

# Taxonomic Notes on Bornean Dipterocarpaceae

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THIS IS THE second precursory paper to the forthcoming publication of a Forester's Manual of the Dipterocarpaceae of Brunei State. Taxonomic and nomenclatural discussion is out of place in the Manual and this paper is therefore presented in order to explain changes that have been made.

The late Dr. D. F. van Slooten and C. F. Symington have between them written much on the infrageneric divisions recognisable within Malaysian dipterocarp genera. Symington (1943 and elsewhere) had crystallised his views on this problem, but never proceeded to a complete revision of the infrageneric classifications or to formal publication of new infrageneric taxa. This gap has remained, and therefore must be filled before further manuals or monographs of the family are completed. I have found it necessary to make nomenclatural changes in most genera where infrageneric divisions are recognised; the present paper explains my reasons for these. With the much more complete herbarium material now available, particularly from Borneo, the subdivision of the large genera *Shorea* and *Hopea*, which Symington has already done so much to elucidate, can now be reassessed. Here, though agreeing with Symington on the basis for subdivisions, I have, with the exception of one section, found it unnecessary to create new names; they have already been provided by Brandis (1895), Heim (1892) and other previous monographers, though in many cases a redefinition is necessary.

I wish to thank the Directors of the following herbaria for putting their facilities at my disposal during my visits to study Dipterocarpaceae: Bangkok Forest Herbarium, Bangkok Agricultural Herbarium, Herbarium Bogoriense, the British Museum, the British Pharmaceutical Society, Cambridge, Kepong, Kew, Kuching, Leiden, the Linnean Society, Oxford, Paris, Sandakan, Singapore and Utrecht. I further thank the Directors of the following herbaria for the loan of material to me at Cambridge: Berkeley, Calcutta, Copenhagen, Florence, Kepong, Kuching, Leiden, and Paris.

In order to avoid synonymy when describing new Dipterocarpaceae in my last paper (this journal, 19, 2 (1962) 253), I examined the Type material of all Dipterocarpaceae occurring between Celebes and the Isthmus of Kra. I have been able to discover the true identity of all but two of the species described to date from

this area, including species founded on sapling or fallen leaves by Korthals (1841), De Vriese (1861, b) and others. The second purpose of this paper is to explain my reasons for changes in nomenclature and synonymy that I have found necessary.

In addition, I have described one more species, *Shorea crassa*, which was not fully understood by me at the time of completion of my last paper, and have given taxonomic status to the geographical subspecies of some *Dipterocarpus* and *Shorea* species.

As full field and herbarium descriptions are given in my forthcoming Manual, I have excluded them here, though short diagnoses are included with some species in order to clarify my arguments.

I have to thank in particular Mr. E. J. H. Corner, F.R.S., for his continued advice and encouragement, and Mr. B. E. Smythies, who has discussed several of the changes herein explained. With Dr. W. Meijer, who is also completing a manual, on North Borneo Dipterocarpaceae, I have continued to exchange views. Mr. P. D. Sell, of Cambridge Herbarium, has on several occasions offered advice on nomenclatural problems.

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#### **ANISOPTERA** Korth., Kruidk (1841) 65.

Types: *A. costata* Korth., *A. marginata* Korth.

—**Hopea** sensu Roxb., Fl. Ind., ed. 2 (1832) 611, pro parte, quoad *H. scaphula* Roxb.

—**Mocanera** Blanco, Fl. Filip., ed. 1 (1837) 446, pro parte, quoad *M. thurifera* Blanco.

—**Antherotriche** Turcz., Bull. Soc. Nat. Mosc. 2 (1846) 505.  
Type. *A. lanceolata* Turcz.

—**Vatica** sensu Dyer, in Hook. f., Fl. Brit. Ind. 1 (1874) 301, pro parte, quoad *V. scaphula*.

—**Scaphula** Parker, Fedde, Rep. 30 (1932) 326.

Type: *Scaphula glabra* (Kurz) Parker.

Korthals described the genus for two species from his Borneon collections.

The two dipterocarp genera appearing in the first edition of Blanco's Flora de Filipinas (1837) are *Vatica* Linn. and *Mocanera*, the latter being a dumping ground for all taxa that could not be placed in *Vatica*. Blume (1852,42) subsequently transferred *M. thurifera*, of which no type exists, to *Anisoptera*. Meanwhile Turczaninow had described a new species and genus from a flowering Cuming collection, no. 882, from Luzon, in the Moscow Herbarium (dupl. in K, PC), referring it to the Tiliaceae. Brandis (1895,44) attributes the reduction of this genus to Walpers (1848,1, 113) but in fact Walpers maintained Turczaninow's name and the reduction was due to Blume (loc. cit.).

Heim (1892, 30–35) recognised three sections:—

- I. *Pilosae*: Leaves, twigs, and petioles tomentose; cotyledons foliaceous, radical free; petiole with a single band of vascular bundles at the 'caractéristique' (distal end of petiole in transverse section).
- II. *Glabrae*: Parts subglabrous, cotyledons fleshy, with the radical imbedded in them; petiole with two vascular arcs.
- III. *Antherotriche*: Anther valves unequal; petiole with complex vascular system.

Brandis (id., 40) ignored Heim's sections, as also did van Slooten (1926,3), partially no doubt because the latter two sections were based on single species and subdivision was certainly premature.

Roxburgh described his *H. scaphula* from flowering material. His brief description, and an unpublished drawing, a copy of which is at Kew, is the basis on which Dyer transferred it to *Vatica*; King (1893,127) and Brandis (1895,132) maintained it in *Vatica*, remarking on its anomalous characters. R. N. Parker demonstrated that Roxburgh's species was identical with *A. glabra* Kurz, the sole member of Heim's section *Glabrae*. He noted the slender style and disc-shaped stylopodium, in contrast to the cylindrical stylopodium of other species, and proposed a new genus for it.

Symington (1943,199) was left to show that the flower characters were correlated with Heim's sections *Glabrae* and *Pilosae*; he emended the section descriptions and reunited *Scaphula*, adding to section *Glabrae* the recently described *A. laevis* Ridl. In his view the close similarity in fruit, leaf, and wood characters justified reduction of Parker's genus, with which I agree.

The generic types are in Heim's section *Pilosae*, which should therefore bear the generic name.

I have examined Cuming 882, and find that in flower and leaf characters it belongs to the Type section. The characters of anther and petiole described by Heim vary from species to species and cannot be considered as a basis for section diagnosis.

I therefore follow Symington in recognising only two sections, *Anisoptera* and *Glabrae*, defined as follows:—

### Section I. ANISOPTERA

—Gen. **Mocanera** Blanco pro parte, **Antherotriche** Turcz.

—Sect. **Pilosae** Heim, Rech. Dipt (1892) 33 (Type: *A. oblonga* Dyer (ut. *A. cochinchinensis* Pierre)); **Antherotriche** (Turcz) Heim, id (1892) 34.

Young parts and lamina below tomentose (excl. *A. marginata*). Flower buds lanceolate; anthers linear; appendage to connective short, stout, less than half length of anther; stylopodium cylindrical to ovoid-conical, narrow; style short; stigma minute.

*Distribution.* 11 species: Burma (2), Thailand (3), Indochina (2), Malaya (4), Sumatra (3), Borneo (3), Philippines (3), Moluccas (2), New Guinea (3).

**Section II. GLABRAE** Heim, Rech. Dipt (1892) 33.

Type: *A. scaphula* (Roxb) Pierre (ut *A. glabra* Kurz).

—Gen. **Hopea** fide Roxb (1832) pro parte; **Vatica** sensu Dyer (1872) pro parte; **Scaphula** Parker.

Young leaves and twigs epilose. Flower buds globose; anthers broadly oblong; appendage to connective many times longer than anther, slender; stylopodium a flattened disc-shaped platform surmounting the ovary; style filiform, long, with distinct trifid stigma.

*Distribution.* 2 species: Thailand, Indochina, Burma (1), Malaya (2), Borneo (1).

**A. grossivenia** V.Sl., Bull. Jard. Bot. Btzg. 3, 16 (1940) 431.

Type: b.b. 29708, fl. and fr., Pepas, Muara Tewe, S.C. Borneo (BO,L).

—*A. curtisii* sensu V.Sl., Bull. Jard. Bot. Btzg. 3,8 (1926) 11, pro parte, quoad spec. Born.

—*A.sp.* 'B', Wyatt-Smith, Mal. For. 18 (1955) 79.

Van Slooten at first did not distinguish this species from *A. curtisii* Dyer of Sumatra and Malaya, which has 25 stamens (c. 36 in this species), longer tomentum, and more prominent nerves. The closely allied *A. aurea* Foxw. of the Philippines has 25 stamens and larger leaves. In young trees the lamina is grey-green lepidote below; Brunei collections (Kep 30610, 80080, 37115, s.n., Kg. Gana) from young trees were tentatively separated as a new species by Wyatt-Smith, but never named in the absence of fertile material.

**A. marginata** Korth., Kruidk. (1841) 66.

Holotype: Korthals. s.n., fl., G. Pamaton, S. Borneo (L).

—*A. grandiflora* Brandis, J. Linn. Soc. Bot. 31 (1895) 43.

Type: Haviland (Garai) 959, fl., near Kuching, Sarawak (SAR, SING, K, BM).

—*A. mindanensis* sensu Wyatt-Smith, Mal. For. 18 (1955) 77, pro parte.

Haviland 959 is from a young tree, and the lamina is shortly evenly pubescent below. Van Slooten (1926, 10), who had no field knowledge, attributed it tentatively to *A. costata*. Symington (1934, 13) put it with *A. marginata*, but stated that diagnosis was difficult owing to the similarity in the flowers. The number of nerves is as this species, however, and the tomentum is shorter,

more even than *A. costata*; *A. costata* is not yet known from Sarawak. I have little doubt that Symington's conclusion is correct. Wyatt-Smith cited Brunei collections of this and *A. laevis* under *A. mindanensis* (see under *A. laevis*). The only Brunei collection of *A. marginata* (Kep 30418) is flowering and is very similar to the Type of *A. grandiflora*.

**A. laevis** Ridl., Fl. Mal. Pen. I (1922) 219.

Type: Ridley 6886, fr., Gardens Jungle, Singapore (SING, K).

—*A. glabra* sensu Ridl., Agr. Bull. S.S. and F.M.S., 1, 2 (1901) 60; Str. Br. R. As. Soc. 54 (1910) 25.

—*A. thurifera* sensu Foxw., Philip. J. Sc. Bot. 6 (1911) 257 quoad Spec. Malay.

—*A. mindanensis* sensu Wyatt-Smith, Mal. For. 18, 2 (1955) 77, pro parte.

Symington (1934, 8) has reviewed the synonymy to that date. Wyatt-Smith referred Kep. numbers of this (all sterile) and *A. marginata* from Brunei to *A. mindanensis* Foxw.

The fruit collections (Brun 3053, 3192) now available confirm in their stylopodia that the present determination is the correct one, Foxworthy's species being in the Type section. Symington (unpublished diary, 23-8-1938) records finding *A. laevis* on Bt. Patoi, Brunei; Kep 35455 from there is his collection, and is presumably the basis on which he cites *A. laevis* from Borneo (1943, 205). His determination is now confirmed.

**DIPTEROCARPUS** Gaertn. f., De Fruct. 3 (1805) 50.

Types: *D. costatus* Gaertn. f.; *D. turbinatus* Gaertn. f.

—**Oleoxylon** Roxb., Trans. Soc. Arts Lond. 23 (1805) 413; Wall. Cat. no. 953; nomen nudum.

—**Pterigium** Correa, Ann. Mus. Par. 8 (1806) 397, pro parte, quoad *P. costatum* (Gaertn. f.) Correa.

—**Mocanera** Blanco, Fl. Filip. I (1837) 446.

Lectotype species: *Mocanera verniciflua* Blanco (*D. gracilis* Bl.).

—**Duvaliella** Heim, Bull. Mens. Soc. Linn. Paris, 2 (1892) 1011.

Type: *Duvaliella problematica* Heim.

The first collections were made by Dr. Buchanan Hamilton near Chittagong, India; he sent what he considered to be four species to Sir Joseph Banks; K. F. Gaertner described two of them, and the Types are now at the British Museum. Later Correa de Serra redescribed Gaertner's species *Dipterocarpus costatus* and *Dryobalanops aromatica* under the generic name *Pterigium*; Steudel (1940, 518, see under *D. aromatica*) transferred both to *Dipterocarpus*, but no subsequent authors accepted his decision.

*Oleoxyton* is a nomen nudum used by Roxburgh in an essay on the natural products of India, in which he described the resinous oil of the genus and its potential commercial value; no. 953 in Wallich's Catalogue refers to a specimen of *D. alatus* Roxb.

Dyer (1874b, 97) created five sections, which he himself admitted to be artificial, being based on the shape of the fruit calyx tube alone. He commented 'herbarium specimens of species of *Dipterocarpus* are rarely complete. Generally they consist of examples of the foliage and detached fruits picked up from the ground beneath the lofty trees'. Later authors have maintained Dyer's sections, Symington (1943, 153) again stating that material was still often inadequate, and flowering collections few. I have been able to examine the flowers of most species in Brunei, though in several they are still unknown; they furnish good specific characters in some cases, but I have not been able to correlate flower characters with others in a natural classification. The genus is very isolated, and extremely homogeneous in spite of its size. In some species it is impossible to make more than an arbitrary decision as to whether the lateral processes of the fruit calyx tube are wings or angles or tubercles. Thus the fruit of *D. globosus* Vesque can be angled, spherical, or tubercled, the 3 types sometimes being found together in mature fruits on a single tree; the fruit of *Dipterocarpus exalatus* V. Sl. has prominent apical tubercles, but also thick ribs which could be described according to personal opinion either as angles or stout wings; the fruit of *D. acutangulus* Vesque and some other species are angled when mature but appear narrowly winged before the calyx tube has swollen to its full proportions. I feel that Dyer's divisions have hence lost their usefulness, and as they have never been claimed as natural infrageneric taxa I prefer not to recognise them.

Following Recommendation 75a of the International Rules of Botanical Nomenclature I have treated the generic name as masculine, and not feminine as did van Slooten (1927, 1941, 1961).

In order to eliminate Blanco's dubious genus *Mocanera*, in which he originally put all Philippine Dipterocarpaceae that he could not place in *Vatica*, I have chosen *D. gracilis* Bl. (of which *Mocanera verniciflua* Blanco is a synonym) as Lectotype and reduced the genus to *Dipterocarpus*. No types of any *Mocanera* species exists, and we must depend for their interpretation largely on the evidence of Merrill (1918).

### **The identity of *Dipterocarpus tampurau* Korth.**

*D. tampurau* (Korth., 1841, 63) is founded on an unnumbered collection of his with leaves and fallen fruit (at BO, U, L.), from Karaoe, Baritto R., S. of Boentok, Borneo. Burck (1887, 198) reduced *Dipterocarpus crinitus* Dyer to *D. tampurau*, though later authors have maintained Dyer's name. It is clear that the leaves come from a sapling of *D. crinitus*; the fruit, with large globose

calyx lobes, can safely be identified as *D. hasseltii* Bl. (1828, 22). I therefore choose the fruit of the Leiden sheet as Lectotype, reducing the name *D. tampurau* to the earlier *D. hasseltii*, and thus eliminate this unsatisfactory name.

**D. gracilis** Bl., Bijdr. 5 (1825) 224.

Type: Blume 1256, fl., G. Parang, W. Java (L, PC, K, CAM).

—*D. pilosus* Roxb., Fl. Ind. 2 (1832) 615, fide Parker, Ind. For. Rec. 13 (1927) 15.

—*Mocanera verniciflua* Blanco, Fl. Filip., ed. 1 (1837) 450.

—*D. marginatus* Korth., Kruidk (1841) 64.

Type: Korthals s.n., st., G. Bahai, S. Borneo (L).

—*D. vernicifluus* Blanco, id., ed. 2 (1845) 314.

—*D. fulvus* Bl., Mus. Bot. 1, 2 (1852) 37.

Holotype: Perrotet no. 1, fr., Manila (L).

—? *Anisoptera palembanica* Miq., Sum (1862) 485.

Holotype: Teysmann 3694 H.B., st., Ogan Hoeloe, near Batoe-radja, Palembang, Sumatra (U).

—*D. velutinus* Vidal, Pl. Vasc. Filip (1886) 59.

Type: Vidal 80, fr., Angat, Prov. Bulacan, Luzon (K).

—*D. bancana* Burck, Ann. Jard. Bot. Btzg. 6 (1887) 196.

Type: Teysmann s.n., Bangka (BO, L).

—*D. skinneri* King, J. As. Soc. Beng. Sc. 62, 2 (1893) 91, var. *hirtus* Ridl. excl.

Type: Curtis 1403, fr. Penang (K, CAL)

—*D. vanderhoevenii* K. et V., Bull. Inst. Bot. Btzg. 2 (1899) 3.

Syntypes: Koorders 11427B–11429B, fr., Soebah, Pekalongan, Sumatra (BO, L).

—*S. mollis* Boerl., Cat Hort. Bog. 2 (1901) 110.

Type: Boerlage s.n., st., from tree no. VIII. D. 53 in Hort. Bog (BO).

—*D. angustialatus* Heim, Bot. Tidsskr. 25 (1903) 43.

Holotype: Schmidt no. 686a, fr., Klong Son, Thailand (CP).

—*D. schmidtii* Heim, loc. cit.

Holotype: Schmidt no. 578a, fr., Lem Dan, Thailand (CP).

The synonymy has already been discussed by van Slooten (1927, 276), and Symington (1938, 321). Smitinand (1958, 32) has reduced *D. angustialatus* Heim here. I have been able to check the authentic material and confirm their conclusions. Van Slooten included *D. lampongus* (Scheff., Nat. Tijd. N.I. 31 (1870) 346) as a synonym. This species is based on two Teysmann collections from S. Sumatra,—Teysmann s.n. fr. Kebang (L, K, not seen by van Slooten) and s.n., fr., Tarabangi (BO, L, K). Van Slooten

considered that the fruit of the latter represent this species, while leaves represent *D. trinervis* Bl. He drew this conclusion as the fruit calyx lobes have short lateral nerves, unlike the latter species. The more abundant material now available proves this character to be variable, and I regard both collections as representing *D. hasseltii*, a species whose fruit are indistinguishable from those of *D. gracilis*.

