TAXONOMIC NOTES ON THE BORNEAN *HELICIA* AND *HELICIOPSIS* (PROTEACEAE)

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CHUNG, R. C. K. 2001. Taxonomic notes on the Bornean *Helicia* and *Heliciopsis* (Proteaceae). This paper is a precursor to the revision of the family Proteaceae for *Tree Flora of Sabah and Sarawak* in which 13 species of *Helicia* and seven species of *Heliciopsis* will be treated. A full description is given for the new combination, *Heliciopsis mahmudii*. Notes on *Helicia petiolaris*, *Helicia* sp. A, *Heliciopsis montana* and reinstatement of *Helicia obovata* as a species distinct from *Helicia attenuata* are provided. A table differentiating *Helicia* and *Heliciopsis* is given and an identification list is provided.

Keywords: Proteaceae - *Helicia* - *Heliciopsis* - Borneo - Sabah - Sarawak - generic delimitation - taxonomy

CHUNG, R. C. K. 2001. Catatan taksonomi tentang *Helicia* dan *Heliciopsis* (Proteaceae) di Borneo. Kertas ini merupakan pendahulu kepada kajian penyemakan famili Proteaceae untuk *Tree Flora of Sabah and Sarawak* yang akan melaporkan hasil kajian taksonomi 13 spesies *Helicia* dan tujuh spesies *Heliciopsis*. Satu penghuraian penuh kombinasi baru bagi *Heliciopsis mahmudii* diberikan. Catatan tentang *Helicia petiolaris*, *Helicia* sp. A, *Heliciopsis montana* dan pengembalian *Helicia obovata* kepada kedudukan asal sebagai satu spesies berbeza daripada *Helicia attenuata* disediakan. Satu jadual yang menyenaraikan perbezaan antara *Helicia* dan *Heliciopsis* diberikan. Selain itu satu senarai pengenalan spesimen turut disediakan.

Introduction

The family Proteaceae consists of 60 genera, of which nine are found in Malesia (the phytogeographic region comprising Malaysia, Singapore, Brunei, Indonesia, the Philippines and Papua New Guinea). Two genera of the family are found in Borneo, namely *Helicia* Lour. and *Heliciopsis* Sleumer (Sleumer 1955a, Cockburn 1980, Ashton 1988, Kessler & Sidiyasa 1994).

The genus *Helicia* was established in 1790 and typified by *H. cochinchinensis* Lour. from Indo-China (Hutchinson 1967). It comprises about 87 species and is distributed from south-western Ghats and Sri Lanka through Southeast Asia to south-eastern parts of China, Hainan, southern parts of Japan, Taiwan, throughout Malesia, to Melanesia and north-eastern parts of Australia (Sleumer 1955a, b, Dasuki 1998).

Sleumer (1955b) first described *Heliciopsis* and typified the genus with *H. velutina* (Prain) Sleumer, a species found in Peninsular Malaysia and Borneo (Hutchinson 1967). The genus comprises seven species and its distribution range from Myanmar and Indo-China through south-eastern China to Thailand and West Malesia (Sleumer 1955a, b, Boer & Sosef 1998).

For the Malesian region, Sleumer (1955a) recognised 61 species of *Helicia* and five species of *Heliciopsis*. Of these, only seven species of *Helicia* and three species of *Heliciopsis* were reported for Borneo, including three endemic species, *Helicia fuscotomentosa* Suesseng., *H. maxwelliana* Gibbs and *H. pterygota* Sleumer. Kochummen (1973) described three new species of *Heliciopsis*, *H. cockburnii*, *H. montana* and *H. whitmorei*, endemic to Peninsular Malaysia while Chai (1996) described one new species, *Helicia mahmudii*, endemic to Sarawak; and Chung (1998) described four new species for Borneo, namely, *Helicia sessilifolia*, *H. symplocoides*, *Heliciopsis percoriacea* and *H. litseifolia*.

In revising the family for the forthcoming volume of the *Tree Flora of Sabah and Sarawak*, all taxa reported for Borneo and the more recent specimen collections from the island have been reinvestigated. The results showed that there were currently 13 species of *Helicia* and seven species of *Heliciopsis* in Borneo. Of these, *Helicia sessilifolia*, *Helicopsis symplocoides*, *Heliciopsis percoriacea* and *H. litseifolia* are new to science. In addition *Heliciopsis montana* is a new record for Borneo. *Helicia obovata* Benn., a species from Java, should be recognised as a species distinct from *Helicia attenuata* (Jack) Blume. Of all the species of *Helicia* and *Heliciopsis* currently recognised in Borneo, *Helicia maxwelliana* Gibbs, *H. pterygota* Sleumer, *H. symplocoides* and *Helicia* sp. A are endemic to Sabah, and *Heliciopsis mahmudii* and *H. percoriacea* are restricted to Sarawak and *Helicia fuscotomentosa* Suesseng. on the other hand, is endemic to Borneo. *Helicia sessilifolia* is found only in Sabah and Sarawak. *Heliciopsis litseifolia* is common throughout Borneo (except Brunei), Peninsular Malaysia and Sumatra.

Materials and methods

This study was based mainly on the taxonomic analysis of herbarium collections deposited at the following herbaria: BM, BO, BRUN, K, KEP, KLU, L, SAN, SAR, SING (abbreviations follow Holmgren *et al.* 1990). All specimens cited had been studied, identified and annotated unless otherwise stated. The dimensions given in the descriptions are for dried material except for the androecium and gynoecium characters which are for flowers rehydrated with water or for spirit collection. The descriptions were made from herbarium specimens thus all colours are for material *in sicco*. Fifty leaves of each species were randomly sampled from herbarium specimens and their morphological characters were determined. In species with only one or a few herbarium specimens data from all the leaves were taken.

The general taxonomic methodology employed in this revision is the standard method advocated by Rollins (1952) and De Vogel (1987), in which well-defined species are studied as detailed as possible. The terminology and definition used mainly followed those by Lawrence (1951), Benson (1957) and Radford *et al.* (1974).

Results and discussion

Generic delimitation between Helicia *and* Heliciopsis

Investigation on the morphology of 13 species of *Helicia* and seven species of *Heliciopsis* from Borneo showed that the two genera were well defined. The differences between them are given in Table 1, Figures 1 and 2 and Plates 1 and 2. *Heliciopsis* can be easily distinguished from *Helicia* by its sexuality and flower type, leaf type, pollen sexine, stigma position, type and its stigamatic surface, ovule type as well as fruit pericarp.

