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The genus *Schismatoglottis* Zoll. & Moritzi (*Araceae : Schismatoglottideae*) in Peninsular Malaysia and Singapore

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Summary. The species of *Schismatoglottis* Zoll. & Moritzi in Peninsular Malaysia and Singapore are enumerated, keyed and illustrated. Seven species are recognized; in addition, *S. penangensis* Engl. is left as a *species dubia*. *S. cordifolia* Ridl. is reduced to the synonymy of *S. calyptrata* (Roxb.) Zoll. & Moritzi; *S. minor* Hook.*f.* is a synonym of *S. brevipes* Hook.*f.*; *S. ridleyana* Engl. and *S. linguiformis* Engl. are synonyms of *S. mutata* Hook.*f.*; *S. kingii* Engl. and *S. marginata* Ridl. (non Engl.) are synonyms of *S. scortechinii* Hook.*f.* No new species are proposed. Biogeography, shoot architecture, morphology, phenology, dispersal and infrageneric taxonomy are briefly discussed.

Schismatoglottis Zoll. & Moritzi (including the Malesian *Apoballis* Schott and *Colobogynium* Schott and the Neotropical *Philonotion* Schott) is a genus of over 100 species of generally diminutive herbs, sometimes rheophytes, in lowland and lower montane rain forests. The genus is centred on Borneo where the greatest diversity and greatest concentration of species occurs; its full range is from tropical southwestern China and Indochina to Malesia east to Vanuatu and a disjunct occurrence of three species in the Neotropics (Bunting 1960, Bunting & Steyermark 1969). The neotropical representation is yet to be subjected to critical re-evaluation, but it does at least appear that these species belong to the same tribe, Schismatoglottideae Nakai (*sensu* Grayum 1990). The remaining, much smaller, genera of the tribe—*Aridarum* Ridl., *Bucephalandra* Schott (incl. *Microcasia* Becc.), *Heteroaridarum* M. Hotta, *Hottarum* Bogner & Nicolson, *Phymatarum* M. Hotta and *Piptospatha* N.E. Br. (incl. *Gamogyne* N.E. Br., *Rhynchopyle* Engl.)—are all endemic to Borneo with the exception of *Piptospatha* which also occurs on the Malay Peninsula and in Thailand. There is thus a spectacular geographical disjunction at least at tribal level across the Pacific. Other amphi-Pacific genera of Araceae are known, including *Arisaema*, *Homalomena* and *Spathiphyllum*, though each has a somewhat different pattern:

Arisaema, a predominantly temperate to subtropical genus, is thought to have migrated from Asia relatively recently along land bridges across the Bering Strait (Grayum 1990). Tropical *Spathiphyllum* is predominantly neotropical and its Old World representation is in Wallacea and to the east. *Homalomena* has a pattern more similar to that of *Schismatoglottis*: centred on Malesia with a few neotropical species but differing from the latter genus in a fairly strong representation in New Guinea and representation (though poor) in India. That may sugggest a Gondwanan pattern, though species limits and relationships in *Homalomena* are not yet well enough understood for firm biogeographic interpretations to be made. *Schismatoglottis,* on the other hand, is very poorly represented in New Guinea and absent from the Indian subcontinent altogether. Thus the remarkable aspect of the tropical transpacific distribution of *Schismatoglottis* is that it does not appear readily explicable as a relict Gondwanan one.

Taxonomic studies have been made on several of the smaller genera of the Schismatoglottideae fairly recently (Bogner 1978, 1980; Hotta 1965, 1976; together with *ad hoc* descriptions of new species—see Hay *et al.* 1995a & b), but *Schismatoglottis* has not been reviewed since the monograph by Engler & Krause (1912) in spite of the addition of many new species, mainly by Alderwerelt van Rosenburgh (1922a,b) and Hotta (1966). The allied genera mentioned here have been maintained by Mayo, Bogner & Boyce (in press), however it is a moot point whether all of these can be kept separate from *Schismatoglottis* as it is possible that *Schismatoglottis* is paraphyletic in relation to them and, if this is demonstrated, it may (or indeed may not) be desirable to reflect that status with changes in nomenclature. Moreover, phenetically, distinction from *Piptospatha* seems reduced to a single character (spathe constriction) in the case of *Schismatoglottis roseospatha* Bogner (Sarawak) and others.

Some morphological notes

A considerable degree of variation in shoot architecture is exhibited by *Schismatoglottis*, with Peninsular Malaysian species falling broadly into two categories. The following observations are made from plants in cultivation.

The commonest and most widely distributed species in the genus, *S. calyptrata* and many (but not all) immediately allied species have hapaxanthic shoots. The majority of (non-climbing) aroids conform more or less closely to Chamberlain's architectural model (*sensu* Hallé & Oldeman, 1970) in which physiognomically unbranched shoots consist of a series of terminally flowering orthotropic modules with shoot growth being renewed by a single relay axis incepted typically in the axil of the penultimate leaf or leaf homologue below the inflorescence (or the last inflorescence in a synflorescence) (Fig. 1a). In *S. calyptrata* and *S. wallichii* it appears that the relay axis aborts (Fig. 1b), so that the shoot dies after fruiting. However, there is a sympodial rhizome system by which the plant perennates, so that these

