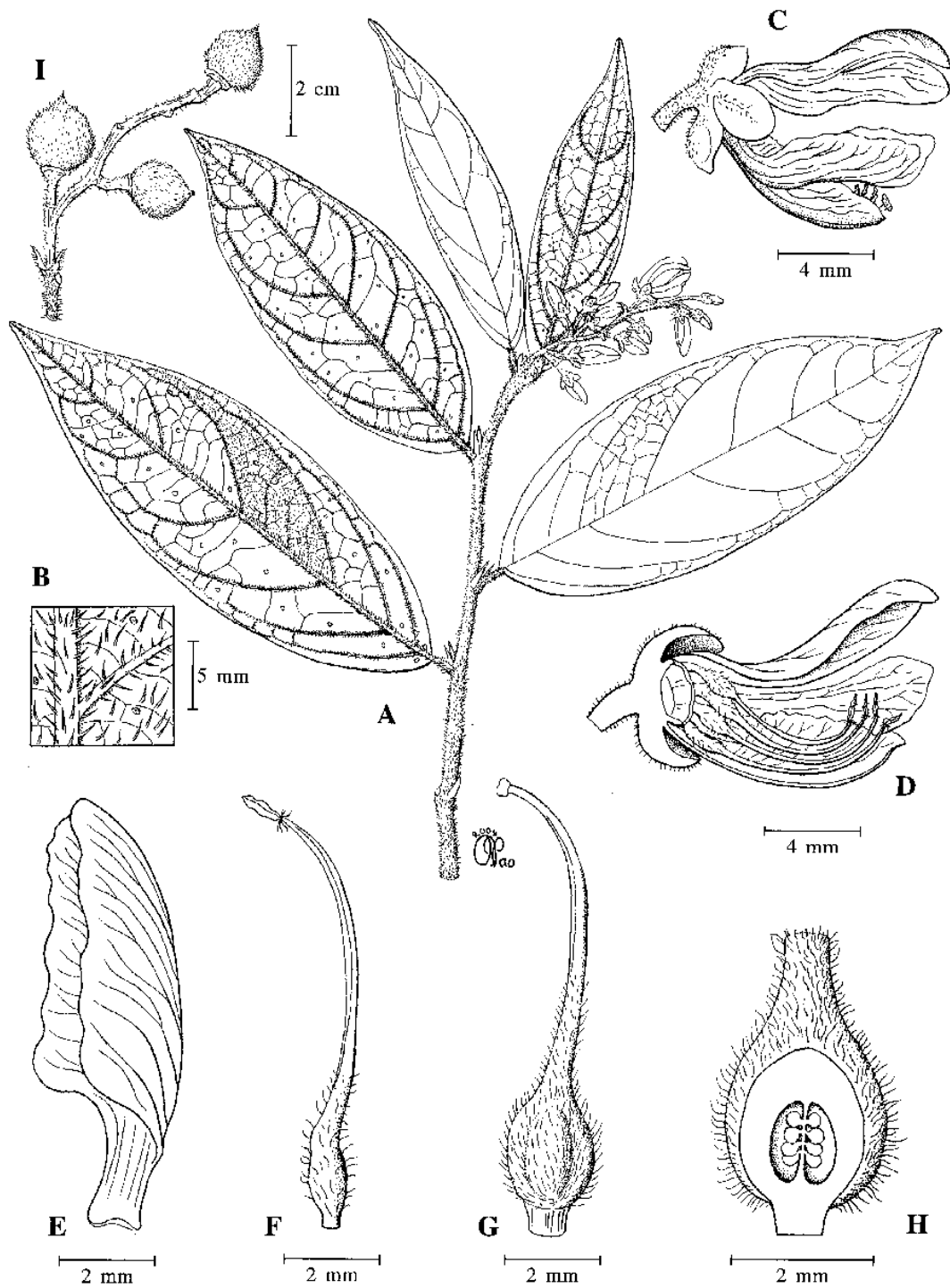


Fig. 10. *Xanthophyllum purpureum*. A, flowering leafy twig; B, detail of lower leaf surface with indumentum; C, open flower; D, longitudinal section of open flower with the gynoecium removed; E, lower petal; F, stamen; G, gynoecium; H, longitudinal section of ovary; I, infructescence. (A–H from SAN 139519, I from SAN 86027.)

and *S* 30529). In Brunei, recorded from Belait district (e.g., *BRUN* 977 and *S* 2830) and in W Kalimantan from Danau Santarum Wildlife Sanctuary (e.g., *Zulkarnain et al.* 475).

Ecology. Confined to peat swamp forest and *kerangas* forest on poor, sandy, wet soil.

39. *Xanthophyllum rectum* W.J.de Wilde & Duyfjes

(Latin, *rectus* = upright; referring to the inflorescences)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 59. **Type:** *Ilias S* 17903, Borneo, Sarawak, Kuching district, Bako National Park (holotype SAR; isotypes A, BO, K, KEP, L, MEL, SAR, SING).

Tree, 5–12 m tall, to 20 cm diameter. **Bark** pale grey, smooth or finely fissured; inner bark yellow-brown. **Twigs** black, smooth, glabrous, c. 5 mm thick, without nodal glands. **Axillary buds**, solitary, less than 0.5 mm long, subglabrous. **Leaves** coriaceous, glabrous, flat and dark grey(-green) brown above, chocolate-brown and not papillose below; blades elliptical-oblong, 7–13 × 3–7.5 cm, base rounded or short-cuneate, apex acute-acuminate (tip bluntish); midrib flat or slightly raised above; lateral veins 4–7 pairs, not forming an intramarginal vein; intercostal venation reticulate, raised and distinct below; glands absent or inconspicuous; petioles 7–12 mm long, glabrous, transversely wrinkled, without glands. **Inflorescences** stout, straight, erect, unbranched, 15–20-flowered; axes 8–13 cm long, 2–8 mm thick, sparsely minutely appressed brown-hairy. **Flowers** solitary, pale purple, drying blackish; pedicels c. 1 mm long; sepals c. 4 mm long, densely brown-hairy outside, somewhat hairy inside; petals c. 8 mm long, keel densely appressed brown-hairy outside, other petals tufted brown-hairy at base, for the rest glabrous; filaments free, c. 5 mm long, widened and patently brown-hairy above base, for the rest glabrous; pistil c. 3 mm long; anthers and mature stigma not seen; ovary sessile, patently (densely) hairy all around, stigma slightly 2-lobed, ovules 4. **Fruits** globose, c. 1.8 cm diameter, smooth, more or less shiny, dark-brown, more or less sparingly hairy all around, glabrescent; pericarp thin; fruiting pedicels c. 2.5 mm long, 3–4 mm thick. **Seed** 1.

Distribution. Endemic in Borneo and confined to Sarawak, where it is known from Bako NP and Sampadi FR in Kuching district (e.g., *S* 4446, *S* 17903, *S* 65493 and *S* 66789).

Ecology. Lowland *kerangas* forest, ridge dipterocarp forest, and rocky *padang* forest.

40. *Xanthophyllum reflexum* Meijden

(Latin, *reflectere* = bend backwards; referring to reflexed petals)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Leiden Bot. Ser. 7 (1982) 104, *op. cit.* (1988) 519; Beaman & Anderson *op. cit.* 266. **Type:** *Othman S* 32576, Borneo, Sarawak, Kuching district, Semengoh FR (holotype L; isotypes SAN, SAR, SING).

Tree, to 16 m tall, to 20 cm diameter. **Bark** whitish brown or pale greenish yellow, smooth, older trunk regularly set with pustulate lenticels 4–7 mm diameter. **Twigs** minutely patently short-hairy, lengthwise faintly grooved, without nodal glands. **Axillary buds** solitary, erect, appressed against twig, scales laterally flattened, triangular, 3–4.5 mm long, minutely

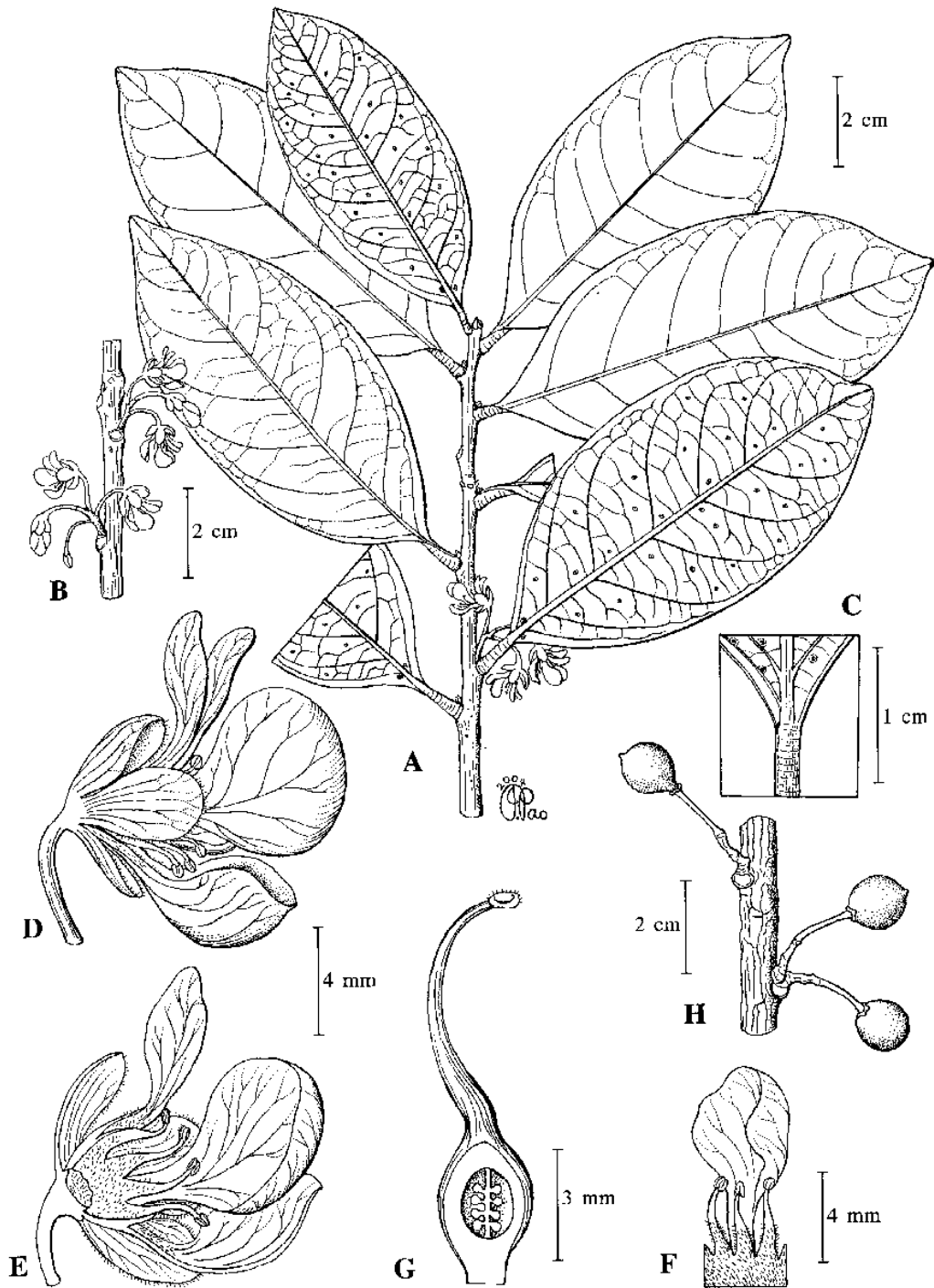


Fig. 11. *Xanthophyllum ramiflorum*. A, flowering leafy twig; B, twig with infructescences; C, detail of lower leaf base with glands; D, open flower; E, longitudinal section of open flower with the gynoecium removed; F, adaxial view of lower petal and 3 stamens; G, gynoecium with longitudinal section of ovary; H, twig with infructescences. (A–G from *S* 16051, H from *S* 12894.)

patently hairy. **Leaves** (sub)coriaceous, *glabrous, flat* and dull, greenish or yellowish brown above, *not papillose below*; blades narrowly (obovate-)elliptical, 11–18 × 3.5–5.5 cm; midrib more or less sunken above; lateral veins 6–9 pairs, indistinct, *in apical part forming an indistinct intramarginal vein*; intercostal venation obscure, *reticulate*; glands 2 (or 3), located near the leaf base, 0.4–0.7 mm diameter; petioles 9–10 mm long, somewhat wrinkled, *densely minutely short-hairy, without glands*. **Inflorescences** shorter or longer than the leaves, *branched*; axes dark, densely patently hairy; lower bracts opposite. **Flowers**: pedicels 2.5–3 mm long; outer sepals 2–2.5 mm long, inner sepals *c.* 4 mm long; petals unequal in length, yellowish white, drying dark red, the longest one 13–14 mm long, keel densely more or less appressed hairy outside, other petals glabrous, reflexed; *filaments free*, widened above base and with a knob-like short hairy appendage at inner side, for the rest glabrous, anthers 0.7–0.8 mm long, hairy or nearly glabrous at base; *ovary* subsessile, *half-patently hairy all around*, style pilose, *stigma slightly hairy*, *ovules 4*. **Fruits** unknown.

Distribution. Endemic in Borneo and confined to Sarawak where the species is known by two collections from Semengoh FR (*S 32576* and *S 91158*).

Ecology. Lowland mixed dipterocarp forest.

41. **Xanthophyllum resupinatum** Meijden

(Latin, *resupinare* = reversed; referring to the leaves looking as if they were turned upside-down)

(subgen. **Xanthophyllum**, sect. **Xanthophyllum**)

Bot. J. Linn. Soc. 67 (1973) 120, *op. cit.* (1982) 74, *op. cit.* (1988) 504; Coode *et al.* (eds.) *op. cit.* 256; Argent *et al.* (eds.) *op. cit.* 511. **Type**: Chai SAN 29838, Borneo, Sabah, Tawau district, Kalumpang (holotype L; isotypes K, SAN, SAR, SING).

Tree, 5–25 m tall, 10–40 cm diameter. **Bark** grey or (dark) brown, smooth or flaking. **Sapwood** white or orange. **Twigs** *smooth, glabrous, without nodal glands*. **Axillary buds** *solitary, inconspicuous, less than 0.5 mm long, more or less enclosed between basal part of the petiole and the twig*. **Leaves** *glabrous, flat, shiny and greenish above, yellowish brown to greenish brown, shiny and not papillose below*; blades elliptical (oblong), 6–12.5 × 2.7–5 cm, *base attenuate into a narrow petiole-like part*, apex acute-acuminate; midrib *conspicuously prominent above, flat, sunken or faintly prominent below*; lateral veins 4–7 pairs, *forming an incomplete, indistinct intramarginal vein*; intercostal venation *scalariform*, indistinct; *glands few, mostly located above the middle of the leaf*, 0.3–0.7 mm diameter; petioles 4.5–7 mm long, appearing longer because of the narrow leaf base, *transversely wrinkled, without glands*. **Inflorescences** borne on the upper parts of twigs, shorter than the leaves, *(un)branched*; axes appressed greyish hairy. **Flowers**: pedicels 4–5 mm long; sepals dark brown to blackish when dry, with scattered minute glandular dots, outer ones *c.* 3 mm long, sometimes with 2 protruding glands halfway, inner sepals 4–5 mm long, slightly keeled; petals white, drying dark brownish, the longest one 7–9 mm long, keel densely half-patently greyish hairy outside, more or less hairy inside near apex, other petals glabrous; *filaments free*, anthers 0.5–0.7 mm long, faintly hairy; *ovary* dark brownish, ribbed, *glabrous or appressed hairy on the ribs in apical part, stigma slightly 2-lobed, ovules 9–14*. **Fruits** globose, *c.* 1.2 cm diameter, blackish, shiny, smooth or finely pustulate; pericarp rather thin, hard; fruiting pedicels 4–5 mm long. **Seed** 1.

Vernacular name. Sarawak—*mangkok* (Iban).

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and N & E Kalimantan). In Sabah, recorded from Sandakan, Semporna and Tawau districts (e.g., *SAN 29606*, *SAN 30405*, *SAN 46327*, *SAN 48298* and *SAN 57381*) and in Sarawak from Belaga and Kapit districts (e.g., *S 3574*, *S 3582*, *S 33144* and *S 41659*). Also occurring in Brunei (e.g., *BRUN 624*, *Dransfield et al. 6636* and *Kirkup 313*) and Kalimantan (e.g., *Burley et al. 872*, *Church et al. 1311* and *Sidiyasa PBU 216*).

Ecology. Mixed dipterocarp forest on flat land, hillsides or sandy ridges, at altitudes to 600 m.

Notes. *Xanthophyllum resupinatum* resembles *X. subcoriaceum* but the latter differs from the former by its reticulate intercostal venation.

42. *Xanthophyllum reticulatum* Chodat

(Latin, *reticulatus* = netted; referring to the leaf intercostal venation)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

In Merrill, PEB (1929) 136; Masamune *op. cit.* 381; Meijden *op. cit.* (1982) 114, *op. cit.* (1988) 523; Coode *et al.* (eds.) *op. cit.* 257. **Lectotype** (Meijden, 1982); *Elmer 21119*, Borneo, Sabah, Tawau (L; isolectotypes BM, BO, BR, BRI, C, G, K, M, P, SING).

Shrub, treelet or small tree, 2–15 m tall. **Bark** whitish. **Sapwood** yellowish or light greenish. **Twigs** smooth, with dense patent brown hairs up to 1 mm long, without nodal glands. **Axillary buds** solitary, half-patent, narrowly triangular, 4–6(–7.5) mm long, hairy. **Leaves** discolorous, bullate, glabrous and green above, green, not or indistinctly papillose and patently long-hairy (hairs 0.5 mm or longer) on midrib and on basal part of veins below; blades narrowly (ovate-)elliptical, 7–19 × 3–6.5 cm, base obtuse to rounded, rarely cuneate, apex acutish; midrib, lateral veins and part of finer intercostal venation sunken above; lateral veins c. 8 pairs (difficult to count), forming a distinct intramarginal vein; intercostal venation reticulate, not strongly prominent; glands numerous, scattered, c. 0.1 mm diameter; petioles c. 5 mm long, smooth, densely patently long-hairy, without glands. **Inflorescences** much shorter than the leaves, unbranched, 3–7 cm long, 5–15-flowered; axes with hairs c. 0.3 mm long; bracts c. 2 mm long. **Flowers:** pedicels 4–10 mm long, finely hairy; sepals sparsely hairy, ciliate on margin, outer sepals c. 2.5 mm long, inner sepals c. 3.5 mm long; petals purple, drying pale pink-brown, subglabrous, the longest c. 12 mm long; filaments almost free, glabrous, anthers 1(–1.5) mm long, glabrous; ovary c. 1 mm stipitate, densely hairy, style sparsely bristly hairy, stigma slightly 2-lobed, ovules 12–14. **Fruits** globose, c. 1.5 cm diameter, with remnant of style, hairy; fruiting pedicels 5–11 mm long, with patent hairs up to 0.2 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sabah and Brunei). In Sabah, recorded from Kinabatangan, Lahad Datu, Pensiangan, Sandakan and Tawau districts (e.g., *Pereira et al. JTP 760*, *SAN 83572*, *SAN 95618*, *SAN 129473* and *SAN 135319*) and in Brunei from Belait and Tutong districts (e.g., *Forman 984* and *Sands et al. 5743*).