I have further added *D. marginatus* Korth. to the synonymy. This species is described from sterile young saplings collected by Korthals, and which are quite typical of saplings of *D. gracilis*, bearing the same rufous tomentum and nervation as in the mature tree. Dyer (1874b, 105) added unnumbered De Vriese collections from W. Borneo. These consist of sapling leaves and fallen fruit; the leaves are more sparsely tomentose, are considerably larger (28–50 × 11–20 cm.), and with a much longer (4–8 cm.) petiole, than those of Korthals' specimens. De Vriese's specimens should be referred to *D. coriaceus* V. Sl.; the large glabrous fruit with narrow winged calyx tube is unequivocal and quite unlike that of *D. gracilis*. Neither Van Slooten (1927, 329, 331) nor other authors seem to have noticed this. Van Slooten remarks that the Bogor duplicate of the 'authentic specimen' bears a fallen fruit, whereas Korthals states that the fruit were not collected; it is evident from his leaf descriptions that van Slooten only saw De Vriese collections.

**D. caudiferus** Merr., Philip. J. Sc. 29, 3 (1926) 398.

Holotype: Castro and Melegrito 1709, fallen fruit and leaves, Banguay Island, N. Borneo (UC).

—*D. macrorrhinus* V. Sl., Bull. Jard. Bot. Btzg. 3, 8 (1927) 300.

Lectotype: b.b. 480, fr., Tanahboemboe, S.E. Borneo (BO).

—*D. kutaianus* V. Sl., id. 3, 16 (1940) 437.

Syntypes: b.b. 19458, fl., Semblimbingan, Pulau Laut (BO); b.b. 14965, y. fr., nr. Meridan, Balikpapan, S.E. Borneo (BO); S A 0427, y. fr., Balleh, Ulu Rejang (KEP).

Van Slooten states that his *D. macrorrhinus* is based on b.b. 480, though citing 4 other sterile collections; I cite it as Lectotype therefore. He finally (1961, 459) himself correctly reduced it to *D. caudiferus*.

*D. kutaianus* is founded on specimens differing from those of the other names in the hispid twigs and buds, and the unconstricted neck of the fruit calyx tube. The first character is typical of immature trees, the second of unripe fruit; I have no doubt that it should be reduced here.

Foxworthy (Philip. J. Sc. 67 (1938) 257) incorrectly reduced this species to *D. warburgii* Brandis, which differs in the larger lamina, long rufous tomentum, and tuberculate fruit calyx tube.



**D. humeratus** V. Sl., Bull. Jard. Bot. Btzg. 3, 8 (1927) 308.

Syntypes: Forbes 3019, fl., between Soeroeloengoen and Loeboekmas, Palembang, Sumatra (BO, BM); F.R.I. no. E. 946, fl. (BO, K, PC), E 947, fl. (BO), E 1150, fr. (BO, K), Lematang Hilir, Palembang; b.b. 2302, st., S. Redjang, Loeboek Bindjai, W. Sumatra (BO).

—*D. validus* sensu Brandis, J. Linn. Soc. Bot. 31 (1895) 37, pro parte, quoad spec. Forbes.

—*D. gibbosus* V. Sl., id., 311.

Syntypes: Boden Kloss 14452, fr., P. Siberoet, Mentawai (SING) Boden Kloss 14633, fr., P. Pagai (BO, SING, K); Boden Kloss 14719, st. (SING, K), 14749, fr. (SING, K), Iboet 471, fr. (BO), P. Sipora.

*Diagnostic Characters.* Fruit calyx glabrous; tube 4 cm. diam., subglobose, thickly incrassate, frequently somewhat verrucose, with 5 prominent obtuse apical tubercles. Lamina 20–38 × 12–33 cm., large, broadly ovate; nerves 20–25 pairs; petiole 4–6 cm. long. Young twigs, petiole, midrib and nerves below persistently shortly cream pubescent; leaf bud and stipule outside densely long fulvous tufted tomentose.

*D. gibbosus* is based on fallen fruit and leaves; the leaves are identical with those of many Borneo collections, also rarely obtuse as in Van Slooten's syntypes. The calyx tubes of the *D. gibbosus* syntypes are yet more incrassate, and the tubercles are merged together; I do not regard this as outside the expected range of variation for this species and have no doubt that they are conspecific. Boden Kloss 14719 possesses fruit of *D. hassettii* Bl. at Kew.

The Forbes collection was cited as *D. validus* by Brandis (see there).

### The identity of *D. elongatus* Korth.

*D. elongatus* Korth (Kruidk. 1841, 62) is based on Korthals, s.n., S. Poenin, Baritto, S. Borneo (L,K), being single sheets with large fallen leaves bearing 30–36 pairs of nerves. Of the three species, *D. humeratus* V. Sl., *D. warburgii* Brandis, and *D. apterus*, Foxw., resembling it, only *D. apterus* has so many nerves in the mature tree; as the somewhat attenuate shape suggests that the tree was young, this is not confirmatory; the absence of a short petiolar tomentum excludes *D. humeratus*, and the riverain habitat recorded by Korthals suggests *D. apterus*. Pierre (1891), Heim (1892), and authors contemporary to them used the petiole anatomy, and particularly the arrangement of the vascular bundles as seen in transverse section at the distal end, known as the 'caractéristique', as a guide to classification and species determination. I find that in the large leaved *Dipterocarpus* species under discussion,

with their complex petiole anatomy, the 'caractéristique' can provide good characters for specific determination: *D. apterus* has a 'caractéristique' with c. 6 arcs of vascular bundles, the 3rd and 4th coalescing to form bands, shared only with *D. warburgii*. Owing to the scantiness of the Type of *D. elongatus* I have not been able to examine the petiole anatomy. I therefore prefer to leave the name a Nomen Dubium, though it most resembles *D. apterus*, and hence concur with Van Slooten's (1961, 474) decision.

### The identity of *D. validus* Bl.

*D. validus* Bl. (Mus. Bot. 2 (1852) 36) is described from Korthals s.n., G. Sakoembang, S. Borneo (L, K), consisting of leafy twigs. Dyer (1874b, 108) considered it conspecific with *D. lowii*, which differs, *inter alia*, in lamina shape, nervation, and tomentum. Brandis (1895, 37) included a Sumatran collection that later became a syntype of *D. humeratus*, which resembles it in the 22–26 pairs of nerves but differs in the short petiole tomentum; the number of nerves is as *D. warburgii*, the 'caractéristique' (see under *D. elongatus*) as *D. warburgii* and *D. apterus*; I have little doubt that *D. warburgii* should be reduced to *D. validus*. Further confirmation is given in the shorter, denser, darker tomentum and darker lamina colour than *D. apterus*, as in *D. warburgii*.

***D. eurynchus*** Miq., Sum (1862) 485.

Type: Teysmann s.n., st., Bangka (BO, U, L, K).

—*D. eurynchoides* Scheff., Nat. Tijd. N.I. 31 (1870) 346.

Type: Teysmann s.n., st., Batoe Balai, prope Muntok, Bangka (BO, U, L, K).

—*D. appendiculatus* Scheff., id (1870) 347.

Type: Teysmann s.n., fr., Gunong Menoeming, prope Muntok, (BO, L, U).

—*D. micropterus* Dyer ex. V. Sl., Reinwardtia 5, 4 (1961) 428 nomen pro syn.

In the oblique nervation and the narrow caudate-acuminate lamina the Types of *D. eurynchus* and *D. eurynchoides* clearly represent sapling collections. The latter has slightly larger leaves than the former, and it is surprising that Scheffer felt confident enough to consider it specifically distinct. The Type of *D. appendiculatus* is from a mature tree. Dyer (1874b, 104) united *D. acutangulus* Vesque with it; this interpretation was followed by subsequent authors until Van Slooten (1927, 326) correctly pointed out that *D. appendiculatus* has a winged calyx tube as Scheffer, but not Dyer, maintained, unlike the angular tube of *D. acutangulus*. Van Slooten (1961, 458) further mentions the nomen *D. micropterus*, written by Dyer on an unnumbered Beccari fruiting specimen at Florence, as a synonym.

I consider that *D. eurynchus* and *D. eurynchoides* are conspecific and that *D. appendiculatus* should be united with them. Of the known small leaved *Dipterocarpus* species *D. borneensis* V. Sl., *D. palembanicus* V. Sl., and *D. acutangulus* Vesque share the same short obtuse hispid leaf bud, though in *D. borneensis* the tomentum is shorter and rust-brown. Van Slooten, (1927, 302) considered *D. eurynchus* and *D. eurynchoides* possibly conspecific with his *D. macrorrhinus* (i.e. *D. caudiferus*, in which the bud is linear, very long, and caducous pubescent), but commented on the very short petioles compared with the latter; they share a petiole length with *D. appendiculatus* shorter than any of the other above species, in which the petiole always exceeds 1.5 cm. long. The few (8–10 pairs) of nerves excludes *D. palembanicus* and *D. macrorrhinus*; the dark purplish brown dry lamina of *D. borneensis* further differs from these Bangka collections. The identity receives further confirmation in the petiole vascular configuration at the 'characteristique' (see under *D. elongatus*); *D. eurynchus*, *D. eurynchoides*, and *D. appendiculatus* differ from *D. borneensis* and *D. acutangulus* in possessing a united inner arc of fused vascular bundles, and from *D. borneensis* which has very large resin canals.

Thus *D. eurynchus* Miq. is the only small glabrescent leaved *Dipterocarpus* known from Bangka.

**D. stellatus** Vesque, Compt. Rend. Paris, 78 (Mar. 1874) 626.

Syntypes: Beccari 2555, fr., Matang, Sarawak (PC, K); Beccari 2907, fr., Sarawak (PC, K).

—*D. nobilis* Dyer, J. Bot. 12 (Apr. 1874) 106.

Syntypes: Beccari 2555, 2907 (K, PC).

Dyer (1874c, 153) later admitted the precedence of Vesque's name. I have found no evidence to support Van Slooten's (1961, 465) suggestion that the syntypes may represent a hybrid between *D. grandiflorus* (with identical fruit, but glabrous leaf) and another species; the many and widespread collections confirm that it is a separate distinct species. I recognise two distinct geographical variants; the differences are mainly of size, and I do not, on the material available, consider them to merit specific status, though intermediate forms are not yet known.

ssp. *stellatus*. Lamina 20–25 × 12–16 cm., basim versus subcordata, ad apicem prominente acuminata; petiolus 4–5 cm. longus; ramuli—7 mm. diam; racemi—20 cm. longi. W. Sarawak.

ssp. *parvus*, ssp. nov. Lamina 10–15 × 5–7 cm., basim versus obtusa, ad apicem plus minus breviter acuminata. Petiolus c. 2 cm. longus; ramuli c. 2 mm. diam.; racemi—10 cm. longi. Brunei, N. Borneo.

**Collections:** Brunei: Brun 3176 (Holotypus in Herb. Kew), 3008, 483, S 5799, Bangar; Brun 3138, Bt. Biang; Brun 77, Lamunin, K. Abang. Rd. North Borneo: San 15403, Leila F.R., Sandakan; San 15131, Sipitang.

**D. acutangulus** Vesque, Compt. Rend. Paris, 78 (1874) 626.

Holotype: Beccari 2913, fr., Sarawak (PC).

—*D. tawaensis* V. Sl., Bull. Jard. Bot. Btzg. 3, 8 (1927) 313.

Type Elmer 21839, fr., Elphinstone Prov., Tawau, North Borneo (BO, K, PC, L, BM).

—*D. helicopteryx* V. Sl., Bull. Jard. Bot. Btzg. 3, 16 (1940) 441.

Lectotype: b.b. 19811, fr., Nunukan, Bulungan, N.E. Kalimantan (BO).

Dyer (1874 c, 152) reduced *D. acutangulus* to *D. appendiculatus* Scheff., with which I do not agree (see under *D. eurynchus*). The slightly different fruit dimensions quoted by Van Slooten for *D. tawaensis* are not sufficient to merit separation, and the material now available shows continuous variation between the two; on other characters they are identical. Under *D. helicopteryx* Van Slooten cites 13 numbers. For facility of citation I choose b.b. 19811 as Lectotype, as many of the other collections are sterile; apart from Kep 35543, which I consider to be *D. globosus*, I regard all the other collections as belonging to Vesque's species. The single character by which Van Slooten's description of *D. helicopteryx* differs from those of the other two is that the longer fruit calyx lobes are twisted like a propellor, a feature found to greater or lesser extent in all dipterocarp fruits, and by itself of no diagnostic value. He states '... the present species resembles *D. tawaensis* V. Sl., from which it is manifestly distinct in vegetative and fruit characters, as also is *D. acutangulus* Vesque'. These manifest differences are not enumerated by him.

**D. geniculatus** Vesque, Compt. Rend. Paris, 78 (Mar. 1874) 626.

Holotype: Beccari 3034, fr., Sarawak (PC).

—*D. angulatus* Dyer, J. Bot. 12 (Apr. 1874) 104.

Holotype: Beccari 3034 (K).

Dyer (1874c, 150) himself recognised precedence of Vesque's name.

There are two well defined geographical forms, differing in the size of all parts but otherwise identical; intermediate forms have not yet been observed, but may well be found when Central Sarawak, where the tree has not been collected, is explored.

ssp. *geniculatus*. Lamina 7–12 × 5–7 cm.; petiolus 3–5 cm. longus; ramuli –7 mm. diam., fructus lobis longioribus 2,—12 × 2.5 cm. W. Borneo, W. Sarawak.

ssp. *grandis*, ssp. nov. Lamina 20–35 × 12–16 cm; petiolus 8–10 cm. longus; ramuli—13 mm. diam.; lobis longioribus 2,—15 × 4 cm. Brunei, North Borneo.

**Collections:** Brunei: 37088, 80091, 48464, S 2170, Brun 3064, 3269, Andulau F.R.; Kep 30586, S. Tutong; Kep 28658, Bt. Kerita, Ladan Hills; S 1870, Ladan Hills F.R. (Holotypus in Herb. Kep), Brun 74, Mile 8½, K. Abang Rd.; Kep 35666, 48106, Labi Hills F.R. North Borneo: San A4051, 15132, Sipitang.

**D. conformis** V. Sl., Bull. Jard. Bot. Btzg. 3, 17 (1941) 102.

Holotype: b.b. 29177, fr., Aloer Boeaja, Langsa, Atjeh, Sumatra (BO).

Borneon collections are constantly smaller in all parts, and the tomentum is shorter. I regard them as constituting a separate subspecies.

ssp. *conformis*. Lamina 20–24 × 12–15 cm., nervis lateralibus utrinsecus 14–16. Petiolus 5–6 cm. longus. Tubus calycis in fructu alis 5,—1 cm. latis. Sumatra.

ssp. *borneensis*, ssp. nov. Lamina 9–12 × 5–7 cm., nervis lateralibus utrinsecus 15–18. Petiolus 1.7–2.5 cm. longus. Tubus calycis in fructu alis 5,—3 mm. latis. Borneo.

**Collections:** Brunei: Brun 3130, 2602, Kuala Temburong Machang; Brun 3390, 5673, S 5715, 5741, Kuala Belalong; Brun 738, Kuala Sekürop, Temburong. North Borneo: San 15102, Pangi (Holotypus in Herb. Leiden).

### CHANGES IN DRYOBALANOPS Gaertn. f.

**D. aromatica** Gaertn. f., De Fruct. 3 (1805) 49.

Holotype: Charles Miller s.n., leaves and one ripe fruit. Tapanuli, Sumatra (BM).

—*Pterigium teres* Correa, Ann. Mus. Hist. Nat. Paris, 10 (1807) 159.

—*D. camphora* Colebr., As. Res. 12 (1816) 535.

—*Shorea camphorifera* Roxb., Fl. Ind. 2 (1832) 616.

—*Dipterocarpus dryobalanops* Steud., Nomencl. Bot., ed. 2, 1 (1840) 518.

—*Dipterocarpus teres* (Correa) Steud., loc. cit.

—*Dryobalanops junghuhnii* Becc., For. Born (1902) 554.

—*Dryobalanops vriesii* Becc., loc. cit.

No Types of Correa's, Roxburgh's, or Colebrooke's names have been found by me, though Correa's illustration closely resembles the fruit of Gaertner's Type. Beccari's species are based on the illustrations in De Vriese (1861). Van Slooten (1932, 7) has discussed the synonymy. I, unlike him, saw the Holotype. I have checked his conclusions; he cites as a synonym *Shorea costata* Pressl (Rostl. 2 (1846) 66), adding 'fide Index Kew'. Index Kewensis is wrong; this is a synonym of *Dipterocarpus costatus* Gaertn. f.

Gaertner's statement that the Holotype originated from Ceylon is erroneous; Miller gives a detailed note on its origin and uses on a label attached to the sheet.

**D. beccarii** Dyer, J. Bot. 12 (1874) 100.

Syntypes: Beccari 2553, fr., Matang, Sarawak (K, PC); Beccari 2944, fr., Sarawak (K, PC).

—*D. oiocarpa* V. Sl. ex Heyne, in Den. Berger et Endert, Med. Proefst. Boschw. 11 (1925) 107; Nutt. Pl. N. I. ed. 2, 2 (1927) 1106, nomen nudum.

—*D. oocarpa* V. Sl., Bull. Jard. Bot. Btzig. 3, 12 (1932) 33.

Lectotype: Endert 5108, y. fr., G. Kombeng, W. Kutei (BO).