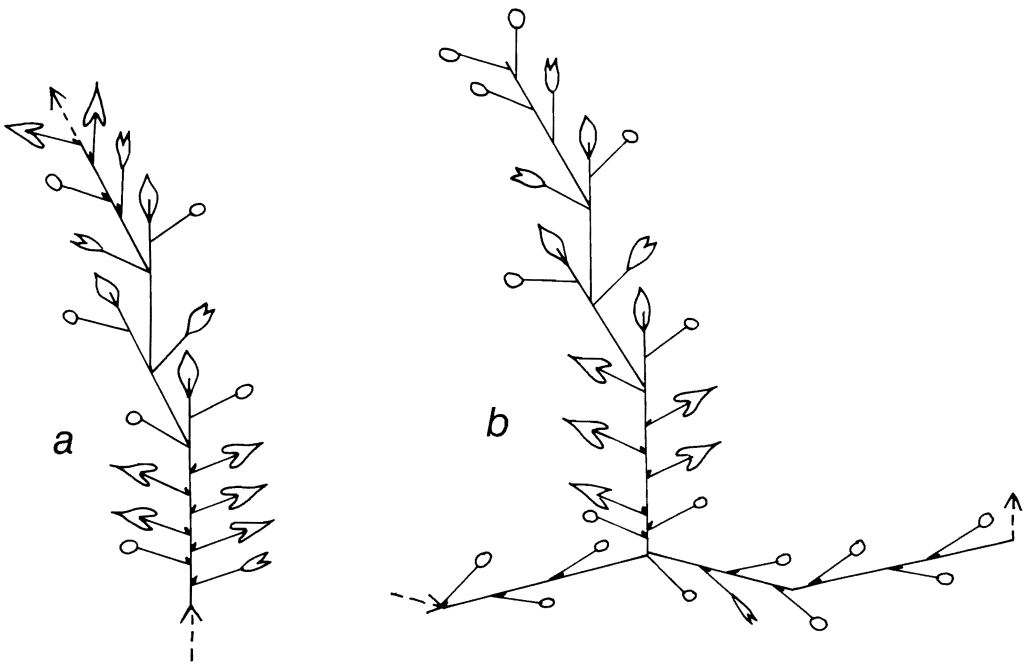

Fig. 1. Schematic representation of shoot organisation in Peninsular Malaysian *Schismatoglottis*: **a.** *S. mutata*, with renewal growth after flowering (top), and hence a pleonanthic shoot; **b.** *S. wallichii* showing an abortive renewal axis after flowering (top), hence a hapaxanthic shoot but with a new shoot developing from a stolon developing laterally from the base of the previous axis. = prophyll; = cataphyll; = foliage leaf; = inflorescence; = axillary bud with potential for reiteration; = repeated pattern of organisation.

species represent an herbaceous manifestation of Tomlinson's model which does not appear to have been recorded hitherto for the Araceae. The vegetative stems of these species are hypogeal. The seedling shoot, once flowering size, may bear a number of close-spaced side shoots and hence be clump-forming, or the side shoots may begin as stolons which eventually terminate in a leafy and ultimately flowering shoot and hence the plant is colony-forming. Other species evidently conform to Chamberlain's model and develop an aerial decumbent to erect stem which branches laterally (reiterating the underlying pattern) in varying degree. In *S. brevicuspis* lateral branches occasionally flower without the production of foliage leaves, giving the appearance of lateral inflorescences subtended by cataphylls.

The leaf sheath in *Schismatoglottis* presents some taxonomically useful variation. In *S. mutata* and *S. brevipes* the wings of the sheath (and the inflorescence bracts) are deliquescent to marcescent. These are persistent in other Peninsular species. In a number of Bornean species other modifications of the leaf sheath occur, such as free-ligular sheaths (e.g., *S. multiflora* Ridl.; also cf. *Piptospatha* and other related genera), or sheaths which are

much reduced in length and whose function of encasing developing leaves is taken over by cataphylls interposed between the foliage leaves (e.g., *S. tecturata* (Schott) Engl.).

Many *Schismatoglottis* species have individuals with variegated leaves, though variegation is apparently entirely absent from certain species or species groups, e.g., *S. brevipes*, *S. mutata*, *S. longifolia* and *S. brevicuspis*. In not a few instances variegated individuals have been recognized formally at the level of variety or forma. This is not continued, as it seems to serve no valuable purpose botanically, though some cultivated forms might be recognized at the rank of cultivar. Though some Peninsular species are highly ornamental and have considerable horticultural potential (e.g., forms of *S. wallichii* and *S. scortechinii*), the genetics of variegation in *Schismatoglottis* does not seem to have been investigated at all. However, there seem to be three parameters of variation: colour, intensity of colour and horizontal distribution of coloured patches. Two colour classes are yellow-green and grey-green. Distribution occurs as irregularly distributed spots and splotches, a central stripe, a stripe on each side of the lamina about midway between the midrib and the margin, a central stripe and two lateral stripes. Spotted and striped patterns are sometimes superimposed in instances where stripes are manifested as aggregations of spots. These patterns are either grey-green or yellow-green, but they may be intense or faint. In rare instances (observed by me only in an unidentified species in Sabah) variegation involves three shades in one leaf perhaps depending on the number of cell layers in which full expression of chlorophyll has been inhibited; in such a case the ground colour is dark green, and the leaf is spotted mid-green and grey green. Species in which variegation does occur generally show several patterns (in different individuals) which remain constant over time. It is interesting that quite distantly related species may show the same or at least much overlapping sets of variegants, suggesting homologous variation or an homologous propensity to vary in this respect. The biological significance of variegation in *Schismatoglottis* is unknown.

Several Peninsular species have an indumentum on the petioles and abaxial sides of the midrib with variation within species in the density. *S. mutata* and *S. brevipes* both have minute velvety hairs not individually discernible with the naked eye but which, where dense, give a velvety aura to the leaf stalks. Minute multicellular emergences give the petioles of *S. scortechinii* an asperous feel. In Borneo species occur with conspicuous multicellular trichomes on the stems, leaves and spathes (e.g., *S. barbata* Engl., *S. ferruginea* Merr.).

Though the inflorescences in *Schismatoglottis* are often quite inconspicuous, they are of intricate and complex structure. The spathe is divided into upper and lower parts delineated from one another by a more or less pronounced constriction and a change in texture, colour and behaviour. The lower spathe encases the female flowers and the developing fruits, and is persistent and green, growing somewhat after flowering as the fruits develop and eventually longitudinally dehiscent from the base as the fruits ripen. The upper spathe, or limb, is more membranous, and exhibits a range of shapes and differing behaviour at and

after anthesis. The generic name alludes to the condition in *S. calyptrata* and *S. wallichii* where immediately after female anthesis the living spathe limb is abruptly abscised at the constriction leaving the distal portion of the spadix exposed during male anthesis and persistent for some time after, finally rotting. Up until that point the limb has been much inflated during female anthesis, gaping ventrally or with the margins loosely overlapping. In *S. longifolia*, *S. mutata*, *S. brevipes* and *S. brevicuspis* the spathe limb is narrowly lanceolate, loosening (together with the lower spathe) at female anthesis and barely open at male; thereafter the limb closes again and perists for some time before rather gradually senescing, eventually becoming deciduous at the level of the constriction together with the by now redundant male and sterile parts of the spadix. A somewhat intermediate state is exhibited by *S. scortechinii* in which the limb opens cowl-like at anthesis and then rapidly senesces (becoming a dirty dark grey colour) and falls away; during senescence the living portions of the spathe limb become first crumbly and brittle and the limb may be dislodged before senescence is complete.