Ecology. Mixed dipterocarp forest, along streams, on swampy places or hillridges, at altitudes to 400 m.

43. **Xanthophyllum rufum** A.W.Benn.

Fig. 12.

(Latin, *rufus* = reddish; referring to the reddish hairs)

(subgen. **Xanthophyllum**, sect. **Xanthophyllum**)

In Hooker *f.*, Fl. Br. Ind. 1 (1874) 210; King *op. cit.* 143; Ridley *op. cit.* (1922) 145; Ng *op. cit.* (1972) 361; Anderson *op. cit.* (1980) 288; Meijden *op. cit.* (1982) 76, *op. cit.* (1988) 505; Turner *op. cit.* 406; Coode *et al.* (eds.) *op. cit.* 256; Argent *et al.* (eds.) *op. cit.* 511. **Type:** Maingay 139 (= *Kew Distr. 1616*), Peninsular Malaysia, Malacca (holotype K; isotype K). **Synonyms:** *X. flavum* Ridl. *op. cit.* (1922) 145; *X. heteropleurum* Chodat *op. cit.* (1929) 134, Masamune *op. cit.* 380, Ng *op. cit.* (1972) 363.

Tree, treelet, rarely shrub, to 40 m tall, to 50 cm diameter. **Bark** greenish grey or brown, smooth, pustulate or scaly, lenticellate. **Sapwood** (white) to yellow. **Twigs** smooth, without nodal glands, rufous-hairy. **Axillary buds** solitary, 1–2 mm long or smaller, densely patently long-hairy. **Leaves** more or less discolorous, glabrous, flat and bright yellow-green to pale greyish green above, paler, papillose and densely patently long-hairy (hairs c. 1 mm long) below; blades elliptical-oblong, 8–25 × 4–13 cm, base cuneate or rounded, sometimes subcordate, apex acute-acuminate; midrib and lateral veins slightly sunken above; lateral veins 5–9 pairs, forming an intramarginal vein; intercostal venation scalariform; glands numerous, scattered, c. 0.1 mm diameter, basal glands larger; petioles 7–21 mm long, densely patently long-hairy, sometimes glabrescent, smooth, apically often with large glands. **Inflorescences** shorter than or as long as the leaves, branched or sometimes unbranched; axes densely rufous-hairy; bracts conspicuous, persistent, often with glands, bracteoles small, subsistent. **Flowers:** pedicels 4–7(–10) mm long; sepals densely rufous-hairy outside, glands inconspicuous or absent, outer sepals 4–6 mm long, slightly ribbed, inner sepals 5–7 mm long, keeled; petals white, the upper ones with a yellow spot, drying yellowish, the longest one 12–15 mm long, keel densely yellowish brown hairy outside, inside hairy in apical part, other petals hairy outside in apical part or only apically tufted; filaments free, widened and densely hairy in lower half, anthers 0.4–0.6 mm long, short-hairy at base or glabrous; ovary densely rufous-hairy all round or hairy in 4(–8) rows, hairs of the median rows mostly longer than the lateral ones, style densely rufous-hairy almost to apex, stigma slightly 2-lobed, ovules 12–14. **Fruits** globose, 1.5–2 cm diameter, subglabrous or with 2–4 sometimes hairy ridges from the style scar, yellowish green, dull, finely tuberculate; pericarp rather thick, hard; sometimes sepals persistent; fruiting pedicels 7–10 mm long, 2(–3) mm thick. **Seed** 1.

Distribution. Sumatra, Peninsular Malaysia, Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, recorded from Keningau, Kinabatangan, Lahad Datu, Pensiangan, Sandakan, Sipitang, Tambunan, Tawau and Tenom districts (e.g., SAN 28690, SAN 44227, SAN 56990, SAN 77539 and SAN 119489) and in Sarawak from Belaga, Betong, Bintulu, Kapit, Kuching and Lundu districts (e.g., S 14805, S 24638, S 37998, S 46667 and S 55664). In Brunei, known by one collection from Belait district (i.e., Flemmich FMS 37109) and in Kalimantan from several localities in the western and eastern parts (e.g., bb. 18840, Burley *et al.* 744, de Jong 872 and Kostermans 5773).

Ecology. Mixed dipterocarp forest or riverine forest, on ridges or hilltops, on sandy (clay) soil, at altitudes to 300 m.

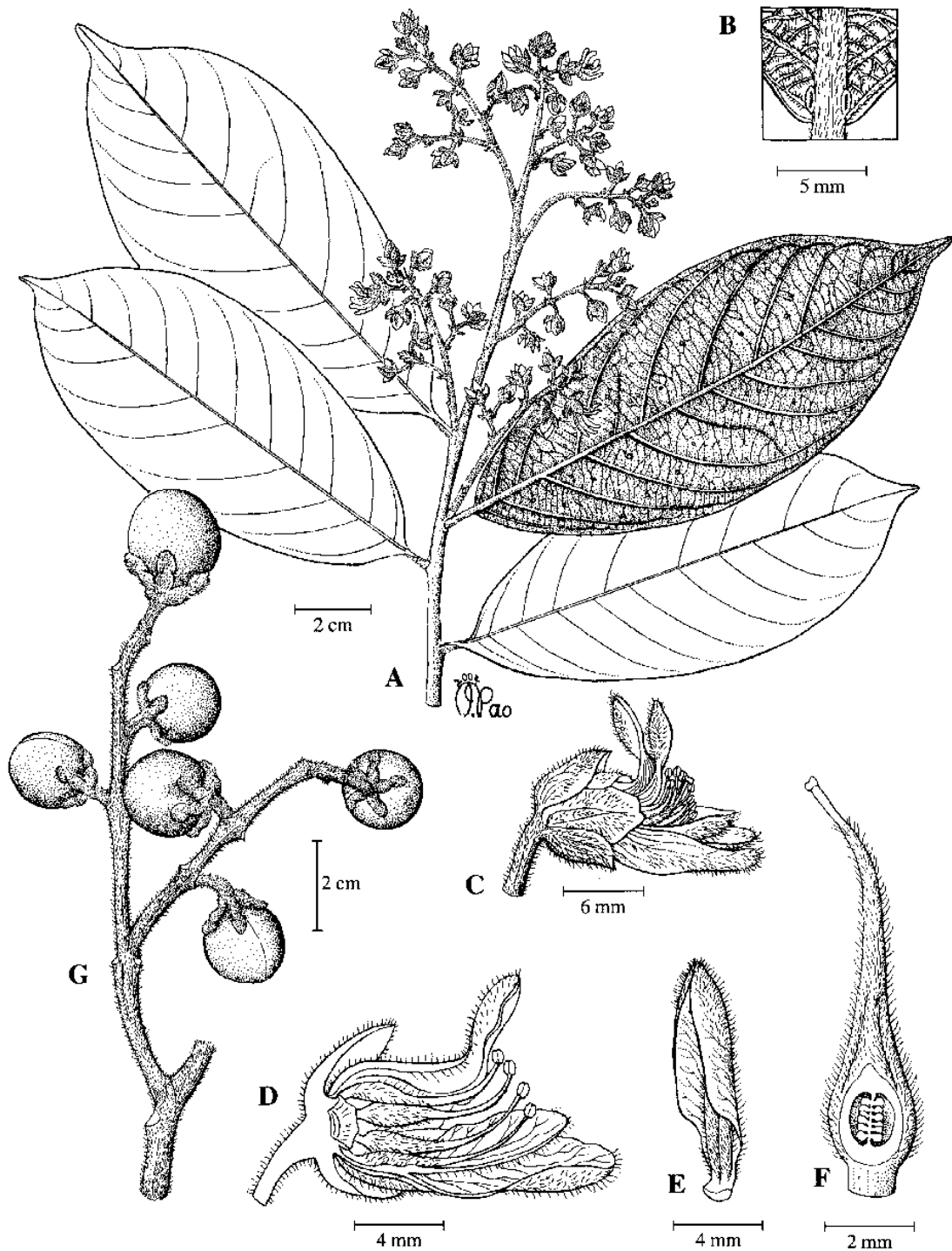


Fig. 12. *Xanthophyllum rufum*. A, flowering leafy twig; B, detail of lower leaf surface with indumentum and glands; C, open flower; D, longitudinal section of open flower with the gynoecium removed; E, lower petal with 2 stamens; F, gynoecium with longitudinal section of ovary; G, infructescence. (A–F from SAN 36554, G from S 17002.)

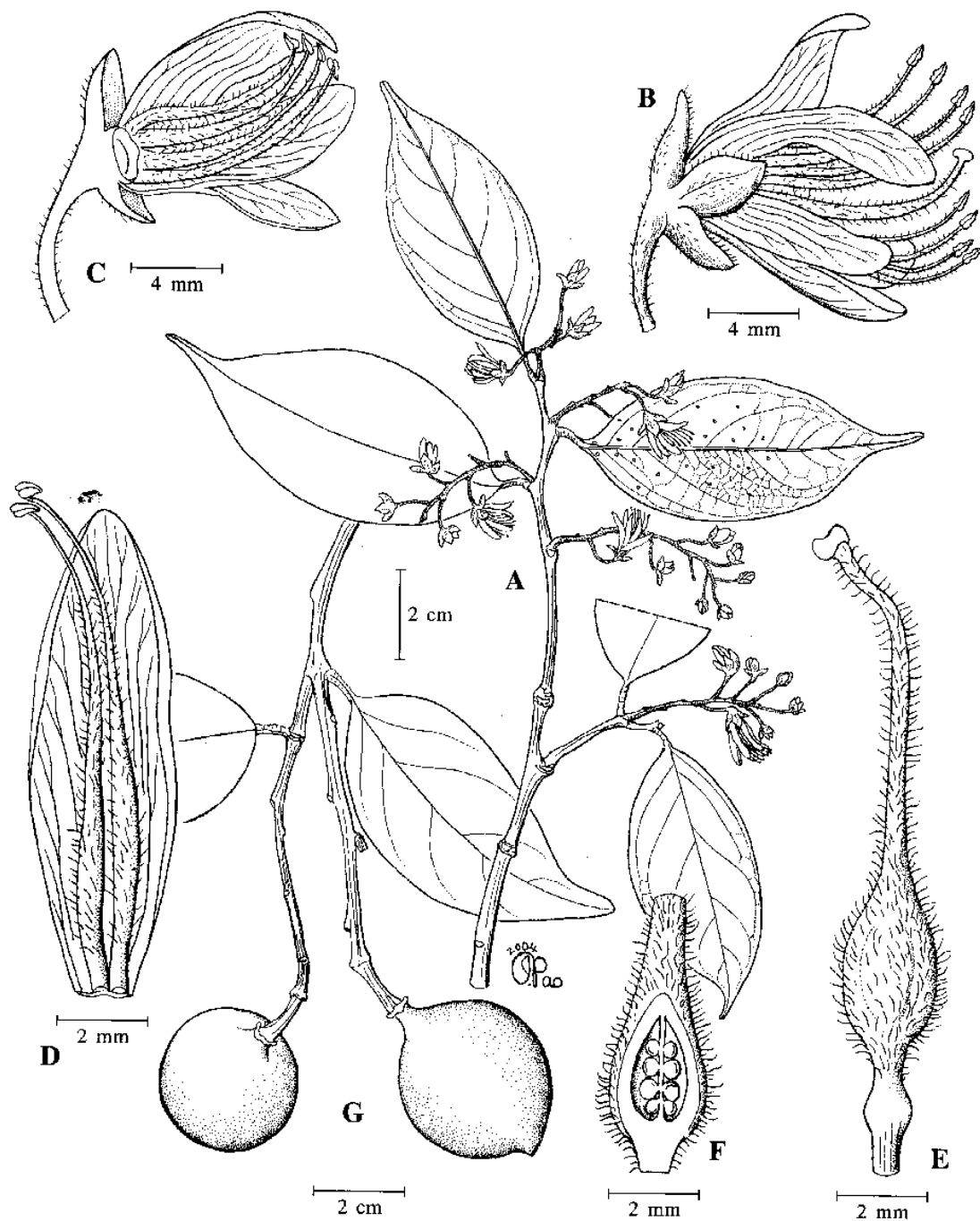


Fig. 13. *Xanthophyllum stipitatum*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoecium removed; D, adaxial view of stamens and petal; E, gynoecium; F, longitudinal section of ovary; G, fruiting leafy twig. (A–F from SAN 66701, G from S 30045.)

44. *Xanthophyllum schizocarpon* Chodat

(Greek, *schizein* = to split, *karpos* = fruit; referring to the sulcate fruit)

(subgen. *Xanthophyllum*, sect. *Xanthophyllum*)

In Merrill, PEB (1929) 136; Masamune *op. cit.* 381; Anderson *op. cit.* (1980) 288; Meijden *op. cit.* (1982) 74, *op. cit.* (1988) 504. **Lectotype** (Meijden, 1982): *Elmer 21519*, Borneo, Sabah, Tawau (L; isolectotypes BM, BO, BR, C, G, K, M, P, SING, U, Z).

Tree, 10–25 m tall, to 35 cm diameter. **Bark** grey or brownish, smooth. **Sapwood** white. **Twigs** smooth, without nodal glands, minutely appressed short-hairy in younger parts or glabrous. **Axillary buds** in clusters of two or three, to 1 mm long, the upper one located up to 3 mm above the axil. **Leaves** more or less discoloured, glabrous, flat and greyish green above, dull glaucous or whitish, (mostly) papillose, often minutely appressed (or subpatently) short-hairy mainly on the veins below; blades lanceolate, 4.5–12(–14) × 1.5–4.5(–7) cm, base cuneate, apex acute-acuminate; midrib flat above; lateral veins 6–7 pairs, not forming an intramarginal vein; intercostal venation indistinct, scalariform; glands numerous, scattered, c. 0.2 mm diameter, basal glands (if present) c. 0.5 mm diameter; petioles 3–5(–8) mm long, minutely appressed hairy or glabrous, smooth, without glands. **Inflorescences** shorter than the leaves, often slightly supra-axillary, 1 or 2 per leaf axil, branched or unbranched, rather few-flowered; axes minutely appressed hairy; lower bracts opposite. **Flowers**: pedicels 6–8 mm long; outer sepals 2.5–4 mm long, inner sepals 3–4.5 mm long, more or less keeled; petals yellow, drying pale yellowish, the longest one 6–7 mm long, keel appressed hairy outside, short-hairy inside in apical part, other petals glabrous to short-hairy on both sides; *stamens* 8 (or 9), *filaments* free, anthers c. 0.3 mm long; *ovary* slightly ribbed, brownish, appressed hairy on median ribs or glabrous, *stigma* slightly 2-lobed, *ovules* 6–8. **Fruits** globose or depressed globose, c. 1.5 cm diameter, irregularly 4-sulcate or not, dull, pale greenish to yellowish brown; pericarp hard and sometimes irregular in thickness; fruiting pedicels 6–9 mm long, c. 3 mm thick. **Seed** 1.

Distribution. Endemic in Borneo (Sabah, Sarawak, and Kalimantan). In Sabah, known from Labuk Sugut, Ranau, Tambunan and Tawau (e.g., *SAN 25303*, *SAN 36305*, *SAN 116377* and *SAN 140151*) and in Sarawak from Bau, Limbang, Miri and Tatau districts (e.g., *S 21915*, *S 21964*, *S 40305*, *S 42931* and *S 72976*). In Kalimantan, the species is represented by two collections, one from G. Bentuang (*Burley et al. 2547*) and the other from Ulu Barito (*Ridsdale PBU 284*).

Ecology. Mixed dipterocarp forest on sandy banks or on basalt hillsides, at altitudes to 800 m.

Notes. *Xanthophyllum schizocarpon* is close to, but generally more delicate than the variable *X. flavescens*. The irregularly 4-sulcate fruits of the type specimen may be caused by gall wasps.

45. *Xanthophyllum stipitatum* A.W.Benn.

(Latin, *stipitatus* = stalked; the ovary)

(subgen. *Exsertum*)

Fig. 13.

In Hooker *f.*, Fl. Br. Ind. 1 (1874) 210; King *op. cit.* 140; Ridley *op. cit.* (1922) 145; Chodat *in* Merrill *op. cit.* (1929) 137; Masamune *op. cit.* 381; Ng *op. cit.* (1972) 363; Anderson *op. cit.* (1980) 288; Meijden *op. cit.* (1982) 142, *op. cit.* (1988) 535; Kessler & Sidiyasa *op. cit.* 194; Turner *op. cit.* 406; Coode *et al.* (eds.) *op. cit.* 257; Argent *et al.* (eds.) *op. cit.* 511; Beaman & Anderson *op. cit.* 266. **Type:** Maingay 140 (= Kew Distr. 3292), Malacca (holotype K; isotype K). **Synonyms:** *X. stipitatum* var. *borneense* Chodat *in* Merrill *op. cit.* (1929) 137; *X. stipitatum* var. *nitidum* Chodat *in* Merrill *op. cit.* (1929) 137, Masamune *op. cit.* 381; *X. stipitatum* var. *pachyphyllum* Chodat *in* Merrill *op. cit.* (1929) 137, Masamune *op. cit.* 381; *X. amoenum* Chodat, Bull. Herb. Boiss. 4 (1896) 259, Masamune *op. cit.* 379, Anderson, *op. cit.* (1963) 153, Ng *op. cit.* (1972) 356, Meijden *op. cit.* (1982) 141, *op. cit.* (1988) 533; **syn. nov.** **Lectotype** (Meijden, 1982): Haviland 2112, Sarawak, Kuching (K; isolectotype SAR).

Tree, rarely shrub, to 50 m tall, to 80 cm diameter, sometimes buttressed. **Bark** pale brown or grey, smooth. **Sapwood** (whitish) yellow. **Twigs** smooth, without nodal glands, glabrous. **Axillary buds** in clusters of 2(–4), the upper largest one c. 2 mm long. **Leaves** glabrous, flat and (dark) brown or reddish brown above, sometimes waxy and not papillose below; blades ovate-elliptical, (2.5–)4–14 × (1–)2–7 cm, base rounded or cuneate, apex (long) acute-acuminate, tip rounded; midrib sunken above; lateral veins 5–7 pairs, not forming an intramarginal vein, prominent or obscure; intercostal venation coarsely reticulate; glands 0–10(–20), scattered or located near the base and in the middle of the leaf, 0.1–0.5 mm diameter; petioles 3–10 mm long, finely transversely wrinkled, glabrous, without glands. **Inflorescences** unbranched, 6–14-flowered; axes finely hairy or subglabrous; bracts minute, caducous. **Flowers** drying black; pedicels 5–15 mm long, minutely woolly hairy; sepals densely minutely hairy on both sides or almost glabrous, outer sepals 2–3 mm long, inner sepals 3–4.5 mm long; petals subequal, 7–11(–12) mm long, white, the three lower ones with a yellow centre, dark when dry, glabrous outside, woolly hairy inside at base and apex; filaments free, 11–13(–16) mm long, short woolly hairy or glabrous in apical part, anthers c. 0.8 mm long, glabrous or with few hairs at base; ovary glabrous or densely woolly hairy, black when dry, stipitate, style woolly hairy or glabrous in upper half, ovules 8–16, stigma slightly 2-lobed. **Fruits** globose, 4–6(or more) cm diameter, sometimes sterile, short- or long-stipitate, black (yellow or orange when ripe), often bluish waxy, glabrous or sparingly hairy (glabrescent); pericarp smooth, (1–)5–15 mm thick; fruiting pedicels (5–)10–15 mm long, 2–4 mm thick. **Seeds** 4–12.