*Diagnostic Characters.* Fruit calyx lobes  $-6.5 \times 0.8$  cm., arising from an  $-8$  mm. diam.,  $-5$  mm. deep, obconical cup. Nut  $-1.4 \times 1.4$  cm., ovoid, subacute. Lamina  $5-8 \times 1.3$  cm., ovate to lanceolate, relatively thin; nerves slender but distinct, pale; with slender but pale, distinct, intramarginal nerve.

Van Slooten (id., 26) has already pointed out that Malayan collections cited by Ridley under the mis-spelling *D. beccariana* should be referred to *D. oblongifolia* Dyer. Van Slooten did not see the Kew syntypes on which Dyer based the species; the Bogor material was apparently poor (not seen by me). A sheet numbered Beccari 2994 at Bogor was considered by Burck (1887, 243) to be an iso-syntype, 2994 being an error for 2944. Van Slooten described the lamina on this specimen as only  $-5$  cm. long and pubescent below, which is not the case with 2944 at Kew; I doubt therefore whether this Bogor sheet is an iso-syntype. It may be this that prevented van Slooten from identifying his *D. oocarpa* with *D. beccarii*; he mentions no diagnostic characters by which the two may be differentiated. All the 33 numbers of *D. oocarpa* cited by van Slooten, and examined by me at Bogor and Leiden, I consider to represent Dyer's species; they all originate from E. Borneo, whereas W. Borneo specimens are cited by him as *D. beccarii*. I have chosen Endert 5108 as Lectotype of *D. oocarpa* for ease of citation.

**D. rappa** Becc., For. Born. (1902) 572.

Holotype: Beccari s.n., st., plain near Kuching (FI).

—*D. oblongifolia* sensu Wyatt-Smith, Mal. For. 18 (1955) 153.

Wyatt-Smith cites sapling and pole species from Brunei and Western North Borneo as his only records of *D. oblongifolia* Dyer in Borneo, but does not mention the Beccari syntypes of that species from Sarawak. The sapling leaves of *D. rappa* are larger and narrower than those of the mature tree, and are glabrous; they differ notably from those of *D. oblongifolia* however in drying a distinct rust-brown, not olive. *D. oblongifolia* has never been found in peat swamp or Heath forest, to which *D. rappa* is confined.

CHANGES IN COTYLELOBIUM Pierre.

**C. burckii** (Heim) Heim, Rech. Dipt (1892) 122.

—*Vatica burckii* Heim, Bull. Mens. Soc. Linn. Paris, 2 (July 1891) 956.

Syntypes: Beccari 3260, fr., Sarawak (K, PC); Beccari 3261, fr., loc. cit (K, PC).

—*C. flavum* Pierre, Fl. Coch. 17 (Oct. 1891) tab. 258a.

Syntypes: Beccari 3389, fr., Danau Lamadjang, W. Kalimantan (PC, K); Beccari 3261 (PC, K).

—*C. asperum* V. Sl., Bull. Jard. Bot. Btzg. 3, 10 (1928) 401.

Holotype: Omar 112, fr., S. Rumbungan, Sarawak (KEP).

One of the syntypes of *V. burckii* Heim, later transferred by him to *Cotylelobium*, is also a syntype of Pierre's later species; Brandis (1895, 115) reduced *C. burckii* to *C. flavum*. Van Slooten (1929, 326), without access to the syntypes, applied the name *C. flavum* to material which he later (1932, 43) had to describe as a separate species *C. malayanum*, and at the same time created the name *C. asperum* for the material which should have been referred to *C. flavum*. Later (1932, 43), having seen the authentic material, he corrected his misinterpretations but continued to give precedence to Pierre's name. He had been misled by Ridley (1922, 239) who had erroneously associated Malayan collections of *C. malayanum* with *C. flavum*.

**VATICA** Linn., Mantissa, 2 (1771) 152.

Type: *V. chinensis* Linn.

—**Seidlia** Kostel., Allg. Med.-Pharm. Fl. 5 (1836) 1945.

Type: *Seidlia lanceaefolia* Kostel.

—**Vateria** sensu Arn., Ann. Nat. Hist. 1, 3 (1839) 155, pro parte, quoad *V. lanceolata* Arn.

—**Retinodendron** Korth., Kruidk (1840) 55.

Types: *R. lanceaefolia* (Kostel) Korth., *R. pauciflora* Korth., *R. rassak* Korth.

—**Isauxis** (Arn) Reichb. Nom (1841) 210.

Types: *I. lanceolata* (W. et A) Reichb., *I. roxburghiana* (W. et A) Reichb.

—**Pteranthera** Bl., Mus. Bot. 2 (1852) 30.

Types: *P. sinensis* (Blanco) Bl., *P. mangachapoi* (Blanco) Bl.

—**Sunaptea** Griff., Notul. 4 (1854) 516.

Type: *S. odorata* Griff.

—**Anisoptera** sensu Hassk., Retzia, 1 (1856) 140, quoad *A. bantamensis* Hassk; Kurz, Flora (1872) 190, quoad *A. odorata* (Griff) Kurz.

—**Synaptea** Kurz, J. As. Soc. Beng. Sc. 39, 2 (1870) 65.

Types: *S. odorata* (Griff) Kurz, *S. grandiflora* Kurz, *S. bantamensis* (Hassk) Kurz.

—**Pachynocarpus** Hook. f., Trans Linn. Soc. 23 (1860) 159.

Type: *P. umbonatus* Hook. f.

—**Eleaogyne** Miq., Sum (1860) 460.

Type: *E. sumatrana* Miq.

### The identity of the type

In the Linnean herbarium are two collections, no. 614.1 and no. 614.2, both in the same stage of flowering, and both of which almost undoubtedly were collected simultaneously off the same tree. On the obverse side of 614.1 is a Latin description in Linnaeus' hand that is a modified form of the generic description he published in the Mantissa, presumably the preliminary version. On 614.2 the word India is written, again in his handwriting. 614.1 must represent the Holotype of the species *V. chinensis* Linn (id (1771, 242) and the genus; the specific epithet is presumably a mistake, one that occurs in several genera, as has been pointed out by Stearn (1957, 144).

There has been a controversy as to the identity of Linnaeus' species. Bentham and Hooker (1862, 192) considered *Hopea grandiflora* Wall., a nomen nudum in Wallich's catalogue, as a synonym of *V. chinensis*, the latter being cited as '*Vatica indica* Linn. (species indica nec chinensis)'. Dyer (1874a, 302) considered Linnaeus' species conspecific with *V. roxburghiana* (W. et A) Bl. of Ceylon and S. India, unaccountably maintaining Blume's name against Linnaeus'. Brandis (1895, 117) accepted Dyer's conclusion but reduced Blume's name.

There is a striking similarity when in flower between *V. odorata* (Griff) Sym., with which *H. grandiflora* is synonymous, and *V. roxburghiana*, though the latter possesses subequal partially reflexed fruit calyx lobes that are free to the base, whereas in *V. odorata* the lobes are distinctly unequal, unreflexed, and united at the base into a cup adnate to the ovary. I have examined the Linnean specimens and consider Dyer to be correct; the more coriaceous lamina and (2) 3–4 cm. long petiole in my opinion excludes the possibility of identifying *V. odorata* with *V. chinensis*, and the specimen is in every way typical of *V. roxburghiana*. As shall be seen, the two interpretations have led to considerable nomenclatural confusion.



### Generic synonymy

*Seidlia lanceaefolia* Kostel. is described from the Wallich specimen no. 4405, determined in the latter's Catalogue as *Vateria lanceolata*.

Arnott (1839, 155) described his *Vateria roxburghiana* (synonymous with Linnaeus' Type species) and placed it in a new subgenus *Isauxis*, at the same time transferring Kosteletsky's genus to it; the subgenus differed from the Type subgenus in the relatively few (15) subglobose, not elongate, stamens. Reichenbach (1841) gave *Isauxis* generic rank.

In 1840 Korthals described *Retinodendron*, with two new species, *R. rassak* and *R. pauciflora*, described from his Borneon collections; he also transferred *S. lanceaefolia* to his genus, though he did not recognise precedence of Kosteletsky's generic name.

Blume (1852, 31) united *Retinodendron* and *Isauxis* with *Vatica*. *Vatica sinensis* Blanco and *Vatica mangachapoi* Blanco, described in the first edition of the Flora de Filipinas (1837), of which no Types exist, he placed in a new genus *Pteranthera* on the basis of Blanco's descriptions. He was puzzled by Blanco's allusion to 'antherae . . . 4-alatae', in the description of *V. sinensis*. Bentham and Hooker (1862, 192) suggested that Blume's action was unjustified; De Candolle (1868, 623) retained the binomial *V. mangachapoi*, stating 'antheris vero non alatis (valvis inapertis?)', though he considered it of uncertain affinities. Subsequent authors have interpreted Blanco's antherine wings as dehisced valves, though in the absence of authentic material this is pure speculation (see under *V. mangachapoi*).

In 1854 Griffith described *Sunaptea* from specimens collected by himself at Mergui and named by him *S. odorata*. The fruit differed from *Vatica* as then understood owing to the unequal length of the calyx lobes, which were united at the base forming a cup adnate to the nut. Kurz (1870, 65) maintained that Griffith's name must be a reprint for *Synaptea*, and added two other species. *S. grandiflora* Kurz, based on *H. grandiflora* Wall., nomen nudum, and *S. bantamensis* (Hassk) Kurz, described originally by Hasskarl as an *Anisoptera*. Kurz later (1872, 190) united *S. grandiflora* under *S. odorata* and transferred it to *Anisoptera*; this combination was not accepted by later authors. I retain Griffith's original spelling as Griffith, in explaining the choice of the name, uses the misspelling twice and clearly intended to use it therefore. Unfortunately all subsequent authors except Heim have adopted Kurz's spelling.

J. D. Hooker in 1860 described a plant collected by Motley on Labuan as *Pachynocarpus umbonatus*; he noted the close similarity of the flowers to those of *Vatica*, but considered that the curious fruit with corky pericarp and adnate corky sepals was sufficiently unique to merit separate generic status.

De Candolle (1868, 617) united Thwaites' Ceylonese genus *Stemonoporus* with *Vatica*. Dyer (1874a, 314) created a new section for *Stemonoporus* in *Vateria* Linn., where it has remained in later publications but for a brief period when it was reinstated as a genus by Heim (1892, 112). Dyer also reduced *Sunaptea* to *Vatica*. Burck (1887, 223) argued that *Pachynocarpus* Hook. f., as well as *Sunaptea* Griff. should be united with *Vatica* owing to their similar floral structure and anatomy. In the generic synonymy he further listed *Anisoptera melanoxylon* Hook. f., following Miquel (1867, 85), though he did not describe the species and evidently saw no specimens. Pierre (1889-91, sub tab. 235 and 258) cited *A. melanoxylon* as the Type species of his genus *Cotylelobium*. Pierre (id., tab. 240-2) again separated *Sunaptea* from *Vatica*, on the basis of the presence of endosperm in the ripe fruit and the structure of the embryo.

Heim (1892, 96-117) radically differed from his immediate predecessors, especially Burck, whose work he critically reassessed. Heim, accusing Burck of basing his decisions almost entirely on anatomical evidence, and ignoring external morphology (which accusation was hardly justifiable) divided *Vatica* again into the following series and genera:

Sériées *Vaticées*: Fruit calyx lobes equal, resin canals medium sized, outer arc of petiolar vascular bundles closed.

Genus *Vatica* (including *Isauxis*). Fruit calyx lobes longer than nut.

Genus *Retinodendron* Korth. Fruit calyx lobes shorter than nut.

Genus *Pachynocarpus* Hook. f. Fruit calyx lobes coalescing and adnate to the nut.

Sériées *Sunapteées*. Fruit calyx lobes unequal, resin canals relatively large, outer arc of petiolar bundles open ventrally.

Genus *Sunaptea* Griff.

He tentatively put *Pteranthera* Bl. in his series *Vateriées*, commenting that Blanco's floral description could well fit *Stemonoporus*, a genus up till the present only definitely known from Ceylon.

Brandis and Gilg (1895, 268) again united these genera with *Vatica*, with the exception of *Pachynocarpus*, though Ridley (1922, 240) continued to maintain *Sunaptea* (as *Synaptea*). *Pachynocarpus* was finally reunited by van Slooten (1927, 72). I am in agreement with van Slooten's and Burck's generic concept; both in the field and in the herbarium it is impossible to subdivide *Vatica* on any other character than that of the fruit calyx; the flowers, the leaf nervation, bark appearance, and wood anatomy are very uniform throughout the genus.

SUMMARY OF THE HISTORY OF THE INFRAGENERIC SUBDIVISIONS OF VATICA

UNEQUAL FRUIT CALYX LOBES.		EQUAL FRUIT CALYX LOBES.		Diagnostic Characters.
Lobes free to base.	Lobes united in a shallow cup.	Lobes shorter than ripe fruit.	Lobes as long as, or exceeding length of ripe fruit.	
		( <i>Vatica chinensis</i> Linn., Type of the genus.)		Authors.
<i>Sect. Euvatica.</i> Type: <i>V. chinensis</i> sensu Benth. et Hook. f. (= <i>V. odorata</i> (Griff) Sym.)		<i>Sect. Isauxis</i> (Arn) Benth. et Hook. f. Type: <i>V. roxburghiana</i> (Arn) Benth. et Hook. f. (= <i>V. chinensis</i> Linn.)	Genus <i>Pachynocarpus</i> Hook. f. Type: <i>P. umbonatus</i> Hook. f.	Bentham and Hooker (1862)
Incertas sedis.		<i>Sect. Euvatica</i> (also <i>Sect. Stemonoporus</i> , = Gen. <i>Stemonoporus</i> Thw.)	Genus <i>Pachynocarpus</i> .	De Candolle (1868)
<i>Sect. Euvatica.</i> ? Type.		Division 1. (incorrectly including <i>V. chinensis</i> Linn.)	Genus <i>Pachynocarpus</i> .	Dyer (1874)
<i>Sect. Euvatica.</i> ? Type.	<i>Sect. 'Synaptea'</i> (Griff) Burck. Type: <i>V. odorata</i> (Griff) Sym.	<i>Sect. Isauxis</i> (Arn) Benth. et Hook. f. (including here <i>V. chinensis</i> Linn.)	<i>Sect. Pachynocarpus</i> (Benth. et Hook. f.) Burck.	Burck (1887)
Genus <i>Sunaptea</i> Griff.		Genus <i>Retinodendron</i> Korth	Genus <i>Pachynocarpus</i> .	Heim (1892)
<i>Sect. Euvatica.</i>	<i>Sect. 'Synaptea'</i> .	Genus <i>Retinodendron</i> .	Genus <i>Pachynocarpus</i> .	King (1893)
<i>Subgenus 'Synaptea'</i> .		<i>Subgenus Retinodendron.</i> (including <i>V. chinensis</i> Linn.)	Genus <i>Pachynocarpus</i> .	Brandis (1895)
<i>Subgenus 'Synaptea'</i> .		<i>Subgenus Isauxis.</i>	<i>Subgenus Pachynocarpus.</i>	Van Slooten (1927)
<i>Section Sunaptea</i> (Griff) Burck. Type: <i>V. odorata</i> (Griff) Sym.		<i>Section Vatica.</i>	<i>Sect. Pachynocarpus</i> (Hook f.) Burck. Type: <i>V. umbonata</i> (Hook f.) Burck.	Present Classification.

### Subgeneric divisions

Bentham and Hooker (loc. cit) recognised that the species in Arnott's *Isauxis* shared with those described under *Retinodendron* Korth. subequal fruit sepals, and united the two under the former name as a section. Their other section, Euvatica, contained the species with unequal fruit calyx lobes,—*Anisoptera bantamensis* Hassk., *A. melanoxyton* Hook. f., and *V. indica* (i.e. *V. chinensis* Linn., which they united with *H. grandiflora* Wall). *Sunaptea odorata* Griff., with which *H. grandiflora* is in fact conspecific, they cited as a species dubium allied to Euvatica, apparently having not at that time seen the excellent specimens of Griffith now at Kew.

De Candolle (id., 618) suggested different subdivisions, though he did not supply names for them. *Stemonoporus* Thw. having been united by him forms one section; the other *Vaticae* were divided again, on whether the fruit calyx was as long as the nut, or shorter and patent. In the first of these subdivisions he included *V. roxburghiana* (hence *Isauxis* Arn.), and in the latter *V. rassak* (hence *Retinodendron* Korth) and *V. chinensis* Linn. Species of Hooker's section Euvatica were excluded from the genus. It is not clear what interpretation De Candolle had of *V. roxburghiana*, in which the fruit calyx is patent and is hardly as long as the fruit. His interpretation of *V. chinensis* is based on the illustration in Smith (1789, 36) in which the Holotype is depicted and hence the calyx of the flower and not the fruit.

Dyer (loc. cit) inexplicably adopted Bentham and Hooker's classification, but as already mentioned, reduced *V. chinensis* to *V. roxburghiana* in section *Isauxis*, and maintained the name Euvatica for species with unequal fruit calyx lobes, including with them *Sunaptea* Griff (as *Synaptea*). Burck (loc. cit), considering only the East Indian species, recognised 5 sections. He created a new section *Pachynocarpus* (Hook. f.) Burck, but accepted De Candolle's basis for division and named two sections, *Retinodendron* (Korth) Burck, with shorter, and *Isauxis* (Arn) Benth. et Hook. f., with fruit calyx lobes longer than the nut. *Isauxis* contained the single species *V. venulosa* Bl (as *V. bancana* Scheff); unlike de Candolle, Burck based his classification on accurate information, but would have been forced, had the type species of *Isauxis* occurred in the East Indies, to include it in section *Retinodendron*. Burck further differentiated between a section Euvatica, with unequal fruit calyx lobes free to the base, and *Sunaptea* (Griff) Burck, (as *Synaptea*), with unequal fruit calyx lobes united at the base and adnate to the ovary. In the latter he inaccurately included *V. bantamensis* (Hassk) Burck, in which the calyx is free, and in the former only his two species *V. borneensis* and *V. teysmanniana*, in the second of which the calyx is united and adnate to the ovary at the base. Burck makes no mention of *V. chinensis* Linn., but we may presume that he accepted Bentham and Hooker's interpretation.