The spadix (see Fig. 2) in *Schismatoglottis* consists of a lower female zone, a middle male zone and a terminal sterile appendix (as is commonly the case in monoecious aroids, e.g., *Alocasia, Typhonium, Arisaema*—though in many instances the appendix is absent, e.g., *Homalomena, Furtadoa, Cryptocoryne, Aglaonema*). The female zone consists of naked pistils usually interspersed with staminodes occurring in much smaller numbers than the pistils (cf. *Homalomena* where, when staminodes are present, one accompanies each ovary). These are referred to here as interpistillar staminodes. Frequently interpistillar staminodes are also concentrated in a ring at the base of the female zone. In species such as *S. brevicuspis*, staminodes of this type may actually be absent from amongst the pistils and confined to a basal ring, but their shape (stalked with the apex expanded) and colour (usually white) suggest that they are homologous to interpistillar staminodes in other species. The appendix is also composed of structures conventionally called staminodes, but their form (mostly columnar) and differing colour suggest that they are not fully homologous with the staminodes of the female zone. Either or both types of staminode may also make up a sterile interstice between the male and female zones, though this is more or less absent in some species, e.g., *S. calyptrata*. *Schismatoglottis wallichii* is remarkable in having a very long interzonal sterile zone composed of appendical staminodes, and the appendix *per se* absent, suggesting that the male zone and appendix may have "exchanged positions" on the spadix. The rather complex situation in *S. scortechinii* is discussed under that species. The male zone in *Schismatoglottis* consists of massed stamens which are generally not aggregated into any pattern able to be equated with male "flowers", though in *S. longifolia* and *S. scortechinii* there is irregular grouping into twos and threes which may suggest some residual homology to "flowers" in the male zone which has been lost in other species. Elsewhere in the range, other species occur in which male "flowers" are discernible (Hotta 1993). Pollen is generally extruded through apical pores in the truncate stamens, and is generally dusty, though in *S. scortechinii* the grains adhere in very slender filaments.

Ripe fruiting spadices are rarely encountered in *Schismatoglottis*, probably due to the

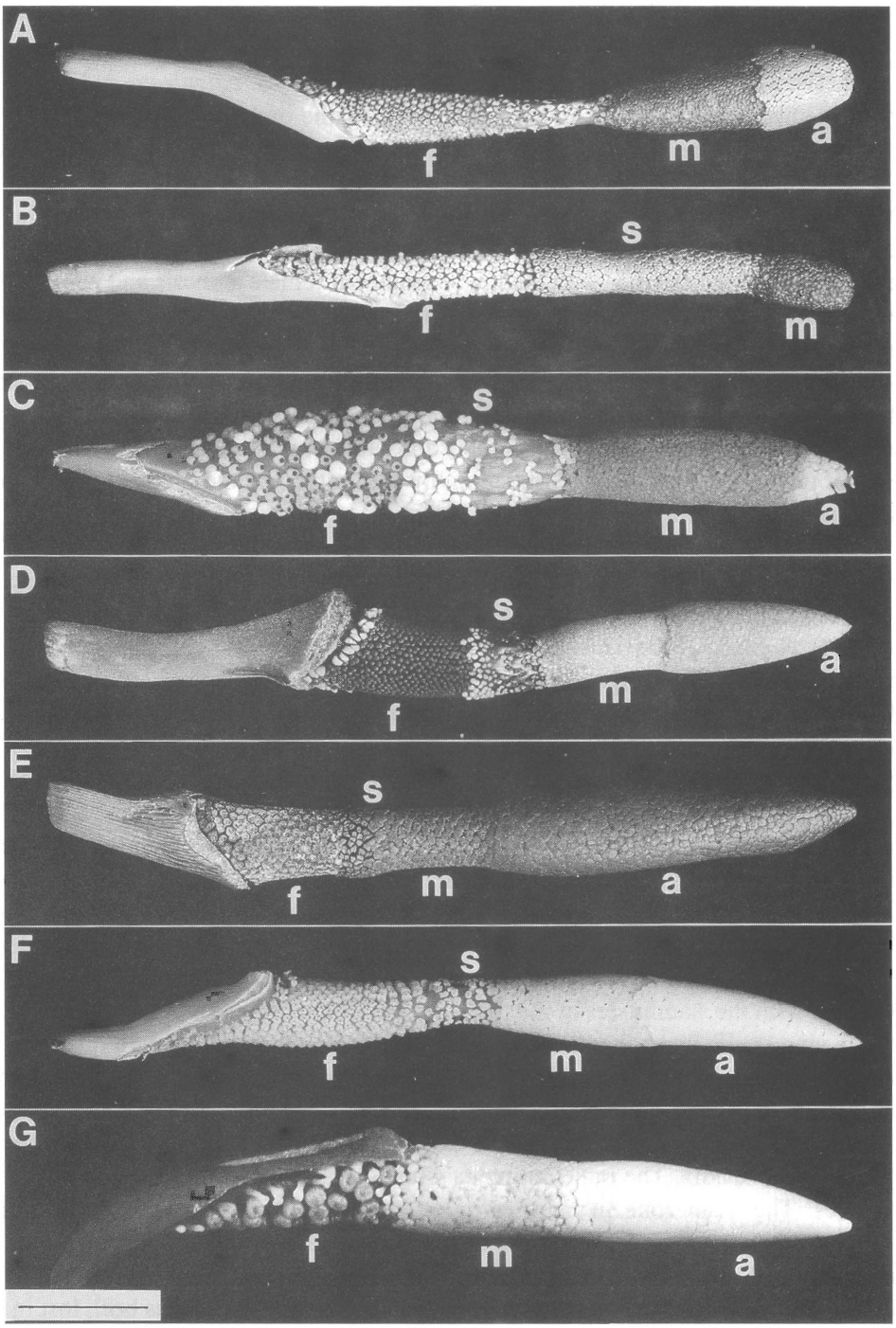

Fig. 2. Spadices of *Schismatoglottis* (not to same scale). **A.** *S. calyptrata* (HRBS Acc. no. 940125). **B.** *S. wallichii* (HRBS Acc. no. 940354). **C.** *S. brevipes* (HRBS Acc. no. 940198). **D.** *S. mutata* (HRBS Acc. no. 940142); the slightly ovoid appendix is not typical: see text. **E.** *S. scortechinii* (HRBS Acc. no. 940325). **F.** *S. brevicuspis* (HRBS Acc. no. 940084). **G.** *S. longifolia* (HRBS Acc. no. 940121). f = female zone; s = interzonal staminodial region; m = male zone; a = appendix. Scale bar: to A = 1.44 cm; to B = 1.77 cm; to C = 0.91 cm; to D = 1.65 cm; to E = 1.5 cm; to F = 1.36 cm; to G = 0.72 cm.

apparently rapid transition from almost ripe infructescence to disintegration. As noted above the fruiting spathe is dehiscent from the base (where known). The fruits are small (*c.* 2–3 mm diam.), greenish, odourless and contain several to numerous minute somewhat sticky seeds. As yet there are no observations that might suggest a dispersal mechanism, and none able to account for the enormous range of *S. calyptrata* (*q.v.*) in terms of long-distance dispersal.