Vernacular names. Sabah—*lahal* (Dusun Tambunan), *tampasak* (Dusun Tambunan). Sarawak—*langir* (Iban), *nyalin paya* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah common and known from Beaufort, Keningau, Kinabatangan, Kota Kinabalu, Kudat, Labuk Sugut, Lahad Datu, Papar, Ranau, Sandakan, Sipitang, Tambunan, Tawau and Tenom districts (e.g., Clemens 31528, SAN 21635, SAN 25427, SAN 43685, SAN 66701 and SAN 73164). In Sarawak also common, recorded from Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu and Simunjan districts (e.g., S 15108, S 29641, S 32849, S 32960, S 43383 and S 50151). In Brunei, known from Belait, Temburong and Tutong districts (e.g., BRUN 5113, van Niel 4336, SAN 17422 and Smythies *et al.* 5846). In Kalimantan, recorded from several localities (e.g., Ambriansyah & Arifin W 259, bb. 18494, Kostermans 6712, Ridsdale & Sidiyasa PBU 665 and Wilkie 94324).

Ecology. Primary forest on hillsides or ridges, or along rivers, also peatswamp forest, at altitudes to 1500 m, on yellow sandy clay and brownish soils or soil over ultrabasic bedrock, occasionally also occurs in *kerangas* forest.

Notes. Ng (*op. cit.* 1972) and Meijden (*op. cit.* 1982, *op. cit.* 1988) recognized *Xanthophyllum amoenum* and *X. stipitatum* as two distinct but closely related species. Ng distinguished *X. stipitatum* from *X. amoenum* in having consistently smaller leaves, whereas Meijden segregated the two species based on the length of petals, hairiness of the style and ovary, number of leaf glands and thickness of the pericarp. In this Flora, and after examining more than 150 new collections from Borneo and Peninsular Malaysia, we adopted a broader species concept and recognised *X. stipitatum* (including *X. amoenum*) as a variable, widespread species.

Uses. The fruit pulp, of a sweetish sour taste, is recorded as edible; the pericarp is used for making shampoo (*S* 53900).

46. *Xanthophyllum subcoriaceum* (Chodat) Meijden

(Latin, *sub* = somewhat, *coriaceus* = leathery; the leaves)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bot. J. Linn. Soc. 67 (1973) 120, *op. cit.* (1982) 85, *op. cit.* (1988) 509; Anderson *op. cit.* (1980) 288; Coode *et al.* (eds.) *op. cit.* 257; Beaman & Anderson *op. cit.* 266. **Basionym:** *X. ellipticum* Miq. var. *subcoriaceum* Chodat in Merrill *op. cit.* (1929) 134. **Lectotype** (Meijden, 1982): *Elmer* 21710, Borneo, Sabah, near Tawau (K; isolectotypes BM, BO, BR, C, G, L, M, P, SING, U, Z).

Shrub or small tree, to 18 m tall and 20 cm diameter. **Bark** whitish or brownish, hard and smooth. **Sapwood** yellow. **Twigs** smooth, without nodal glands, slender, pale green, glabrous. **Axillary buds** in clusters of two (or three), (0.5–)1–2.5 mm long, glabrous. **Leaves** subcoriaceous, glabrous, sometimes slightly bullate between lateral veins and dull (pale) green above, yellowish green and not papillose below; blades elliptical, 5–12 × 1.5–5.5 cm, base cuneate, sometimes more or less rounded, margin sometimes curved upwards when dry, apex acuminate or cuspidate; midrib raised above; lateral veins (3–)4–6 pairs, mostly indistinct, forming a distinct intramarginal vein; intercostal venation usually obscure, reticulate; glands (0–)2–12, located at some distance from the midrib, 0.2–0.4 mm diameter; petioles 5–9 mm long, glabrous, finely wrinkled, without glands. **Inflorescences** shorter than or nearly as long as the leaves, mostly unbranched, (4–)6–12-flowered; axes sparsely hairy; lowermost bracts sometimes leaf-like. **Flowers:** pedicels 2–4 mm long, glabrous or sparsely appressed hairy; sepals (nearly) glabrous outside, outer sepals 1.6–1.8 mm long, inner sepals 2–2.5 mm long; petals white, drying orange, ciliate apically, outside glabrous except at base, longest one 8–10 mm long; filaments free, anthers 0.5–0.7 mm long, sparsely hairy at base; ovary 0.5–1.5 mm stipitate, glabrous or subglabrous, style sparsely appressed hairy, stigma slightly 2-lobed, ovules 4. **Fruits** at first with subpersistent style, globose, 1.5(–1.7) cm diameter, glabrous, smooth, pale green to brown, dull or shiny, sessile or c. 1.5 mm stipitate; pericarp thin; fruiting pedicels 3(–7) mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, recorded from Kinabatangan, Lahad Datu, Ranau and Tawau districts (e.g., *SAN* 25006, *SAN* 35873, *SAN* 40528, *SAN* 56244 and *SAN* 99855) and in Sarawak from Kapit, Kanowit and Miri districts (e.g., *S* 22229, *S* 23907, *S* 29199, *S* 41448 and *S* 57274). In Brunei, known by one collection (*BRUN* 737) from Temburong district and in C Kalimantan, recorded from few localities (e.g., *Mogea & de Wilde* 4240, *Mogea & de Wilde* 4269 and *Mogea & de Wilde* 4441).

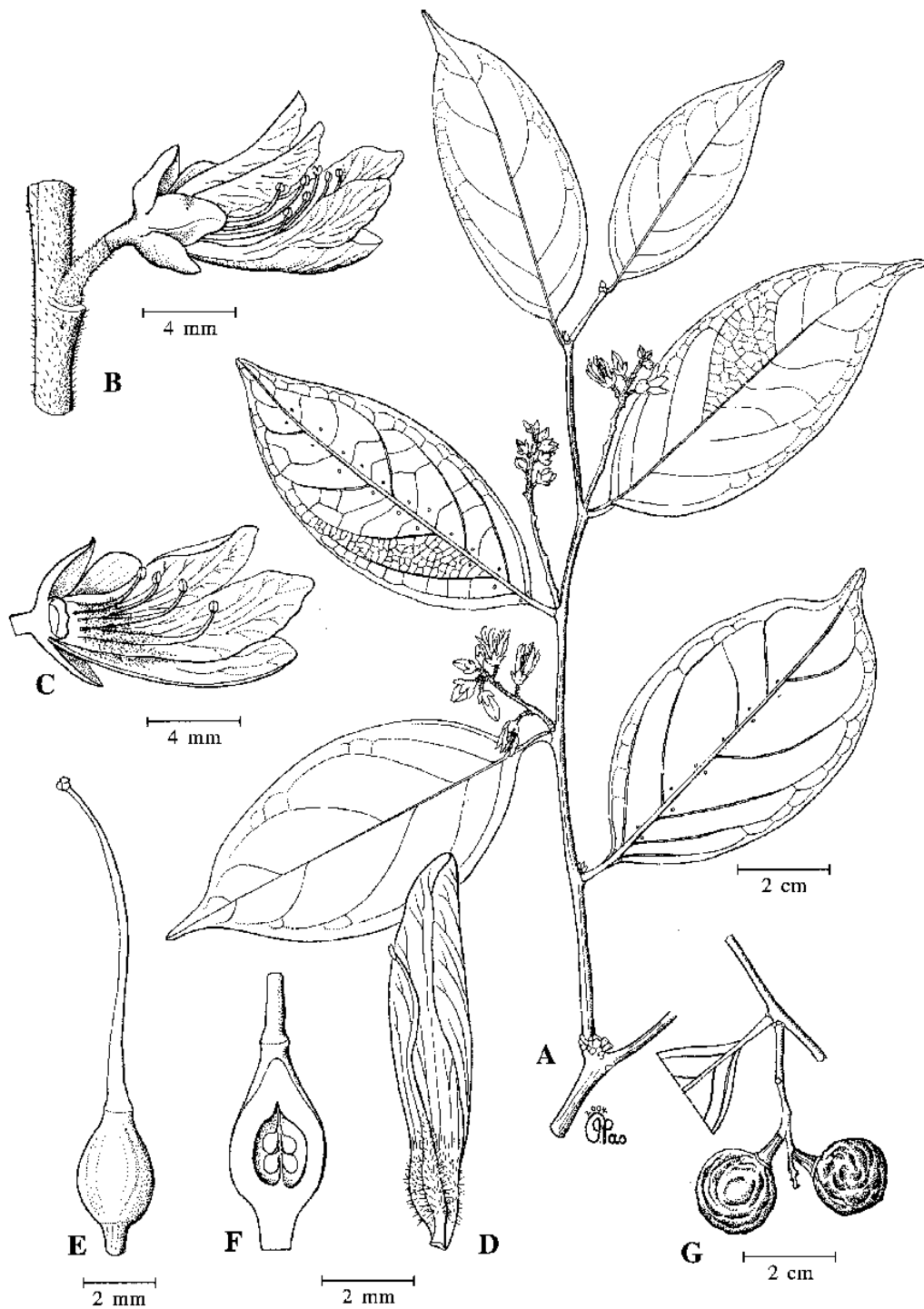


Fig. 14. *Xanthophyllum tenue*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoecium removed; D, adaxial view of stamen and petal; E, gynoecium; F, longitudinal section of ovary; G, infructescence. (A–F from SAN 36153, G from SAN 61774.)

Ecology. Lowland swamp forest and mixed dipterocarp forest, on flat land, hillsides or ridges, on yellow sandy clay soil, at altitudes to 700 m.

Notes. *Xanthophyllum subcoriaceum* closely resembles *X. neglectum* and *X. tenue*. Without examining the indumentum of the ovary and/or fruit, it is difficult to distinguish the three species. The ovaries and/or fruits are conspicuously hairy in *X. neglectum* and glabrous in *X. tenue*. In *X. subcoriaceum*, on the other hand, glabrous as well as finely hairy ovaries/fruits seem to occur. The distinction of the three species needs further study.

47. *Xanthophyllum tardicrescens* Meijden

(Latin, *tarde* = slowly, *crescens* = growing; the twigs)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bot. J. Linn. Soc. 67 (1973) 120, *op. cit.* (1982) 87, *op. cit.* (1988) 510; Anderson *op. cit.* (1980) 288. **Type:** Anderson *et al.* S 24331, Borneo, Sarawak (holotype L; isotypes K, KEP, SAN, SAR).

Treelet, to 6 m tall, to 6 cm diameter. **Twigs** smooth, without nodal glands, yellow-green, glabrous, bearing 2 (or 3) leaves per shoot. **Axillary buds** in clusters of 2 (or 3), shorter than 1 mm. **Leaves** glabrous, flat and green above, greenish, dull and not papillose below; blades narrowly elliptical, 7–16(–17) × 2–5(–7) cm, base rounded-truncate or cordate, apex long-acuminate with rounded tip; midrib prominent above; lateral veins 3–4 pairs, slightly sunken above, the basal veins long, reaching often beyond the middle of the leaf, or forming an intramarginal vein; intercostal venation indistinct, reticulate; glands 6–12, scattered, 0.2–0.3 mm diameter; petioles 3.5–5 mm long, glabrous, hardly wrinkled or finely transversely wrinkled, without glands. **Inflorescences** as long as or shorter than the leaves, unbranched; axes nearly glabrous; flowers often in clusters of 2 or 3; bracts late-caducous. **Flowers:** pedicels 3–4 mm long, sparsely appressed hairy; sepals sometimes with glandular spots at apex, outer sepals c. 2 mm long, inner sepals c. 2.5 mm long; petals white, the upper ones with a yellow spot, drying yellowish orange, the longest one 7–8 mm long, keel nearly glabrous outside, other petals glabrous; filaments connate for 0.7–1 mm, short hairy above base, for the rest glabrous, anthers c. 0.7 mm long; ovary short stipitate, more or less appressed hairy all around, stigma slightly 2-lobed, ovules 4. **Fruits** (immature) globose, smooth, somewhat shiny, yellowish green, sparsely appressed hairy all around, glabrescent; pericarp thin; fruiting pedicels c. 4 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sarawak and Brunei). In Sarawak, recorded from Semengoh FR, Kuching district (e.g., S 3390, S 14948 and S 24331) and in Brunei, known by two rather doubtful collections (BRUN 3642 and BRUN 15587) from Belait and Temburong districts, respectively.

Ecology. Mixed dipterocarp forest.

Notes. *Xanthophyllum tardicrescens* is reminiscent of *X. pauciflorum*, *X. neglectum* and *X. subcoriaceum* but the latter three species differ in having a cuneate (not truncate or cordate) leaf base. The leaf shape of *X. tardicrescens* is similar to that of *X. purpureum*, but in the latter the leaves are hairy and papillose below.

48. **Xanthophyllum tenue** Chodat

Fig. 14, Plate 8B.

(Latin, *tenuis* = slender, thin; the twigs)

(subgen. **Xanthophyllum**, sect. **Eystathes**)

In Merrill, PEB (1929) 135; Masamune *op. cit.* 382; Anderson *op. cit.* (1980) 288; Meijden *op. cit.* (1982) 83, *op. cit.* (1988) 508; Argent *et al.* (eds.) *op. cit.* 511; Beaman & Anderson *op. cit.* 266. **Type:** *Elmer 21355*, Borneo, Sabah, near Tawau (holotype G; isotypes BM, BO, BR, C, G, K, L, M, P, SAN, SING, U, Z).

Treelet or tree, 3–25 m tall, to 20(–40) cm diameter. **Bark** greyish or pale brown, smooth or scaly. **Sapwood** yellowish. **Twigs** smooth, without nodal glands, glabrous to patently short-hairy. **Axillary buds** in clusters of two (or three), 1.5–2.5 mm long, (sparsely) minutely hairy, sometimes irregularly shaped, and larger because of cork-formation in apical region. **Leaves** slightly bullate or flat between lateral veins and green or brown-green above, pale green or yellowish green, not papillose, glabrous or minutely patently hairy below; blades (narrowly) elliptical, (5–)7–16 × (2–)2.5–6.5 cm, base cuneate, apex long-acuminate; midrib glabrous or patently minutely hairy in basal half, slightly raised to flat above; lateral veins 4–6 pairs, forming an indistinct intramarginal vein; intercostal venation reticulate (or subscalariform), indistinct or slightly prominent; glands (0–)4–25, mostly located near midrib, 0.3–0.7 mm diameter, basal glands often present; petioles 6–11 mm long, smooth, patently short-hairy or glabrous, glands absent or small. **Inflorescences** much shorter than the leaves, unbranched, 5–8-flowered; axes short-hairy. **Flowers:** pedicels 2–6(–10) mm long, short-hairy; sepals nearly glabrous outside, outer sepals 2–3 mm long, inner sepals 2.5–4.5 mm long; petals yellowish or white, drying orange, the longest one 8–9(–11) mm long, keel sparsely to densely appressed hairy on both sides, other petals glabrous to (sparsely) hairy; filaments connate for up to 1.5 mm, anthers c. 0.4 mm long; ovary glabrous (rarely sparsely appressed hairy, soon glabrescent), 0.5–1 mm stipitate, style glabrous or sparsely appressed hairy in basal part, early falling, stigma slightly 2-lobed, ovules 4. **Fruits** globose, 1.2–1.9 cm diameter, glabrous, dull, wrinkled, pale greenish brown; pericarp soft, thin; fruiting pedicels 2–7(–10) mm long, c. 2 mm thick. **Seeds** 1 or 2.

Distribution. Endemic in Borneo (Sabah, Sarawak and Kalimantan). In Sabah, recorded from Keningau, Kota Belud, Ranau, Tambunan and Tawau (e.g., *SAN 29512*, *SAN 36153*, *SAN 42451*, *SAN 65335* and *SAN 91655*) and in Sarawak from Belaga, Kapit, Lubok Antu and Marudi districts (e.g., *Burt 4935*, *Nooteboom & Chai 1755*, *S 39793*, *S 43632* and *S 57274*). In Kalimantan, known by few collections from W, C and E parts (e.g., *Endert 3674*, *Kato et al. B 9361*, *Nooteboom 4685* and *Wiriadinata et al. ITTO/BB 214*).

Ecology. Mixed dipterocarp forest and lower montane forest, on riverbanks or hillsides, at altitudes to 1500 m.

49. **Xanthophyllum trichocladum** Chodat

Fig. 15.

(Greek, *tricho* = hairy, *klados* = twig; the hairy twigs)

(subgen. **Xanthophyllum**, sect. **Eystathes**)

In Merrill, PEB (1929) 137; Masamune *op. cit.* 382; Meijden *op. cit.* (1982) 115, *op. cit.* (1988) 523. **Lectotype** (Meijden, 1982): *Elmer 21549*, Borneo, Sabah, near Tawau (L; isolectotypes BM, BO, BR, C, G, K, M, P, SING, U, Z).

Shrub or small tree, 12(–18) m tall, to 25 cm diameter. **Bark** whitish or yellowish grey, smooth. **Sapwood** white or yellowish. **Twigs** *without nodal glands, densely patently yellow-brown long-hairy*, hairs *c.* 1 mm long. **Axillary buds** *solitary, ovate-oblong*, (1.5–)2.5–5(–6) mm long, densely hairy. **Leaves** *discolorous, flat*, green and hairy on the midrib *above*, *papillose and densely patently long-hairy all over below*; blades *narrowly elliptical*, 11–31 × 3–9 cm, base *cordate, sometimes covering upper side of petiole, apex subacute*; midrib sunken or flat; *lateral veins 9(–12) pairs, forming a distinct intramarginal vein; intercostal venation reticulate; glands numerous, scattered, c.* 0.1 mm diameter; *petioles 4–7 mm long, densely patently long-hairy, smooth, without glands*. **Inflorescences** shorter than or as long as the leaves, *unbranched* (or sometimes with one side-branch at very base); *axes with dense brown patent hairs 0.5–1 mm long*. **Flowers**: pedicels 3–7 mm long; *sepals densely brown hairy outside (hairs to 1 mm long)*, outer sepals 3 mm long, inner sepals 3.5–4(–5) mm long; petals pink, the upper ones with a yellow spot, drying dark reddish, the longest one 13(–16) mm long, keel glabrous to appressed hairy outside along central veins, other petals (sub)glabrous or sparsely ciliate at base; *filaments free or to 1.5 mm connate*, anthers 2–3 mm long, faintly hairy at base, ciliate along slits; *ovary patently hairy, stigma slightly 2-lobed, ovules 11–16*. **Fruits** globose, *c.* 1.5 cm diameter, densely hairy; pericarp thin; sepals subsistent; fruiting pedicels 4–7 mm long, *c.* 2.5 mm thick. **Seed** 1.