Table 1 Differences between *Helicia* and *Heliciopsis* in Borneo

Genus/characters	*Helicia*	*Heliciopsis*
Plant		
• Sexuality	Monoecious	Dioecious
Leaf		
• Type	One form, simple	Two forms, simple and sometimes deeply lobed
Flower		
• Type	Bisexual	Unisexual
Pollen		
• Sexine	Psilate	Reticulate
Stigma		
• Position	Terminal	Lateral
• Type	Punctiform	Discoid (female flower); pistillode (male flower)
• Surface	Without cleft	With distinct cleft
Ovule		
• Type	Anatropous	Orthotropous
Fruit		
• Shape	Subglobose to ellipsoid	Cylindric-ellipsoid
• Pericarp	Not differentiated	Differentiated into three layers
• Mesocarp	Without a distinct fibrous tissue	With a distinct fibrous tissue

Enumeration of Bornean species

The species listed in Table 2 will be treated in the *Tree Flora of Sabah and Sarawak* account. Names printed in bold type are described and discussed in the present paper; numbers and letters refer to the species numbers and letters of the accepted species and varieties.

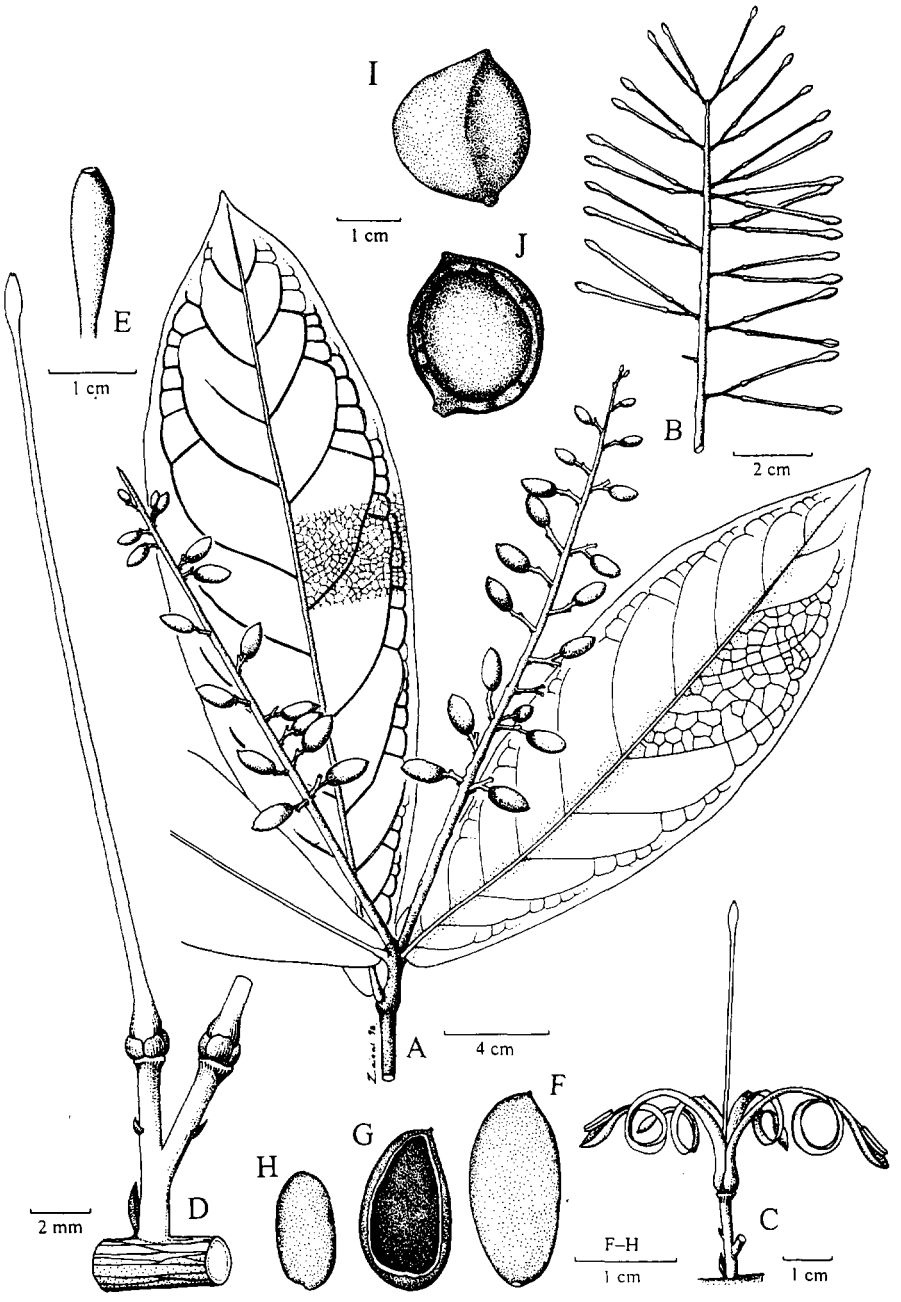

Figure 1 *Helicia obovata* (A–H); *H. maxwelliana* (I–J). A, fruiting leafy twig; B, inflorescence; C, open flower; D, open flower with perianths removed; E, stigma; F & I, fruit; G & J, longitudinal section of fruit; H, lateral view of seed (A, F–H from *SAN 132690*, B from *SAN 122694*, C–E from *S 52402*, I–J from *Nais et al. SP 5164*). Drawn by M. Zainal.