In the Malay Peninsula, *Schismatoglottis* is confusable with other terrestrial herbaceous genera which have striate leaf venation. Among these are *Homalomena* from which it differs in not being aromatic and in the caducous or deliquescent/deciduous spathe limb and the appendix (this sometimes also absent or much reduced in *S. wallichii*, as noted above) and in the lack of definable male flowers in the male zone. Confusion may also occur with *Furtadoa*, which is much like an elliptic-leaved *Homalomena* with pistillodes in the male flowers, and with *Piptospatha*, which has free-ligulate leaf sheaths and is rheophytic (*Schismatoglottis* may also be like this in East but not Peninsular Malaysia, and in other parts of its range). It is distinguished from *Aglaonema* by differentiation of the spathe into upper and lower parts separated by a constriction, the presence of interpistillar staminodes and/or an appendix, the much larger number of smaller pistils and the much smaller fruits. These distinguishing features are summarised in the key below.

Key to striate-veined herbaceous aroid genera in the Malay Peninsula

1. Colonial in tidal mud. ..... *Aglaodorum*
   Not so. 2

2. Leaf sheath free for most of its length, ligulate. ..... *Piptospatha*
   Leaf sheath fully attached (except distal few mm). 3

3. Stems and leaves aromatic when crushed. 4
   Stems and leaves not aromatic. 5

4. Female flowers with staminodes; male flowers with pistillodes. ..... *Furtadoa*
   Female flowers usually with staminodes; male flowers never with pistillodes ..... *Homalomena*

5. Spathe not constricted. 6
   Spathe constricted. 7

6. Male zone with clearly definable male flowers; inflorescence more or less nodding (ventral side down) after anthesis; interpistillar staminodes usually present; fruit small (mm), green ..... *Homalomena*

Male zone a mass of stamens; inflorescence more or less supine (ventral side up) after anthesis; interpistillar staminodes absent; fruit large (cm), red ..... *Aglaonema*

7. Spathe fully persistent after anthesis; male zone with clearly definable male flowers ..... *Homalomena*
   Spathe limb caducous or rotting; male zone a mass of stamens .... *Schismatoglottis*

A note on cited collections

Plants seen in the field by the author in January 1994 (Hay *et al.* 9000–9297) were mostly sterile. Living plants were collected (without vouchers in sterile instances) for the purpose of preparing herbarium material after flowering in cultivation at the Royal Botanic Gardens Sydney. Spirit material and dried specimens are being accumulated from these plants, and will be distributed to herbaria at K, KEP and UPM and other herbaria where surplus material allows, in due course. Where species are widespread and common and have been gathered by many collectors, a small representative sample of specimens has been cited, as a full listing seems superfluous. However, I have cited my own collections fully, since they, as living plants, have been the main source of data from which the descriptions presented here have been compiled.

Lectotype specimens selected here have been chosen on the basis of their being the most complete and/or most widely distributed extant of the syntypes, unless some other explanation is given.

Systematic enumeration

SCHISMATOGLOTTIS Zoll. & Moritzi, Syst. Verz. (1846) 83; Schott, Prodr. Syst. Aroid. (1860) 320; Engl. in DC., Monogr. Phan. 2 (1879) 349; Hook.*f.*, Fl. Brit. Ind. 6 (1894) 537; Ridl., Materials Fl. Mal. Pen. 3 (1907) 30; Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 82; Ridl., Fl. Mal. Pen. 5 (1925) 110; Henderson, Mal. Wildfl. Monoc. (1954) 231.

Type species: *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi.

Apoballis Schott, Oest. Bot. Zeitschr. 8 (1858) 317. Type species: *Apoballis neglecta* Schott [*nom. superfl. pro Schismatoglottis rupestris* Zoll. & Moritzi *ex* Schott; = *S. latifolia* Miq.].

Colobogynium Schott, Oesterr. Bot. Zeit. 15 (1865) 34. Type species: *Colobogynium tecturatum* Schott [= *Schismatoglottis tecturata* (Schott) Engl.].

Evergreen, sometimes colony-forming herbs mostly of rain forest floor or rheophytes, with

clear sap and the vegetative tissue not or barely aromatic; stem hypogeal and then rhizomatous, hapaxanthic (no renewal growth of axis after flowering) and suckering or stoloniferous, or epigeal and sympodial, pleonanthic, erect, decumbent or creeping; leaves several together, simple, lanceolate to cordate, often variegated, with pinnate primary venation and striate secondary venation, pink, bronze or green when young; petiole well developed, sheathing basally, sometimes narrowly and thinly alate on adaxial angles and the wings then often crisped, sometimes asperous or minutely hairy or velvety; sheath persistent to deliquescent, sometimes free-ligulate (not in Peninsular Malaysia). Inflorescence mostly powerfully fragrant (esters), anatomically terminal, sometimes physiognomically lateral by displacement, rarely and irregularly anatomically lateral where lateral "vegetative" shoots flower "terminally" without producing foliage leaves, rarely solitary, usually several to many together in sympodial series interspersed with cataphylls forming a synflorescence; peduncles generally short and erect at anthesis, sometimes long and abruptly down-turned apically (*S. longifolia*), after anthesis usually actively declinate; spathe weakly to strongly constricted approximately at the mid-point, the lower part ("tube": but not tubular) convolute and ovoid, persistent into fruiting, the upper part ("limb") broad and inflated to gaping at anthesis, then caducous to deciduous, to narrow and clasping (opening slightly at anthesis, then closing) and shortly persistent then falling, often conspicuously mucronate, green to yellowish white; spadix shortly stipitate to sessile, sometimes partly adnate to the spathe, subequalling the spathe in length; female zone of naked pistils accompanied by clavate to mushroom-shaped to globose sterile organs usually interpreted as staminodes, these very irregularly interspersed among the pistils, distant to clumped, sometimes occurring in two sizes (*S. brevipes*, *S. mutata*), sometimes absent from among the pistils but then occuring as a single ring at the base of the female zone or as a sterile zone at its distal end; male zone contiguous with female zone or separated by a sometimes partly naked sterile zone; a distal appendix of staminodes usually present, sometimes entirely absent or very much reduced; ovaries globose to flask-shaped, unilocular with 2–4 parietal placentas, multiovulate; ovules anatropous or hemianatropus; style short to nil; stigmas mostly papillate; male flowers not recognizable as such, the zone a mass of stamens, or male flowers 2–3-staminate; stamens truncate, the thecae equalling to exceeding the connective, opening by apical pores; pollen shed in monads, powdery or rarely extruded in thin filaments (*S. scortechinii*), small, *c.* 17mm, inaperturate, boat-shaped, elliptic to oblong, bilaterally symmetrical, exine sculpturing psilate (microscopic details from Grayum 1992); staminodes of the appendix generally different in form, colour and reaction to alcohol from those of the female zone (appendical and interpistillar type staminodes occurring together between the male and female zones in *S. scortechinii*); ripening fruit enclosed by persistent spathe base; ripe fruit green, exposed by spathe dehiscing acropetally (where known); seeds numerous, small, longitudinally striate where known, minutely strophiolate, albuminous; x = 13; 2n = 26, 39, 52, with B chromosomes sometimes present (Petersen 1989).