Vernacular name. Sabah—*bongkulat* (Dusun Kinabatangan).

Distribution. Endemic in Borneo (Sabah, Sarawak and Kalimantan). In Sabah common, recorded from Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan, Tambunan and Tawau districts (e.g., *SAN 35929, SAN 38119, SAN 76752, SAN 89870 and SAN 130727*) and in Sarawak from Kapit and Kuching districts (e.g., *S 29694, S 37695, S 66089 and Whitmore 8413*). In E Kalimantan, rare and collected once (*Kostermans 6582*) from Loa Djanan.

Ecology. Mixed dipterocarp forest, on flatland, hillsides or near streams, at altitudes to 500 m.

50. *Xanthophyllum velutinum* Chodat

(Latin, *velutinus* = velvety; referring to the twig and leaf lower surface)

(subgen. *Xanthophyllum*, sect. *Xanthophyllum*)

Bull. Herb. Boiss. 4 (1896) 259; Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 382; Meijden *op. cit.* (1982)75, *op. cit.* (1988) 505; Coode *et al.* (eds.) *op. cit.* 257; Argent *et al.* (eds.) *op. cit.* 514; Beaman & Anderson *op. cit.* 267. **Type:** *Beccari 1629*, Borneo, Sarawak (holotype K; isotypes FI, G, P, W).

Tree, 5–25 m tall, to 20 cm diameter. **Bark** pale brown or grey, smooth or longitudinally fissured. **Sapwood** whitish or yellowish. **Twigs** *smooth, without nodal glands, densely set with short and long grey or brown hairs 0.3–1 mm long*. **Axillary buds** *solitary, 1–3 mm long*, hairy like the twig. **Leaves** *sometimes discolorous, flat*, greyish green, in basal part sometimes sparsely hairy especially on the veins and midrib *above*, *brownish, not or indistinctly papillose and densely (or sparsely) hairy like the twig below*; blades *narrowly elliptical to elliptical*, (6–)9–22 × 3–9 cm, base *cuneate or rounded, apex acuminate or cuspidate*; midrib, veins and intramarginal vein slightly sunken or flat and mostly obscure above; *lateral veins 8–11(–12) pairs, strongly prominent, forming a prominent intramarginal vein; intercostal venation scalariform; glands (7–)10 or more, scattered, 0.2–0.6 mm diameter, basal glands c.* 1 mm diameter; *petioles (4–)8–14(–16) mm long, smooth, hairy like the twig, without glands*. **Inflorescences** about as long as or shorter than the

leaves, *branched* (exceptionally unbranched); axes densely patently brownish hairy in the basal part; flowers often in clusters of 3. **Flowers:** pedicels 1.5–7 mm long, densely (brown) hairy; sepals greyish hairy, outer sepals 2–3 mm long, with 2–4 glandular spots, inner sepals 3.5–5 mm long, keeled; petals white or yellow, drying brownish orange, the longest one 9–11 mm long, keel appressed hairy outside, sparsely hairy inside in middle part, other petals ciliate in basal half, glabrous outside, upper petals reflexed; *filaments free*, sparsely appressed hairy, anthers *c.* 1 mm long, usually cohering around the stigma, ciliate along slits; *ovary* sessile, ribbed, *glabrous or at apex hairy on 2 ribs down to halfway*, style reflexed at end of anthesis, hairy, *stigma slightly 2-lobed*, *ovules (4–)8–12*. **Fruits** often with *persistent sepals*, broadly ovoid, 2–2.5 cm diameter, beaked, sometimes with *c.* 8 ribs, *glabrous*, finely pustulate to tuberculate, dull brown; pericarp thick, hard; fruiting pedicels 2–7 mm long, *c.* 3 mm thick. **Seed** 1.

Vernacular name. Sabah—*ansarapak* (Dusun).

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah common, known from Keningau, Kinabatangan, Lahad Datu, Pensiangan, Pitas, Sandakan, Tawau and Tenom districts (e.g., *SAN 31915*, *SAN 43153*, *SAN 58756*, *SAN 64765*, *SAN 118648*, *SAN 120327* and *SAN 121263*) and in Sarawak from Bintulu, Kapit, Kuching, Lundu, Marudi, Miri and Samarahan districts (e.g., *S 21514*, *S 37041*, *S 40071*, *S 41591* and *S 43429*). In Brunei, recorded from Belait and Tutong districts (e.g., *BRUN 16536*, *BRUN 16777*, *Dransfield et al. JD 7273* and *SAN 17537*). In E Kalimantan, known from few collections (e.g., *Ambriansyah AA 785* and *Kessler et al. 311*).

Ecology. Mixed dipterocarp or old secondary forest and riverine forest or lower montane forest, commonly on ridges or hillslopes, on clay or sandy soils, also on ultrabasic bedrock, at altitudes to 900 m.

51. *Xanthophyllum vitellinum* (Blume) D.Dietr.

(Latin, *vitellinus* = egg-yolk yellow; referring to the colour of the petals)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Syn. Pl. 2 (1840) 1277; Chodat *op. cit.* (1891) *t.* 9, f. 1–2, *t.* 12, f. 4 c–e; Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 382; Backer & Bakhuizen *f. op. cit.* 200; Meijden *op. cit.* (1982) 97, *op. cit.* (1988) 514; Turner *op. cit.* 406; Argent *et al.* (eds.) *op. cit.* 514; Pendry *op. cit.* 537; Beaman & Anderson *op. cit.* 267. **Basionym:** *Jakkia vitellina* Blume, Cat. Gew. Buitenzorg (1823) 17, 64, *op. cit.* (1825) 61 ('*Jackia*'). **Lectotype** (Meijden, 1982): *Anonymous (Blume?) s.n.*, Java (L [*Acc. No. 90817256*]; isolectotypes AMD [*Acc. No. 036929*], BO, L [*Acc. Nos. 90817262, 90817263, 90817270 & 925250351*], MEL, U [*Acc. Nos. 40574 & 40575*]). **Synonyms:** *Jakkia longiflora* Blume *op. cit.* (1825) 61; *X. longifolium* (Blume) D. Dietr. *op. cit.* 1277; *X. paniculatum* Miq. *op. cit.* (1861) 393; *X. hookerianum* King *op. cit.* 139, Ridley *op. cit.* (1922) 144, Ng *op. cit.* (1972) 359; *X. kunstleri* King *op. cit.* 139, Ng *op. cit.* (1972) 359; *X. curtisii* King *op. cit.* 138, Ridley *op. cit.* (1922) 146; *X. griffithii* var. *curtisii* (King) Ng *op. cit.* (1972) 359; *X. robustum* Chodat, Bull. Herb. Boiss. 4 (1896) 262, Merrill *op. cit.* (1921) 326, *op. cit.* (1923) 387, Masamune *op. cit.* 381; *X. robustum* var. *elmeri* Chodat in Merrill *op. cit.* (1929) 136, Masamune *op. cit.* 381.

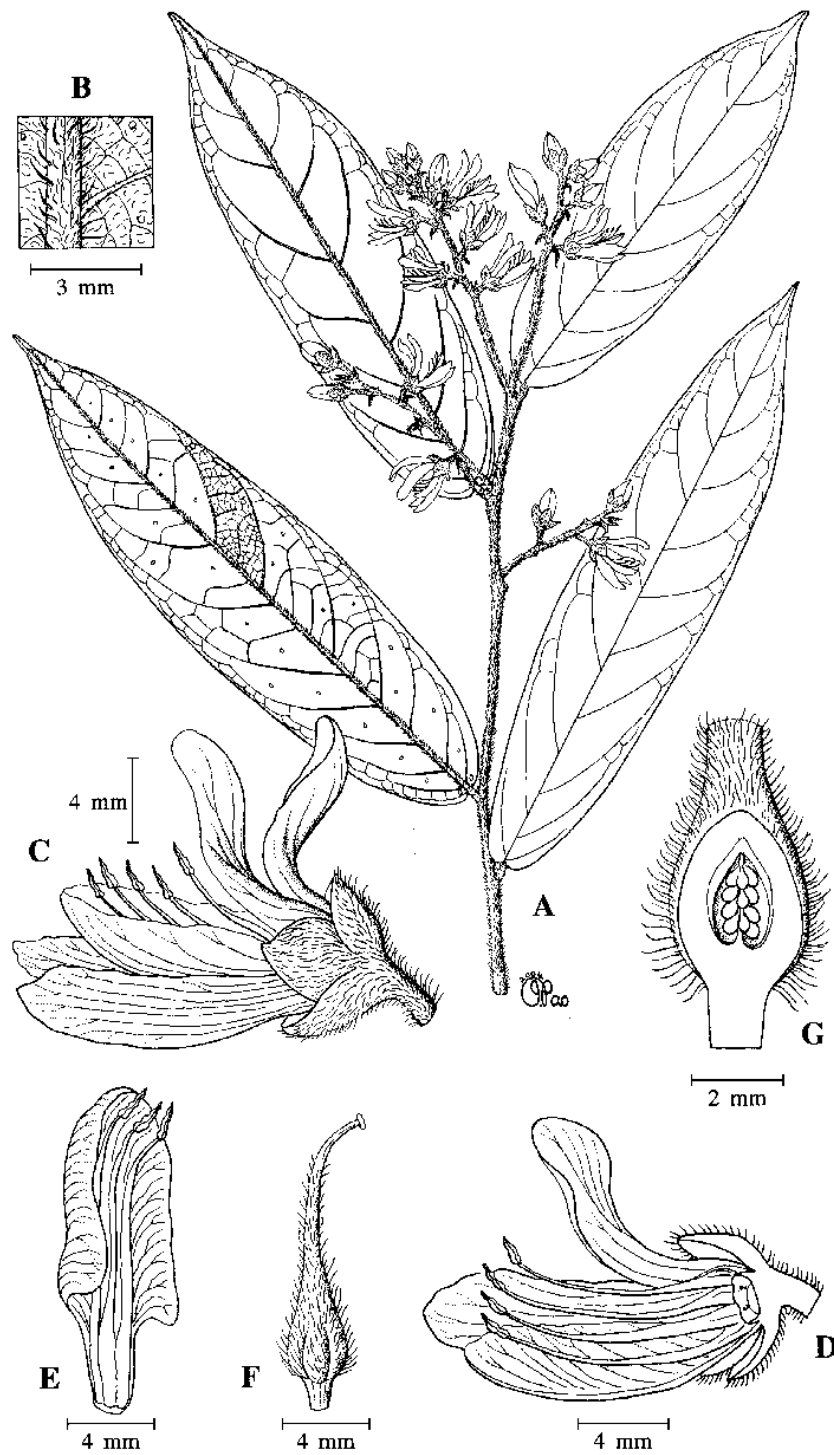


Fig. 15. *Xanthophyllum trichocladum*. A, flowering leafy twig; B, detail of lower leaf surface with indumentum and glands; C, open flower; D, longitudinal section of open flower with the gynoecium removed; E, adaxial view of stamens and petal; F, gynoecium; G, longitudinal section of ovary. (All from S 37695.)

Shrub, treelet or tree, to 25 m tall and to 40 cm diameter. **Bark** whitish or greyish brown, smooth, lenticellate. **Sapwood** yellowish. **Twigs** smooth, stout, 2–3 mm diameter, glabrous, without nodal glands. **Axillary buds** solitary, not appressed to the twig, varying from narrowly triangular with thickened base, 1.5–3 mm long, to rhomboid-ovate or ovate-oblong and then often 6–11 mm long, variously hairy. **Leaves** membranous or subcoriaceous, glabrous, flat and green to (dark) brown above, not papillose below; blades (narrowly) elliptical, 6–20(–30) × 2.5–11 cm, base cuneate, apex acute-acuminate; midrib prominent or nearly flat in basal half above; lateral veins (6–)7–9(–11) pairs, in apical half forming an indistinct intramarginal vein; intercostal venation coarsely reticulate, areoles subequal or unequal in size 1–5 mm diameter; glands mostly more than 10, located near midrib or scattered, 0.2–0.4 mm diameter, basal glands mostly present; petioles 8–14(–16) mm long, glabrous, smooth or finely transversely wrinkled, often with a pair of glands in apical half. **Inflorescences** 8–30 cm long, branched; axes often in pairs in lower part, glabrous or patently or appressed short-hairy, in basal part flowers in clusters of up to 3, solitary in apical part; lower bracts nearly opposite. **Flowers:** pedicels 1.5–6 mm long; sepals basally often somewhat thickened and wrinkled, outer sepals 2–3.5 mm long, inner sepals (2.5–)3–5.5 mm long; petals yellow or white, drying orange to dark reddish (blackish) and often with white incrustations, the longest one 7–12(–15) mm long, keel appressed hairy outside, other petals glabrous outside or with a few hairs at apex; stamens 8 (or 9), filaments free (or connate to 1 mm), widened above base and with a knob-like hairy appendage at inner side, for the rest glabrous, anthers 0.4–0.6(–0.7) mm long; ovary to 1 mm stipitate, half-patently hairy all around, style largely hairy, stigma slightly 2-lobed, ovules 4. **Fruits** globose, (1.5–)1.8 cm diameter, often wrinkled when dry, dull or shiny, pale or dark brown(-green), hairy or glabrescent all around; pericarp rather thin; fruiting pedicels 3–6 mm long, c. 2 mm thick. **Seed** 1.

Vernacular names. Sabah—*turupok* (Dusun). Sarawak—*sabetong* (Kayan), *sambubu* (Malay).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Java, Borneo (Sabah, Sarawak and Kalimantan) and the Philippines. One of the most common species. In Sabah, recorded from Beaufort, Keningau, Kinabatangan, Kota Belud, Kota Marudu, Labuk Sugut, Lahad Datu, Penampang, Ranau, Sandakan, Tambunan, Tawau and Tenom districts (e.g., SAN 17307, SAN 28610, SAN 36387, SAN 41483, SAN 91919 and SAN 129970) and in Sarawak from Belaga, Kapit and Lubok Antu districts (e.g., Haviland 2835, S 23996, S 43459, S 46723 and S 67266). In Kalimantan known by several collections (e.g., Ambriansyah et al. AA 253, bb. 12229, bb. 13881, Ender 5181 and Mogeia et al. 3489).

Ecology. Mixed dipterocarp forest, riverine forest or lower montane forest, on flatland, hillsides or ridgetops, on brown soil, black sandy soil or sandy clay soil, occasionally on ultrabasic bedrock, at altitudes to c. 800 m.

52. *Xanthophyllum* sp. A

Plates 8C–D.

(subgen. *Xanthophyllum*, sect. *Eystathes*)

The specimens representing this taxon have been collected from slender trees, 3–7(–12) m tall, growing in stunted forest on ultrabasic soil at 400–700 m altitudes. The leaves are drying greenish, thickly coriaceous, ovate-elliptical, with a blunt apex and 4–7 pairs of faint

(on both surfaces) lateral veins. The inflorescences are unbranched, slender, 2–5 cm long and 4–10-flowered. The petals are creamy with the upper ones having a yellow blotch. The fruits are globose, *c.* 1 cm diameter and short-hairy.

Notes. Based primarily on its unbranched, slender inflorescences, *Xanthophyllum* sp. A keys out close to *X. neglectum* and *X. rectum*. It differs from the latter species, however, in having greenish (on drying), thickly coriaceous leaves with a blunt apex and faint lateral veins (on both surfaces).

Specimens examined. BORNEO—Sabah, Lahad Datu district, G. Silam (*SAN 98132*, *SAN 98164*, *SAN 98176*, *SAN 100814* and *SAN 100981*); Kinabatangan district, Imbak (*SAN 138170*); Keningau district, Nabawan FR (*SAN 139139*). PHILIPPINES—Palawan Islands (*SMHI 2153*, doubtful record).

53. *Xanthophyllum* sp. B

(subgen. *Xanthophyllum*, sect. *Eystathes*)

This taxon resembles *Xanthophyllum vitellinum* but differs in its globose, 2–3 mm diameter, glabrous axillary buds which are wrinkled on drying. Its leaves are smaller, 5–8 cm long, thinly coriaceous with hardly visible lateral veins and intercostal venation.

Specimens examined. BORNEO—Sarawak, Kapit district, Bt. Raya (*S 23996*); Sri Aman district, Sg. Engkari (*S 69725*).

54. *Xanthophyllum* sp. C

(subgen. *Xanthophyllum*, sect. *Eystathes*)

On account of its slender and unbranched inflorescence, this taxon also keys out close to *X. neglectum*. Taxonomically, however, *Xanthophyllum* sp. C is closely related to *X. vitellinum*. It differs from the latter in its unbranched inflorescence, glabrescent fruits which turn black on drying, yellowish green leaves with a subattenuate base, and sharply defined intercostal venation with the finer areoles more regular in size and shape. On account of its fine intercostal venation, this taxon also comes close to *X. nitidum*.

Specimens examined. BORNEO—Sabah, Labuk Sugut district, Bt. Meliau (*SAN 39311*), Sg. Meliau (*SAN 99667*), Sg. Tinumbukan (*SAN 90482*); Sandakan district, Bt. Malawati (*SAN 46638*), Bt. Takunan (*SAN 92417*).