Little remained of *Vatica* after it had been redivided by Pierre and Heim. Heim made a critical reassessment of his two remaining sections, *Euvatica* sensu Benth. et Hook. f., and *Isauxis* (Arn) Benth. et Hook. f., properly questioning the true identity of Linnaeus' species in order to decide the correct nomenclature of the sections. He discusses the two interpretations, but reaches no conclusions, having presumably not seen the Type. *Isauxis* he maintains for *V. roxburghiana*, at the same time correctly stating that if Dyer were correct the name should be changed for *Euvatica*. In *Euvatica* sensu Benth. et Hook. f. he only includes *V. scaphula* Roxb (*Anisoptera scaphula* (Roxb) Pierre), *V. maingayi* Dyer, and *V. helferi* Dyer, as anomalous species of uncertain affinities; he at the same time implies that the section might have to be disbanded. *V. bancana* (i.e. *V. venulosa*) he did not see, but judged from the description to probably represent a separate genus.

King (1893, 102), considering only Malayan species, suggested that *Isauxis* should be excluded also as a separate genus, synonymous with *Retinodendron*; he accepted the latter name as it is the earlier used at generic rank. He retained *Sunaptea* in *Vatica*, and accepted two sections in the genus: *Euvatica*, with unequal fruit calyx lobes free to base; and 'Synaptea', with unequal lobes united at the base and adnate to the ovary. He accepted Bentham and Hooker's identification of *V. chinensis* Linn., but failed to note that by their interpretation the species had a calyx united at the base and adnate to the ovary. Thus King had accepted a concept of the sections that is the exact antithesis of De Candolle's twenty five years earlier.

Brandis (loc. cit) recognised three subdivisions, treating them as subgenera: *Retinodendron*, *Isauxis*, and *Synaptea*. He accepted Burck's interpretation of *Isauxis*, including in it *V. kunstleri* Brandis, *V. bancana* Scheff., and *V. schefferi* Brandis, which are in fact conspecific (see under *V. venulosa*). He transferred *V. chinensis* Linn. to section *Retinodendron* yet correctly reduced *V. roxburghiana* to Linnaeus' species. His retention of both names *Retinodendron* and *Isauxis* is unjustifiable; by his interpretation *Retinodendron* should have borne the generic name, while his *Isauxis* would require a new name as the Type of *Isauxis* had been reduced to *V. chinensis*, Type of the genus.

In the most recent classification, of van Slooten (1927, 72), *Retinodendron* was united with *Isauxis*, and two other divisions were accepted, *Sunaptea* (Griff) Burck (as *Synaptea*) and *Pachynocarpus* (Hook. f.) Burck; they ranked as subgenera.

Symington (1943, 211) accepted van Slooten's classification, but recommended, owing to the great similarity of all species on floral structure, that these subdivisions merited no higher a rank than sections. I am in agreement with this view; the subdivisions of *Vatica* are no better defined than those of *Shorea*, and I prefer to consider them as sections in both genera.

Accepting *V. roxburghiana* as a synonym of *V. chinensis* Linn., Section *Isauxis* thus becomes the Type section and must bear the generic name.

The definitions of the sections are as follows:

**Section I. PACHYNOCARPUS** (Hook. f) Burck, Ann. Jard. Bot. Btzg. 6 (1887) 232.

Type: *V. umbonata* (Hook f) Burck.

—Gen. **Pachynocarpus** Hook f.

Calyx lobes thickened, corky, coalescing with each other and with the nut, forming a cup more or less enclosing it.

*Distribution.* 2 species: Malaya (1), Borneo (1).

**Section II. VATICA.**

—Gen. **Seidlia** Kostel.; **Vateria** sensu Arn (1839) pro parte, quoad sect. *Isauxis* Arn.; **Retinodendron** Korth., pro parte; **Isauxis** (Arn) Reichb.; **Eleaogyne** Miq.

—Sect. **Isauxis** (Arn) Benth et Hook. f., Gen. Pl. 1 (1862) 192. (Type: *V. chinensis* L (ut *V. roxburghiana* (Arn) Benth. et Hook. f)); **Retinodendron** (Korth) Burck, Ann. Jard. Bot. Btzg. 6 (1887) 224.

Calyx lobes entirely free, subequal, frequently becoming reflexed.

*Distribution.* 40 species: Ceylon (3), S. India (1), S. China (1), Burma (7), Thailand (2), Indochina (6), Malaya (9), Sumatra (7), Borneo (15), Philippines (1), Moluccas and Celebes (1), Java (2), New Guinea (1).

**Section III. SUNAPTEA** (Griff) Burck, Ann. Jard. Bot. Btzg. 6 (1887) 223 (ut *Synaptea*).

Type: *V. odorata* (Griff) Sym.

—Gen. **Sunaptea** Griff., **Pteranthera** Bl., **Anisoptera** sensu Hassk (1856) 140; **Synaptea** Kurz.

—Sect. **Euvatica** sensu Benth. et Hook. f., Gen. Pl. I (1862) 192; Dyer, in Hook. f., Fl. Brit. Ind. I (1874) 301; Burck, Ann. Jard. Bot. Btzg. 6 (1887) 224; King, J. As. Soc. Beng. Sc. 62, 2 (1893) 102.

Fruit calyx lobes unequal, thin, with 2 lobes longer than the other three, not becoming reflexed.

*Distribution.* 31 species: Burma (1), S. China (1), Thailand (2), Indochina (1), Malaya (10), Sumatra (3), Java (1), Borneo (17), Philippines (5), Celebes (1), Moluccas (1).

—*V. umbonata* (Hook. f) Burck, Ann. Jard. Bot. Btzg. 6 (1887) 232.

Holotype: Motley s.n., fr., Labuan (K).

—*Pachynocarpus umbonatus* Hook f., Trans. Linn. Soc. 23 (1862) 159.

—*V. verrucosus* (Burck), loc. cit.

Type: Teysmann 11350 HB, fr., S. Landak, W. Borneo (BO, L, K).

—*P. verrucosus* (Burck) Heim, Rech. Dipt (1892) 107.

—*V. cupularis* V. Sl. ex Heyne, Nutt. Pl. ed. 2, 2 (1927) 1129, et Bull. Jard. Bot. Btzg. 3, 9 (1927) 132.

Syntypes: b.b. 364, y. fr., Assem Assem, Pleihari, S.E. Borneo (BO); b.b. 2130, very y. fr., loc. cit (BO).

The Holotype was not seen by either Burck or Van Slooten, though the latter (1927, 131) who cited most of the then extant collections under *V. verrucosa*, alluded to the similarity of the two species. He further described *V. cupularis*, stating that it differed in the 'not furrowed calyx tube and by the nut itself, the diameter of the exserting part of which is c. 2 cm. A striking character by which the leaves may be distinguished is their midrib and lateral nerves, which are hardly prominent on the lower side'. The leaf character is typical of the species as a whole. The fruit characters indicate, and the syntypes confirm, that Van Slooten is describing immature fruit of *V. umbonata*. Recent Brunei collections (Brun 3, 690, 860) bear fruit at all stages and confirm my judgment.

**V. venulosa** Bl., Mus. Bot. Lugd. Bat. 2 (1852) 32.

Holotype: Muller s.n., st., Pattay, S. Borneo (L).

—*V. bancana* Scheff., Nat. Tijd. N. I. 31 (1870) 348.

Syntypes: Teysmann 12052 HB, fl. and y. fr., Nr. Djeboes, Bangka (BO, U, K); Teysmann 7629 HB, fl., Bangka (BO, L, U, K).

—*V. schouteniana* Scheff., id. 32 (1873) 408.

Type: Teysmann 12053 HB, y. fr., near Koba, Bangka (K).

—*Dryobalanops schefferi* Hance, J. Bot. 14 (1876) 307.

Type: Teysmann s.n., fl. and fr., Lampongs, Sumatra (BM, K).

—*Retinodendron kunstleri* King, J. As. Soc. Beng. Sc. 62, 2 (1893) 129.

Syntypes: Kings Collector 3249, fr. (K, BM, CAL), 4450, y. fr. (CAL), 5335, y. fr. (K, CAL), 6210, y. fr. (K, BM), 6227, y. fr. (BM) Larut, Perak; Wray 1341, fl., Tapah, Perak (K, CAL).

—*V. kunstleri* (King) Brandis, J. Linn. Soc. Bot. 31 (1895) 127.

—*V. schefferi* (Hance) Brandis, id (1895) 128.

The synonymy here quoted is the same as that of Van Slooten (1927, 96) who described and discussed the species under the name *V. bancana* Scheff. I confirm his conclusions. He did not have access to authentic material of *V. schouteniana* and *D. schefferi*, the later of which he reduced only tentatively; I have been able to see the Types of all the synonyms and confirm his conclusions. *Vatica venulosa* Bl. consists of a sterile leafy twig, which in the nervation, shape, texture and length of petiole exactly matches *V. bancana*, which has been collected at Marabahan near the Type locality (b.b. 11026) of Blume's species. In spite of the poor material I am forced to conclude that the two are conspecific, in which case Blume's name antedates *V. bancana*.

**V. sarawakensis** Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 970.

Holotype: Beccari 3018, fl., Sarawak (K).

—*V. ramiflora* V. Sl., Bull. Jard. Bot. Btzg. 3, 9 (1927) 118.

Lectotype: Elmer 20855, fr., Elphinstone Province, Tawau, North Borneo (SING).

—*V. elmeri* Merr. ex. V. Sl., id. 3, 17 (1942) 240, nomen pro syn.

Under the name *V. ramiflora* Van Slooten originally cited Elmer 20855, fr., 21004, fr., 21065, fl., and 21150, fl. and fr., all from the same locality. Later (1942, 240) he transferred no. 21150 to a separate species, *V. acrocarpa*, at the same time redescribing the fruit from no. 20855 at Singapore, the Bogor specimens being fragmentary; I therefore cite this sheet as lectotype. At the same time he cited Merrill's nomen, which appears on all the duplicates of no. 20855 examined by me (BO, SING, L, PC, K). The leaves, twigs and inflorescences of Van Slooten's specimens differ in no way from the Holotype of *V. sarawakensis*, which he did not see, basing his description of that species (1927, 106) on Haviland 1991, Kuching, which has immature fruit.

**V. borneensis** Burck, Ann. Jard. Bot. Btzg. 6 (1887) 230.

Holotype: Beccari 2623, y. fr., Matang, Sarawak (BO).

—*V. urbani* Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 956.

Holotype: Beccari 2536, fl., Matang, Sarawak (K).

—*V. beccarii* Dyer ex Brandis, J. Linn. Soc. Bot. 31 (1895) 133, nomen pro syn.

Brandis (loc. cit) further cited Beccari 1625, and 1969, flowering collections from Sarawak, under Heim's name but still maintained the fruiting Type of Burck separately; Van Slooten (1927, 77) cited *V. urbani* as an insufficiently known species, having seen none of the cited material. The leaves and twigs are unequivocal and there is no doubt as to the synonymy of the two species. Beccari 2536 at Kew has the name *V. beccarii* written on it in Dyer's handwriting.



**V. mangachapoi** Blanco, Fl. Filip. ed. 1 (1837) 401.

—*Mocanera mangachapoi* Blanco, id (1837) 450.

—? *V. sinensis* Blanco, id (1837) 401, non *V. sinensis* Gmel.,  
*V. chinensis* Linn.

—*V. apterantha* Blanco, id. ed. 2 (1845) 281.

—*Dipterocarpus mangachapoi* Blanco, id (1845) 313.

—*Shorea mangachapoi* (Blanco) Bl., Mus. Bot. 2 (1852) 34.

—*Pteranthera sinensis* (Blanco) Bl., id (1852) 30.

—*P. mangachapoi* (Blanco) Bl., id (1852) 30.

—? *Anisoptera mangachapoi* (Blanco) A. DC., Prodr. 16, 2  
(1868) 616.

—*V. bureavi* Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 955.  
Holotype: Beccari 3332, fl., Sarawak (K).

—*Cotylelobium philippinense* Heim ex Brandis, J. Linn. Soc. Bot.  
31 (1895) 134, nomen pro syn.

—*V. reticulata* King, J. As. Soc. Beng. Sc. 62, 2 (1893) 106;  
non *V. reticulata* (Thw.) A. DC.

Type: Kunstler 6969, fl. and y. fr., Perak (PC, K, BM, CAL).

—*Synaptea reticulata* (King) Ridl., Fl. Mal. Pen. 1 (1922) 243.

—*V. patula* Sym., Str. Br. R. As. Soc. 19, 2 (1941) 148.

Merrill (1918, 272) has discussed the difficulty of establishing the true identity of Blanco's *V. mangachapoi*; in order to be consistent I have accepted his interpretation, and base mine on his collection Species Blancoanae no. 866, fr., Bataan Prov., Luzon, at Kew. The first 8 synonyms were cited under *V. mangachapoi* by him; there is no authentic material for any of these names, so that the evidence for their identity is hardly satisfactory. Symington (loc. cit) created the name *V. patula* for the Malayan species previously named *V. reticulata* King, which is a homonym of *V. reticulata* (Thw) A. DC. (Prodr. 16, 2 (1868) 620); he noted the similarity of *V. patula* to Philippine collections identified under this species at Manila, but considered that the latter were too heterogeneous to represent a single species. Having seen the species in the field and examined the Kew sheets, I do not agree, but feel that the Philippine sheets cited by Merrill are without doubt referable to a single species which is conspecific with Merrill's cited collection, and that *V. patula* Sym. in no way differs from it. I further reduce *V. bureavi*, based on a flowering specimen quite typical of this species. Heim's nomen *C. philippinense*, which was written on Vidal 74, a flowering specimen from Bosobosa District, Morong, Luzon at Kew by him has already been reduced to *V. mangachapoi* by Brandis.

**HOPEA** Roxb., Pl. Corom. 3 (1819) 7.

Type: *H. odorata* Roxb.

—**Hopea** Roxb., Hort. Beng. (1814) 42, nomen nudum.

—**Neisandra** Rafin., Sylva Tellur (1838) 163.

—**Hoppea** Roxb. fide Endl., Gen. Pl (1840) 1014.

—**Petalandra** Hassk., Hort. Bog. Desc (1858) 104.

Type: *P. micrantha* Hassk.

—**Balanocarpus** Bedd., For. Man. Bot (1873) 236 bis.

Types: *B. erosa* Bedd., *B. utilis* Bedd.

—**Doona** sensu Burck, Ann. Jard. Bot. Btzg. 6 (1887) 231, pro parte, quoad *D. javanica* Burck, *D. micrantha* (Hassk) Burck, *D. odorata* (Roxb.) Burck.

—**Hancea** Pierre, Fl. Coch. 16 (1891) sub tab. 244.

Type: *H. pierrei* (Hance) Pierre.

—**Pierrea** Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 958, non *Pierrea* Hance, J. Bot. 15 (1877) 339.

Type: *P. pachycarpa* Heim.

—**Dioticarpus** Dunn, Kew Bull (1920) 337.

Type: *D. barryi* Dunn.

—**Pierreocarpus** Ridl. ex Sym., Gard. Bull. S.S. 8 (1934) 30, nomen pro syn. sub *H. pachycarpa* (Heim) Sym.

Roxburgh's name, which appeared first as a nomen nudum in 1814, was not published with a description until 1819. It is antedated by *Hopea* Garden ex Linn., Mantissa I (1767) 14, et Systema Naturae ed. 12, 2, 509; (Type: *H. tinctoria* Linn.). *Hopea* Linn. was reduced to *Symplocos* Jacq. by L'Heritier (Trans. Linn. Soc. 1 (1791) 176). Linnaeus' genus has only been maintained separately by C. G. Ortega, who described an *H. ternifolia* (Hort. Matr. Desc. (1800) 131, tab. 17) from Venezuela, and Dalzell and Gibson, who placed *Symplocos spicata* Roxb. and *S. racemosa* Roxb. there (Bomb. Fl. (1861) 140). Other authors have followed L'Heritier's interpretation. Roxburgh himself commented '*Hopea tinctoria* of Linnaeus is now referred to the genus *Symplocos* Linn., Spec. Plant. edit Willdenow, 3, p. 1436.' There are at present 86 species maintained in *Hopea* Roxb., and I have therefore put forward a recommendation for conserving Roxburgh's name against that of Linnaeus. Rafinesque (1838), apparently without access to herbarium material, proposed the new binomial *Neisandra indica* for *Hopea decandra* Ham, a nomen nudum, which was later mentioned by Wight (1840, 88), but never described. Rafinesque argued

that the 5-merous perianth and 10 stamens of this species excluded it from *Hopea* L. (a genus with which its author had not intended to associate it) and that a new name was therefore required. *H. decandra* was later reduced to *H. odorata* Roxb., the species having 15 and not 10 stamens as originally described. Rafinesque's genus is therefore based on a myth, but is at present the earliest valid name for the genus under consideration.

*Hopea* Vahl (Enum. 1 (1805) 3) is a misspelling of *Hoppea* Willdenow (Gentianaceae).

Endlicher (1840) misspelt Roxburgh's genus *Hoppea*.

Korthals (1841, 75) first records the genus in the East Indies, describing two species, *H. sangal*, and *H. balangeran* (*Shorea balangeran* (Korth) Burck). Miquel (1861, 489) added further species, for four of which he designated a separate section, *Dryobalanoides*, on account of their many indistinct nerves, resembling those of *Dryobalanops*.

Hasskarl (1858) described *Petalandra* from flowering and fruiting collections of Teysmann from Java, differing from *Hopea* Roxb. in having 10, not 15, stamens. Bentham and Hooker (1862, 193) reduced *Petalandra* to *Hopea*; they did not recognise Miquel's sections, nor did De Candolle (1868, 632). The latter nevertheless recognised two divisions, one of which contained only *H. grandiflora* Wall., characterised by the broadly imbricate sepals, longer filament, and trilobed stigma, and retained *Petalandra* as a separate genus; *H. grandiflora* is a synonym of *Vatica odorata* (see there).