Engler & Krause (1912) recognized 14 species from Peninsular Malaysia, reduced here to seven, including four highly variable entities, *S. calyptrata, S. mutata*, *S. scortechinii* and *S. wallichii*.

In spite of considerable diversity within the genus in spadix structure, male "flower" structure, spathe behaviour during anthesis, leaf structure and stem architecture, infrageneric classification was not attempted at all by Engler & Krause (1912) who abandoned Engler's earlier (1879) scheme (which was based on far fewer species; the number known increased almost 10-fold in the interim). The species of *Schismatoglottis* in the Malay Peninsula, though rather few, are quite diverse, some without clear relationships to others in the area. *S. brevipes* and *S. mutata* are closely related to one another and to the more widespread *S. latifolia* Miq. *S. brevicuspis* is evidently related to a group of species in Borneo including *S. retinervia* Furtado, but not to other Peninsular species. *S. calyptrata* and *S. wallichii* are evidently both members of a "euschismatoglottis" grouping which includes many species and covers the entire old-world range of the genus. *S. scortechinii* appears quite isolated, with possible relationship to Bornean *S. asperata* Engl. The highly distinctive *S. longifolia* also appears isolated, though a species collected recently in Sarawak is very similar in aspect, but, according to Bogner (pers. comm.) the latter has the basal placentation of *Hottarum*, but it lacks the free ligulate leaf sheath of that genus. Clearly these relationships require further exploration, and even an interim informal infrageneric scheme does not seem useful amongst so few species.

KEY TO THE SPECIES OF *SCHISMATOGLOTTIS* IN PENINSULAR MALAYSIA AND SINGAPORE

1. Stem epigeal 2
   Stem hypogeal 5

2. Leaf sheath persistent; spadix covered with flowers/floral organs 3
   Leaf sheath deliquescent-deciduous, turning brown; spadix axis partly naked between male and female zones 4

3. Leaves of a rich deep green with distinctly tesselate fine venation, never variegated; upper spathe bright green, hardly opening, semipersistent; male zone about equalling appendix ..... 6. *S. brevicuspis*
   Leaves dull mid/dark green to pale green, sometimes glaucous, sometimes variegated; upper spathe opening cowl-like, pale greyish green, more or less caducous, blackening; male zone much shorter and narrower than appendix ..... 5. *S. scortechinii*

4. Feeble plants with decumbent to creeping stem *c.* 1 cm diam; leaf bases obtuse to slightly cordate; male zone and appendix together less than half the length of the spadix ..... 3. *S. brevipes*
   Robust herbs with erect to decumbent stem *c.* 2–4 cm diam; leaf base deeply cordate; male zone and appendix together exceeding half the length of the spadix .. 4. *S. mutata*

5. Inflorescences nodding on long slender peduncles ..... 7. *S. longifolia*

Inflorescences erect, the exposed part of the peduncle shorter than the inflorescence 6

6. Leaf bases acute to truncate, very rarely somewhat cordate; spadix cylindric with a distinct sterile zone between the male and female zones and the appendix absent or extremely reduced (a few terminal staminodes) ..... 2. *S. wallichii*
Leaf bases cordate with the posterior lobes rounded to more or less triangular; spadix hour-glass shaped, with the narrowest portion at the junction of the male and female zones; interzonal sterile zone more or less absent (sometimes a small concentration of interpistillar staminodes) and the appendix conspicuous, hemispherical to bullet-shaped ..... 1. *S. calyptrata*

1. Schismatoglottis calyptrata (Roxb.) Zoll. & Moritzi in Moritzi, Syst. Verz. (1846) 83; Schott, Prodr. Syst. Aroid. (1860) 321; Engl. in DC. Monogr. Phan. 2 (1879) 352; Ridl., Materials Fl. Mal. Pen. (1907) 31, J. Straits Branch Roy. Asiat. Soc. 57 (1910) 112, Fl. Mal. Pen. 5 (1925) 111; Engl. & Krause in Engl., Pflanzenr. 55 (IV.23Da) (1912) 114; Henderson, Mal. Wildfl. Monoc. (1954) 231, fig. 137A; Chin, Gard Bull. Sing. 35 (1982) 182. Type: *Arisarum esculentum* Rumph., Herb. Amboin. 5 (1747) t. 111, fig. 1. (lecto, selected here; see below). (Fig. 2A)

Calla calyptrata Roxb., Fl. Ind. 3 (1832) 514.
Homalomena calyptrata (Roxb.) Kunth, Enum. Pl. 3 (1841) 57.
Zantedeschia calyptrata (Roxb.) C. Koch, Ind. Sem. Hort. Berol. App. (1854) 9.
Schismatoglottis calyptrata var. *concolor* Hallier *f.*, Bull. Herb. Boiss. (1898) 620; Ridl., Materials Fl. Mal. Pen. 3 (1907) 31, Fl. Mal. Pen. 5 (1925) 111; Engl., Pflanzenr. 55 (IV.23Da) (1912) 115; *nom. superfl. pro var. typ.*

[*S. longipes sensu* Hook.*f.*, Fl. Brit. Ind. 6 (1894) 538, *non* Miq. (see below)].

[*Schismatoglottis calyptrata* var. *picta sensu* Ridl., Materials. Fl. Mal. Pen. (1907) 31, Fl. Mal. Pen. 5 (1925) 111; ?*non* (Schott) Hallier *f.* (see below)].

Schismatoglottis calyptrata var. *albidomaculata* (Hallier *f.*) Ridl., Materials Fl. Mal. Pen. 3 (1907) 31, *pro parte quoad specim. cit.* (see below).

Schismatoglottis cordifolia Ridl., J. Straits Branch Roy. Asiat. Soc. 57 (1911) 112. Type: Malaysia, Perak, Temangoh Woods, *Ridley s.n.* (SING!, holo).

Schismatoglottis calyptrata var. *ornata* Ridl. *ex* Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 116; Ridl., Fl. Mal. Pen. 5 (1925) 111. Type: *Ridley s.n.* (SING!, holo).

Schismatoglottis calyptrata forma *minor* Engl. in Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 116. Type: Singapore, Bukit Timah, *Engler s.n.* (B, presumed lost).