ABBREVIATIONS OF FREQUENTLY CITED REFERENCES

Anderson, J.A.R. 1980. A Checklist of the Trees of Sarawak. Dewan Bahasa dan Pustaka, Cawangan Sarawak for Forest Department, Sarawak.
CLTS

Argent, G., A. Saridan, E.J.F. Campbell, P. Wilkie, G. Fairweather, J.T. Hadiah, D.J. Middleton, C. Pendry, M. Pinard, M. Warwick & K.S. Yulita (eds.). 1997. Manual of the Larger and More Important Non-dipterocarp Trees of Central Kalimantan, Indonesia. Vols. 1 & 2. Forest Research Institute, Samarinda.
MNDT-CK

Ashton, P.S. 1964. A Manual of the Dipterocarp Trees of Brunei State. Oxford University Press.
MDB

Ashton, P.S. 1968. A Manual of the Dipterocarp Trees of Brunei State and of Sarawak, Supplement. Borneo Literature Bureau for Sarawak Forest Department.
MDBS

Ashton, P.S. 1988. Manual of the Non-Dipterocarp Trees of Sarawak. Dewan Bahasa dan Pustaka, Sarawak Branch for Forest Department, Sarawak.
MNDTS

Backer, C.A. & R.C. Bakhuizen van den Brink, Jr. 1964, 1965 & 1968. Flora of Java. Vols. 1, 2 & 3. N.V. P. Noordhoff, Groningen.
FJ

Beaman, J.H., C. Anderson & R.S. Beaman. 2001. The Plants of Mount Kinabalu 4. Dicotyledon Families: Acanthaceae to Lythraceae. Natural History Publications (Borneo), Kota Kinabalu and Royal Botanic Gardens, Kew.
PMK

Browne, F.G. 1955. Forest Trees of Sarawak and Brunei and Their Products. Government Printing Office, Kuching.
FTSB

Burgess, P.F. 1966. Timbers of Sabah. Forest Department, Sabah.
TBS

Burkill, I.H. 1966. A Dictionary of the Economic Products of the Malay Peninsula. Vols. 1 & 2 Second edition. Ministry of Agriculture and Cooperatives, Kuala Lumpur.
EPMP

Cockburn, P.F. 1976 & 1980. Trees of Sabah. Vols. 1 & 2. Sabah Forest Record No. 10. Forest Department, Sabah. Borneo Literature Bureau, Kuching for Forest Department, Sabah.
TS

Coode, M.J.E., J. Dransfield, L.L. Forman, D.W. Kirkup & Idris M. Said (eds.). 1996. A Checklist of the Flowering Plants and Gymnosperms of Brunei Darussalam. Ministry of Industry and Primary Resources, Brunei Darussalam and Royal Botanic Gardens, Kew.
CLBD

Corner, E.J.H. 1988. Wayside Trees of Malaya. Vols. 1 & 2. Third edition. Malayan Nature Society, Kuala Lumpur.
WSTM

Flora Malesiana Series I (Seed Plants). Flora Malesiana Foundation, Leiden (to be listed without editor names, but to include author names, volume and page numbers)
FM

Kessler, P. & K. Sidiyasa. 1994. Trees of the Balikpapan-Samarinda Area, East Kalimantan, Indonesia. Tropenbos Series 7. The Tropenbos Foundation, Wageningen.
TBSA-EK

Keith, H.G. 1947. The Timbers of North Borneo. North Borneo Forest Records No. 3. Government of the Colony of North Borneo, Sandakan.
TNB

Keng, H. 1969. Orders and Families of Malayan Seed Plants. University of Malaya Press, Kuala Lumpur.
OFMSP

Kochummen, K.M. 1997. Tree Flora of Pasoh Forest. Malayan Forest Records No. 44, Forest Research Institute Malaysia, Kuala Lumpur.
TFPF

Mabberley, D.J. 1987 (reprinted with corrections, 1998). The Plant Book. Cambridge University Press, Cambridge.
PB

Masamune, G. 1942. *Enumeratio Phanerogamarum Bornearum*. Taihoku.
EPB

Merrill, E.D. 1921. A Bibliographic Enumeration of Bornean Plants. J. Str. Br. Roy. As. Soc., Special Number.
EB

Merrill, E.D. 1929. *Plantae Elmerianae Borneenses*. University of California Publications in Botany. Vol. 15. University of California Press, Berkeley.
PEB

Newman, M.F., P.F. Burgess & T.C. Whitmore. 1996. Manuals of Dipterocarps for Foresters: Borneo Island Light Hardwoods. Royal Botanic Garden, Edinburgh and Center for International Forestry Research, Bogor.

MDFB-LHW

Newman, M.F., P.F. Burgess & T.C. Whitmore. 1998. Manuals of Dipterocarps for Foresters: Borneo Island Medium and Heavy Hardwoods. Royal Botanic Garden, Edinburgh and Center for International Forestry Research, Bogor.

MDFB-MHHW

Ng, F.S.P. 1991 & 1992. Manual of Forest Fruits, Seeds and Seedlings. Vols. 1 & 2. Malaysian Forest Records No. 34. Forest Research Institute Malaysia, Kuala Lumpur.

MFSS

Perry, L.M. 1980. Medicinal Plants of East and Southeast Asia. MIT Press, Massachusetts.

MPESA

Plant Resources of South East Asia. 1989–2003. Vols. 1–19. Pudoc Scientific Publishers, Wageningen and Backhuys Publishers, Leiden (to be listed without editor or author names, but to include volume and page numbers).

PROSEA

Ridley, H.N. 1923–1925. The Flora of the Malay Peninsula. Vols. 1–5. L. Reeves & Co., Ltd., London.

FMP

Smythies, B.E. 1965. Common Sarawak Trees. Borneo Literature Bureau, Kuching.

CST

Soepadmo, E. et al. (eds.). 1995, 1996, 2000, 2002 & 2004. Tree Flora of Sabah and Sarawak. Vols. 1, 2, 3, 4 & 5. Forest Research Institute Malaysia, Kuala Lumpur, Forestry Department Sabah, Sandakan and Forestry Department Sarawak, Kuching (to be listed without editor names, but to include author names, volume and page numbers).

TFSS

Stapf, O. 1894. On the Flora of Mount Kinabalu, in North Borneo. Transactions of the Linnean Society, London, Ser. 2, 4. Pp. 69–263.

FMK

Whitmore, T.C. 1972 & 1973 (ed.) and **F.S.P. Ng** 1978 & 1989 (ed.). Tree Flora of Malaya, Vols. 1 & 2 and 3 & 4. Malaysian Forest Records No. 26. Forest Research Institute Malaysia. Longman Malaysia Sdn. Bhd., Kuala Lumpur (to be listed without editor names, but to include author names, volume and page numbers).

TFM

Whitmore, T.C. & I.G.M. Tantra. 1986. Tree Flora of Indonesia. Check List for Sumatra. Forest Research and Development Centre, Bogor.

CLS

Whitmore, T.C., I.G.M. Tantra & U. Sutisna. 1990. Tree Flora of Indonesia. Check List for Kalimantan, Part 1 and Parts 2.1–2.2. Forest Research and Development Centre, Bogor.
CLK

Willis, J.C. 1973. A Dictionary of the Flowering Plants & Ferns (revised by H.K. Airy Shaw). Cambridge University Press, Cambridge.
DFPF

Wong, T.M. 1982 (revised by Lim, S.C. & R.C.K. Chung, 2002). A Dictionary of Malaysian Timbers. Malayan Forest Records No. 30. Forest Research Institute Malaysia, Kuala Lumpur.
DMT

COMMONLY USED ABBREVIATIONS FOR LOCALITIES

English		Malay	
Word	Abbreviation	Word	Abbreviation
Central	C	Batang	Btg.
Division	Div.	Bukit	Bt.
East	E	Gunung	G.
Forest Reserve	FR	Kampung	Kg.
Hectare	ha	Sungai	Sg.
Island	Is.	Tanjung	Tg.
Mountain	Mt.		
National Park	NP		
North-East	NE		
North-West	NW		
River	R.		
South	S		
South-East	SE		
South-West	SW		
West	W		

PLATES

R.C.K. Chung



S.N. Phoon



S.N. Phoon

R.C.K. Chung



Plate 1. Cunoniaceae. *Weinmannia fraxinea*: A, habit; B, stipules; C, apical bud showing a continuous growth and producing a pair of young leaves; D, seedling on the forest floor.



C.M. Pannell
A



C.M. Pannell
B



C.M. Pannell
C

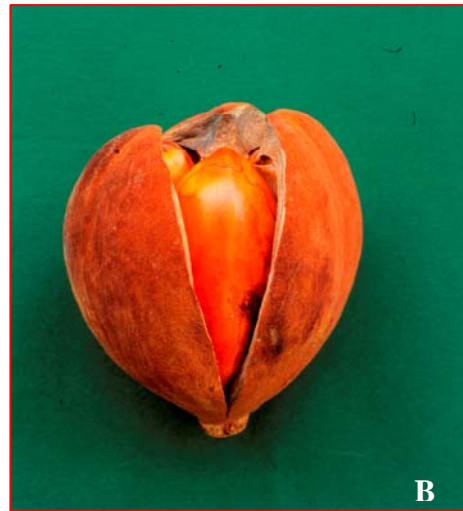


C.M. Pannell
D

Plate 2. Meliaceae. A, part of bole and outer bark of *Aglaia beccarii*; B, lower leaf surface of *A. densisquama*; C, longitudinal (above) and cross (below) sections of fruits of *A. forbesii* showing arillate seeds; D, fruiting leafy twigs of *A. glabrata*.



C.M. Pannell
A



C.M. Pannell
B



C.M. Pannell
C



C.M. Pannell
D

Plate 3. Meliaceae. A–C, *A. macrocarpa*: A, fruiting leafy twigs, B, dehiscent ripe fruit showing arillate seeds, C, fruiting (young) leafy twig; D, leafy twig of *A. meliosmoides*.



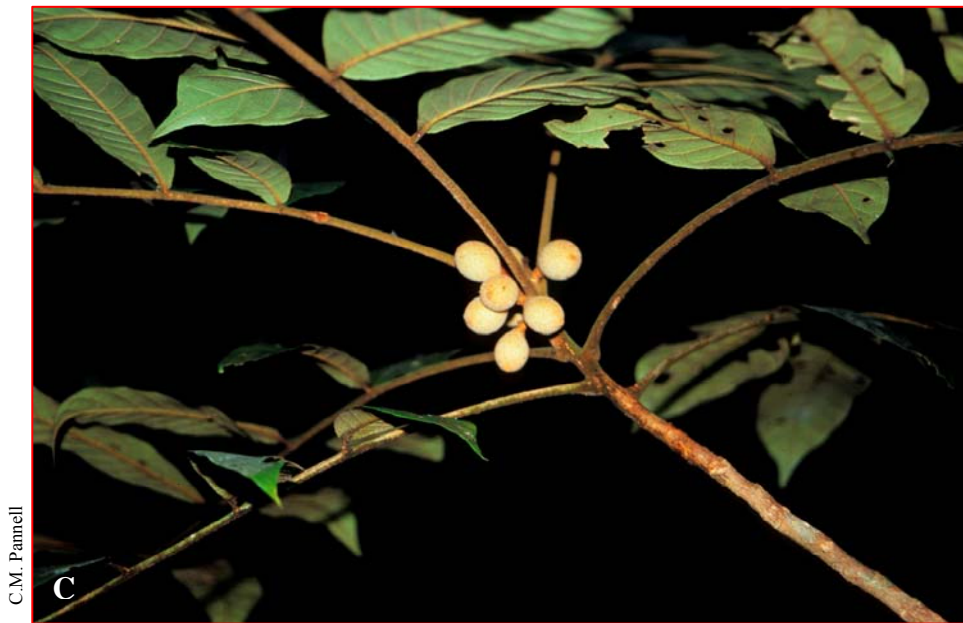
C.M. Pannell

A



C.M. Pannell

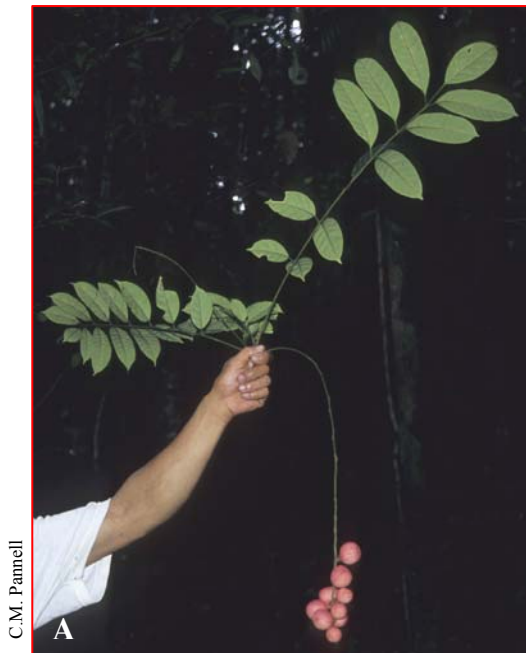
B



C.M. Pannell

C

Plate 4. Meliaceae. A–B, *A. rufibarbis*: A, leafy twig, B, flowering leafy twig; C, fruiting leafy twig of *A. tomentosa*.



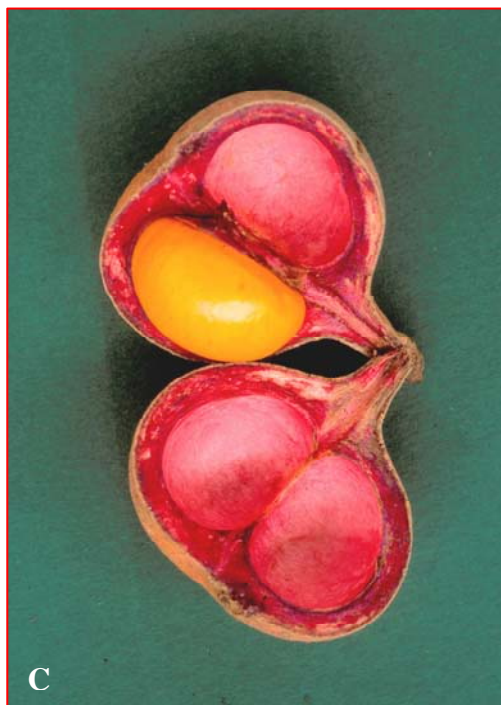
C.M. Pannell

A



C.M. Pannell

B



C.M. Pannell

C



C.M. Pannell

D

Plate 5. Meliaceae. A, fruiting leafy twig of *Aphanamixis borneensis*; B, flowering leafy twig of *Chisocheton erythrocarpus*; C, dehiscent ripe fruit of *C. erythrocarpus* showing arillate seeds; D, fruiting leafy twig of *Chisocheton lansiiifolius*.



C.M. Pannell
A



C.M. Pannell
B



E. Soepadmo
C



E. Soepadmo
D



E. Soepadmo
E

Plate 6. Meliaceae. A–B, fruits of *Dysoxylum cauliflorum*; C, fruits of *Lansium domesticum*; D, flowering leafy twig of *Xylocarpus granatum*; E, fruit of *X. granatum*.

W.J.J.O. de Wilde & B.E.E. Duyfjes



W.J.J.O. de Wilde & B.E.E. Duyfjes

W.J.J.O. de Wilde & B.E.E. Duyfjes



W.J.J.O. de Wilde & B.E.E. Duyfjes

Plate 7. Polygalaceae. A, fruiting leafy twig of *Xanthophyllum brevipes*; B, leafy twig of *X. ceraceifolium* showing the transversely wrinkled petioles; C, lower leaf surface of *X. discolor*; D, fruits of *X. ecarinatum*.



Plate 8. Polygalaceae. A, leafy twig of *Xanthophyllum heterophyllum*; B, fruiting leafy twig of *X. tenue*; C, flowering leafy twig of *Xanthophyllum* sp. A; D, fruiting leafy twig of *Xanthophyllum* sp. A.

INDEX TO SCIENTIFIC NAMES

(compiled by S. Julia, H.S. Tan & O. Zainun)

Names in italics here refer to either basionyms or synonyms; family names given in upper case are those of families revised in this volume. Pages where descriptions of families, genera and species are given printed in bolds; pages with illustrations are listed in bolds and italics; and pages with plates are printed in bold within brackets.

A

Agathis	9, 196
Aglaia	18, 19, 20, 21, 23, 24 , 26, 27, 41, 109, 113, 147, 162, 180, 186
sect. <i>Aglaia</i>	26, 37, 38, 41, 42, 43, 46, 47, 48, 49, 51, 54, 56, 57, 58, 59, 61, 62, 63, 64, 66, 68, 69, 70, 72, 75, 76, 78, 79, 80, 81, 82, 83, 84, 86, 87, 88, 89, 90, 91, 92, 93, 97, 98, 99, 100, 101, 103, 106
sect. <i>Amoora</i>	26, 44, 53, 72, 73, 77, 85, 88, 94
sect. <i>Lansium</i>	178, 184
sect. <i>Neoaglaia</i>	26, 27, 39, 67, 102
<i>Aglaia acida</i>	48
<i>Aglaia acuminata</i>	91
<i>Aglaia affinis</i>	79
<i>Aglaia alternifoliola</i>	67
<i>Aglaia angustifolia</i>	26, 29, 37
<i>Aglaia aquea</i>	180
<i>Aglaia argentea</i>	18, 26, 30, 38
var. <i>borneensis</i>	38
var. <i>curtisii</i>	38
var. <i>hypoleuca</i>	38
<i>Aglaia aspera</i>	90
<i>Aglaia baramensis</i>	51, 52, 64
<i>Aglaia barbatula</i>	81
<i>Aglaia beccariana</i>	37
<i>Aglaia beccarii</i>	27, 28, 33, 35, 36, 39 , 40 , 41, (305)
<i>Aglaia bernardoii</i>	61
<i>Aglaia bordenii</i>	80
<i>Aglaia borneensis</i>	87
<i>Aglaia brachybotrys</i>	38
<i>Aglaia brevipetiolata</i>	72
<i>Aglaia bullata</i>	26, 29, 41
<i>Aglaia calelanensis</i>	90
<i>Aglaia canariifolia</i>	49
<i>Aglaia caudatifoliolata</i>	62
<i>Aglaia cauliflora</i>	63
<i>Aglaia celebica</i>	63
<i>Aglaia chaudocensis</i>	58
<i>Aglaia cinerea</i>	43

<i>Aglaia clementis</i>	51, 53
<i>Aglaia conduplicifolia</i>	44
<i>Aglaia confertiflora</i>	63
<i>Aglaia copelandii</i>	91
<i>Aglaia cordata</i>	103, 106
<i>Aglaia coriacea</i>	26, 36, 42
<i>Aglaia crassinervia</i>	26, 31, 33, 35, 43, 45
<i>Aglaia cucullata</i>	26, 27, 31, 33, 44
<i>Aglaia cumingiana</i>	26, 29, 37, 46
<i>Aglaia cuprea</i>	97
<i>Aglaia cupreolepidota</i>	49
<i>Aglaia curranii</i>	48
<i>Aglaia curtisii</i>	62
<i>Aglaia cuspidella</i>	79
<i>Aglaia densisquama</i>	26, 31, 47, (305)
<i>Aglaia diffusa</i>	48
<i>Aglaia discolor</i>	38
<i>Aglaia domestica</i>	180
<i>Aglaia dookoo</i>	180
<i>Aglaia dyeri</i>	103, 106
<i>Aglaia dysoxylifolia</i>	63
<i>Aglaia edulis</i>	26, 27, 32, 33, 36, 47
<i>Aglaia elaeagnoidea</i>	26, 32, 49
var. <i>pallens</i>	49
<i>Aglaia elliptica</i>	26, 27, 36, 51, 66
subsp. <i>clementis</i>	50, 52
subsp. <i>elliptica</i>	50, 52
<i>Aglaia elmeri</i>	71
<i>Aglaia erythrosperma</i>	26, 28, 37, 53, 55
<i>Aglaia eusideroxylon</i>	67
<i>Aglaia exstipulata</i>	26, 34, 54
subsp. <i>brunneostellata</i>	54
subsp. <i>exstipulata</i>	54
<i>Aglaia forbesii</i>	26, 34, 36, 56, (305)
<i>Aglaia foveolata</i>	26, 36, 57
<i>Aglaia fusca</i>	80
<i>Aglaia gamopetala</i>	69
<i>Aglaia ganggo</i>	91
<i>Aglaia glabrata</i>	26, 32, 36, 58, (305)
<i>Aglaia glabriflora</i>	26, 32, 59, 60, 61, 70
<i>Aglaia glabrifolia</i>	69
<i>Aglaia glomerata</i>	103, 106
<i>Aglaia grandifoliola</i>	67
<i>Aglaia grandis</i>	26, 30, 61
<i>Aglaia griffithii</i>	54
? <i>Aglaia harmsiana</i>	51, 52
<i>Aglaia havilandii</i>	51, 52
<i>Aglaia helmsleyi</i>	61
<i>Aglaia hemsleyi</i>	61