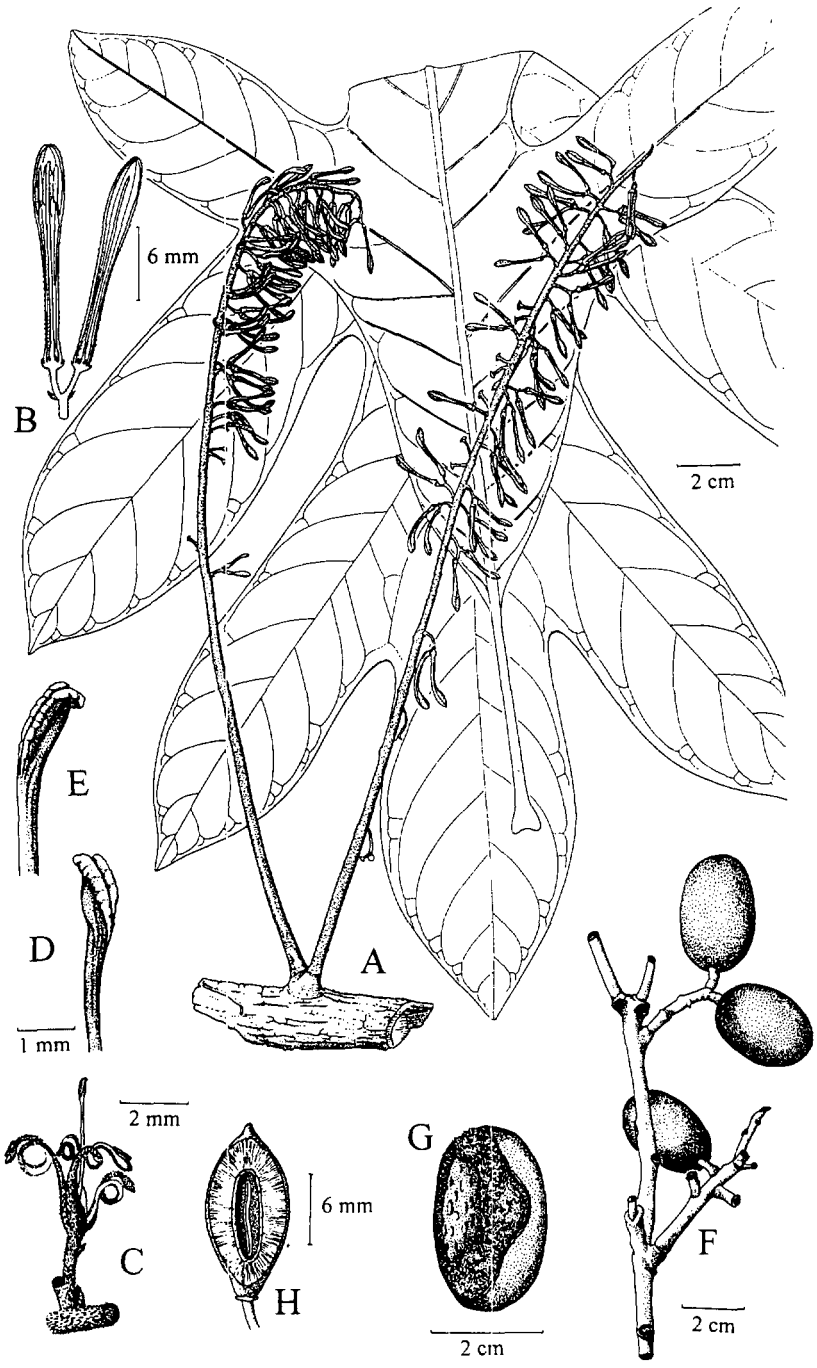

Figure 2 *Heliciopsis artocarpoides* (A–B, H); *H. litseifolia* (C & E); *H. mahmudii* (D); *H. velutina* (F–G). A, flowering leafy twig; B, longitudinal section of male flower buds; C, open female flower; D-E, stigma; F, infructescence; G, fruit with exocarp removed; H, longitudinal section of fruit (A–B from *S 40002*, C & E from *Jacobs 5401*, D from *S 33791*, F–G from *SAN 134087*, H from *KEP 80440*). Drawn by R. Wise and M. Zainal.