Burck (1887, 160) discovered that the petiole and twig anatomy of *H. odorata* Roxb., *P. micrantha* Hassk., and of three further species described by him, was more similar to that of *Shorea*, and yet more to that of *Doona* Thw. (previously considered endemic to Ceylon), than to members of Miquel's section *Dryobalanoides*. As Miquel's section, unlike *Shorea* and *Doona*, shared with *H. odorata* and its allies two, not three, aliform fruit calyx lobes, he concluded that this character was not of value in delimiting genera and reduced the latter to *Doona*. Heim (1892; 61, 64) is justly critical of Burck, not only for also ignoring the striking differences of the flower and particularly the stamens, which are clavate in *Doona* Thw., but for transferring the Type species of *Hopea* Roxb. to *Doona*, which was only described in 1851, at the same time maintaining Roxburgh's name for a quite separate taxon. Within his *Hopea* Burck still maintained Miquel's subdivisions; in 'Euhopea', with distinct lamina nervation, he included *H. sericea* Bl. and *H. diversifolia* Miq. Both these names are now reduced to *H. sangal* Korth., as also are *P. micrantha* and the three East Indian *Doona* species described by Burck (See under *H. sangal*).

Pierre (1891) separated Miquel's section *Dryobalanoides* as a separate genus *Hancea*, based on the only Indochinese species, *H. pierrei*, of that section.

Heim (1892, 59–65) re-united *Petalandra* and *Hancea* with *Hopea*, as well as the East Indian species of *Doona* sensu Burck. He placed *H. recopei* Pierre, described a year previously, in a new genus which he never named, separated, according to Heim, by the absence of connectival appendages, and the incompletely septate apically depressed ovary. Subsequent authors have retained this species in *Hopea*. Heim recognised four sections:

- I. *Euhoepa*. Distinct nervation, 15 stamens.
- II. *Dryobalanoides* Miq. Nervation indistinct; 15 stamens; stylopodium distinct; median vascular bundle of the outer arc of petiolar bundles inverted.
- III. *Hancea* (Pierre) Heim. As II, but without stylopodium, median bundle not inverted.
- IV. *Petalandra* (Hassk) Heim. As I, but with 10 stamens.

King (1893, 123) revised the Malayan species, and maintained the two sections of Miquel; *Petalandra* was not considered. He ignored Heim's work.

Brandis (1895, 53) maintained three sections, following Heim but uniting *Hancea* with *Dryobalanoides*. He placed *H. recopei* in section *Petalandra*.

Heim (1891) further described *Pierrea pachycarpa* from a single Beccari sheet at Kew with young malformed fruit. Ridley identified a flowering collection of Haviland with it at Kew, and wrote on it, but did not publish, a new generic name *Pierreocarpus*, presumably realising that Heim's generic name was preoccupied by *Pierrea* Hance, which was later reduced to *Homalium* Jacq. (Flacourtiaceae). Symington (1934, 30) on the basis of the floral morphology reduced the genus to *Hopea*. *Pierrea* Heim has been conserved against *Pierrea* Jacq. and is cited in the list of nomina conservanda in the International Rules of Nomenclature.

Beddome (1874) described two species from India which bore flowers typical of *Hopea*, but fruit with short subequal calyx lobes; he described a separate genus *Balanocarpus* for them.

Heim (1892, 74) recognised 4 sections in the genus:

- I. *Eubalanocarpus*. With fleshy deeply lobed cotyledons, and morphology of *Hopea*, sect. *Euhoepa*, but for the fruit calyx. *B. erosa* Bedd.
- II. *Pachynocarpoides* Heim. Thinner, less deeply divided cotyledons; incrassate fruit calyx and pericarp, and slightly different petiole anatomy. *B. utilis* Bedd.
- III. *Microcarpae* Heim. Petiole anatomy at distal end and pericarp as I; petiole anatomy at proximal end as II. Fruit smaller than both. *B. zeylanicus* Trimen.
- IV. *Sphaerocarpae* Heim. As section III, but differing in having the largest sepals inside; median vascular bundle of outer petiolar arc inverted as in *Hancea*. *B. sphaerocarpus* Heim.

Heim further described a genus *Richetia*, with similar floral structure to his section *Richetioides* of *Shorea*, but with short subequal fruit calyx lobes.

It is not surprising that King (id. 130) Brandis and Gilg (1895, 267) and Brandis (1895, 106) do not even take Heim's sections into consideration. It is more surprising however that King describes a *B. penangianus*, from material already described by Heim as *Richetia penangiana*, though King makes no mention of Heim or *Richetia*. He further adds a species *B. hemsleyanus*, which, he states himself, bears flowers identical with several *Shorea* species. Thus *Balanocarpus* became a dumping ground for dipterocarps of wide affinities sharing in common only the characters of the fruit calyx. Brandis (loc. cit.) further added to the confusion by reducing the remains of Heim's *Richetia* to it, yet did not recognise sections in this genus.

Though *B. hemsleyanus* King was transferred to *Shorea* by Foxworthy (1932, 167), it was left to Symington (1934, 26) to point out the heterogeneous nature of the genus. He later (1938, 336) justified Heim's creation of a taxon *Richetia*, and united it with *Shorea*, not giving it a taxonomic rank, but suggesting that at future date, united with Heim's section *Richetioides*, it might be separated as a genus. He finally (1943) united all remaining *Balanocarpus* from Malaya with *Hopea*, with the exception of *B. heimii* King, which he regarded as an anomalous form no more related to *Balanocarpus* Bedd. sensu stricto than to *Shorea* or *Hopea*. He retained the former name for it as it was commonly known by it in Malaya. The Type species of Beddome should undoubtedly be referred to *Hopea*, following Symington's, in my opinion justifiable, arguments, and a future monographer must find a new generic name for *B. heimii*.

*Dioticarpus barryi* Dunn was described from Barry s.n., Beddome 27, Barber 3163, and Hayne 2133 at Kew, collected in the Tinnevely Hills of Madras Presidency. Dunn recognised that the flowers were as those of *Balanocarpus* Bedd., but commented that two of the fruit calyx lobes were aliform, and not as closely adpressed to the nut as in *Balanocarpus*. These are, of course, characters typical of *Hopea*, to which genus I reduce it.

Symington did not regard the presence of only 10 stamens in *H. sangal* Korth., to which he had reduced *Petalandra* Hassk., as sufficient to justify a separate section for it. His view has received support from recent collections from Brunei. I have found that the flowers of *H. treubii* and *H. vacciniifolia*, each in different subsections of Section *Dryobalanoides*, also share this character, and the reduction has thus apparently taken place several times. The infrageneric classification followed here is one suggested, but not given taxonomic expression, by Symington (1943, 108) who recognized *Euhopea*, *Pierrea*, *Dryobalanoides* and *Bracteata* 'groups'. *Balanocarpus sphaerocarpus* Heim (1892, 77), Type species of

*Balanocarpus* section *Sphaerocarpae* Heim, is based on Beccari 3021, fr., from Matang, Sarawak (Holotype: K). This is in fact a *Hopea*, belonging to the *Bracteata* group of Symington. *Sphaerocarpae* is therefore the legal name for the *Bracteata* group.

As Symington himself points out, his *Euhoepa* and *Pierrea* groups are more closely allied to one another than they are to *Dryobalanoides* and *Sphaerocarpae*, and *vice versa*. The primary dichotomy based on the two distinct types of lamina nervation divides the genus into two clearly defined natural groups, and the original classification of Miquel once more should be accepted. The other two divisions are less well defined and I am treating the genus as having two sections, each with a pair of subsections.

Section definitions are therefore as follows:—

**Section I. DRYOBALANOIDES** Miq., Sum (1861) 489.

Types: *H. dryobalanoides* Miq., *H. myrtifolia* Miq., *H. mengersawan* Miq.

Nervation dryobalanoid or subdryobalanoid (*H. nervosa*, *H. sublanceolata* excl). Bark smooth, fissured, or cracked, not evenly flaky.

**Subsection 1. Dryobalanoides.**

—Gen. **Hancea** Pierre; sect. **Hancea** (Pierre) Heim, Rech. Dipt. (1892) 62.

Nervation dryobalanoid, bracts fugaceous; corolla pale; racemes regularly branched, branchlets short; flowers many; ovary and stylopodium ovoid to pyriform, rarely truncate.

*Distribution.* 23 species: Indochina (1), Thailand (3), Burma (1), Malaya (14), Borneo (15), Sumatra (5), Phillippines (4).

**Subsection 2. Sphaerocarpae** (Heim) Ashton, comb. nov.

Type: *H. sphaerocarpa* (Heim) Ashton, comb. nov.

—Gen. **Balanocarpus** Bedd., sect. **Sphaerocarpae** Heim, Rech. Dipt. (1892) 77.

Lamina nervation subdryobalanoid (*H. nervosa*, *H. sublanceolata* excl); bracts subpersistent; racemes irregularly branched, with long branchlets and few flowers (*H. nervosa*, *H. sublanceolata* excl); corolla dark coloured; ovary and stylopodium truncate; bark smooth or cracked and with small irregular scales.

*Distribution.* 9 species: Malaya (6); Borneo (6); Sumatra (1).

**Section II. HOPEA**

Nervation scalariform; bark surface smooth or evenly flaky.

**Subsection 1. Hopea**

—Gen. **Neisandra** Rafin., **Hoppea** Endl., **Petalandra** Hassk.

—Sect. **Petalandra** (Hassk) Heim, Rech. Dipt. (1892) 63.

(Type: *H. sangal* Korth., ut *H. hasskarliana* Heim).

—Gen. **Balanocarpus** Bedd., sect. **Pachynocarpoides** Heim, id (1892) 75 (Type: *H. utilis* (Bedd) Ashton); sect. **Microcarpa** Heim, id (1892) 76 (Type: *H. zeylanicus* (Trimen) Ashton).

—Gen. **Doona** sensu Burck, pro parte; **Dioticarpus** Dunn.

Lamina base usually equal or subequal; raceme generally tomentose (*H. pentanervia* Sym., *H. dolosa* V. Sl., *H. nodosa* V. Sl. excl). rarely fascicled; ovary and stylopodium more or less ovoid, or if elongate, without median constriction; style evident.

*Distribution.* 46 species: Ceylon (3), S. India (7), Burma (5), Thailand (8), Indochina (6), S. China (1), Malaya (7), Sumatra (4), Java (1), Borneo (5), Phillipines (2), Celebes and Moluccas (3), New Guinea (10).

## **Subsection 2. Pierrea** (Heim) Ashton, stat. nov.

Type: *H. Pachycarpa* (Heim) Sym.

Gen. **Pierrea** Heim, **Pierreocarpus** Ridl. ex Sym.

Lamina base unequal (*H. glaucescens* Sym., *H. wyattsmithii* Wood ex Ashton excl); racemes glabrescent, fascicled. Ovary and stylopodium hour-glass shaped, elongate; style short, obscure; bark smooth, rarely shallowly patchily flaked (*H. philippinensis*).

*Distribution.* 7 species; Malaya (3), Borneo (4), Philippines (1).

This is the 'Pierrea group' of Symington (1943, 108–110); it has not previously been given formal taxonomic status.

## **H. dryobalanoides** Miq., Sum (1861) 492.

Syntypes: Teysmann s.n., st., S. Pagu, Sumatra (U); Teysmann s.n., y. fr., Priaman, Padang, Sumatra (U).

—*H. sarawakensis* Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 971.

Holotype: Beccari 2987, y. fr., Sarawak (K).

—*H. borneensis* Heim, id (1891) 972.

Holotype: Beccari 2532, fl., Matang, Sarawak (K).

—*H. micrantha* sensu King, J. As. Soc. Beng. Sc. 62, 2 (1893) 126, in nota; Foxw., Mal. For. Rec. 10 (1932) 137. pro parte.

Symington (1939, 345) has reviewed the synonymy; I have examined the authentic material and endorse his conclusions.

I further reduce *H. borneensis* here; it is based on a poor specimen with young fruit; the lamina and acute midrib drying black are unequivocal though.

**H. sangal** Korth., Kruidk. 3 (1841) 75.

Type: Korthals s.n., st., S.E. Borneo (BO, U, L).

—*Dryobalanops* ? *sericea* Korth., id (1841) 72.

—*Hopea sericea* (Korth) Bl., Mus. Bot. Lugd.-Bat. 1 (1852) 35.

—*Petalandra micrantha* Hassk., Hort. Bog. Desc. (1852) 105.

Holotype: Teysmann 12043, fl. and fr., Java (BO).

—*H. fagifolia* Miq., Sum (1862) 490.

Type Teysmann 3236, st., Bangka (U, K).

—*H. diversifolia* sensu Scheff., Nat. Tijd. N.I., 31 (1879) 351.

—*H. odorata* sensu Hance, J. Bot. 5 (1876) 308, et auct (1876–1927) pro parte.

—*Doona micrantha* (Hassk) Burck, id (1887) 234.

—*D. javanica* Burck, id (1887) 235.

Type: Burck, s.n. fl., Java (BO, U, K).

—*Dryobalanops neglectus* Korth. ex Burck, id (1887) 243. nomen pro syn.

—*H. micrantha* Benth. et Hook. f. fide Heim, Rech. Dipt. (1892) 64, in obs.

—*H. hasskarliana* Heim, loc. cit.

—*H. javanica* (Burck) Heim, loc. cit.

—*H. curtisii* King, J. As. Soc. Beng. Sc. 62, 2 (1893) 124.

Syntypes: Curtis 1562, fr., Penang (K, BM, CAL); Kings Collector 8161, fr., Kinta R., Perak (K, BM, CAL).

—*H. globosa* Brandis, J. Linn. Soc. Bot. 31 (1895) 61.

Holotype: Wray 816, fr., Perak (K).

—*D. micrantha* Burck, var. *macrosepala* Boerl. ex Sym., Gard. Bull. S.S. 8. (1934) 18, nomen pro syn.

—*H. fagifolia* Miq., var. *fol. latioribus* Boerl ex Sym., loc. cit., nomen pro syn.

—*H. fagifolia* var. *javanica* Boerl. ex Sym., loc. cit., nomen pro syn.

—*H. macrosepala* Boerl. ex Sym., loc. cit., nomen pro syn.

—*H. lowii* Dyer ex Brandis, id (1895) 63.

Syntypes: Teysmann s.n., fl., Sumatra (K); Low s.n., st., Borneo (K).

—*H. multiflora* sensu Foxw., Mal. For. Rec. 10 (1932) 119. pro parte.

—*H. albescens* sensu Foxw., id (1932) 122.



Symington (1934, loc. cit.) has already critically discussed the synonymy of this species. I have been able to re-examine the authentic material and confirm his judgments. I also add, however *Hopea sericea* (Korth.) Bl, originally described as *Dryobalanops? sericea* by Korthals. The type, which is sterile and probably comes from a young tree, is a close match of the Holotype of *H. sangal* described in the same work; it is typical of the species. On the holotype is the unpublished name *Dryobalanops neglectus* in Korthals' hand.

**SHOREA** Roxb, ex Gaertn. f., De Fruct. 3 (1805) 48.

Type: *Shorea robusta* Gaertn. f.

—**Vatica** sensu Wight et Arnott, Prodr. Fl. Pen. Ind. Or. 1 (1834) 84, pro parte, quoad *V. laccifera* W. et A., *V. tumbugaia* W. et A.

—**Saul** Roxb. ex Wight et Arnott, loc. cit., nomen pro syn.

—**Isoptera** Scheff. ex Burck, Med. Lands Pl. Tuin. 3 (1886) 27.

Type: *I. borneensis* Scheff. ex Burck.

—**Ridleyinda** O.K., Rev. Gen. Pl. 1 (1891) 65.

Type: *R. borneensis* (Scheff. ex Burck) O. K.

—**Richetia** Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 975.

Types: *R. coriacea* Heim, *R. oblongifolia* Heim, *R. latifolia* Heim, *R. acuminata* Heim, *R. penangiana* Heim.

—**Parahopea** Heim, Rech. Dipt (1892) 66.

Type: *P. balangeran* (Korth) Heim.

—**Pachyclamys** (Dyer ex King) Ridl., Fl. Mal. Pen. 1 (1922) 233.

Types: *P. hemsleyanus* (King) Ridl., *P. thistletoni* (King) Ridl.

The generic name *Shorea* was attributed to Roxburgh by Gaertner, who described *Shorea robusta* from a fruiting specimen from India, in the Banksian Herbarium, now in the British Museum. Wight and Arnott (1834, loc. cit) cited *Shorea* as a synonym of *Vatica*; this view was followed by Endlicher (1841, 1014) and Lindley (1846, 394). Blume (1852, 32) reinstated the genus and described the first species from the East Indies. The names *Saul iallarea* and *Saul tumbugaia* were written by Roxburgh on specimens in the East India Company Herbarium, which were described as *Vatica* by Wight and Arnott, who quoted Roxburgh's nomina in the synonymy.

Burck (1886) described *Isoptera* from a specimen named *Isoptera borneensis* in Scheffer's handwriting at Leiden, and differing from *Shorea* as then understood on account of the orbicular subequal coriaceous patent fruit sepals. Kuntze (1891) argued

that *Isoptera* was an orthographic variant of *Isopteris*, and was therefore antedated by *Isopteris* Wall (Cat. 1828, 1832). This argument is unjustifiable as Wallich's name is a nomen nudum, synonymous with *Trigoniastrum hypoleucum* Miq (Trigoniaceae). *Isoptera* was reduced to *Shorea* by Symington (1932, 238), who pointed out that except in the fruit calyx the genus differed in no way from the Type section of *Shorea*. He (1943, 5) continued to recognise it as a 'subgroup' of section *Shorea* however. I do not do so here; short subequal fruit calyx lobes occur in most sections in *Shorea* and appear to be specifically diagnostic only.