<i>Aglaia heptandra</i>	102
<i>Aglaia heteroclita</i>	71
<i>Aglaia heterophylla</i>	79
<i>Aglaia hiernii</i>	26, 30, 34, 62
<i>Aglaia humilis</i>	56
<i>Aglaia hypoleuca</i>	38
<i>Aglaia ignea</i>	85
<i>Aglaia kabaensis</i>	103, 105
<i>Aglaia kinabaluensis</i>	188
<i>Aglaia korthalsii</i>	26, 32, 63 , 64, 65
<i>Aglaia kunstleri</i>	71
<i>Aglaia laevigata</i>	69
<i>Aglaia lanceolata</i>	78
<i>Aglaia lancifolia</i>	18, 23, 26, 30, 50 , 52, 64
<i>Aglaia lancilimba</i>	26, 32, 66
<i>Aglaia lanuginosa</i>	61
<i>Aglaia lawii</i>	27, 28, 32, 33, 41, 67
subsp. <i>lawii</i>	67
subsp. <i>oligocarpa</i>	67
subsp. <i>submonophylla</i>	67
<i>Aglaia laxiflora</i>	26, 29, 35, 68
<i>Aglaia lepantha</i> var. <i>borneensis</i>	69
<i>Aglaia lepantha</i>	26, 33, 60 , 61, 69 , 70
var. <i>borneensis</i>	69
<i>Aglaia leucophylla</i>	26, 33, 34, 35, 37, 70
<i>Aglaia luzoniensis</i>	26, 27, 71
<i>Aglaia macrocarpa</i>	26, 29, 33, 72 , (306)
<i>Aglaia maingayi</i>	67
<i>Aglaia malaccensis</i>	26, 29, 37, 73
<i>Aglaia matthewsii</i>	75
<i>Aglaia megistocarpa</i>	81
<i>Aglaia meliosmoides</i>	26, 27, 74 , 75 , 93, (306)
<i>Aglaia micropora</i>	91
<i>Aglaia minahassae</i>	48
<i>Aglaia minutiflora</i> var. <i>griffithii</i>	54
<i>Aglaia monophylla</i>	72
<i>Aglaia monozyga</i>	26, 37, 76
<i>Aglaia motleyana</i>	48
? <i>Aglaia moultonii</i>	51, 52
<i>Aglaia multiflora</i>	69
<i>Aglaia multifoliola</i>	38
<i>Aglaia multinervis</i>	26, 28, 30, 33, 77
<i>Aglaia neotenica</i>	26, 28, 74 , 78 , 79
<i>Aglaia odoardi</i>	75
<i>Aglaia odoratissima</i>	26, 32, 33, 64, 79
<i>Aglaia oligantha</i>	80
<i>Aglaia oligocarpa</i>	67
<i>Aglaia oligophylla</i>	26, 29, 36, 80 , 175, 180, 187, 188
<i>Aglaia pachyphylla</i>	26, 30, 81

<i>Aglaia palembanica</i>	26, 34, 82
<i>Aglaia pallens</i>	49
<i>Aglaia pamattonis</i>	83
<i>Aglaia parvifolia</i>	49
<i>Aglaia pedicellata</i>	67
<i>Aglaia perfulva</i>	61
<i>Aglaia pinnata</i>	103, 106
<i>Aglaia polyantha</i>	80
<i>Aglaia ?polystachya</i>	110
<i>Aglaia pseudolansium</i>	186
<i>Aglaia racemosa</i>	67
<i>Aglaia ramotricha</i>	26, 33, 83
<i>Aglaia ridleyi</i>	94
<i>Aglaia rimosa</i>	78
<i>Aglaia rivularis</i>	18, 23, 26, 27, 84
<i>Aglaia rizalensis</i>	72
<i>Aglaia rubescens</i>	73
<i>Aglaia rubiginosa</i>	18, 26, 28, 31, 55, 85
<i>Aglaia rufa</i>	103, 106
<i>Aglaia rufibarbis</i>	26, 34, 86, (307)
<i>Aglaia rufinervis</i>	26, 34, 87
<i>Aglaia rugulosa</i>	26, 29, 37, 88
<i>Aglaia samarensis</i>	48
<i>Aglaia sarawakana</i>	63
<i>Aglaia scortechinii</i>	26, 32, 88
<i>Aglaia sessilifolia</i>	26, 28, 89
<i>Aglaia sexipetala</i>	26, 34, 35, 90
<i>Aglaia shawiana</i>	75
<i>Aglaia silvestris</i>	26, 32, 91
<i>Aglaia simplex</i>	71
<i>Aglaia simplicifolia</i>	26, 28, 76, 79, 92, 93, 100
<i>Aglaia simplicifolia</i>	99
<i>Aglaia soepadmoi</i>	26, 30, 93, 95
<i>Aglaia speciosa</i>	26, 32, 93
<i>Aglaia spectabilis</i>	26, 29, 37, 94, 96, 162
<i>Aglaia squamulosa</i>	26, 30, 31, 97
<i>Aglaia stellatopilosa</i>	26, 36, 60, 70, 98
<i>Aglaia stellatotomentosa</i>	61
<i>Aglaia stellato-tomentosa</i>	61
<i>Aglaia stenophylla</i>	37
<i>Aglaia sterculioides</i>	26, 28, 74, 99
<i>Aglaia submonophylla</i>	67
<i>Aglaia subsessilis</i>	26, 35, 36, 100
<i>Aglaia tarangisi</i>	46
<i>Aglaia tembelingensis</i>	51
<i>Aglaia tenuicaulis</i>	26, 35, 101
subsp. <i>semengohensis</i>	101, 102
subsp. <i>tenuicaulis</i>	101, 102
<i>Aglaia teysmanniana</i>	27, 28, 33, 102

<i>Aglaia tomentosa</i>	26, 34, 35, 103 , (307)
subsp. <i>cordata</i>	104 , 105, 106
subsp. <i>kabaensis</i>	104 , 105
subsp. <i>tomentosa</i>	104 , 105, 106
<i>Aglaia triandra</i>	75
<i>Aglaia trichostemon</i>	87
<i>Aglaia trimera</i>	67, 73
<i>Aglaia tripetala</i>	44
<i>Aglaia triplex</i>	73
<i>Aglaia unifoliolata</i>	72, 75
<i>Aglaia variisquama</i>	26, 31, 106
<i>Aglaia villosa</i>	51, 52
<i>Aglaia</i> sp. 1	88
<i>Aglaia</i> sp. 2	53
<i>Aglaia</i> sp. 2/B	53
<i>Aglaia</i> sp. 3	77
<i>Aglaia</i> sp. 3/C	77
<i>Aglaia</i> sp. 4	63
<i>Aglaia</i> sp. 5	90
<i>Aglaia</i> sp. 6	43
<i>Aglaia</i> sp. 7	57
<i>Aglaia</i> sp. 7/K	43
<i>Aglaia</i> sp. 8/L	57
<i>Aglaia</i> sp.	43
<i>Aglaiopsis</i>	25
<i>Aglaiopsis lancifolia</i>	64
<i>Ailanthus integrifolia</i>	115
<i>Alliaria</i>	146
<i>Alliaria acutangula</i>	149
<i>Alliaria arborescens</i>	152
<i>Alliaria beccariana</i>	156
<i>Alliaria cyrtobotrya</i>	160
<i>Alliaria densiflora</i>	162
<i>Alliaria grandis</i>	166
<i>Alliaria hiernii</i>	156
<i>Alliaria mollissima</i>	168
<i>Alliaria oppositifolia</i>	171
<i>Alliaria teysmannii</i>	168
<i>Amoora</i>	25, 109
sect. <i>Aphanamixis</i>	107
<i>Amoora aherniana</i>	44
<i>Amoora borneensis</i>	109
<i>Amoora cucullata</i>	44
<i>Amoora curtispica</i>	39
<i>Amoora korthalsii</i>	39
<i>Amoora lanceolata</i>	77
<i>Amoora lepidota</i>	67
<i>Amoora maingayi</i>	67
<i>Amoora malaccensis</i>	75

<i>Amoora ridleyi</i>	94
<i>Amoora rubescens</i>	73
<i>Amoora rubiginosa</i>	85
<i>Amoora spectabilis</i>	94
<i>Amoora teysmanniana</i>	102
<i>Amoora wallichii</i>	94
<i>Andersonia</i>	109
<i>Antelaea</i>	112
<i>Aphanamixis</i>	19, 23, 24, 107 , 109
<i>Aphanamixis borneensis</i>	108 , 109 , (308)
<i>Aphanamixis humile</i>	187
<i>Aphanamixis humilis</i>	187
<i>Aphanamixis pedicellata</i>	109
<i>Aphanamixis polystachya</i>	109, 110
<i>Aphanamixis reticulosa</i>	80
<i>Aphanamixis rohituka</i>	110
<i>Aphanamixis sumatrana</i>	110
<i>Aphanamixis sumatrana</i>	109
<i>Argophilum pinnatum</i>	103, 106
<i>Azadirachta</i>	20, 23, 24, 111 , 112
<i>Azadirachta excelsa</i>	19, 23, 112, 113 , 114
<i>Azadirachta indica</i>	19, 111, 112 , 115
<i>Azedarach excelsa</i>	113
B	
<i>Barringtonia asiatica</i>	13
<i>Beddomea</i>	25
<i>Beddomea luzoniensis</i>	72
? <i>Beddomea racemosa</i>	92
<i>Beddomea simplicifolia</i>	92
<i>Biasolettia</i>	12
<i>Biasolettia nymphaeaeifolia</i>	13
Brunelliaceae	2
Burseraceae	208
C	
<i>Carapa</i>	215
<i>Carapa borneensis</i>	218
<i>Carapa granata</i>	217
<i>Carapa granatum</i>	217
<i>Carapa moluccensis</i>	217, 218
<i>Carapa obovata</i>	217, 218
<i>Cedrela</i>	20, 22 , 24
<i>Cedrela</i>	198
sect. <i>Toona</i>	198
<i>Cedrela celebica</i>	204
<i>Cedrela febrifuga</i>	202
<i>Cedrela hexandra</i>	202
<i>Cedrela odorata</i>	19, 23

<i>Cedrela sureni</i>	202
<i>Cedrela toona</i>	199
<i>Cedrela velutina</i>	202
Cephalotaceae	2
<i>Chickrassia</i>	143
<i>Chickrassia tabularis</i>	145
Chisocheton	18, 19, 20, 21, 23, 24, 113, 115 , 116, 147
Chisocheton amabilis	18, 118, 119
<i>Chisocheton beccarianus</i>	133, 134
<i>Chisocheton brachyanthus</i>	119, 138
Chisocheton ceramicus	118, 120 , 138
<i>Chisocheton clementis</i>	120
Chisocheton crustularii	117, 121
Chisocheton cumingianus	121
subsp. balansae	122
subsp. cumingianus	122
subsp. kinabaluensis	116, 122
<i>Chisocheton divergens</i>	132
var. patens	132
Chisocheton erythrocarpus	118, 123 , (308)
<i>Chisocheton glomeratus</i>	138
Chisocheton granatum	117, 124
<i>Chisocheton hackenbergii</i>	119
<i>Chisocheton illustris</i>	119
<i>Chisocheton kinabaluensis</i>	122
<i>Chisocheton kingii</i>	124
Chisocheton koordersii	24, 115, 117, 124
Chisocheton lansiiifolius	118, 125 , 127 , 133, 175, 180, (308)
Chisocheton macranthus	116, 126 , 130, 147
Chisocheton maxilla-pisticis	118, 128 , 129
Chisocheton medusae	116, 130 , 131
<i>Chisocheton medusae</i>	126
<i>Chisocheton medusae</i> f. <i>hiascens</i>	130
Chisocheton patens	23, 115, 116, 118, 132 , 133, 141, 162
<i>Chisocheton paucijugus</i>	133, 134
Chisocheton pentandrus	118, 133 , 134
subsp. medius	134, 135
subsp. paucijugus	133, 134
subsp. pentandrus	133, 134, 135
Chisocheton polyandrus	117, 130, 135
<i>Chisocheton rhytidocalyx</i>	120
<i>Chisocheton rigidus</i>	174
Chisocheton ruber	18, 116, 136
Chisocheton sarasinorum	117, 137 , 138
Chisocheton sarawakanus	117, 118, 138 , 139
Chisocheton setosus	117, 121, 141
<i>Chisocheton spectabilis</i>	120
Chisocheton sp. nov. aff. <i>diversifolius</i>	143
Chisocheton tomentosus	130

Chisocheton velutinus	119, 140 , 141 , 142
<i>Chisocheton</i> sp. B	141
Chisocheton sp. B	142
<i>Chisocheton</i> sp. C	123
<i>Chisocheton</i> sp.	135
Chukrasia	19, 20, 21, 24, 143
Chukrasia tabularis	18, 19, 143 , 144
Clausena	183
<i>Cipadessa borneensis</i>	183
<i>Clausena chrysogyne</i>	183
<i>Clemensia</i>	115
<i>Clemensia macrantha</i>	126
Combretaceae	11, 12
Connaraceae	2
Cunonia	2
CUNONIACEAE	1 , 2, 304
tribe Caldcluvieae	2
tribe Codieae	2
tribe Cunonieae	2
tribe Geissonieae	2
tribe Schizomerieae	2
tribe Spiraeanthemeae	2
D	
<i>Dasycoleum</i>	115
<i>Dasycoleum beccarianum</i>	133, 134
<i>Dasycoleum cumingianum</i>	122
<i>Dasycoleum sarawakanum</i>	138
<i>Didymocheton</i>	146
Dysoxylum	18, 19, 20, 23, 24, 116, 146 , 147
sect. Cyrtochiton	147, 149, 154, 155, 160, 165, 166, 171, 175
sect. Dysoxylum	147, 151, 152, 156, 158, 162, 163, 167, 168, 172, 173, 174
Dysoxylum acutangulum	18, 147, 149
subsp. acutangulum	147, 150
subsp. foveolatum	150
Dysoxylum alliaceum	23, 147, 149, 151 , 152, 153 , 175
<i>Dysoxylum alternatum</i>	162
Dysoxylum angustifolium	147
Dysoxylum arborescens	147, 148, 152 , 162
<i>Dysoxylum beccarianum</i>	156
Dysoxylum brachybotrys	147, 149, 154 , 176
<i>Dysoxylum brachystachys</i>	154
Dysoxylum carolinae	18, 147, 148, 155
Dysoxylum cauliflorum	147, 148, 156 , 157 , 184, (309)
var. <i>tomentellum</i>	162
Dysoxylum crassum	18, 147, 148, 158 , 159

Dysoxylum cyrtobotryum	147, 149, 154, 160 , 161 , 176
var. <i>borneense</i>	160
Dysoxylum densiflorum	147, 148, 162
<i>Dysoxylum elmeri</i>	162
Dysoxylum excelsum	147, 149, 152, 163 , 164
Dysoxylum flavescens	18, 147, 149, 165
<i>Dysoxylum foxworthyi</i>	156
<i>Dysoxylum fulvum</i>	175
Dysoxylum grande	147, 149, 165
<i>Dysoxylum havilandii</i>	164, 165
<i>Dysoxylum kinabaluense</i>	160
<i>Dysoxylum lampongum</i>	151
Dysoxylum macrocarpum	147, 149, 166
Dysoxylum magnificum	23, 147, 148, 152, 167 , 175
<i>Dysoxylum molle</i>	168
Dysoxylum mollissimum	23, 147, 148, 152, 168 , 175
subsp. <i>molle</i>	169
subsp. <i>mollissimum</i>	169
var. <i>halmaherae</i>	168
var. <i>sumatranum</i>	168
<i>Dysoxylum motleyanum</i>	164
Dysoxylum oppositifolium	147, 171
Dysoxylum pachyrhache	147, 149, 170 , 171
Dysoxylum papillosum	147, 148, 172
Dysoxylum parasiticum	147, 148, 173
<i>Dysoxylum procerum</i> var. <i>motleyanum</i>	164
<i>Dysoxylum ramiflorum</i>	173
Dysoxylum rigidum	23, 147, 148, 152, 174 , 180
<i>Dysoxylum rubrum</i>	152
Dysoxylum rugulosum	147, 149, 155, 162, 173, 175
Dysoxylum sessile	147
<i>Dysoxylum</i> sp. 1	155
Dysoxylum sp. 3	147, 162, 176
<i>Dysoxylum teysmannii</i>	168
<i>Dysoxylum thyrsoides</i>	151
<i>Dysoxylum undulatum</i>	175

E

Elaeagnus	49
Elaeocarpaceae	2
Entandrophragma	19
Entandrophragma utile	19
<i>Epicharis</i>	146
<i>Epicharis densiflora</i>	162
<i>Epicharis exarillata</i>	67
<i>Epicharis hierniana</i>	156
<i>Epicharis macrocarpa</i>	72
<i>Epicharis pachyrhachis</i>	171

<i>Epirhizanthus</i>	221
<i>Epirixanthes</i>	219, 221
<i>Euphora exstipulatis</i>	54
<i>Euphoria exstipulata</i>	54
F	
Fabaceae	220
subfam. Caesalpinioideae	220
subfam. Faboideae	220
Fraxinus	8, 20
G	
<i>Goniocheton</i>	146
<i>Goniocheton arborescens</i>	152
<i>Granatum moluccense</i>	218
<i>Granatum obovatum</i>	217
<i>Guarea alliacea</i>	151
<i>Guarea densiflora</i>	162
Gyrocarpus	11
H	
<i>Hartighsea</i>	146
<i>Hartighsea angustifolia</i>	37
<i>Hartighsea mollissima</i>	168
<i>Hearnia</i>	25
<i>Hearnia beccariana</i>	37
<i>Hearnia cumingiana</i>	46
<i>Hearnia elliptica</i>	51, 52
<i>Hearnia lancifolia</i>	64
<i>Hearnia sarawakana</i>	63
<i>Hearnia villosa</i>	51, 52
Hernandia	11, 12
<i>Hernandia nymphaeifolia</i>	13, 14 , 15
<i>Hernandia ovigera</i>	15
<i>Hernandia ovigera</i>	13
<i>Hernandia peltata</i>	13
HERNANDIACEAE	11
subfam. Gyrocarpoideae	11
subfam. Hernandioideae	11
Heynea	19, 20, 23, 24, 177
<i>Heynea sumatrana</i>	177
<i>Heynea trijuga</i>	177, 179
<i>Heynea velutina</i>	177
I	
<i>Illigera</i>	11, 12
<i>Illigera celebica</i>	12
<i>Illigera megaptera</i>	12

J

<i>Jackia</i>	221
<i>Jackia excelsa</i>	252
<i>Jackia vitellina</i>	292
<i>Jakkia</i>	221
<i>Jakkia excelsa</i>	252
<i>Jakkia longiflora</i>	292
<i>Jakkia vitellina</i>	292