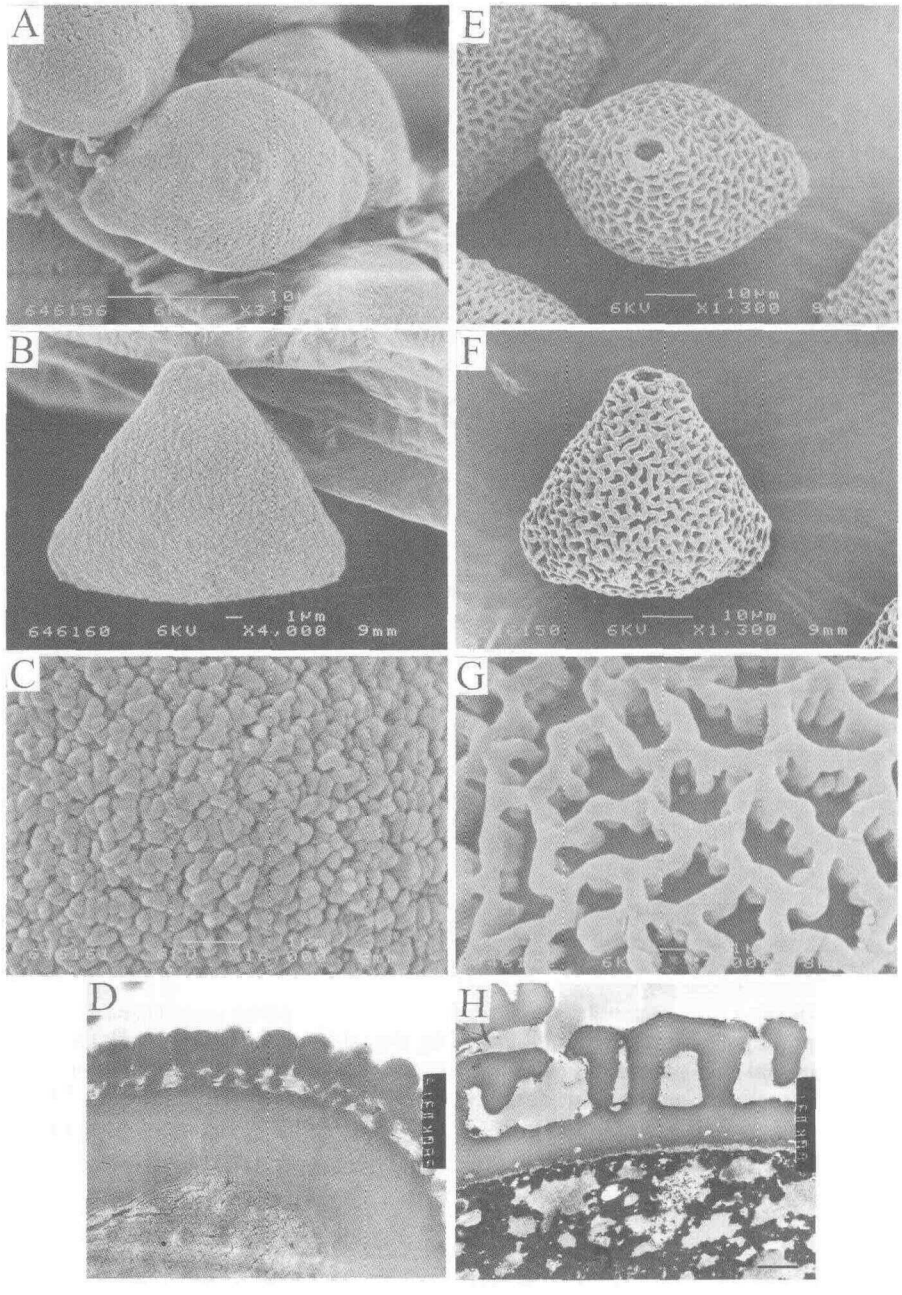

Plate 1 Scanning (A–C, E–G) and transmission (D, H) electron micrographs showing pollen of *Helicia* (A–D: sexine psilate) and *Heliciopsis* (E–H: sexine reticulate). — A: *H. pterygota* (*SAN 60133*), polar view. — B & C: *H. fuscotomentosa* (*SAN 31127*), equatorial view (B) and the exine detail (C). — D: *H. petiolaris* (*Jangarun JE 3*), showing the pollen wall structure. — E–H: *H. artocarpoides* (E–G: *SAN 113515*; H: *SAN 32548*), showing polar view (E), equatorial view (F), the exine detail (G) and the pollen wall structure (H). — Bar equals 0.36 μm in D; 1 μm in B–C, G–H; and 10 μm in A, E–F.

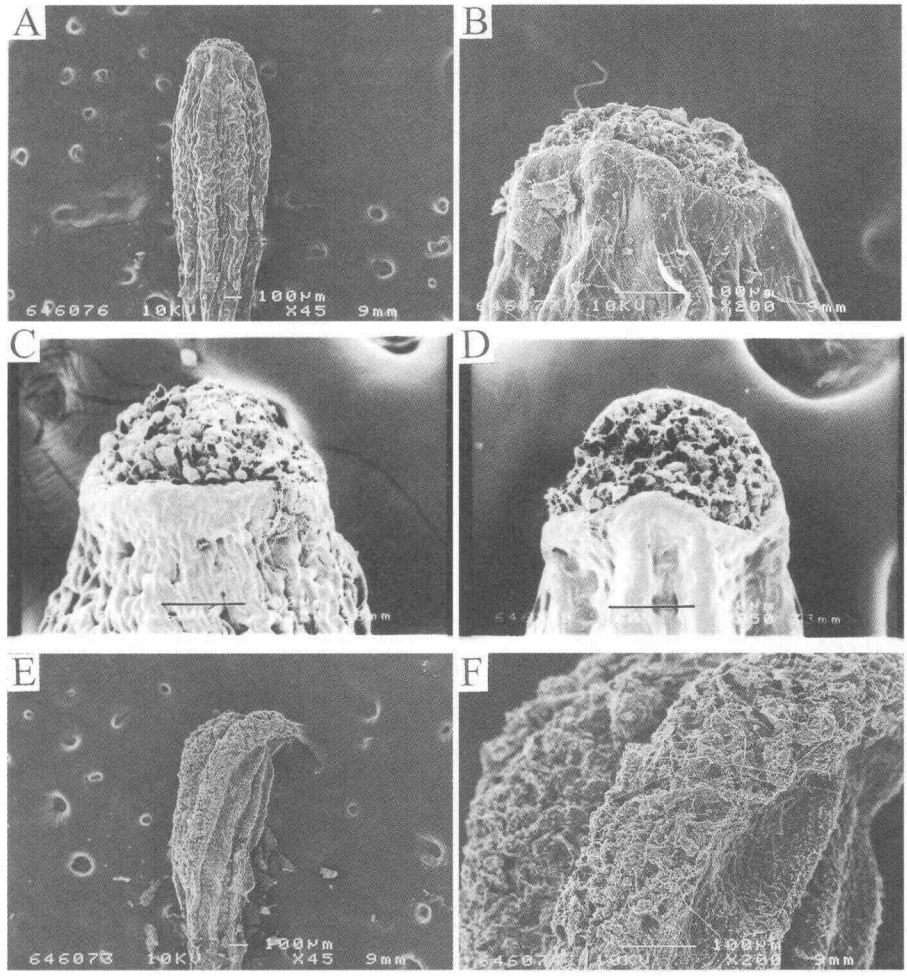

Plate 2 Scanning electron micrographs showing stigma shape of *Helicia* (A–D: punctiform, terminal and stigmatic surface without cleft) and *Heliciopsis* (E–F: discoid, lateral and stigmatic surface with distinct cleft). — A & B: *H. petiolaris* (*Simpson 2515*). — C: *H. obovata* (*S 52402*). — D: *H. rufescens* (*FRI 31484*). — E & F: *H. litseifolia* (*Jacob 5401*). — Bar equals 100 μm in A–F.

Description of new combination

S3. *Heliciopsis mahmudii* (P. Chai) R. C. K. Chung, ***comb. nov.***
Basionym: *Helicia mahmudii* P. Chai, Sandakania 7 (1996) 59. **Type:** *Chai S 33791*, Borneo, Sarawak, Lanjak-Entimau Wildlife Sanctuary (holo SAR!; iso K, KEP!, L, MO, SAN).