*Parahopea* was founded by Heim on Beccari 3461, a flowering specimen that in fact represents *S. balangeran* (Korth) Burck. Heim regarded the specimen as having characters totally intermediate between *Hopea* and *Shorea*; he compared the sepals and receptacle to those of *Shorea*, the petals to *Hopea*, as also the stamens and some aspects of the petiole anatomy; other characters of the stamens and petiole anatomy he compared with *Shorea*. The genus was reunited with *Shorea* and placed in section Anthoshorea Heim by Brandis (1895, 86), with the abrupt comment 'I cannot follow Heim in regard to his genus *Parahopea*'. The species is in every way typical of the section to which Brandis referred it. Heim did not see the fruit of this species which are typical of *Shorea*.

Heim further described a genus *Richetia*, based on 4 species described by him and which are regarded here as synonyms of *S. multiflora* (Burck) Sym. (see there), and also *R. coriacea* Heim. In anatomical characters he compared *Richetia* with his section Richetioides of *Shorea*, but the short subequal fruit sepals, and some minor differences in the embryo and petiole anatomy, led him to consider it generically distinct. Brandis and Gilg (1895, 267) united *Richetia* with *Balanocarpus* Beddome (see under *Hopea*), a heterogeneous genus which came to contain species of wide affinity sharing only the short subequal fruit sepals. King (1893, 134) had already described his *B. hemsleyanus*, which, he rightly indicated, resembled *Shorea* in all but fruit characters. He further described *S. thistletoni* King however, a species again differing from others in the short lobed fruit calyx, creating a new section, Pachychlamys, for it. Ridley (1922) transferred *B. hemsleyanus* to Pachychlamys, and raised it to generic level. Foxworthy (1932, 167) reduced the genus once more to *Shorea*. Symington (1938, 331) transferred the *Balanocarpus* species originally placed by Heim in *Richetia* to *Shorea*, recognising that they represent a distinct natural unit; but he never finally gave them taxonomic status.

Heim (1892) established nine sections in *Shorea*:

I. *Eushorea*. Stamens c. 30; anthers obovoid; appendage pilose; cotyledons large, fleshy; pericarp thin, twigs with long cortical petiolar vascular bundles and very many cortical resin canals;

petiole with very many (14–15 at base, 24–29 at ‘caractéristique’ (see under *Dipterocarpus elongatus*) resin canals; ‘caractéristique’ with outer arc of c. 12 bundles, and 3 inner arcs.

II. *Anthoshorea* Heim. Stamens 15–17; anthers oblong; appendage long, setiform; petals oblong, obtuse; albumen usually present in ripe seed; cotyledons thin, an outer enclosing an inner; twig with 1–12 cortical resin canals, small; cortical petiolar bundles short; petiolar vascular bundles in an outer arc of 6–7 and a single central arc with 2 resin canals.

III. *Hopeoides* Heim. Differing from section II in having over 20 stamens, little albumen, the cotyledons fleshy, bifurcated and imbricated, and with one resin canal in the central petiolar vascular arc; petiolar bundles in twig cortex intermediate in length between I and II.

IV. *Pachycarpa* Heim. Stamens 15; anthers short, glabrous; appendage long, setiform; cotyledons large, fleshy, entire; pericarp very thick; twigs with petiolar cortical bundles exceeding an internode in length; petiolar outer vascular bundle arc very disjointed, with many irregularly arranged bundles.

V. *Brachyptera* Heim. Lamina nervation as *Eushorea*; petals as *S. bakeriana*; stamens as section III; cotyledons fleshy but not imbricate; fruit sepals short; ‘caractéristique’ with outer arc as *Eushorea* and single central resin canal of *Hopeoides*; with parenchymatous gum cells as in *Richetia*.

VI. Unnamed. Stamens 15; style as Section V; style and appendage very long; petiolar ‘caractéristique’ with outer arc and a complex of bundles within as in *Eushorea*. The ‘Type’, *S. bakeriana* Heim, is synonymous with *S. macrophylla* (De Vriese) Ashton, which, under the name *S. gysbertsiana* Burck, was Type also of Section IV.

VII. Unnamed. ‘Type’: *S. rugosa* Heim. Stamens in number and appearance like *S. bakeriana*, but filaments long and geniculate; embryo as *S. brachyptera* but fruit sepals aliform.

VIII. Unnamed. ‘Type’: *S. pierriana* Heim (a synonym of *S. scrobiculata* Burck). Ovary, style, anthers, as *Eushorea*; leaf as *Euhopea*; petals with hairs on inner face; connectival appendage with single terminal bristle.

IX. *Richetioides* Heim. 15 stamens; anthers short, connectival appendage long, slender, curved; ovary as *Eushorea* but more shortly tomentose; embryo as *Anthoshorea* and *Hopeoides*, but no endosperm; fruit sepals unequal, aliform; cortical parenchyma with gum cells as *Richetia*; petiolar vascular supply as *Eushorea*.

The last six of Heim’s sections are founded on a total of nine species; he in other words had been able to recognise three apparent natural groups within *Shorea*, but had nine species that he

could not place in any of them; his decision to found six further sections for them, in view of the very few specimens he had at his disposal, was rash.

Brandis and Gilg (1895, 264) and Brandis (1895, 73) retained some of Heim's sections, but simplified the classification and recognised the following sections based on quite different criteria;

I. *Brachyptera* Heim emend. Brandis. Segments of fruit calyx shorter than twice length of fruit.

II. *Eushorea*. Fruit calyx with 3 long lobes; stamens 20–60, appendage ciliate. Flowers usually in unilateral spikes or racemes.

III. *Anthoshorea* Heim. Fruit calyx with 3 long lobes; stamens generally 15–17, rarely 23–30; anthers oblong, connective terminating in a long, filiform, naked appendage, sometimes scabrous towards the apex; style longer than ovary; stigma generally 3-dentate; no stylopodium.

IV. *Pinanga* Brandis. Fruit calyx with 3 long lobes; anthers short, appendage to connective not ciliate, sometimes scabrous towards apex.

V. *Mutica* Brandis. Fruit calyx with 3 long lobes; anthers of inner stamens or all inappendiculate.

Symington (1943, 4) has suggested that a subdivision of Brandis' concept of the Type section is necessary, and further (id., 58) demonstrated that Malayan species of sections *Brachyptera*, *Pinanga*, and *Mutica* were divisible into three apparently natural groups, based on the characters of the stamen; he did not however give any of these groups taxonomic status. I have been able to examine the flowers and fruit of every species in the genus in which they have been collected, and with the aid of the several new species from Borneo described here have confirmed and elaborated Symington's plan in the present classification.

Symington (id. 58) also pointed out that, in Malaya, groups can be recognised in the field based on bark and slash characters; these can for the most part be equated with botanical divisions recognisable in the herbarium on floral and other characters. Thus the field group 'Balau' (called 'Selangan Batu' in Borneo) was equivalent to the Type section, 'Meranti Pa'ang' to *Anthoshorea* Heim, and 'Meranti Damar Hitam' to the '*Richetia* group' (Section *Richetioides* Heim). The 'Red Meranti' field group was, he admitted, heterogeneous botanically, for this field group includes sections *Brachyptera*, *Pinanga* and *Mutica* as interpreted by Brandis and defined above.

Whitmore (1962) has demonstrated that genera, and sometimes infrageneric taxa, in *Dipterocarpaceae* are characterised by distinct types of bark morphology. Though the number of species examined by him were small, his evidence suggests that each of the sections here proposed is characterised by its bark; I summarise the bark morphology in my section descriptions therefore.

Foresters may be surprised to find that in the classification I have adopted here I have divided the Red Meranti field group into a number of botanical sections, thus placed on an equivalent rank to sections *Shorea*, *Anthoshorea*, and *Richetioides*. The Red Meranti group, in Borneo as elsewhere, is easy with experience to recognise in the field; wood anatomists, though admitting that there is a wealth of anatomic variation within them, find that Red Merantis can always be distinguished from other field groups. Unfortunately not only are the anatomical diagnostic characters of the Red Meranti field group solely negative distinctions, but they are not constant. *Shorea albida* Sym., which to foresters and wood anatomists is a Red Meranti, is botanically typical of section *Anthoshorea*, whose other members belong to the White Meranti field group. Whitmore (1962) has further confirmed that the bark morphology of *S. albida*, though typical, possesses characters that put it unequivocally in section *Anthoshorea*. He also recognises that the sections within the Red Meranti field group examined by him can be distinguished by a set of bark characters as distinct as those provided by sections *Shorea*, *Richetioides*, and *Anthoshorea*.

The botanical heterogeneity of the Red Merantis in Borneo is further accentuated by sections *Rubella* and *Pachycarpa*, neither of which occur elsewhere; moreover the Balau (Selangan Batu) field group in Borneo comprises not only the Type section but also the monotypic section *Neohopea*, which is very isolated on flower and fruit characters; the wood anatomy is indistinguishable though from that of section *Shorea* according to Balan Menon (in correspondence).

The main reason why field workers find the Red Merantis so easily recognisable is owing to the distinctive pink or red colouring of their wood and inner bark. Here the homogeneity seems to end though, and in my opinion it is misleading to consider the Red Merantis as a group of phyletically interallied subsections more closely allied to one another than to the other sections of *Shorea*. I am unable to form a definition of the group on botanical characters that would be watertight.

The sections adopted by me therefore are named and defined as follows:

### **Section I. SHOREA**

Stamens 20–60, in several verticils; filaments broad at base, gradually tapering; anthers with 4 pollen sacs, more or less broadly oblong; appendage to connective shorter than anther, with one or several bristles. Ovary with stylopodium; style shorter than ovary; ovary and stylopodium tomentose. Stipules and bracts fugaceous, small. Midrib raised or depressed above, always evident.

Bark surface flaky or dippled (*S. biawak* Ashton excepted); radially oblique stone cell fingers often present; phelloderm pale, thick, conspicuous; expansion tissue in short fingers, more numerous towards outer surface.

### Subsection I. *Shorea*.

—Gen. *Vatica* sensu Wight et Arnott (1834) 84, pro parte; *Saul* Roxb. ex Wight et Arnott, *Isoptera* Scheff ex Burck, *Ridleyinda* O.K.

Flower buds elongate; petals linear, falling early; appendage to connective with few bristles.

*Distribution.* 35 species: Ceylon (3), S. and E. India (2), Burma (2), Thailand (4), Indochina (3), Philippines (5), Malaya (12), Borneo (10), Molluccas (1).

### Subsection 2. *Barbata* Sym. ex Ashton, subsect. nov.

Type: *S. maxwelliana* King.

*Alabastra subglobosa.* Petala breves obtusa, delapsa basi connata. Aristae et apices antherorum exteriorumque conferte setosae.

*Distribution.* 9 species. Ceylon (2), Burma (1), Thailand (1), Malaya (3), Sumatra (2), Borneo (5).

### Section II. *NEOHOPEA* Ashton, sect. nov.

Type: *S. isoptera* Ashton.

Flores parvi, alabastris globosis. Stamina 15, verticillis 3; filamentis crassis brevibus compressis vix attenuatis; antheris subglobosis, loculis 4; aristis brevissimis crassis glabris. Ovarium stylopodiumque conicum puberulens. Stylum brevissimum. Lobi calycis in fructu aliformes subaequales. Stipulae bracteique minute fugaces. Lamina intercostis scalariformibus, costa media lata supra applanata.

*Distribution.* 1 species: Borneo.

The bark is similar in appearance to that of the Type section, as also is the lamina nervation and the ovary and stylopodium. The number and character of the stamens are quite different however; moreover the fruit calyx of the single species is unique, and on this account it could be considered to merit separate generic status. G.H.S. Wood had made some preliminary notes on the single species, with intent to later publish it, under the name *Neohopea isoptera*. In view of the fact that the outer 3 calyx lobes in fruit are slightly longer than the inner 2 are, I feel that to create a new genus would obscure its true affinities, which seem certainly to be with section *Shorea*. The fruit calyx character does further obscure the narrow boundary between the genera *Shorea* and *Hopea*, and indicates the need for a critical re-assessment of the generic distinctions in Brandis's Tribe Shoreae when the family is treated monographically.

**Section III. RICHETOIDES** Heim, Rech. Dipt. (1892) 48.

Type: *S. faguetiana* Heim.

—Gen. **Richetia** Heim.

Flowers usually small; stamens 15 (rarely 10), in 3 verticils; filaments broad at base, frequently gibbous, tapering more or less abruptly medially, filiform below anther; anthers with 2 pollen sacs, broadly oblong to subglobose; appendage to connective longer than anther, erect, filiform, slender, more or less scabrous towards apex; ovary with stylopodium, shortly tomentose or glabrescent; style shorter than ovary. Stipules and bracts minute, fugaceous; lamina nervation usually more or less scalariform, pellucid; midrib raised or sunken above, evident.

Bark surface scaly (*S. acuminatissima* excepted); phelloderm thin, inconspicuous; expansion tissue in long fingers, becoming wider outwards; outer bark with 1 (2) sheet-like rhytidome layers.

*Distribution.* 24 species; Southern Thailand (1), Malaya (9), Sumatra (5), Borneo (17), Philippines (1).

Symington (1938, 330; 1943, 44) recognised this section as a natural group under the name 'Richetia group'. Richetioides is the correct name, being the first name published at this status.

**Section IV. RUBELLA** Ashton, Sect. nov.

Type: *S. rubella* Ashton.

*Alabastra fusiformis.* Stamina 15, filamentis loratis compressis, sub antheros abrupte attenuatis; antheris anguste oblongis oculis 4; aristis crasse filiformibus brevibus paullum recurvis. Ovarium glabrum stylopodio prominenti glabro; stylo quam ovarium plus quam 2-plo longiori filiformi. Stipulae bractee bracteolique fugaces. Lamina intercostis scalariformibus; costa media supra lata applanata.

The bark surface appears similar to fissure barked species of section *Mutica*, but has not been examined morphologically.

*Distribution.* 1 species: Borneo.

The anthers are similar to *S. ochracea* in section *Anthoshorea*, though the appendages are atypically short; they are also short however in *S. albida* in that section. The lorate filaments are unique; the lamina with widely spaced nerves and cuneate base is similar to *S. kunstleri* in section *Brachyptera*, and quite unlike *Anthoshorea*, in which the lamina shape and nervation has a characteristic appearance with many close nerves; the bark and the pink wood recall section *Mutica*, as also the raceme with fugaceous bracts, though the flowers are remote as in section *Brachyptera*; it is on this basis that I have decided to create a separate section for *S. rubella*.

**Section V. ANTHOSHOREA** Heim, Rech. Dipt. (1892) 41.

Type: *S. harmandii* Lanessan.

—Gen. **Parahopea** Heim.

—Sect. **Hopeoides** Heim, id (1892) 43. Types. *S. hypochra* Hance, *S. henryana* Lanessan, *S. cambodiana* Pierre, *S. maritima* Lanessan.

Flowers usually large. Stamens 15–30, in 3 verticils or irregular; filaments broad at base, gradually tapering; anthers with 4 pollen sacs, narrowly oblong to linear; appendage to connective unreflexed, prominent, usually at least half as long as anther, stout or slender, scabrous or glabrous. Ovary pubescent or glabrous; no distinct stylopodium; style longer than ovary, more or less trifid apically. Stipules caducous; bracts and bracteoles frequently large, subpersistent. Midrib depressed, obscured by lamina above. Bark surface with irregular section fissures, frequently short and anastomosing; inner edge of outer bark ill defined, outer surface rotting off, rarely flaking regularly; periderms undulate or incomplete or absent; inner bark simply laminate.

*Distribution.* 25 species. Eastern Deccan, India (1) to North East India (2), Burma (6), Thailand (5), Indochina (4), Malaya (10), Sumatra (6), Borneo (9), Philippines (3), Java (1), Celebes (1), Moluccas (2).

I follow Brandis (1895) in uniting Hopeoides with Anthoshorea. The number of species now known confirm that Heim's sections are connected by intermediate forms and are not distinguishable.

**Section VI. OVALIS** Sym. ex Ashton, sect. nov.

Type: *S. ovalis* (Korth) Bl.

Alabastra late ovoidea obtusa. Stamina 55–67; filamentis longissimis filiformibus, in alabastra plicatis; antheris subglobosis loculis 4; aristis vestigialibus. Ovarium stylopodiumque anguste conicum conferte tomentosum; stylo brevi. Stipulae bractee bracteolique subpersistentes. Lamina intercostis scalariformibus; costa media supra depressa obscura.

The fissured bark surface and red inner bark appear similar to that of section Mutica, but have not been examined in detail.

*Distribution.* 1 species: Malaya, Sumatra, Borneo.

This is the 'ovalis group' of Symington (1943, 58).

**Section VII. MUTICA** Brandis, J. Linn. Soc. Bot. 31 (1895) 100.

Lectotype species: *S. leprosula* Miq.

Buds more or less ovoid. Stamens 15, in 3 verticils; filaments broad at base, tapering gradually to anthers; anthers with 4 pollen sacs, broadly oblong to subglobose; appendage to connective, at least on outer anthers, shorter than anther, becoming reflexed.



Ovary with distinct stylopodium, both more or less densely tomentose; style shorter than ovary, or very slightly longer. Branchlets of raceme short, flowers dense. Stipules, bracts and bracteoles usually caducous, rarely subpersistent. Midrib depressed or raised above, evident.

Bark surface usually V-section fissured, only flaking in very old trees.

Whitmore (1962) separates *S. quadrinervis* V. Sl. and *S. acuminata* Dyer into another subgroup as they only become fissured after attaining a great size and have a unique bark surface pattern; they differ also from others in their persistent stipules and stipular bracts and large spreading inflorescence; I do not feel that these differences alone merit placing them in a separate subsection.

He further places *S. macroptera* in the 'Kawang' group (i.e. *Pachycarpa*). The bark becomes scaly very early, with a short intermediate fissured stage. This would be true also of the closely related *S. acuta* Ashton, but on other characters they are quite typical of this section. He places *S. macrantha* and *S. singkawang* Miq in the 'Pauciflora Group' (*Brachyptera*), but on characters other than bark they clearly belong here.

*Distribution.* 23 species: Penisular Thailand (4), Malaya (15), Sumatra and Bangka (7); Borneo (18).