K

Khaya	19, 22 , 24
Khaya ivorensis	19, 22
Khaya senegalensis	19, 22

L

Lansium	19, 20, 23, 24, 125, 178 , 186
sect. <i>Neolansium</i>	178, 184
<i>Lansium aqueum</i>	180
<i>Lansium breviracemosum</i>	180
<i>Lansium cinereum</i>	186
<i>Lansium domesticum</i>	19, 125, 175, 180 , 181 , 182, (309)
var. <i>aqueum</i>	180
<i>Lansium humile</i>	187
<i>Lansium membranaceum</i>	180
<i>Lansium pedicellatum</i>	67
<i>Lansium silvestre</i>	91
Lauraceae	11, 12
Leguminosae	208
Lepisanthes	180
<i>Lepisanthes forbesii</i>	156
Lovoa	19
Lythraceae	124, 217

M

<i>Macrocheton</i>	146
<i>Macrocheton excelsum</i>	164
<i>Macrochiton excelsum</i>	146, 164
Malvaceae subfam. Sterculioideae	99
<i>Megaphyllaea</i>	115, 130
Melia	17, 20 , 24, 112
<i>Melia azadirachta</i>	112
<i>Melia azedarach</i>	19, 20, 24
<i>Melia excelsa</i>	113
<i>Melia indica</i>	112
<i>Melia koetjape</i>	196
<i>Melia parasitica</i>	173
MELIACEAE	17 , 18, 19, 158, 305, 306, 307, 308, 309
subfam. Cedreloideae	18, 20
subfam. Melioideae	18, 19

Meliosma	75
<i>Milnea</i>	25
<i>Milnea edulis</i>	48
<i>Milnea lancifolia</i>	64
N	
<i>Nemedra</i>	25
<i>Nemedra elaeagnoidea</i>	49
<i>Nimmonia lawii</i>	67
Nymphaea	13
Nypa	218
O	
Oleaceae	8
Oxalidaceae	2
Oxalidales	2
P	
Pancheria	2
<i>Piptosaccos</i>	146
<i>Piptosaccos hypophyllantha</i>	173
Polyalthia sclerophylla	120
Polygala	219, 220
Polygala paniculata	219, 220
Polygala venenosa	220
POLYGALACEAE	219 , 220, 310, 311
tribe Moutabeae	220
tribe Polygaleae	220
tribe Xanthophylleae	220
<i>Prasoxylon</i>	146
<i>Prasoxylon alliaceum</i>	151
Pseudoclausena	20, 23, 24, 183
Pseudoclausena chrysogyne	183, 185
f. <i>velutina</i>	183, 184
<i>Pterophylla</i>	2
<i>Pterophylla fraxinea</i>	8
Punica granatum	124, 217
Punicaceae	124
Q	
Quercus	257
R	
Reinwardtiodendron	20, 23, 24, 184 , 186
Reinwardtiodendron anaimalaiense	186
Reinwardtiodendron cinereum	186
Reinwardtiodendron humile	186, 187, 189
Reinwardtiodendron kinabaluense	186, 188
? <i>Ricinocarpodendron</i>	107

<i>Ricinocarpodendron borneense</i>	109
<i>Ricinocarpodendron polystachyum</i>	110
Rutaceae	183
S	
Sabiaceae	75
Salomonina	219, 220
<i>Salomonina cantonensis</i>	221
<i>Salomonina ciliata</i>	221
Sandoricum	18, 19, 20, 21, 23, 24, 188 , 190
<i>Sandoricum beccarianum</i>	190, 191 , 193
<i>Sandoricum borneense</i>	18, 23, 190, 192
<i>Sandoricum caudatum</i>	190, 194 , 195
<i>Sandoricum dasyneuron</i>	191, 194 , 198
<i>Sandoricum emarginatum</i>	191
<i>Sandoricum indicum</i>	196
<i>Sandoricum koetjape</i>	19, 188, 190, 191, 196
<i>Sandoricum maingayi</i>	196
var. <i>quadripetalum</i>	196
<i>Sandoricum nervosum</i>	196
<i>Sandoricum radiatum</i>	197
<i>Sandoricum vidalii</i>	197
Sapindaceae	54, 180, 208
Saxifragaceae	2
<i>Schizochiton amabile</i>	119
var. <i>sumatranum</i>	119
<i>Schizochiton ceramicum</i>	120
<i>Schizochiton paucijugum</i>	133, 134
<i>Schizochiton spectabile</i>	120
Scorodocarpus	23
Securidaca	219, 221
<i>Securidaca inappendiculata</i>	221
<i>Securidaca philippinensis</i>	221
Shorea guiso	207
Simaroubaceae	115
<i>Skaphium</i>	221
Sonneratia	218
Sparattanthelium	11
Sterculia	99
Sterculiaceae	99
<i>Surenus toona</i>	200
Swietenia	18, 20, 21 , 24
<i>Swietenia macrophylla</i>	18, 21
<i>Swietenia sureni</i>	202
<i>Swietenia surenis</i>	204
T	
Terminalia	17, 20, 204
Toona	18, 19, 20, 22, 24, 184, 198 , 199, 200, 202

Toona calantas	202
Toona ciliata	18, 198, 199 , 201 , 202, 203
var. <i>hexandra</i>	200
<i>Toona hexandra</i>	200, 202
Toona sinensis	199
Toona sureni	199, 202 , 204
<i>Toona velutina</i>	202
<i>Tremandraceae</i>	2
<i>Trichilia</i>	177
<i>Trichilia arborescens</i>	152
<i>Trichilia excelsa</i>	113
<i>Trichilia mollissima</i>	168
<i>Trichilia pentandra</i>	133
<i>Trichilia rufinervis</i>	87
V	
Vavaea	17, 20, 24, 204
Vavaea amicorum	204 , 205
<i>Vavaea bantamensis</i>	204
Vesselowskyia	2
<i>Vitex bantamensis</i>	204
W	
Walsura	19, 20, 23, 24, 177, 206 , 207
sect. <i>Heynea</i>	177
sect. <i>Neowalsura</i>	183
<i>Walsura borneensis</i>	183
<i>Walsura chrysogyne</i>	183
Walsura decipiens	207, 208 , 209 , 214
Walsura dehiscens	24, 207, 208
<i>Walsura glabra</i>	183
Walsura grandifolia	18, 133, 162, 207, 210 , 214
<i>Walsura hosei</i>	183
<i>Walsura multijuga</i>	183
<i>Walsura neurodes</i>	212
Walsura pachycaulon	207, 211 , 213 , 214
Walsura pinnata	133, 207, 208, 211, 212 , 214
<i>Walsura pinnata</i>	208, 210
<i>Walsura punctata</i> var. <i>papillosa</i>	109, 177
Walsura sarawakensis	207, 214
<i>Walsura sumatrana</i>	177
Walsura trifoliolata	206
<i>Walsura trijuga</i>	177
<i>Walsura velutina</i>	183
<i>Walsura villamilii</i>	212
Walsura sp. A	214
Weinmannia	1, 2 , 3
sect. <i>Fasciculatae</i>	3
sect. <i>Inspersae</i>	3

sect. <i>Leiospermum</i>	3
sect. <i>Racemosae</i>	3
sect. <i>Simplicifoliae</i>	3
sect. <i>Spicatae</i>	3
sect. <i>Weinmannia</i>	3
<i>Weinmannia aphanoneura</i>	4, 5
<i>Weinmannia blumei</i>	8
var. <i>major</i>	8
<i>Weinmannia borneensis</i>	8
<i>Weinmannia clemensiae</i>	3, 7
<i>Weinmannia dulitensis</i>	8
<i>Weinmannia fraxinea</i>	1, 2, 4, 6, 8, 9, (304)
<i>Weinmannia furfuracea</i>	1

X

<i>Xanthophyllum</i>	219, 220, 221 , 222, 223, 224, 229
subgen. <i>Brunophyllum</i>	223, 242, 247, 265
subgen. <i>Coriaceum</i>	223, 276
subgen. <i>Exsertum</i>	223, 285
subgen. <i>Triadelphum</i>	223, 246, 248, 258, 262
subgen. <i>Xanthophyllum</i>	223, 226, 235, 236, 238, 239, 241, 242, 244, 246, 250, 251, 254, 255, 257, 259, 260, 261, 263, 264, 265, 266, 267, 268, 270, 271, 272, 274, 275, 278, 280, 281, 282, 285, 287, 289, 290, 291, 292, 294, 295
sect. <i>Eystathes</i>	223, 226, 235, 236, 238, 239, 241, 242, 244, 246, 254, 257, 259, 260, 261, 263, 264, 265, 266, 267, 268, 270, 271, 272, 274, 275, 278, 281, 287, 289, 290, 292, 294, 295
sect. <i>Xanthophyllum</i>	223, 250, 251, 255, 261, 280, 282, 285, 291
<i>Xanthophyllum adenotus</i>	223, 227, 231, 235, 237 , 272, 274
var. <i>adenotus</i>	236 , 274
var. <i>arsatii</i>	236
var. <i>lineare</i>	260
<i>Xanthophyllum affine</i>	252
<i>Xanthophyllum amoenum</i>	286, 287
<i>Xanthophyllum arsatii</i>	235, 236
<i>Xanthophyllum beccarianum</i>	223, 224, 232, 236 , 238, 271
<i>Xanthophyllum beccarinum</i>	236
<i>Xanthophyllum bicolor</i>	223, 225, 232, 238 , 239, 272, 275
<i>Xanthophyllum borneense</i>	223, 225, 227, 232, 233, 239
<i>Xanthophyllum brachystachyum</i>	223, 224, 231, 238, 241 , 271
<i>Xanthophyllum brevipes</i>	222, 223, 225, 232, 240, 241 , 242, (310)
<i>Xanthophyllum ceraceifolium</i>	223, 227, 233, 236, 242, 243, (310)
<i>Xanthophyllum citrifolium</i>	250
<i>Xanthophyllum clovis</i>	223, 225, 232, 244, 245

<i>Xanthophyllum contractum</i>	223, 228, 230, 246
<i>Xanthophyllum cordatum</i>	235, 236
f. <i>aequale</i>	235, 236
<i>Xanthophyllum crassum</i>	223, 226 , 231
<i>Xanthophyllum curtisii</i>	292
<i>Xanthophyllum densiflorum</i>	274
<i>Xanthophyllum discolor</i>	223, 225, 233, 246 , 275, (310)
subsp. <i>discolor</i>	247 , 275
subsp. <i>macranthum</i>	246
subsp. <i>macranthum</i>	247
<i>Xanthophyllum ecarinatum</i>	222, 223, 229, 234, 247 , (310)
<i>Xanthophyllum ellipticum</i>	223, 229, 234, 248 , 249 , 258
var. <i>subcoriaceum</i>	250, 287
<i>Xanthophyllum excelsum</i>	252
<i>Xanthophyllum ferrugineum</i>	223, 228, 230, 235, 250 , 251, 254
<i>Xanthophyllum flavescens</i>	222, 223, 228, 229, 230, 231, 251 , 253 , 254, 262, 285
<i>Xanthophyllum flavum</i>	282
<i>Xanthophyllum glabrescens</i>	239
<i>Xanthophyllum gracile</i>	254
<i>Xanthophyllum griffithii</i>	223, 225, 227, 233, 235, 254
subsp. <i>angustifolium</i>	255
var. <i>angustifolium</i>	255
var. <i>curtisii</i>	254, 292
var. <i>montanum</i>	254
var. <i>papillosum</i>	255
<i>Xanthophyllum havilandii</i>	223, 228, 230, 231, 254, 255 , 257, 262
<i>Xanthophyllum heterophyllum</i>	223, 226, 233, 256 , 257 , 260, (311)
<i>Xanthophyllum heteropleurum</i>	282
<i>Xanthophyllum hildebrandii</i>	223, 229, 258
<i>Xanthophyllum hookerianum</i>	292
<i>Xanthophyllum hosei</i>	255, 257
<i>Xanthophyllum hypoleucum</i>	246, 274
<i>Xanthophyllum impressum</i>	223, 226, 233, 259
<i>Xanthophyllum insigne</i>	265
<i>Xanthophyllum kalimantanum</i>	248
<i>Xanthophyllum kingii</i>	250
<i>Xanthophyllum korthalsianum</i>	223, 225, 233, 259 , 260
<i>Xanthophyllum kunstleri</i>	292
<i>Xanthophyllum lineare</i>	223, 227, 234, 260
<i>Xanthophyllum longifolium</i>	292
<i>Xanthophyllum longum</i>	223, 227, 231, 261
<i>Xanthophyllum macrophyllum</i>	223, 228, 230, 254, 261 , 262
<i>Xanthophyllum molle</i>	275
<i>Xanthophyllum montanum</i>	223, 229, 234, 262
<i>Xanthophyllum neglectum</i>	223, 226, 227, 233, 234, 263 , 264, 289, 295
<i>Xanthophyllum nigricans</i>	223, 228, 234, 264
<i>Xanthophyllum nitidum</i>	223, 227, 235, 265 , 268, 295

Xanthophyllum obscurum	222, 223, 229, 234, 265
Xanthophyllum ovatifolium	223, 228, 234, 266 , 268
Xanthophyllum pachycarpon	223, 228, 235, 267 , 268
<i>Xanthophyllum pallidum</i>	252
<i>Xanthophyllum paniculatum</i>	292
Xanthophyllum parvifolium	223, 225, 232, 248, 268 , 269
<i>Xanthophyllum parvum</i>	254
Xanthophyllum pauciflorum	223, 226, 232, 268 , 289
Xanthophyllum pedicellatum	223, 224, 231, 238, 270 , 271
Xanthophyllum penibukanense	223, 225, 232, 239, 271 , 273 , 275
Xanthophyllum pseudoadenotus	223, 225, 233, 272 , 274, 275
<i>Xanthophyllum pseudostipulaceum</i>	254
Xanthophyllum pulchrum	223, 225, 231, 272, 274 , 275
subsp. <i>stapfii</i>	274, 275
Xanthophyllum purpureum	223, 224, 232, 238, 241, 271, 275 , 277 , 289
Xanthophyllum ramiflorum	223, 225, 232, 276 , 279
Xanthophyllum rectum	223, 227, 235, 278 , 295
Xanthophyllum reflexum	223, 226, 234, 278
Xanthophyllum resupinatum	223, 228, 230, 280 , 281
Xanthophyllum reticulatum	223, 224, 231, 238, 271, 281
<i>Xanthophyllum robustum</i>	292
var. <i>elmeri</i>	292
Xanthophyllum rufum	223, 224, 229, 282 , 283
<i>Xanthophyllum sarawakense</i>	252
Xanthophyllum schizocarpon	223, 224, 230, 285
<i>Xanthophyllum scortechinii</i>	265
<i>Xanthophyllum stapfii</i>	274
Xanthophyllum stipitatum	222, 223, 227, 229, 234, 284 , 285 , 287
var. <i>borneense</i>	286
var. <i>nitidum</i>	286
var. <i>pachyphyllum</i>	286
Xanthophyllum subcoriaceum	223, 228, 230, 264, 281, 287 , 289
Xanthophyllum tardicrescens	223, 227, 234, 289
Xanthophyllum tenue	223, 228, 230, 231, 264, 288 , 290 , 289, (311)
Xanthophyllum trichocladum	223, 224, 232, 238, 271, 290 , 293
Xanthophyllum velutinum	223, 224, 229, 254, 291
Xanthophyllum vitellinum	223, 227, 231, 233, 234, 292 , 295
var. <i>clovis</i>	244, 259
Xanthophyllum sp. A	223, 227, 229, 294 , 295, (311)
Xanthophyllum sp. B	223, 227, 229, 295
Xanthophyllum sp. C	223, 227, 229, 295
Xylocarpus	18, 19, 20, 21, 23, 24, 215 , 217
Xylocarpus granatum	124, 217 , (309)
<i>Xylocarpus minor</i>	217
Xylocarpus moluccensis	216 , 217, 218
Xylocarpus rumphii	215

INDEX TO VERNACULAR NAMES

(compiled by S. Julia, O. Zainun & H.S. Tan)

Scientific names in brackets are the correct names corresponding to vernacular names listed below.

A

- ansarapak (*Xanthophyllum velutinum* Chodat) 292
apau (*Sandoricum beccarianum* Baill.) 191
apoh (*Sandoricum borneense* Miq.) 192
apok (*Sandoricum borneense* Miq.) 192
apolah (*Xanthophyllum ecarinatum* Chodat, *X. ellipticum* Miq.) 248, 250
atap bojig (*Sandoricum dasyneuron* Baill.) 196

B

- bagok (*Xanthophyllum brachystachyum* W.J.de Wilde & Duyfjes) 241
bait (*Xanthophyllum ellipticum* Miq., *X. flavescens* Roxb.) 250, 252
bait musang (*Xanthophyllum bicolor* W.J.de Wilde & Duyfjes, *X. pulchrum* King) 239, 274
balim (*Aglaia crassinervia* Kurz ex Hiern, *A. spectabilis* (Miq.) S.S.Jain & Bennet) 44, 97
bekak (*Aglaia* L.; *Chisocheton ceramicus* (Miq.) C.DC.) 24, 120
beluno-beluno (*Aglaia monozyga* Harms) 77
berindu (*Chisocheton patens* Blume) 132
bersangai (*Aglaia rubiginosa* (Hiern) Pannell) 86
bibilad (*Aglaia teysmanniana* (Miq.) Miq.) 103
bila (*Xanthophyllum brachystachyum* W.J.de Wilde & Duyfjes) 241
binkang (*Dysoxylum cyrtobotryum* Miq.) 162
blutai (*Xanthophyllum penibukanense* Heine) 271
bongkulat (*Xanthophyllum trichocladum* Chodat) 291
buah keras laut (*Hernandia nymphaeifolia* (C.Presl) Kubitzki) 13
buah kong (*Xanthophyllum ecarinatum* Chodat) 248
buah pasat (*Heynea trijuga* Roxb.) 178
buah pesak kanan (*Chisocheton amabilis* (Miq.) C.DC.) 119
buniau (*Aglaia silvestris* (M.Roem.) Merr.) 92
bunya (*Aglaia erythrosperma* Pannell, *A. silvestris* (M.Roem.) Merr.; *Dysoxylum cyrtobotryum* Miq.; *Pseudoclausena chrysogyne* (Miq.) T.Clark) 54, 92, 162, 184
bunyak (*Aglaia elliptica* Blume) 52
bunyaw (*Aglaia elliptica* Blume; *Dysoxylum brachybotrys* Merr.) 52, 155
bunyo (*Aglaia silvestris* (M.Roem.) Merr.) 92
burangkuk (*Xanthophyllum adenotus* Miq.) 236
buyau (*Aglaia elliptica* Blume, *A. lancifolia* (Hook.f.) Harms) 52, 64

C

- chenaga gayong (*Aglaia rubiginosa* (Hiern) Pannell) 86
chendana (*Vavaea amicorum* Benth.) 206

D

- demining (*Xanthophyllum neglectum* Meijden) 264
dual merah (*Sandoricum beccarianum* Baill.) 191

duku (*Lansium domesticum* Corrêa) 182
duku-langsar (*Lansium domesticum* Corrêa) 19, 182
durong (*Dysoxylum excelsum* Blume) 164

E

embaloh (*Aglaia lancifolia* (Hook.f.) Harms) 64
empawas (*Dysoxylum magnificum* Mabb.) 168