Small tree *c.* 5 m tall, 4 cm in diameter. *Bark* surface dark brown, thin, finely vertically cracked. *Twigs* terete, dark brown, youngest part reddish-brown hairy, late-glabrescent. *Leaves* simple, thinly to thickly coriaceous, dull olive-green above, light creamy brown below when dry, slightly bullate and shining above, glabrous;

Table 2 Distribution of the Bornean species of *Helicia* and *Heliciopsis*

No.	Species	Distribution	Rarity
H	*Helicia* Lour., Fl. Cochinch. 1 (1790) 83		
H1	*H. attenuata* (Jack) Blume	Sabah, Sarawak, Brunei, Kalimantan	Common, widespread
H2	*H. excelsa* (Roxb.) Blume	Sabah, Sarawak, Kalimantan	Common
H3	*H. fuscotomentosa* Suesseng.	Sabah, Sarawak, Brunei, Kalimantan	Endemic
H4	*H. maxwelliana* Gibbs	Sabah	Endemic, rare
H5	***H. obovata*** Benn.	Sabah, Sarawak	Common (Sabah), rare (Sarawak)
H6	***H. petiolaris*** Benn.	Sabah, Sarawak, Brunei, Kalimantan	Common, widespread
H7	*H. pterygota* Sleumer	Sabah	Endemic
H8	*H. robusta* (Roxb.) R. Br. *ex* Wall. var. *robusta*	Sabah, Sarawak, Brunei, Kalimantan	Common
H9	*H. rufescens* Prain	Sarawak, Brunei	Rare
H10	*H. serrata* (R. Br.) Blume var. *serrata*	Sabah, Sarawak, Brunei	Common
H11	*H. sessilifolia* R. C. K. Chung	Sabah, Sarawak	Endemic, uncommon
H12	*H. symplocoides* R. C. K. Chung	Sabah	Endemic, rare
H13	**H. sp. A**	Sabah	Rare
S	*Heliciopsis* Sleumer, Blumea 8, 1 (1955) 79		
S1	*H. artocarpoides* (Elmer) Sleumer	Sabah, Sarawak, Brunei, Kalimantan	Common
S2	*H. litseifolia* R. C. K. Chung	Sabah, Sarawak, Kalimantan	Scattered
S3	***H. mahmudii*** (P. Chai) R. C. K. Chung	Sarawak	Endemic, rare
S4	***H. montana*** Symington *ex* Kochummen	Sabah	Uncommon
S5	*H. percoriacea* R. C. K. Chung	Sarawak	Endemic, rare
S6	*H. rufidula* Sleumer	Sarawak	Uncommon
S7	*H. velutina* (Prain) Sleumer	Sabah, Sarawak, Brunei, Kalimantan	Common

blade oblong-lanceolate, 29–42 cm × 9–11.5 cm; base cuneate, margin entire, apex obtuse and shortly pointed; midrib distinctly raised and with sharp angle on both surfaces; lateral veins ascending, 26–30 pairs, visible above, raised below; intercostal veins visible on both surfaces; petiole 4.5–6(–7) cm long, 7–13 mm thick, swollen and wrinkled at the base, deep brown when dry, glabrous. *Deeply lobed leaves* not known. *Inflorescences* borne on stem, about 30 cm above the ground, solitary, *c.* 5 cm long, laxly flowered except for *c.* 1 cm from the base; rachis terete, *c.* 1.5 mm diameter, reddish-brown hairy; bracts subulate, up to *c.* 2 mm long, reddish-brown hairy, caducous. *Female flowers*: pedicel (4–)5–6 mm long, solitary or mostly in pairs, connate up to 0.8–1.5 mm from the base, reddish-brown hairy; perianth 7–8 mm long, reddish-brown hairy; limb ellipsoid, *c.* 1(–1.5) mm diameter; anthers 1.5–2 mm long, sterile; ovary ovoid, glabrous; style slender, glabrous, clavate towards the apex; stigma discoid, lateral, stigmatic surface with distinct cleft; disk-glands truncate, free, 0.2–0.4 mm apart from each other. *Male flowers* and *fruits* unknown.

Distribution: Endemic to Borneo (Sarawak), rare and known from two collections, namely *S 33791* (from Lanjak-Entimau Wildlife Sanctuary, Lubok Antu) and *S 66455* (from Bintulu).

Habitat and ecology: In open places colonised by secondary pioneer vegetation following landslips, at altitude range of 600–850 m.

Notes: All anthers of mature flower buds and flowers were without pollen, thus they were parts of non-functional stamens (staminodes). Furthermore the stigma was lateral and discoid with a distinct cleft stigmatic surface, a distinct character typical of *Heliciopsis*. Consequently the species must be assigned to *Heliciopsis*.

Notes on other species

H5. *Helicia obovata* Benn.

In J. Bennett & R. Brown, Pl. Jav. Rar. (1838) 83. **Type:** *Horsfield s.n.*, Java (holo BM!; iso K). **Synonym:** *Helicia attenuata auct. non* (Jack) Blume: Sleumer, Blumea 8, 1 (1955) 61, Fl. Malesiana 1, 5 (1955) 186, *p.p., quoad syn. H. obovata* Benn.

Distribution: Endemic to Borneo. In Sabah, common, known from Ranau, Tambunan, Tenom, Keningau and Kota Belud districts. In Sarawak, uncommon, known only from a single collection, *S 52402*, from Bt. Tebunan, Lawas. Not yet reported for Brunei and Kalimantan.

Habitat and ecology: Lowland to hill mixed dipterocarp forests, sometimes also found in lower montane forest at 200–1000(–1500) m altitude.

Notes: Sleumer (1955b) identified (specimens *SANA 3627*, *SANA 4446* and *SANA 4529*) from Tuaran and Tambunan as *Helicia attenuata*. Detailed study on these specimens, together with those recently collected from Sabah and Sarawak, conclusively demonstrated that the specimens belong to *H. obovata*, a species known from Java. The species was characterised by its angular young twigs, thinly coriaceous leaves with subcordate to nearly auriculate or truncate bases, subterminal and axillary inflorescences with rachis (2–)2.5–3 mm in diameter, wrinkled pedicels, broadly ovate disk-glands, and small ellipsoid fruits which turn black when dry.

H6. *Helicia petiolaris* Benn.