Stoloniferous herb forming colonies; stems hypogeal, hapaxanthic, with several leaves together; leaves usually dull mid-green, sometimes bivittate grey or spotted (other variegation patterns recorded elsewhere in the range and likely here); blades mostly cordate to sagittate, sometimes oblong-lanceolate with the base cordate; petiole smooth, to *c.* 50 cm long (often less), *c.* 1 cm diam., sheathing for *c.* 1/3 its length, flattened adaxially with the angles rounded to sharper and sometimes minutely alate distally; wings of sheath to c. 1 cm wide, persistent, membranous, straight to slightly inrolled, tapering and fully attached to very shortly (1–2 mm) ligulate; anterior lobe *c.* 13–25 cm long, widest at the base or *c.* 1/3 along its length, *c.* 7–18 cm wide; primary lateral veins 10–15 per side diverging at 45–70°, nearly always raised adaxially towards the midrib, marginally impressed, entirely raised abaxially, sometimes branched; interprimary veins irregularly present; secondary and tertiary venation inconspicuous; posterior lobes rounded to rather sharply triangular, *c.* 2.5–10 cm long. Inflorescences 1–8 together, with a strong esteric odour at female anthesis; exposed part of peduncle short, rarely to *c.* 10 cm, erect at anthesis, then deflected; spathe to *c.* 12 cm long; lower spathe narrowly ovoid, c. half the length of the whole spathe, green, often minutely longitudinally ridged and asperous; limb separated from lower spathe by an abrupt constriction corresponding to the base of the male zone of the spadix, at female anthesis much inflated, narrowing and turbinate, the apex conspicuously mucronate, completely surrounding the spadix and gaping ventrally or with the margins loosely overlapping, creamy to pale greenish-yellow, caducous immediately after female anthesis; spadix *c.* 3/4 the length of the spathe, narrowly horologiform; female zone about half the length of the whole spadix, sessile, somewhat to markedly obliquely inserted to partially adnate to spathe, *c.* 5–8 mm diam. below, distally tapering to *c.* 3–4 mm diam.; pistils pale green, very numerous, *c.* 1 mm tall, flask-shaped and close-packed below, distally becoming more widely spaced and subglobose, finally rather widely scattered and squashed by the constricting spathe; interpistillar staminodes white, mostly conspicuously taller than pistils, few in number, scattered, stalked, clavate; sterile zone between male and female zones absent save sometimes for a relative concentration of interpistillar staminodes amongst the distal pistils; male zone narrowly obconic, approximately half the length of the female zone, distally *c.* 1 cm diam., ivory; anthers dumbbell-shaped from above, *c.* 0.5 × 1 mm, with thecae apically impressed; pollen shed through apical pores, dusty; appendix bullet-shaped to hemispherical, basally nearly always somewhat wider than apex of male zone, creamy yellow; staminodes of appendix columnar, irregularly polygonal in cross-section, *c.* 0.5 mm diam.; fruiting spathe declinate, urceolate.

DISTRIBUTION. Tropical southwestern China to Indo-China and throughout Malesia, east to Vanuatu, in lowland and lower montane rain forest and forest margin in both wet and well drained sites, from sea level to *c.* 1700 m alt.

Selected other specimens seen (this species has been collected on a great many occasions):

PENINSULAR MALAYSIA. Perak, Bukit Larut, *Boyce* 687 (K, KEP); Penang, Waterfall, *Curtis* 2828 (K, SING); Trengganu, Bukit Bauk Forest Reserve, *Hardial Singh* 5 (SING); Selangor, Langat, Ulu Lui, *Hassan-Kasim s.n.* (SING); Perlis, Bukit Bintang, nr Kangar, *Hay et al.* 9013 (distr. ex cult. Hort. Reg. Bot. Sydney, Acc. No. 940058); Selangor, Gombak Valley, *Hay et al.* 9042, 9056 (distr. ex cult. HRBS, 940086, 940100); Perak, foothills of G. Bubu, *Hay et al.* 9129 (distr. ex cult. HRBS, 940125); Negeri Sembilan, Jaram Toi Recreation Area, *Hay et al.* 9155 (distr. ex cult. HRBS, 940151); Perak, Bukit Larut, *Hay et al.* 9087, 9088, 9089, 9090 (distr. ex cult. HRBS, 940181, 940182, 940183, 940184); Terengganu, Ayer Terjun, Sekayu F.R., *Hay et al.* 9217, 9238, 9239 (distr. ex cult. HRBS, 940285, 940306, 940307); Pahang, The Gap, Semangoh Pass, *Hay et al.* 9272 (distr. ex cult. HRBS, 940339); Pahang, Bukit Fraser, *Hay et al.* 9273, 9292 (distr. ex cult. HRBS, 940340, 940359); Pahang, Kuala Tembeling, *Holttum* 20536 (SING); Johor, G. Pulai, *Maxwell* 81-8 (SING); Kelantan, Kuala Relai, *Mohd. Nur* 10227 (SING); Negeri Sembilan, Perhentian Tinggi, *Ridley s.n.* (SING); Perak, *Scortechini* 622a (CAL, K, SING). **SINGAPORE.** Bukit Timah, *Ridley s.n.* (SING).

Putative hybrid with *S. wallichii*:
PENINSULAR MALAYSIA. Negeri Sembilan, Jaram Toi Recreation Area, *Hay et al.* 9159 (distr. *ex* cult. HRBS, 940155).

Apparently no material of *Calla calyptrata* was preserved by Roxburgh. However, he had a drawing made (No. 1661 (K!, CAL)) and he also cited *Arisarum esculentum* Rumph. as a synonym. The lectotype, Rumphius' plate of *Arisarum esculentum*, is stylised, nevertheless it does clearly represent a *Schismatoglottis*: parallel leaf venation, caducous spathe limb and wings of the leaf sheath adnate to the petiole (cf. the free-ligulate sheath in, e.g., *Piptospatha* and a few *Schismatoglottis* spp.). In addition, the plant figured is clearly stoloniferous, the leaf blades are ovato-sagittate, the stem is hypogeal without evidence of renewal growth and the spathe limb is broadly inflated. Hence the illustration accords with *S. calyptrata* in the current sense. However, the representation of the spadix is inadequate for unequivocal distinction of the species in a genus in which vegetative features may vary greatly and reproductive differences are often quite narrow. The other candidate for selection as lectotype, Roxburgh's above-mentioned drawing, is also rather stylised and inadequate for precise identification. It includes a somewhat rudimentary analytical drawing of the spadix, a pistil and a stamen, but it erroneously (for any species of *Schismatoglottis*) represents the primary leaf venation as joined intramarginally and the stem as a tuberous rhizome with the leafy crown subtended by cataphylls as though the plant was a deciduous geophyte. To define the application of the name unequivocally, an epitype (Art. 9.7, Tokyo Code) is required, conforming with the sense in which the name is generally applied. It seems desirable, though not imperative, that this should be selected from Amboina material if possible, since Roxburgh based his description of *Calla calyptrata* on living material cultivated at Calcutta obtained from that island. The only adequate specimen that I have seen of this species collected in Amboina is that of Zippelius (*s.n.*; L!). However, I shall forbear to select an epitype until I have seen material of

Robinson's Pl. Rumph. Amb. 112 (see Merrill, 1917), which may be more widely distributed than the Zippelius specimen.