Brandis included here also *S. ovalis* Korth., *P. malaanonan* (Blanco) Merr (as *S. malaanonan* (Blanco) Bl.), *S. palembanica* Miq (Type of Section *Brachyptera*), and *S. glauca* King and *S. inappendiculata* Burck of section *Shorea*. Four of the species quoted by him belong to the section as I here interpret it, and his section description approximates more to this section than to any other. I have therefore chosen *S. leprosula* as lectotype and redefined the section.

### Section VIII. PACHYCARPA Heim, Rech. Dipt. (1892) 44.

Lectotype: *S. macrophylla* (De Vriese) Ashton.

—Sect. **Pinanga** Brandis, J. Linn. Soc. Bot. 31 (1895) 90.

Lectotype species: *S. pinanga* Scheff.

Buds ovoid to fuseiform; stamens 15, in 3 subequal verticils; filaments lorate, adnate along the margin, forming a tube round the ovary, tapering more or less abruptly below the anthers; anthers subglobose or broadly oblong; appendage to connective filiform, slender, glabrous, erect, 2 to many times length of anther; ovary small, glabrescent or glabrous; style filiform, stylopodium indistinct, or both spindle shaped, tapering distally and basally; 3 outer fruiting calyx lobes broad at base; stipules, bracts, and bracteoles persistent, large; lamina nervation scalariform; midrib above more or less depressed, evident.

Bark surface remaining smooth and hoop-marked longer than in other sections, later becoming more or less flaked, sometimes scroll marked.

*Distribution.* 6 species: Borneo.

*Pachycarpa* Heim is the earliest name referable to this section. Heim quoted *S. gysbertsiana* Burck and *S. gysbertsiana* var. *scabra* Burck as syntypes; I choose *S. macrophylla*, to which I reduce *S. gysbertsiana* (see there), as lectotype, as the syntypes of var. *scabra* represent two species.

Brandis (1895) included species from this section in sections *Anthoshorea* Heim and *Pinanga*. In the latter he included species which fall into sections *Mutica*, *Brachyptera*, and *Richetioides* as at present defined, as well as *Pachycarpa*; his section description is too brief and broad to select a lectotype on its basis. I therefore choose *S. pinanga* Scheff. as the section bears its name and thus reduce it here.

### Section IX. BRACHYPTERA Heim, Rech. Dipt. (1892) 46.

Type: *S. palembanica* Miq.

Buds more or less ovoid. Filament broad and compressed at base, tapering somewhat abruptly medially and filiform below the anthers; anthers 4-celled, subglobose or broadly oblong; appendage to connective slender, filiform,  $1\frac{1}{2}$ – $3\frac{1}{2}$  times length of anthers. Ovary with distinct stylopodium, ovary and stylopodium more or less pyriform; or without distinct stylopodium but with style frequently pubescent towards base. Raceme spreading, branchlets long, flowers remote; stipules and bracteoles frequently somewhat persistent; lamina nervation scalariform; midrib raised, applanate or depressed above, not obscured by lamina.

Heim based the section on *S. brachyptera* Heim, later reduced by Symington (1933, 141) to *S. palembanica*. This is the earliest name for the section; the species were dispersed in many sections by Brandis (1895).

#### Subsection 1. *Smithiana* Ashton, subsect. nov.

Type: *S. smithiana* Sym.

Stylum brevissimum. Stamina 22—26.

Bark surface with deep V-section fissures, unflaked, as section *Mutica*; but with sheet like rhytidome layers as in subsect. *Brachyptera* and other flaky-barked groups.

*Distribution.* 1 species: Borneo.

Though a reduction of the number of stamens to 10 in sections where the rule is 15 is not rare, an increase is unique, and has prompted me to consider this species as in a separate subsection from the others of section *Brachyptera*. The bark morphology according to Whitmore is also unique.

## Subsection 2. Brachyptera.

—Sect. **Pachychlamys** Dyer ex King, J. As. Soc. Beng. Sc. 62, 2 (1893) 109 (Type: *S. palembanica* Miq).

—Gen **Pachychlamys** (Dyer ex King) Ridl.

Style as long as, or longer than, the ovary; stamens 15.

Bark surface square section fissured, appearing flaky rather than fissured; phloem matrix proliferation tissue with pale stone cells in conspicuous simple laminae; phelloderm thin, inconspicuous.

*Distribution.* 21 species: Malaya (5), Sumatra (4), Borneo (19), Philippines (3).

In several species the flakes are subpersistent and the appearance of the bark seems to me to be fissured rather than flaky. Further morphological examination of these species is needed before the homogeneity of the bark structure within the subsection is confirmed.

The Type of section *Pachychlamys* was cited by King as *S. thistle-toni* King, a synonym of *S. palembanica* reduced by Symington (1933, 141).

## **SHOREA CRASSA** Ashton sp. nov (Sect Shorea).

*S. inappendiculatae* Burck affinis, sed stamina 38–46, costis lateralibus utrinsecus 7–11 minus confertis, petiolo longiore, ex integro sparsius tomentosus.

Ramuli, stipulae externe, gemmae petiolique conferte breviter tomentosi; costae subtus sparsium tomentosi. Ramuli apicem versus  $-5 \times 2.5$  mm., primo compressi dein teretes glabrescentes, pallide fusci, minute lenticellati, saepe fissuli; internodis 1–2.5 cm. longis; cicatricibus stipularum c. 2 mm. longis, cuneatis pallidis apicem versus directis. Gemma  $-6 \times 6$  mm., ovoidea compressa subacuta. Stipula  $-8 \times 4$  mm., ovata concava subacuta caduca. Lamina 10–18  $\times$  5–10 cm., elliptica vel ovata; basi cuneata vel anguste obtusa; apice in acumen  $-1$  cm. longum abrupte attenuata; costis lateralibus utrinsecus 7–11 prominentibus remotis angulo  $40^\circ$ – $50^\circ$  exorientibus; intercostis angustis sinuatis conferte scalariformibus; lamina subtus pallide cremeo vel aureo-lepidota. Petiolus 2–5 cm. longus, 2–2.5 mm. diam., crassus, breviter cremeo-tomentosus. Lamina delapsa supra pallide ochraceo-fusca, subtus cremeo-lepidota, ad costam mediam plus minus revoluta. Racemi  $-13$  cm. longi, semel ramosi, stipitis basi in fructu  $-2$  mm. diam., terminales vel axillares, teretes vel paullum compressi, crassi, semper breviter cremeo- vel pallide fusco-tomentosi; ramulis  $-4.5$  cm. longis, floribus distichis  $-12$  gerentibus; bracteolis  $-3$  mm. longis suborbicularibus breviter pubescentibus caducis. Alabastrum  $-15 \times 3.5$  mm. anguste lanceolatum. Calyx externe tomentosus, intus glabrescens; lobis late ovatis subacutis; lobis exterioribus quam interioribus paullum longioribus obtusioribus. Corolla cremea basi

rosea; petalis linearibus, externe breviter tomentosis, intus glabrescentibus. Stamina 38–46; filamentis basibus latis attenuatis hispidis; antheris anguste oblongis, loculis apicem versus attenuatis, subaequalibus vel externis 2 paullum longioribus; aristis prominentibus sed quam loculis brevioribus, setosis. Ovarium ovoideum, basi glabra, aliter tomentosum; stylopodium quam ovarium longius, cylindricum tomentosum, stylo brevissimo glabro. Pedicellus in fructu 3–5 × 2 mm. Calyx apicem versus puberulus, basim versus confertius pubescens; lobis longioribus 3, –9 × 2.3 cm. late spatulatis coriaceis obtusis, basim versus c. 8 mm. latis attenuatis, partibus basalibus c. 15 × 13 mm. ellipticis tenue saccatis incrassatis; lobis brevioribus 2, –7 × 0.7 cm., lineare oblongis obtusis, basi ut in lobis longioribus. Nux –2.5 × 2 cm., ellipsoidea plane conferte breviter cremeo tomentosa, ad stylopodium –7.5 mm. longum attenuata.

**Collections:** Sarawak: S 9468, S. Iran, Pelagus; S 11701 (Holotypus in Herb. Kew), 11081, 10035, Semengoh F.R., Kuching; S 20, Lundu; Kep 35527, Pangkalan Ran; Kep 48159, S. Lumut; Kep 48190, Brun 641, 642, Bt. Puan; Kep 48227, S. Badas; Kep 48270, S 5644, 5645, 1911, 1863, Brun 3080, 832, 570, Andulau F.R.; Brun 5156, Berakas F.R.

**S. scrobiculata** Burck, Med. Lands Pl. Tuin, 3 (1886) 22.  
Syntypes: Beccari 2538, fl., Matang, Sarawak (BO, K, FIR, PC, BM); Beccari 2917, y. fr., Sarawak (BO, K, PC, BM.).

—*S. pierreana* Heim, Rech. Dipt. (1892) 43.

Holotype: Beccari 2538 (K).

Heim cited *S. pierreana* as 'Type' of his eighth section of *Shorea*. He described the section but did not name it, and cited *S. pierreana* as Type species though he had not previously published it. As the section was monotypic, and Beccari 2538 the only number cited in the section, I conclude that the section description is a valid description of *S. pierreana*, which is thus a valid name; it is founded on the Kew isosyntyple of *S. scrobiculata* Burck however.

**S. seminis** (De Vriese) V. Sl., in Merrill, Pl. Elm. Born (1929) 204.

—*Hopea seminis* De Vriese, Minyak Tengawang (1861) 32.

Holotype: De Vriese s.n., st., Seminis, Sambas, W. Borneo (L).

—*H. lanceolata* De Vriese, loc. cit.

Holotype: De Vriese s.n., st., Seminis (L).

—*Shorea schefferiana* Hance, J. Bot. 16 (1878) 303.

Holotype: 6526 HB, fl., Sambas, W. Borneo (BM).

—*Isoptera borneensis* Scheff. ex Burck. Med. Lands Pl. Tuin. 3 (1886) 27.

Lectotype: Kater 11157 H.B., fr., W. Borneo (L).

—*Ridleyinda borneensis* (Scheff. ex Burck.) O.K., Rev. Gen. Pl. 1 (1891) 65.

—*H. ovalifolia* sensu Foxw., Philip. J. Sc. Bot. 6 (1911) 263.

Van Slooten (1941, 117) has made a thorough study of this species. I have not found it necessary to differ from his conclusions, but have further reduced here *Shorea schefferiana* Hance, founded on a typical flowering specimen. Burck distributed numerous specimens, both flowering and fruiting, from the cultivated trees at Bogor, under his name *Isoptera borneensis*; I have seen these at BO, L, K, and the Herbarium of the British Pharmaceutical Society. Kater, administrator at Pontianak at the time of Teysmann's visit, sent herbarium specimens and young plants to Bogor, his collections being the earliest to my knowledge collected; I choose Kater 11157 as lectotype of *I. bornensis* Scheff. ex Burck, for brevity of citation, as it is a good fruiting specimen and the original specimen named by Scheffer. *Ridleyinda* has been discussed in the generic introduction.

Van Slooten fails to realise, however, the very close similarity of this species with *S. sumatrana* (V. Sl. apud Endert ex Thorenaar) Sym. of Sumatra and Malaya, stating '*Sh. seminis* is distinguishable from *Sh. sumatrana* by the size and shape of its leaves, the number of its lateral nerves, the number of its stamens and the wider outer lobes of its fruiting calyx'. I found this species to have two distinct habits, as a low overhanging tree with many branches, or as a tall straight-boled tree. This appears to depend on its habitat, either on stable soils on high river levées, or on frequently flooded shifting banks on river bends. The low form retains a juvenile foliage type that apparently was the only form that Van Slooten saw; but in the erect form there is no difference in leaf characters with *S. sumatrana*. The fruit is also found to be identical, but in the many flowers examined by me I could confirm that the number of stamens in *S. sumatrana* is c. 25, whereas in *S. seminis* it is always 30–40; this remains as the only reliable diagnostic character between the two species.

**S. laevis** Ridl., Fl. Mal. Pen. 1 (1922) 232.

Lectotype: Kep 1905, fl. Serting F.R., K. Pilah, Negri Sembilan, Malaya (KEP, K); Burn Murdoch s.n., y. fr., loc. cit. (K).

—*S. ciliata* sensu Foxw., Mal. Foc. Rec. 1 (1921) 69; id. 3 (1927) 67; id. 8 (1930) 19; Edwards, Mal. For. Rec. 9 (1931) 142.

—*H. laevifolia* Parijs, Fedde, Rep. 33 (1933) 244.

Holotype: b.b. 13894, st. S. Tjoentjoeng, W. Kalimantan (L).

—*S. laevifolia* (Parijs) Endert, Tectona 28 (1935) 292.

Foxworthy and Edwards mistook this species for *S. ciliata* King, which is in subsection Shorea; Foxworthy (1932, 179) corrected his mistake, and chose Kep 1905 as lectotype; Ridley's syntypes were Kep 5502, st., 5506, st., Bentong, Pahang, and Kep 1904, y. fr., and 1905, Serting F.R.; he further added Moorhouse 404, st., a specimen he had originally cited as *S. ciliata* King, but Symington (1933, 146) correctly transferred this specimen to *S. maxwelliana* King (see there). Parijs' sterile Holotype was transferred by Ender't correctly to *Shorea*. It consists of a leafy twig from a young tree, the undersurface not being lepidote. From field observations I have made I have no hesitation in reducing it to *S. laevis*, abundant material of which we now have from Brunei in all stages.

**S. ovalis** (Korth) Bl., Mus. Bot. 1, 2 (1852) 33.

—*Dilleneacea* ? *nervosa* Wall., Cat (1828–49) 6635, nomen nudum.

—*Vatica ovalis* Korth., Kruidk. 3 (1841) 73.

Type: Korthals s.n., Prarawing, S. Borneo (L, K).

—*V. ? eximia* Miq., Sum (1861) 486.

Type: Teysmann 3596 H.B., st., prope Muara Doea, Palembang (L, K, PC.).

—*V. ? sub-lacunosa* Miq., loc. cit.

Holotype: Teysmann 3233 H.B., st., prope Plangas, Bangka (L).

—*Hopea aspera* De Vriese, Minyak Tei Kawang (1861) 31.

Holotype: De Vriese, s.n., st., Sambas, Borneo (L).

—*Shorea sub-lacunosa* (Miq) Scheff., Nat. Tijd. N.I. 31 (1870) 350.

—*var. angustifolia* Scheff., loc. cit.

Syntypes: Teysmann s.n., st., G. Monoeming, Bangka (BO); Teysmann s.n., st., prope Djeboes, Bangka (BO, L).

—*S. eximia* (Miq) Scheff., Nat. Tijd. N.I. 31 (1870) 349.

—*var. angustifolia* (Scheff) Burck, Ann. Jard. Bot. Btzg. 6 (1887) 218.

—*S. sericea* Dyer, in Hook. f., Fl. Brit. Ind. 1 (1874) 306.

Holotype: Maingay 202, fl., Malacca (K).

—*S. fusca* Burck, Ann. Jard. Bot. Btzg. 6 (1887) 207.

Syntypes: s.n., st., Bangka (L); Maingay 202 (L, K).

—*S. rigida* Brandis, in Hook. f., Ic. Pl. (1895) t. 2402.

Type: Ridley 6393, y. fr., Singapore (K, BM).

—*S. furfuracea* sensu Brandis, J. Linn. Soc. Bot. 31 (1895) 98, pro parte; Ridl., Fl. Mal. Pen. I (1922) 232, pro parte, quoad spec. Malay.; V. Sl. ex Heyne, Nutt. Pl. N. I. 1. (1917) 229; non *S. furfuracea* Miq.

I have checked the conclusions of Symington (1933, 143; 1939 370) with the authentic material of all the above synonyms, and differ only in the following respects; He quoted 's.n., ? Sumatra' (Bangka), a sterile specimen at Leiden, as Holotype of *S. fusca* Burck; it is in fact a syntype with the Leiden sheet of Maingay 202, both of which are quoted by Burck. I have further added to the synonymy *Hopea aspera* De Vriese. The Holotype, a seedling collection, bears the characteristic subpersistent subamplexicaul subcordate stipules of this species.

The very numerous collections of this species confirm, as Symington (1939, loc. cit.) suggested, that there are three distinct geographical subspecies. Owing to the very large number of collections examined by me I only quote the Holotypes and indicate the distribution of these forms.

*Ssp. ovalis*. Ramuli lamina subtusque plus minus breviter scabride roseo-fusco-tomentosi. Lamina 10–18 × 3–7 cm., oblonga vel ovata, basi obtusa, applanata vel superficie inferiore concava; costis lateralibus 55°–70° exorientibus.

89 numbers examined; Malaya (E. Pahang, E. Trengganu, Penang); Sumatra (Djambi, Indragiri); Bangka; Billiton; Borneo (E. North Borneo, throughout Kalimantan).

*Ssp. sericea* (Dyer) Ashton, stat. nov.

—*S. sericea* Dyer, *S. fusca* Burck, *S. rigida* Brandis.

Ramuli et lamina subtus plus minus breviter plane roseo-fusco-tomentosi. Lamina 14–22 × 4–10 cm., late oblonga vel obovata, basi cuneata, superficie superiore concava; costis lateralibus angulo 50°–55° exorientibus.

Holotypus: Maingay 202, fl., Malacca (K). 51 other numbers examined; Malaya (east coast, Penang, excl.); Sumatra (Palembang; Sidjundjung, W. Sumatra), Billiton, Bangka.

*Ssp. sarawakensis* Ashton ssp. nov. Ramuli longissime rufo-cristato-tomentosi; cristis–3 mm. longis; lamina costis subtus sparsim scabrido-tomentosis, aliter glabra nitens. Lamina 12–17 × 2–4.5 cm., anguste oblonga, margine revoluta, basi obtusa; lamina deflexa; costis lateralibus 55°–65° exorientibus.

Holotypus: Brun 3281, fl., Andulau F.R., Brunei (K); 24 other numbers examined; Borneo (Sarawak, Brunei, S. W. North Borneo).