In J. Bennett & R. Br., Pl. Jav. Rar. (1838) 84; Merrill, Bibl. Enum. Born. Pl. (1921) 235; Masamune, En. Phan. Born. (1942) 257; Sleumer, Blumea 8 (1955) 67, Fl. Malesiana 1, 5 (1955) 188; Kochummen, Tree Fl. Malaya 2 (1973) 315; Anderson, Checkl. Trees Sarawak (1980) 289; Cockburn, Trees Sabah 2 (1980) 76; Ashton, Man. Non-Dipt. Trees Sarawak 2 (1988) 332; Whitmore, Tantra & Sutisna, Tree Fl. Indon., Checkl. Kalimantan 2, 1 (1990) 292; Turner, Gard. Bull. Sing. 47, 2 (1995) 409; Coode *et al.* (eds.), Checkl. Flow. Pl. Gymno. Brunei (1996) 258; Argent *et al.* (eds.), Man. Non-Dipt. Trees Centr. Kalimantan 2 (1997) 516; Sosef, Hong & Prawirohatmodjo (eds.), PROSEA 5, 3 (1998) 286. **Type:** *Jack, Herb. Wallich 1041.1*, Peninsular Malaysia, Penang (holo K!; iso BM!). **Synonyms:** *Roupala moluccana auct. non* R. Br., *nec* Roxb.: Jack, Mal. Misc. 1 (1820) 10 (*Rhopala*); *Helicia attenuata auct. non* (Jack) Blume: Ridley, J. Fed. Mal. Stat. Mus. 7 (1916) 49; *H. erratica auct. non* Hook. *f.*: Suessenguth in Fedde, Rep. 54 (1951) 226, *p.p.*; *H. kingiana* Prain, Kew Bull (1912) 342; *H. obscurinervis* Chatterjee, Kew Bull. (1948) 65; *H. petiolaris* Benn. var. *kingiana* (Prain) Sleumer, Blumea 8 (1955) 67, Fl. Malesiana 1, 5 (1955) 188.

Distribution: Peninsular Malaysia, Singapore, and Borneo (Sabah, Sarawak, Brunei, and West and Central Kalimantan).

Habitat and ecology: Scattered in lowland mixed dipterocarp and *kerangas* forests on leached acid yellow sandy soils; locally abundant in lower montane forest (Mt. Kinabalu, Mt. Mulu, and Mt. Pueh) and on sandstone ridges up to 2100 m altitude.

Notes: In his revision, Sleumer (1955b) segregated *Helicia petiolaris* into two varieties, *viz.*, *petiolaris* and *kingiana*. These varieties are distinguished by the characters of the petiole (1.5–2.5 cm long in var. *petiolaris* and less than 1 cm long in var. *kingiana*) and fruit (very shortly apiculate to nearly rounded at the top and slightly contracted at the base in var. *petiolaris* and distinctly apiculate and manifestly contracted into a stipe in var. *kingiana*). After examining all available Bornean specimens, it was concluded that these characters cannot be used to distinguish the two varieties. For example, specimens *S 19384* (from Sarawak), *S 7849* and *Niga NN 59* (from Brunei) as well as *SAN 127100* and *SAN 133961* (from Sabah) had petiole length within the range of var. *kingiana* but with fruit similar to that of var. *petiolaris*.

Among the Bornean specimens of *H. petiolaris*, there were, in fact, three forms of fruits. These were depressed ovoid, non-apiculate fruit measuring (1.2–)1.5–2 × 1.6–2.2(–2.5) cm with pericarp 1–1.5 mm thick and branched stalk up to *c.* 2(–2.5) mm in diameter; subglobose to broadly ellipsoid, apiculate fruit measuring 2.2–3.5 × 1.7–2.3 cm with pericarp of 2–3 mm thick and unbranched stalk of 2.5–4 mm in diameter; and broadly ellipsoid, depressed, apiculate fruit measuring 2.5–3.9 × 2.4–4 cm with pericarp of 2.5–4 mm thick and unbranched stalk of 2.5–4 mm in diameter.

H13. *Helicia* sp. A

Synonym: *Helicia robusta* var. *integrifolia auct. non* Elmer: Sleumer, Blumea 8, 1 (1955) 57, Fl. Malesiana 5, 2 (1955) 186, *p.p., quoad specim. Clemens 55095*.

Distribution: Known only from Marai Parai, Mt. Kinabalu, Sabah (*Clemens 55095*) on ultramafic soils.

Habitat and ecology: Montane forest at *c.* 3400 m altitude.

Notes: In Sleumer's (1955b) treatment, specimen *Clemens 55095* collected from Mt. Kinabalu, Sabah, at *c.* 3400 m is indentified as *Helicia robusta* var. *integrifolia*, a variety known only from the Philippines. This study showed that this collection differed from var. *integrifolia* by its recurved leaf margin (plane in var. *integrifolia*), laxly flowered inflorescences (densely flowered in var. *integrifolia*) with thick rachis (thin in var. *integrifolia*), long perianth (short in var. *integrifolia*) and long pedicel (short in var. *integrifolia*). More specimens are, however, needed to confirm its taxonomic status. As a result I have left this taxon unnamed.

S4. *Heliciopsis montana* Symington *ex* Kochummen

Gard. Bull. Sing. 26 (1973) 287, Tree Fl. Malaya 2 (1973) 317; Turner, Gard. Bull. Sing. 47, 2 (1995) 409. **Type:** *Kochummen FRI 16172*, Peninsular Malaysia, Pahang, Fraser's Hill (holo KEP!).

Distribution: Peninsular Malaysia and Borneo (new record). In Sabah uncommon, known by a single collection (*SAN 76428*) from Pinosuk Plateau, Mt. Kinabalu, Ranau. No record from Sarawak, Brunei and Kalimantan.

Habitat and ecology: Lower montane forest at 1500–1800 m altitude.

Identification list

The numbers and letters behind the collections refer to the species numbers and letters of the accepted species and varieties as given in Table 2. When the number of the collection is not available or unknown then dates or sheet numbers are mentioned between brackets (when no sheet number is known, the herbarium is mentioned with collecting location). The collections from institutions can be found under the abbreviation of the institution (the collectors are mentioned between brackets).