The distinctive (in Peninsular Malaysia) dome-shaped appendix and obconic male zone are also found in a number of Bornean and Javan species with distinct ecology and vegetative morphology and does not, on its own, serve to identify this species. It is distinguished by these features together with the stoloniferous habit, the dull green leaves in which the primary lateral venation is usually faintly raised on the adaxial side, especially near the midrib. The interpistillar staminodes are significantly taller than the pistils in Malaysian material, whereas in the eastern part of the range, e.g., in New Guinea, the interpistillar staminodes approximately equal the pistils in height.

A few specimens occur which are intermediate between this species and *S. wallichii* (e.g., Hay *et al.* 9159). In the latter species, the sterile and male zones of the spadix are in reverse order to that in *S. calyptrata*, so that there is no appendix (though there may be a very small terminal cluster of staminodes at the spadix apex). In the intermediate specimens, the male zone is longer than in *S. calyptrata s.s.* and is separated from the female by a narrow zone of staminodes of the type found in the appendix of *S. calyptrata* and the sterile zone in *S. wallichii s.s.* The appendix is much shorter, and the distal portion of the spadix is rather narrowly clavate: i.e., intermediate between the more or less cylidrical spadix of *S. wallichii* and the abruptly clavate one of *S. calyptrata* and without the slight but abrupt difference in width between the male zone and appendix of the latter species. Occasional specimens are also found in which the structure of the spadix is typical for *S. calyptrata* except for a very short sterile zone between the male and female zones; these have been determined as *S. calyptrata*, but if hybridization has taken place with *S. wallichii*, they may suggest that some introgression is occurring. Cytological investigation and experimental crossing are required to confirm whether or not these species are genetically isolated. The descriptions of both *S. calyptrata* and *S. wallichii* presented here are based on material adjudged to be broadly "typical".

The forms and varieties listed above in synonymy are those which have been applied to leaf variegants among Peninsular Malaysian material. There are additional ones from other parts of the range. Though they are circumscribable, none is formally maintained here since, as noted in the introduction, a great many species of *Schismatoglottis* show the same or a very similar, possibly homologous range of variegation patterns and to recognise forms in one species would demand that they be erected for dozens more. Instead, variation in variegation patterns has been incorporated into the species decriptions as being a characteristic at species level.

Burkill (1935) cited reports that the "root" and leaves are edible.

S. cordifolia was distinguished by Ridley (1911) on the grounds of its narrow leaf shape and the "[male] flowers with more sinuous margins than in *S. calyptrata*". The former character

is of no significance, the range of leaf form in *S. calyptrata* being great. The latter character appears to have more to do with the stage of ripeness of the anther thecae than with a taxic difference in morphology. *S. longipes* Miq. was placed in the synonymy of *S. calyptrata* by Engler & Krause (1912). I have not yet had the opportunity to confirm that this is correct. However, the Malayan material determined as *S. longipes* by Hooker (*loc. cit.*; *Scortechini 622a*) is clearly *S. calyptrata* with slightly longer than usual peduncles, so I have included only *S. longipes sensu* Hook.*f.* as a synonym for the present. *S. calyptrata* var. *picta* (Schott) Hallier *f.* was based on *S. picta* Schott, in turn based on material from Java. The type of *S. picta* may be conspecific with *S. calyptrata*, though this is yet to be verified. Nevertheless Malayan material cited under var. *picta* by Ridley (*ll.cc.*) is clearly *S. calyptrata*. Ridley (1907: 31) attributed the varietal name "*albidomaculata*" to Hallier (1898: 621). This name appears at the rank of *forma* there, while var. *albidomaculata* Hallier *f.* had only appeared invalidly as a *nomen nudum* in Hallier (1897: 260). I conclude that valid var. *albidomaculata* is attributable to Ridley (1907: 31), based on Hallier's form of the same name. A type has not been located, but it is not a Malayan plant in Hallier's sense.

2. Schismatoglottis wallichii Hook.*f.*, Fl. Brit. Ind. 6 (1894) 537; Ridl., Materials Fl. Mal. Pen. 3 (1907) 33, Fl. Mal. Pen. 5 (1925) 112; Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 98, fig. 63; Henderson, Mal. Wildfl. Monoc. (1954) 232, fig. 137, B,C,D. Type: Malaysia, Perak, *Scortechini* 237b (K!, lecto; SING!, iso-lecto, selected here). (Fig. 2B)

Schismatoglottis wallichii var. *oblongata* Hook.*f.*, *loc. cit.*; Ridl. Materials Fl. Mal. Pen 3 (1907) 33, Fl. Mal. Pen. 5 (1925) 112. Type: Malaysia. Perak, Gopeng, *Kunstler* 4660 (K!, lecto; CAL!, iso-lecto, selected here).

Schismatoglottis wallichii f. *oblongata* (Hook.*f.*) Engl. & Krause, *loc. cit.* p.100.

Schismatoglottis wallichii var. *fasciata* Ridl., Materials Fl. Mal. Pen. 3 (1907) 33, J. Straits Branch Roy. Asiat. Soc. 57 (1910) 112, Fl. Mal. Pen. 5 (1925) 112. Type: Malaysia, Selangor, Pahang Track, *Ridley* 14443 (SING!; holo).