G

gayan (*Aglaia silvestris* (M.Roem.) Merr.) 92
golurut (*Dysoxylum cauliflorum* Hiern) 158

J

jalungang sasak (*Aglaia hiernii* King) 63
jarum-jarum (*Dysoxylum* Blume, *D. parasiticum* (Osbeck) Kosterm.) 146, 174
jelungan sasak (*Aglaia rubiginosa* (Hiern) Pannell) 86

K

kabok (*Xanthophyllum flavescens* Roxb.) 252
kalantopak (*Chisocheton ceramicus* (Miq.) C.DC.) 120
kalimangang (*Dysoxylum arborescens* (Blume) Miq.) 154
kamoayau burong (*Dysoxylum cyrtobotryum* Miq.) 162
kandis dahan (*Xanthophyllum pedicellatum* Meijden) 271
kayu paya (*Xanthophyllum ellipticum* Miq.) 250
kayu ta'an (*Aglaia crassinervia* Kurz ex Hiern) 44
kayu tunying (*Dysoxylum alliaceum* (Blume) Blume) 151
kayu-papan (*Weinmannia fraxinea* (D.Don) Miq.) 8
kechapi (*Sandoricum koetjape* (Burm.f.) Merr.) 197, 198
kela buno (*Aglaia stellatopilosa* Pannell) 99
kelampu (*Dysoxylum cyrtobotryum* Miq.; *Sandoricum* Cav., *S. borneense* Miq., *S. dasyneuron* Baill.) 162, 188, 192, 196
kelampu paya (*Sandoricum beccarianum* Baill.) 191
kementing laut (*Hernandia nymphaeifolia* (C.Presl) Kubitzki) 13
kemuning (*Xanthophyllum neglectum* Meijden) 264
kokosan (*Lansium domesticum* Corrêa) 182
koping-koping (*Aglaia argentea* Blume, *A. pachyphylla* Miq.) 39, 82
krupok (*Sandoricum dasyneuron* Baill.) 196
kurapit (*Xanthophyllum adenotus* Miq.) 236

L

labonoh (*Aglaia hiernii* King) 63
lahal (*Xanthophyllum stipitatum* A.W.Benn) 286
lahau (*Xanthophyllum flavescens* Roxb.) 252
lambunan (*Aglaia rivularis* Merr.) 85
lambunau (*Aglaia elliptica* Blume) 52
lamie (*Xanthophyllum flavescens* Roxb.) 252
langir (*Xanthophyllum obscurum* A.W.Benn., *X. stipitatum* A.W.Benn) 266, 286
langitan (*Heynea trijuga* Roxb.) 178
langkabang (*Dysoxylum densiflorum* (Blume) Miq.) 163

- langsung (*Aglaia beccarii* C.DC.; *Lansium* Corrêa, *L. domesticum* Corrêa) 19, 41, 178, 182
 langsung burung (*Aglaia forbesii* King) 57
 langsung gajah (*Aglaia elliptica* Blume) 52
 langsung hutan (*Aglaia leucophylla* King) 71
 langsung monyet (*Aglaia luzoniensis* (Vidal) Merr. & Rolfe, *A. tomentosa* Teijsm. & Binn.)
 72, 105
 langsung munchit (*Aglaia korthalsii* Miq.) 64
 langsung munyit (*Aglaia elliptica* Blume, *A. odoratissima* Blume, *A. oligophylla* Miq.;
Reinwardtiidendron humile (Hassk.) Mabb.) 52, 80, 81, 187
 langsung-langsung (*Aglaia* L., *A. beccarii* C.DC., *A. crassinervia* Kurz ex Hiern, *A. elliptica*
 Blume, *A. leptantha* Miq., *A. leucophylla* King, *A. luzoniensis* (Vidal) Merr. & Rolfe,
A. monozyga Harms, *A. multinervis* Pannell, *A. odoratissima* Blume, *A. oligophylla*
 Miq., *A. pachyphylla* Miq., *A. silvestris* (M.Roem.) Merr., *A. spectabilis* (Miq.) S.S.Jain
 & Bennet; *Dysoxylum alliaceum* (Blume) Blume; *Sandoricum beccarianum* Baill.)
 24, 41, 44, 52, 70, 71, 72, 77, 78, 80, 81, 82, 92, 97, 151, 191
 lantupak (*Aglaia* L., *A. argentea* Blume, *A. crassinervia* Kurz ex Hiern, *A. cumingiana*
 Turcz., *A. edulis* (Roxb.) Wall., *A. elliptica* Blume, *A. forbesii* King, *A. glabrifolia*
 Hiern, *A. hiernii* King, *A. korthalsii* Miq., *A. lawii* (Wight) C.J.Saldanha ex
 Ramamoorthy subsp. *oligocarpa* (Miq.) Pannell, *A. laxiflora* Miq., *A. leptantha* Miq.,
A. leucophylla King, *A. luzoniensis* (Vidal) Merr. & Rolfe, *A. macrocarpa* (Miq.)
 Pannell, *A. multinervis* Pannell, *A. odoratissima* Blume, *A. oligophylla* Miq., *A.*
palembanica Miq., *A. ramotricha* Pannell, *A. rubiginosa* (Hiern) Pannell, *A.*
scortechinii King, *A. sexipetala* Griff., *A. silvestris* (M.Roem.) Merr., *A. spectabilis*
 (Miq.) S.S.Jain & Bennet, *A. squamulosa* King, *A. subsessilis* Pannell, *A. tomentosa*
 Teijsm. & Binn., *A. variisquama* Pannell; *Aphanamixis* Blume; *Chisocheton ceramicus*
 (Miq.) C.DC., *C. erythrocarpus* Hiern; *Dysoxylum alliaceum* (Blume) Blume, *D.*
cyrtobotryum Miq., *D. excelsum* Blume) 24, 39, 44, 46, 48, 52, 57, 61, 63, 64, 68, 69,
 70, 71, 72, 73, 78, 80, 81, 83, 84, 86, 89, 91, 92, 97, 98, 100, 105, 107, 120, 123, 151,
 162, 164
 lantupak burung (*Aglaia korthalsii* Miq.) 64
 lantupak jambu (*Aglaia elliptica* Blume) 52
 lantupak mata kucing (*Sandoricum beccarianum* Baill.; *Walsura pinnata* Hassk.) 191,
 212
 lantupak paya (*Aglaia rubiginosa* (Hiern) Pannell) 86
 lengud-lengud (*Aglaia elaeagnoidea* (A.Juss.) Benth.) 49
 lepuniau (*Aglaia silvestris* (M.Roem.) Merr.) 92
 limpaga (*Azadirachta excelsa* (Jack) Jacobs; *Toona ciliata* M.Roem., *T. sureni* (Blume)
 Merr.) 113, 200, 203
 linkas (*Heynea trijuga* Roxb.) 178
 lisi-lisi (*Chisocheton pentandrus* (Blanco) Merr.; *Dysoxylum rugulosum* King) 133, 176
 lombunan (*Dysoxylum excelsum* Blume) 164

M

- malangsang (*Aglaia teysmanniana* (Miq.) Miq.) 103
 maliadoh (*Reinwardtiidendron cinereum* (Hiern) Mabb.) 187
 manggi (*Aglaia multinervis* Pannell) 78
 mangok (*Xanthophyllum obscurum* A.W.Benn., *X. pachycarpon* W.J.de Wilde & Duyfjes,
X. resupinatum Meijden) 266, 267, 281
 manok indu (*Xanthophyllum adenotus* Miq.) 236
 masa pinsang (*Xanthophyllum obscurum* A.W.Benn.) 266
 mata kucing ambok (*Sandoricum beccarianum* Baill.) 191

mata kucing hutan (*Sandoricum beccarianum* Baill.) 191
 membalun (*Dysoxylum* Blume) 146
 menjalin (*Xanthophyllum ellipticum* Miq., *X. pulchrum* King) 250, 274
 merasam (*Aglaia spectabilis* (Miq.) S.S.Jain & Bennet) 97
 merbau lalat (*Heynea trijuga* Roxb.) 178
 minyak berok (*Xanthophyllum* Roxb.) 221
 mumutah (*Aglaia teysmanniana* (Miq.) Miq.) 103

N

ngilas (*Xanthophyllum obscurum* A.W.Benn.) 266
 nyalin (*Xanthophyllum* Roxb.) 221
 nyalin bukit (*Xanthophyllum heterophyllum* Meijden) 258
 nyalin daun kecil (*Xanthophyllum brachystachyum* W.J.de Wilde & Duyfjes) 241
 nyalin padang (*Xanthophyllum ramiflorum* Meijden) 276
 nyalin paya (*Xanthophyllum stipitatum* A.W.Benn) 286
 nyalin tikus (*Xanthophyllum ellipticum* Miq.) 250
 nyireh (*Xylocarpus* J.König) 215
 nyireh batu (*Xylocarpus moluccensis* (Lam.) M.J.Roem.) 218
 nyireh bunga (*Xylocarpus granatum* J.König) 218
 nyireh-peti (*Xylocarpus moluccensis* (Lam.) M.J.Roem.) 218

O

olop-olop (*Dysoxylum arborescens* (Blume) Miq.) 154

P

pangak (*Aglaia leucophylla* King) 71
 pasak bumi (*Aglaia angustifolia* (Miq.) Miq.) 38
 paybut (*Aglaia lancifolia* (Hook.f.) Harms) 64
 penapan (*Xanthophyllum pulchrum* King) 274
 penatang (*Xanthophyllum flavescens* Roxb.) 252
 penyan-ketidoh (*Walsura dehiscens* T.Clark) 210
 pisitan (*Lansium domesticum* Corrêa) 182
 polong longom (*Dysoxylum alliaceum* (Blume) Blume) 151
 pulu (*Aglaia hiernii* King) 63
 punyau (*Aglaia tomentosa* Teijsm. & Binn.) 105

R

rambai (*Baccaurea motleyana* (Müll. Arg.) Müll. Arg.) 182
 ranggo (*Toona sureni* (Blume) Merr.) 203
 ranggoh (*Toona sureni* (Blume) Merr.) 203
 ranggu (*Azadirachta excelsa* (Jack) Jacobs; *Toona ciliata* M.Roem) 113, 200
 runu (*Aglaia rivularis* Merr.) 85

S

sabetong (*Xanthophyllum flavescens* Roxb., *X. pachycarpon* W.J.de Wilde & Duyfjes, *X. vitellinum* (Blume) D.Dietr.) 252, 267, 294
 sambubu (*Xanthophyllum pachycarpon* W.J.de Wilde & Duyfjes, *X. vitellinum* (Blume) D.Dietr.) 267, 294
 sangai (*Aglaia rubiginosa* (Hiern) Pannell) 86

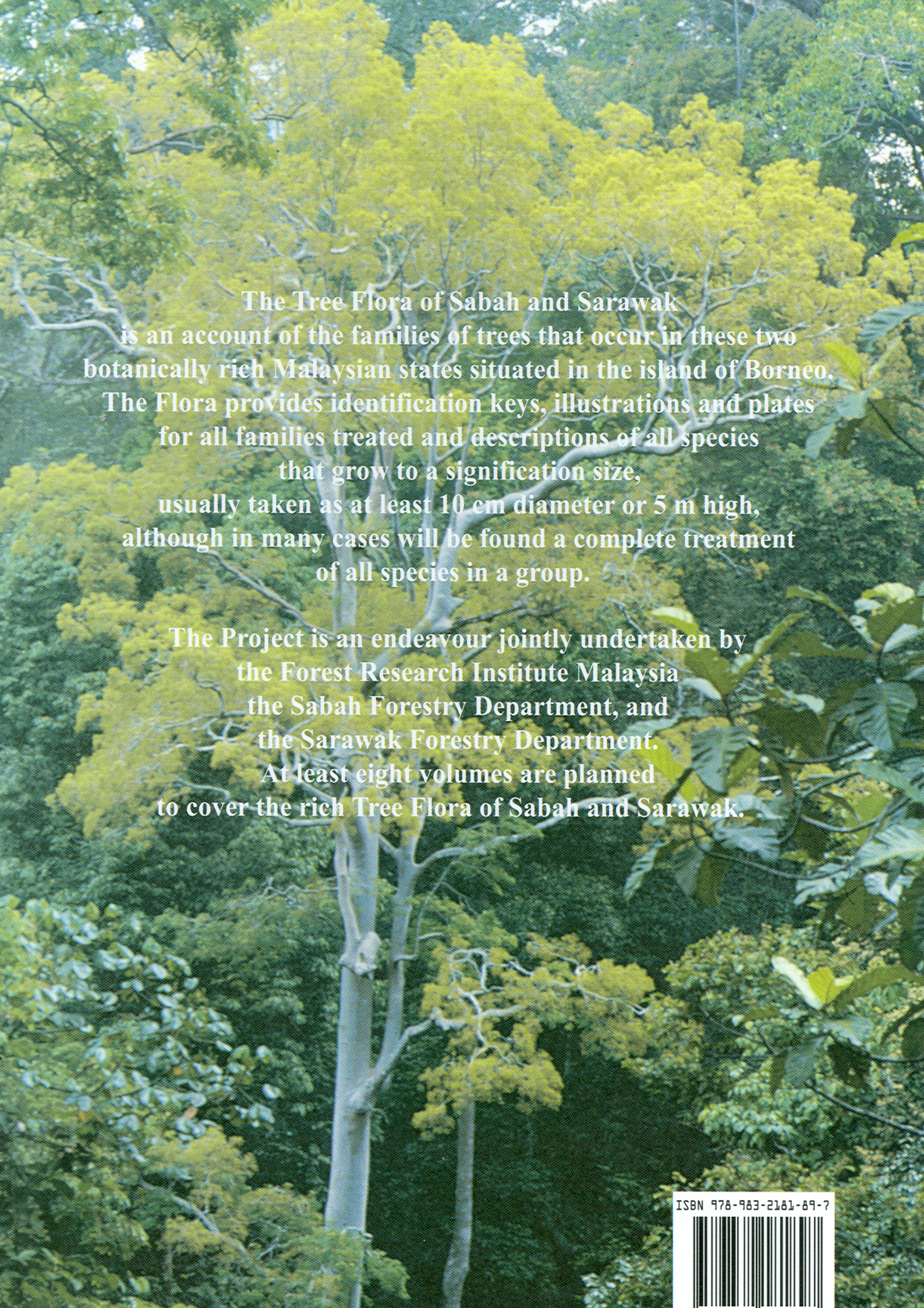
sankuang (*Aglaia lancifolia* (Hook.f.) Harms) 64
 segan (*Aphanamixis* Blume) 107
 segera (*Aglaia* L., *A. angustifolia* (Miq.) Miq., *A. argentea* Blume, *A. beccarii* C.DC., *A. crassinervia* Kurz ex Hiern, *A. densisquama* Pannell, *A. edulis* (Roxb.) Wall., *A. elliptica* Blume, *A. erythrosperma* Pannell, *A. forbesii* King, *A. foveolata* Pannell, *A. glabrata* Teijsm. & Binn., *A. hiernii* King, *A. korthalsii* Miq., *A. lancifolia* (Hook.f.) Harms, *A. lawii* (Wight) C.J.Saldanha ex Ramamoorthy subsp. *oligocarpa* (Miq.) Pannell, *A. leptantha* Miq., *A. leucophylla* King, *A. macrocarpa* (Miq.) Pannell, *A. meliosmoides* Craib, *A. neotenica* Kosterm., *A. odoratissima* Blume, *A. oligophylla* Miq., *A. rufinervis* (Blume) Bentv., *A. sexipetala* Griff., *A. silvestris* (M.Roem.) Merr., *A. simplicifolia* (Bedd.) Harms, *A. squamulosa* King, *A. stellatopilosa* Pannell, *A. tomentosa* Teijsm. & Binn., *A. variisquama* Pannell; *Aphanamixis* Blume; *Azadirachta excelsa* (Jack) Jacobs; *Chisocheton* Blume, *C. ceramicus* (Miq.) C.DC., *C. erythrocarpus* Hiern; *Dysoxylum* Blume, *D. alliaceum* (Blume) Blume, *D. brachybotrys* Merr., *D. cauliflorum* Hiern, *D. cyrtobotryum* Miq., *D. densiflorum* (Blume) Miq., *D. excelsum* Blume, *D. rugulosum* King; *Heynea trijuga* Roxb.) 24, 38, 39, 41, 44, 47, 48, 52, 54, 57, 58, 59, 63, 64, 68, 70, 71, 73, 76, 79, 80, 81, 87, 91, 92, 98, 99, 105, 107, 113, 115, 120, 123, 146, 151, 155, 158, 162, 163, 164, 176, 178
 segera ayer (*Aglaia elliptica* Blume, *A. lancifolia* (Hook.f.) Harms) 52, 64
 sendana (*Vavaea amicornum* Benth.) 206
 sentul (*Sandoricum* Cav., *S. koetjape* (Burm.f.) Merr.) 19, 188, 197, 198
 senumpol (*Xanthophyllum ferrugineum* Meijden) 251
 sigarangan (*Xanthophyllum penibukanense* Heine) 271
 sigirah (*Aglaia crassinervia* Kurz ex Hiern) 44
 sintotobou (*Xanthophyllum adenotus* Miq.) 236
 suloh (*Aglaia forbesii* King) 57
 sumu silan (*Weinmannia fraxinea* (D.Don) Miq.) 8
 suren (*Toona sureni* (Blume) Merr.) 203
 surian (*Toona* (Endl.) M.Roem.) 198
 surian batu (*Chukrasia* A.Juss.) 143

T

takalis (*Heynea trijuga* Roxb.) 178
 tama malid (*Dysoxylum arborescens* (Blume) Miq.) 154
 tampasak (*Xanthophyllum flavescens* Roxb., *X. stipitatum* A.W.Benn) 252, 286
 tanggal (*Aglaia odoratissima* Blume) 80
 tansang lang (*Weinmannia fraxinea* (D.Don) Miq.) 8
 tantau (*Dysoxylum cyrtobotryum* Miq.) 162
 tapah (*Dysoxylum cauliflorum* Hiern) 158
 tarak (*Toona sureni* (Blume) Merr.) 203
 tekaran (*Weinmannia fraxinea* (D.Don) Miq.) 8
 tekarau (*Weinmannia* L.) 2
 turupok (*Xanthophyllum vitellinum* (Blume) D.Dietr.) 294

U

ubah apau (*Sandoricum beccarianum* Baill.) 191
 uban (*Weinmannia fraxinea* (D.Don) Miq.) 8
 uchong chit (*Dysoxylum cauliflorum* Hiern) 158



The Tree Flora of Sabah and Sarawak
is an account of the families of trees that occur in these two
botanically rich Malaysian states situated in the island of Borneo.
The Flora provides identification keys, illustrations and plates
for all families treated and descriptions of all species
that grow to a significant size,
usually taken as at least 10 cm diameter or 5 m high,
although in many cases will be found a complete treatment
of all species in a group.

The Project is an endeavour jointly undertaken by
the Forest Research Institute Malaysia
the Sabah Forestry Department, and
the Sarawak Forestry Department.
At least eight volumes are planned
to cover the rich Tree Flora of Sabah and Sarawak.

ISBN 978-983-2181-89-7