Agullana 3881: H8 — **Amdjah** 281: H1 — **Argent & Amiril** 9368: S1.

bb series 7917 (NIFS): H2; 11097 (NIFS): H1; 15623 (NIFS): H2; 28336 (NIFS): H3 — **Bernstein** JHB 365: H6 — **BNBFD series** 2529: H10; 4586 (Puasa): H2; 10016 = FMS 48800 (Keith): S1; 10659 = FMS 55142 (Enggoh): S1 — **BRUN series** 234 (Ashton): H10; 258 (Ashton): H6; 3186 (Ashton): S7; 5226 (Ashton): H8; 5504 (Ashton): H3; 15017 (Suhaili *et al.*): H6; 15019 (Suhaili *et al.*): H6; 15262 (Idris *et al.*): H3; 15339 (Salleh *et al.*): H10; 16240 (Salleh *et al.*): H6; 17634 (Idris): H3; 17675 (Ariffin): H10; 17750 (Joffre): H6; 17867 (Joffre): H10.

Chew & Corner RSNB 4102: H3; 4169: H2; 4198: H3; 4786: H12 — **Chew, Corner & Stainton** 34: H7; 219: H3; 1841: H3 — **Church** 173: S2; 196: H6 — **Church & Mahyar** 1848: S7 — **Clemens** 11082: H4; 27083: H8; 27563: H7; 28070: H7; 28130: H2; 28292: H2; 28724: H3; 29874: H7; 30080: H7; 31898: H4; 32711: H7; 35111: H7; 55095: H13 — **Coode** MC 6973: S1; 7218: S1; 7720: H10.

Davis 477: H6 — **De Wilde & De Wilde-Duyfjes** 16611: S2 — **Ding Hou** 430: H10 — **Dransfield** JD 7163: H1.

Elmer 12946: S1; 21346: H2; 21539: H1; 21674: S7; 21817: H1 — **Endert** 3890: H3.

FMS series 38808 (Castro): H1; 38962 (Puasa): H2; 49006 (Apostol): H3 — **FRI series** 31484 (Kamarudin): H9 — **Forman** LLF 800: H6.

Gibbs 3137: H4.

Hallier 1677: H2; 2385: H2 — **Horsfield** *s.n.*: H5.

Jacobs 5401: S2; 5406: S6 — **Jaheri** 873: H1; 1092: H1 — **Jangarun** JE 3: H6.

KEP 80440: S1 — **Kirkup** DK 697: H10; 853: H1 — **Kostermans** 4364: S7 — **Korthals & Labohm** 1208: H8.

Nais *et al.* SP 5164: H4 — **Nielson** 674: S1 — **Niga** NN 53: H10; 59: H6; 140: H3 — **Nooteboom** 1316: H5 — **Nooteboom & Aban** 1522: H6; 1573: H6 — **Nooteboom & Chai** 1850: H8; 1860: H8; 2174: H2.

Ramos 1653: H2 — **Ridsdale** PBU 595: S2.

S series 12782 (Hj. Bujang): H3; 12793 (Hj. Bujang): H3; 13314 (Ilias): H2; 13715 (Ilias): H1; 15571 (Anderson): H10; 15595 (Ilias): H8; 16601 (Ilias): S1; 18481 (Chai): H1; 19086 (Ashton): H6; 19384 (Ashton): H6; 19547 (Chai): S2; 19977 (Othman): H6; 21569 (Ashton): H3; 22028 (Banyeng): H8; 22120 (Sibat): H10; 22130 (Sibat): H8; 22550 (Ilias): H10; 22929 (Ilias): H8; 24498 (Banyeng & Sibat): S1; 24896 (Jugah): H3; 24938 (Ilias): H2; 25214 (Banyeng & Benag): S1; 25403 (Anderson): S1; 25877 (Ilias): H6; 26033 (Ilias): H10; 26179 (Ilias): H3; 26339 (Ilias): H2; 27236 (Ilias): H9; 27782 (Ilias): H2; 28270 (Anderson & Ilias): H3; 28683 (Anderson & Ilias): H3; 28703 (Anderson & Ilias): S1; 28981 (Ilias & Mamit): H1; 29994 (Othman): S2; 31501 (Chai & Ilias): H1; 32343 (Chai *et al.*): H3; 33791 (Chai): S3; 34320 (Tong): S2; 34497 (James *et al.*): S2; 35506 (Chai): H8; 35941 (Chai): H2; 35995 (Ilias & Jugah): H3; 36365 (Ilias): H1; 36740 (Chai): S7; 36859 (Martin & Othman): H3; 37231 (Chai *et al.*): H6; 38086 (Lee): H6; 38381 (Ilias & Yeo): H6; 39729 (Chai): H6; 40002 (Lee): S1; 40296 (Rena): H6; 40716 (Ilias): H6; 41258 (Othman): H1; 42990 (Ilias): H6; 44647 (Yii): S7; 44688 (Yii): H8; 45027 (Banyeng & Ilias): H6; 45251 (Dayang Awa & Ilias): S1; 456 (Igon): H1; 45626 (Dayang Awa & Ilias): H2; 47168 (Abg. Mohtar *et al.*): H3; 47633 (Dayang Awa & Lee): H6; 47675 (Dayang Awa & Lee): H6; 48191 (Abg. Mohtar): S2; 48444 (Yii & Dami): H2; 4867 (Hasan): H9; 48880 (Othman, Yii *et al.*): H1; 49967 (Othman *et al.*): S5; 50576 (Dayang Awa & Lee): H6; 52402 (Lee): H5; 52434 (Lee): H11; 52436 (Lee): H11; 52500 (Lee): S1; 52966 (Abg. Mohtar): H3; 53813 (Lee): H6; 53933 (Abg. Mohtar *et al.*): H1; 58652 (Yii & Abu): H6; 5932 (Ashton): H3; 59359 (Kandau): H10; 66455 (Yii *et al.*): S3; 7849 (Ashton): H6; 8428 (Anderson): H2 — **SAN A series** (Forest Department, Sandakan) 3627: H5; 4332 (Wood & Wyatt-Smith): H1; 4446 (Wood & Wyatt-Smith): H5; 4529 (Wood & Wyatt-Smith): H5; 4651 (Wood): H10; 10488 (Angian): H8 — **SAN series** 76827 (Shea & Aban): H5; 100248 (Ag. Amin & Kumin): H6; 100266 (Sigin & Ismail): H8; 101427 (Fedilis & Matin): S1; 103091 (Ag. Amin): H6; 103543 (Fedilis & Sumbing): S1; 105196 (Ag. Amin): H6; 106842 (Amin *et al.*): H8; 107422 (Sigin *et al.*): (SAN); 108210 (Argent *et al.*): S1; 108333 (Dewol & Tuyuk): H6; 108449 (Dewol *et al.*): H2; 109188 (Dewol): H2; 109374 (Amin *et al.*): H8; 109743 (Sigin *et al.*): H6; 110149 (Sumbing): H2; 110255 (Fedilis): H1; 110338 (Sumbing): S2; 111295 (Leopold & Ismail): H7; 111305 (Leopold & Ismail): H11; 111423 (Leopold & Ismail): H6; 111835 (Mansus *et al.*): H8; 113142 (Fedilis): H6; 113515 (Joseph *et al.*): S1; 113698 (Dewol *et al.*): S1; 113706 (Joseph & Donggop): H8; 114323 (Amin): H8; 114329 (Amin & Jarius): H8; 116360 (Amin & Jarius): H8; 116520 (Amin *et al.*): H8; 117132 (Mansus *et al.*): H2; 117716 (Mansus & Matin): H1; 118366 (Sumbing): H6; 119597 (Sumbing): H1; 121704 (Fedilis): H5; 121817 (Fedilis): H7; 121893 (Sumbing): H8; 122383 (Meijer): H8; 122694 (George *et al.*): H5; 123190 (Amin *et al.*): H8; 123776 (Bousi *et al.*): H1; 124076 (Joseph *et al.*): H8; 125292 (Fedilis): H2; 125465 (Asik): H7; 125541 (Asik & Sumbing): H7; 126705 (Ag. Amin): H6; 127100 (Ag. Amin): H6; 127592 (Fedilis & Asik): H8; 127810 (Sumbing): H7; 128254 (Fedilis & Sumbing): H1; 128355 (Fedilis & Asik): H1; 128600 (Sumbing): H8; 128611 (Joseph & Donggop): H8; 128803: H1; 129127 (Soinin *et al.*): H8; 130754: H7; 130776 (George & Good): S1; 132690 (Leopold *et al.*): H5; 133063: H5; 133552 (Julius): H5; 133961 (Leopold): H6; 134087 (Leopold): S7; 134533 (Berhaman): H1; 136714 (Asik): H8; 15232 (Wood): S7; 17039 (Wood & Charington): H5; 17494 (Symthies *et al.*): H6; 18784 (Tingguan): H8; 19650 (Meijer): H2; 20971 (Meijer):