*Ssp. sarawakensis* is the only one known from Sarawak and Brunei; no intermediate forms have been collected between this and the other subspecies, and the range does not overlap with them. The other two subspecies are only identifiable when mature, —young trees and saplings are identical; it is therefore not possible from herbarium material to confirm whether intermediate forms exist. The Holotype of *S. ovalis* is from a young sapling; as however there is only one subspecies recorded from S. Borneo, where

it originated, I feel that it is justifiable to attach the specific epithet to the S. Borneon subspecies. Similarly it is not possible definitely to determine which subspecies are represented by the types of *V ? eximia*, *V ? sublacunosa* and *H. aspera*, all of which represent young stages.

**S. macroptera** Dyer, in Hook. f., Fl. Brit. Ind. 1 (1874) 308.

Holotype: Maingay 1198 (Kew Distrib. no. 208), y. fr., Malacca (K).

—*S. bailloni* Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 973.

Holotype: Beccari 2891, fr., Sarawak (K).

—*S. sandakanensis* Sym., Gard. Bull. S.S. 9 (1938) 343.

Holotype: Kep 38730 (San 4354), fl., Kabili F.R., Sandakan (KEP).

Symington (loc. cit) regarded *S. bailloni* and *S. sandakanensis* as specifically distinct from *S. macroptera*, though Brandis (1895, 90) had previously already reduced *S. bailloni*. These forms, with *S. acuta* Ashton, and probably *S. ferruginea* Dyer ex Brandis, constitute a group of closely related taxa sharing in common the auriculate fruit calyx lobes and coriaceous sparsely tomentose to glabrescent lamina with c. 13 pairs of nerves, drying rust-brown. According to Symington *S. sandakanensis* differs from *S. macroptera* in having a longer, thinner lamina, longer, more lax raceme, larger flower, longer fruit calyx, and a tomentose, globose, not ovoid, nut. Of these, only the shape and size of lamina, raceme, and calyx lobes remain good diagnostic characters in the light of more recent collections, and these differences I do not regard as great enough to merit separate specific status. I have on the other hand treated my recently described *S. acuta* as specifically distinct, as the difference in size of all parts is very great, and, unlike *S. sandakanensis*, no intermediate forms have been recorded; I also regard *S. ferruginea* as specifically distinct at present as the flowers have never been collected, and affinities are therefore not definitely known. *S. bailloni*, like *S. sandakanensis*, represents a geographically well defined population which differs only slightly from the Malayan *S. macroptera*, and I prefer to regard it as a geographical subspecies. *S. macroptera*, as it occurs in Brunei, represents yet a further form, which Wyatt-Smith has called *S. macropteraefolia* on Herbarium specimens. Intermediate forms have been collected between this and ssp. *bailloni* in C. and N. E. Sarawak, and between it and ssp. *sandakanensis* in W. North Borneo. After the following descriptions I have not been able to cite all collections examined owing to the necessity for brevity, and therefore cite only the Type numbers and geographical distribution, and indicate the number of collections examined.



*Ssp. macroptera*. Ramuli petioli racemique conferte plane breviter alutaceo-tomentosi; lamina 10–15 × 3–5 cm., elliptica vel oblonga, basi late cuneata, in apicem gradatim attenuata; costis lateralibus utrinsecus 12–15 (18), subtus prominentibus nec acutis. Petiolus c. 1.5 cm. longus. Racemi –10 cm. longi, semel ramosi vel basim versus bis ramosi. Lobi longiores calycis in fructu –12 cm. longi. 195 numbers examined; Malaya, Sumatra, Riouw, Karimata.

*Ssp. bailloni* (Heim) Ashton, stat. nov.

Ramuli petioli racemique sparsim cristato-tomentosi vel glabrescentes, sicco nigrescentes. Lamina 12–19 × 3.5–7 cm., anguste elliptica, basi anguste cuneata, in apicem gradatim attenuata; costis lateralibus utrinsecus 11–14 (15), subtus prominentibus nec acutis. Petiolus c. 1.5 cm. longus. Racemi c. 13 cm. longi; semel ramosi vel basim versus bis ramosi; ramulis –2.5 cm. longis. Lobi longiores calycis in fructu –13 cm. longi.

Holotypus; Beccari 1891 (K); 33 other numbers examined; Sarawak: Baram to W. Sarawak.

*Ssp. sandakanensis* (Sym.) Ashton, stat. nov.

—*S. sandakanensis* Sym. (1938) 343 (species).

Tomentum ut in *ssp. macroptera*. Lamina (9) 18–23 × (4) 6.5–9.5 cm., oblonga, tenuis, basi obtusa, in apicem abrupte attenuata; costis lateralibus utrinsecus 13–15, subtus prominentibus angustis acutis. Petiolus –2 cm. longus. Racemi –16 cm. longi, bis ramosi, ramulis –8 cm. longis. Lobi longiores calycis in fructu –14 cm. longi.

Holotypus: Kep 38730 (KEP); 33 other numbers examined; E. North Borneo, S.E. Kalimantan.

*Ssp. macropterifolia* Ashton, *ssp. nov.*

Tomentum ut in *ssp. macroptera*. Lamina 8–16 × 4–6 cm., ovata, coriacea, basi obtusa, in apicem gradatim attenuata; costis lateralibus 10–14, subtus prominentibus angustis acutis. Petiolus –1.5 cm. longus. Racemi –16 cm. longi, bis ramosi, ramulis –8 cm. longis. Lobi longiores calycis in fructu –14 cm. longi.

Holotypus: San 16255, fr., Sipitang, North Borneo (K); 27 other numbers examined; S. W. North Borneo; Lawas, Sarawak; Brunei.

**S. parvifolia** Dyer, in Hook. f., Fl. Brit. Ind. 1 (1874) 305.

Syntypes: Maingay 1577, fl., 1197, fl., 2549, fl., Malacca (all sub Kew Distrib. no. 206), (K).

—*S. scutulata* King, J. As. Soc. Beng. Sc. 62, 2 (1893) 110.

Type: Curtis 1396, sapling, Penang (K, CAL).

Symington (1933, 137) has critically discussed this species and reduced *S. scutulata* correctly to it. He further (1943, 85) indicated that 3 geographical variants are distinguishable in Malaya.

Two of these, the 'Selangor' and 'Pahang' forms are well distinguished and occur throughout the range of the species. The third, 'Perak', form has the tomentum characters of the Selangor form, and the leaf shape of the Pahang form; a similar form is also found in the Tawau area of N. E. Borneo which is also an area of overlap between the Pahang and Selangor forms. The Perak form appears to be ill-defined from the other two forms, and may represent either the result of hybridisation or incomplete differentiation. I am giving the 'Pahang' and 'Selangor' forms of Symington the rank of subspecies, but, on the evidence at present available, prefer to treat the 'Perak' form as merely intermediate individuals between the former two.

*Ssp. parvifolia*. Lamina 5–9 × 2.5–5 cm., late ovata, basi obtusa vel cordata; costis lateralibus subtus glabrescentibus, vix elevatis; margine non revoluto. 133 numbers examined; Malaya (Widespread; E. Pahang excl); Sumatra (Riouw, Tapanuli, Djambi, Rawas, Banjuasan, Palembang); Borneo (E., C., and S.E.).

*Ssp. velutinata* Ashton, ssp. nov.

Lamina 6–11 × 3.5–6 cm., ovata vel elliptica, basi obtusa vel cuneata; costis lateralibus subtus crassis prominentibus; margine saepe paullum revoluto.

Holotypus: Kep. 4502, fl., Belingo F.R., Temerloh, Pahang (KEP); 24 other numbers examined. Malaya (E. Pahang, Perak, E. Negri Sembilan); Sumatra; Borneo (Widespread).

This is the only subspecies found in Brunei and Sarawak. 5 Brunei collections differ from *ssp. velutinata* in that a pair of large glabrous domatia seem to remain persistently at the base of the lamina (domatia are usually found only in the young stages in this species). This form occurs on soils with a marked sand content; when more material is available it may be necessary to give it separate taxonomic status, but as the single character of the persistence of the domatia is the only difference I have been able to discern I am unwilling to do so at present.

As the Type of *S. scutulata* King is a sapling it is not possible to refer it to a subspecies; other collections from Penang bear characters intermediate between the two subspecies.

**S. macrophylla** (De Vriese) Ashton, comb. nov.

—*H. macrophylla* De Vriese, Minyak Tengkawang (1861) 28. Lectotype: De Vriese s.n., st., 'Borneo' (L, sub. no. 2207, 23).

—*S. gysbertsiana* Burck, Med. Lands Pl. Tuin. 3 (1886) 15.

Syntypes: S.n., fr., cult. in Hort. Bog (K, L); Teysmann 231, fr., W. Borneo (BO, L, U, K).

—*var. scabra* Burck, id (1886) 17, pro parte, quoad. syntypus s.n., fr., cult. in Hort. Bog (K, L).

—*S. bakeriana* Heim, Bull. Mens. Soc. Linn. Paris, 2 (1891) 974.

Holotype: Beccari 3849, fr., Serang R., Sarawak (K).

Closely allied to *S. stenoptera* Burck, of the Heath forests of W. Kalimantan and W. Sarawak, which is a smaller tree, with larger, thickly coriaceous lamina with more prominent nerves, shorter broader stipules, and glabrous young parts. *S. macrophylla*, though varying much in the persistence of the tomentum, is apparently always sparsely or densely tomentose on freshly opened parts; the tomentum is persistent in young trees. The differences between these two species are small, and the fruit are identical, but I hesitate to unite them as I have very little field experience of *S. stenoptera*, which, besides occurring only in a very different habitat from *S. macrophylla*, is said by those who know it to be always easily distinguishable in the field.

De Vriese described *Hopea macrophylla*, and also *H. splendida* (loc. cit) on his return from Indonesia to Leiden, and shortly before his death. I have seen seven collections of De Vriese under these names in his herbarium at Leiden, and two at Utrecht; none exist at Kew, and I have not seen any at Bogor, where there may be duplicates. Of the collections two only are determined in De Vriese's hand, both at Leiden. These are a sterile specimen named *H. macrophylla*, which without doubt represents *S. gysbertsiana* Burck, and a sterile specimen named *H. splendida* which equally unequivocally represents *S. martiniana* Scheff. This latter species is characterised by the relatively small thin lamina, pale twigs with broad amplexicaul stipule scars, and broadly ovate subcordate subpersistent stipules. For both his species De Vriese described flowers and fruit. There is only one fruit specimen at Leiden, with leaves of *S. martiniana* and fragmentary fallen fruit appearing to represent *S. pinanga* Scheff. The three flowering specimens at Leiden, only one of which bears leaves, appear to have originated from the same tree, an immature specimen of *S. stenoptera* Burck. At Utrecht are a sterile duplicate determined as *H. splendida*, and a flowering duplicate determined as *H. macrophylla*, in Boerlage's hand. De Vriese's descriptions are not sufficiently diagnostic to be able to decide which fertile specimens he was describing under each species. but the leaf descriptions are unequivocal. I therefore feel compelled to cite the two specimens determined at Leiden by De Vriese as lectotypes. Thus *S. gysbertsiana* Burck becomes *S. macrophylla* (De Vriese) comb. nov., and *S. martiniana* becomes *S. splendida* (De Vriese) comb. nov.

Burck (1877, 208), following the 'Kew Rule', reduced *H. macrophylla* to *S. martiniana*, and *H. splendida* in part to *S. stenoptera* and in part to *S. martiniana*.

Burck's *S. gysbertsiana* var. *scabra* is founded on two syntypes. One is a fruiting collection from a tree cultivated at Bogor from seed sent by Gysberts from W. Borneo; this differs from the species syntypes only in the tomentose, not puberulent parts, which may well be related to the age of the tree from which it was collected;

the other syntype, Beccari 3077, fr., Sarawak, represents *S. pinanga* Scheff. I therefore do not consider this variety as a distinct taxon. The Holotype of *S. bakeriana* Heim is a typical glabrous fruiting specimen of *S. macrophylla*, and I have no hesitation in reducing it.

**S. mecistopteryx** Ridl., Kew Bull. (1925) 280.

Holotype: Taha s.n., Fallen leaves and fr., Kinabatangan, North Borneo (K).

—*S. chrysophylla* Ridl., id (1926) 470.

Holotype: Cabiling 1, 6, very y. fr., Pintasan, North Borneo (K).

Ridley, when describing *S. chrysophylla* a year later than his *S. mecistopteryx*, stated that it was a very distinct plant, differing in the gold tomentose lamina undersurface from his former species. The colour of the tomentum alone is hardly a criterion for describing a separate species in section *Pachycarpa*. The Holotype of *S. mecistopteryx*, with ripe fruit, differs only in that the tomentum is sparser, and brownish; the Holotype of *S. chrysophylla* bears old flowers with fallen corollae and stamens. From field observations I have confirmed that the tomentum is sparser, slightly longer, and brownish in immature trees, an effect exaggerated in the old fallen and slightly decayed leaves of Taha s.n. Van Slooten (1929b, 202) questioned whether the two were distinct, but Symington (1938, 349) considered them so. The present abundant collections confirm the contrary.

**S. beccariana** Burck, Ann. Jard. Bot. Btzg. 6 (1887) 213.

Lectotype: Beccari 1127, fr., Sarawak (BO).

—*S. franchetiana* Heim Bull. Mens. Soc. Linn. Paris, 2 (1891) 956.

Holotype: Beccari 1126, fl., Sarawak (K).

—*S. beccarii* Dyer ex Brandis, J. Linn. Soc. Bot. 31 (1895) 87, nomen pro syn.

Closely allied to *S. pinanga* and *S. amplexicaulis* Ashton. Burck based this species on the Bogor duplicates of Beccari 1127 and 2912. The latter specimen consists of fragmentary leaves and fallen fruit, with no twig and broken petiole; though the Kew and Florence duplicates are unequivocal, Burck did not see them, and his duplicate is inadequate to distinguish from *S. amplexicaulis*. to eliminate all ambiguity I therefore choose Beccari 1127 as lectotype.

*S. franchetiana* Heim is described from a further Beccari collection at Kew, with flowers; Brandis (1895, 87) had already reduced it to *S. beccariana*, at the same time adding Beccari 2480 and 1128, both in fruit. Wyatt-Smith has indicated on Beccari

2480 and 2912 at Kew that he considers them to represent my *S. amplexicaulis*. In this I cannot agree; the leaf and petiole are quite typical of *S. beccariana*, though the stipule scars are rather long, but not amplexicaul. The subterete twigs also resemble *S. amplexicaulis*, but they are clearly old twigs, which would explain these features.

**S. pinanga** Scheff., Nat. Tijd. Ned. Ind. 31 (1870) 350.

Syntypes: s.n., fl. and fr., cult. in Hort. Bogor (BO, L, U).

—*S. gysbertsiana* Burck, var. *scabra* Burck, Med. Lands Pl. Tuin. 3 (1886) 17, pro parte, quoad syntypus Beccari 3077, fr., Sarawak (BO).

—*S. compressa* Burck, id (1886) 26.

Type: Burck, s.n., fl., cult. in Hort. Bogor (BO, L).

Among the most variable of all dipterocarps as regards density of tomentum, lamina size, and number of nerves. As these characters vary much according to the age of the trees as well as between individuals, I have not been able to discern any discontinuities in the variation upon which I could found infraspecific taxa; much more field knowledge of the population throughout its range is necessary before the nature of the variation can be understood. In Brunei there is a tendency for individuals on ridges to be glabrous, and with c. 18 pairs of nerves, whereas in the valleys the leaves are tomentose below, and with c. 15 pairs of nerves; Brun 124 however is tomentose but bears many nerves, and there is no clear break in the variation between the two forms. The Type of *S. compressa* is an extreme form with unusually large  $-25 \times 10$  cm. lamina,  $-20$  pairs of nerves, and densely tomentose twigs and lamina undersurface; the very stout compressed twigs, as well as the characters mentioned, suggest that it originated from a young tree, and I consider that it falls within the bounds of variation of *S. pinanga* as I am interpreting it. The authentic material of *S. pinanga* bears  $-18 \times 7$  cm. subglabrous laminae with 10–12 pairs of nerves. Beccari 3077, one of the syntypes of *S. gysbertsiana* var *scabra*, bears c. 14 pairs of nerves and a sparsely tomentose lamina undersurface. In all cases the falcate downcurved stipule scar, relatively short petiole, and slender hardly raised nerves, distinguish this species from the others in section Pachycarpa, and it is on this basis that I unite both *S. compressa* and Beccari 3077 with Scheffer's species.

**S. ferruginea** Dyer ex Brandis, J. Linn. Soc. Bot. 31 (1895) 91.

Holotype: Beccari 2604, fr., Matang, Sarawak (K).

—*S. discolor* Heim, Rech. Dipt. (1892) 67, nomen nudum.

The species appears to belong to the group of closely allied species including *S. macroptera* and *S. acuta*, with which it shares a similar leaf, tomentum, and fruit. The narrow lamina with very

slender hardly raised nerves and sparsely tomentose under-surface is sufficiently distinct to allow me always to distinguish it from *S. macroptera* in the field without difficulty. The two sometimes grow together and I saw no evidence of hybridisation. As flowers are unknown its systematic position must remain uncertain.

*S. discolor* is a nomen, accompanied by a description, written on the Kew sheet of Beccari 2604, in the hand of Heim. He never published this description, but in his 'Recherches' discussed the species, quoting Beccari's number, under his genus *Parahopea*. There he mentions the similarity, a very superficial one in my opinion, in leaf indumentum and shape to *Shorea balangeran* (Korth) Burck, referring to the powdery tomentose undersurface, and remarking on the auriculate fruit calyx. It is quite evident that he did not mean this to be a species description of *S. discolor* however, for he alludes to an already published description by him in the Bulletin Mensuel de la Société Linnéenne de France of Nov. 1, 1891. This description in fact does not exist in that or any other journal to my knowledge, and I consider Heim's name to be a Nomen Nudum therefore.

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