H2; 20980 (Meijer): H2; 21380 (Singh): H1; 21791 (Nicholson): S1; 23811 (Meijer): S1; 27444 (Singh): H5; 27726 (Bakar): H6; 28114 (Mikil): S1; 30803 (Burgess): S1; 31127 (Singh): H3; 32548 (Aban): S1; 33071 (Lajangah): H5; 33635 (Lajangah): H6; 35332 (Ampuria): H8; 35570 (Sayu): S1; 35872 (Aban): S2; 36200 (Mikil): H7; 36404 (Ampuria): H10; 37040 (Aban): H2; 38270 (Sinanggul): S7; 40550 (Sinanggul): H2; 41294 (Mikil): H2; 42052 (Mikil): H5; 43165 (Rundi): H2; 44530 (Lajangah): H3; 46172 (Nordin): H1; 46718 (Mikil): H7; 46755 (Mikil): H7; 47637 (Ahmad): H2; 49604 (Francis): H8; 49710 (Sadau): H3; 51362 (Sinanggul): H3; 52038 (Banang): H8; 53453 (Singh): H1; 55813 (Binideh): H5; 57025 (Sinanggul): H2; 57121 (Sinanggul): H1; 57706 (Indar): H7; 60133 (Leopold): H7; 60792 (Aban): H3; 60837 (Amin & Suali): H11; 60838 (Ag. Amin & Suali): H7; 63638 (Binson): H3; 64963 (Cockburn): H2; 66095 (Ag. Amin *et al.*): H7; 66280 (Cockburn): H5; 67059 (Aban): H8; 67659 (Leopold & Saikeh): S2; 68416 (Cockburn, Chow & Aban): H1; 70906 (Cockburn): H10; 71047 (Kumin): H2; 71830 (Aban *et al.*): H7; 72476 (Maurus *et al.*): S7; 73222 (Saikeh): H3; 74102 (Aban & Saikeh): H3; 74271 (Chow & Aban): H6; 74508 (Chow & Leopold): H2; 74972 (Dewol *et al.*): H6; 76179 (Shea & Minjulu): H5; 76428 (James & Leopold): S4; 76495 (Leopold): H3; 77421 (Jumatin): H6; 77482 (Dewol): H1; 77505 (Dewol): H1; 78559 (Alotsius): S7; 79157 (Free & Sumbing): H1; 79182 (Free & Sumbing): H2; 80755 (Dewol): H8; 81048 (Aban & Kodoh): H1; 81852 (Aban & Kodoh): H10; 81901 (Kodoh & Aban): H10; 82714 (Tarmiji & Ali): H8; 83228 (Aban): H1; 83845 (Dewol): H3; 84047 (Dewol): H2; 84349 (Ag. Nordin): H6; 84792 (Talib & Marsal): H6; 85604 (Ag. Nordin): H8; 85955 (Ag. Nordin): H1; 86010 (Ag. Nordin): H8; 86092 (Ag. Nordin): H6; 86103 (Talib *et al.*): H3; 86251 (Leopold & Ag. Amin): H6; 87168 (Leopold): H8; 87241 (Fedilis): S1; 88129 (Fedilis & Sumbing): H2; 88192 (Fedilis & Sumbing): H2; 91252 (Aban): H1; 91474 (Fedilis & Sumbing): S1; 91494 (Fedilis & Sumbing): S7; 91746 (Patrick): H1; 93197 (Dewol): H2; 94347 (Aban *et al.*): H1; 94893 (Fedilis): S1; 95287 (Amin *et al.*): H10; 95717 (Fedilis & Sumbing): S1; 96046 (Fedilis): H1 — **Sands** MS 5704: S1; 5969: H10 — **SFN** 18979 (Kloss): H2 — **Simpson** 2515: H6 — **Smith** *s.n.*: H10 — **Steven** *et al.* 403: S1.

Teijsmann 11530: H2.

Van Balgooy & Van Setten 5630: S7.

Wong WKM 112: H10; 689: H6; 1110: H6; 1442: H6; 1632: H10.

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