Clump- to colony-forming, usually stoloniferous herb, sometimes with individual crowns markedly distant; stems hapaxanthic, hypogeal, with up to *c.* 5 leaves per module; petiole *c.* 15–45 cm long, smooth, adaxially flattened to somewhat channelled, the angles blunt to somewhat acute but not alate, sheathing in lower *c.* 1/4; wings of sheath persistent, membranous, straight to slightly inrolled, to *c.* 1 cm wide, tapering, fully attached except for *c.* 1 mm ligulate apex; blades very variable in shape, mostly ± oblong-ovate, occasionally broadly ovate to oblong-lanceolate, the base acute to obtuse, more rarely truncate to cordate, mid- to very dark green and dull to somewhat glossy adaxially, paler and dull green abaxially, often variegated with a central dark green strip, bivittate grey-green, spotted yellow-green (observed by me only in Sarawak material), or occasionally with a pale midrib, 30 × 17 cm to 23 × 4 cm to 12 × 5 cm; primary lateral veins impressed

adaxially, prominent abaxially, (6–)10–14 on each side of the midrib, 1.5–3 cm apart, diverging at 30–90°; interprimary veins irregular but conspicuous; secondary venation often very inconspicuous, tertiary venation barely visible; posterior lobes 0–6 cm long. Inflorescences 2–several together, with a powerful esteric odour; peduncle mostly hidden within the subtending leaf sheath, to *c.* 12 cm long; spathe *c.* 8–18 cm long; lower spathe more or less cylindrical at anthesis, green, to 2.5 cm wide; limb (incl. mucro) about equalling the lower spathe in length, ivory to pale yellow, inflated to *c.* 4 cm wide and turbinate at anthesis, slightly gaping or with the margins loosely overlapping, thence abruptly caducous, the interface between the limb and the lower spathe only weakly constricted; spadix to *c.* 12 cm long, sessile, cylindrical to distally subclavate; female zone about half the length of the spadix, obliquely inserted to adnate for *c.* 1/2 its length to the spathe; interpistillar staminodes scattered, narrowly stalked and clavate-headed, about twice the height of the pistils, sometimes also crowded at the interface between the female and sterile zones; ovaries more or less flask shaped. *c.* 1 mm tall; stigma sessile, button-like; sterile zone interposed between female and male zones abruptly but slightly thicker than distal part of female zone, cylindrical, somewhat shorter than (then hidden within lower spathe) to somewhat exceeding (then distally exposed from mouth of lower spathe) the male zone, composed of columnar, flat-topped staminodes markedly dissimilar to interpistilar ones; male zone cylindric with the apex rounded, to somewhat clavate, composed of stamens not aggregated into recognisable "flowers", *c.* 0.7–1 cm diam.; stamens ± rectangular to dumbbell-shaped from above (connective reaching anther apex in the former, not in the latter), the filament slab-like, *c.* 1 mm tall, the thecae impressed apically, the rims interrupted laterally by a narow slit; pollen ivory, dusty; appendix absent or reduced to a small cluster of columnar staminodes at the summit of the male zone apex (but see discussion of putative hybrids under *S. calyptrata*); 2n = 26 (see Petersen, 1989).

DISTRIBUTION. Peninsular Malaysia and Singapore where it is common and widespread in the lowland and lower montane rain forest to *c.* 1500 m alt. It has also occasionally been collected in Sarawak (e.g., at Lundu).

Selected other specimens seen (this species has been collected on many occasions):

PENINSULAR MALAYSIA. Selangor, Ulu Gombak, *Boyce* 675 (K, KEP); Johor, Pulau Tinggi, *Burkill* 917 (SING); Selangor, Sungei Buloh, *Chin & Jacobsen* 3364 (K, L); Selangor, Kuala Lumpur, *Curtis* 2393 (SING); Province Wellesley, Ulu Kubang, *Curtis s.n.* (SING); Pahang, Kemaman, Bukit Kajang, *Corner* 30233 (K, SING); Melaka, Bukit Sadanen Reserve, *Derry* 345 (SING); Trengganu, Bukit Bauk Forest Reserve, *Hardial Singh* 4 (K, L, SING); Pahang, Sungei Yu, *Hardial Singh & Mohd. Nur* 105 (K, SING); Selangor, Gombak Valley, *Hay et al.* 9051, 9054, 9055 (distr. ex cult. HRBS, 940095, 940098, 940099); Negeri Sembilan, Jaram Toi Recreation Area, *Hay et al.* 9159 (distr. ex cult. HRBS, 940155); Johor, G. Panti via Kg. Lukit, *Hay et al.* 9195, 9196, 9198 (distr. ex cult. HRBS, 940263, 940264, 940266); Johor, Kota Tinggi-Mersing Rd., *Hay et al.* 9207 (distr. ex cult. HRBS, 940275); Terengganu, Ayer Terjun, Sekayu F.R., *Hay et al.* 9218,

9219, 9229, 9242, 9244, 9245, 9246, 9255, 9258 (distr. ex cult. HRBS, 940286, 940287, 940297, 940310, 940312, 940313, 940314, 940323, 940326); Pahang, Bukit Fraser, *Hay et al.* 9287 (distr. ex cult. HRBS, 940354); Selangor, Rantau Panjang Forest Reserve, *Hume* 7544 (SING); Negeri Sembilan, Bukit Tangga, *Nur* 11782 (K, SING); Perak, *Scortechini* 237b (K); Perak, Tapah, *Wray* 803 (CAL). **SINGAPORE.** Bukit Timah, *Goodenough s.n.*, *Ridley s.n.* (both SING).

This species is extraordinarily variable in vegetative characters, and it is surprising that there are not more synonyms. Habit ranges from stoloniferous with few-leaved crowns through to clump-forming with multifoliar crowns. Leaf shape varies from cordatosagittate (rare) through sagittate, subtriangular, oblong, ovate-elliptic to oblong-lanceolate. Leaf colour ranges from dark to pale green, variegated yellow-green or grey-green or not, variegated in fasciate or spotted patterns, primary lateral venation widely to narrowly spaced and diverging at low to high angles. The unifying factor is the comparatively constant inflorescence morphology with its very distinctive long sterile zone between the female zone and the male zone which is terminal (though a few staminodes may be present at the very apex of the spadix).

Burkill (1935) cited a report that the "root" is edible.

3. Schismatoglottis brevipes Hook.*f.*, Fl. Brit. Ind. (1894) 538; Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 102, fig. 56. Type: Malaysia, Perak, *Scortechini* 623b (K!, holo) (Fig. 2C)

Schismatoglottis minor Hook.*f.*, *loc. cit.*; Ridl., Materials Fl. Mal. Pen. 3 (1907) 32, Fl. Mal. Pen. 5 (1925) 113; Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 105. Type: Malaysia, Perak, *Scortechini* 532b (K!, holo).

[*Schismatoglottis brevicuspis auctt. non* Hook.*f.*: Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 98, *pro parte quoad specim. cit. Curtis s.n.* (Penang, Waterfall), *Ridley s.n.* (Pahang, Tahan R.; Selangor, Petaling), see below].

[*Schismatoglottis scortechinii auct. non* Hook.*f.*: Ridl., Fl. Mal. Pen. 5 (1925) 113, *pro parte quoad S. brevipes in synon.*].

Stem epigeal, pleonanthic, to *c.* 30 cm long, *c.* 8 mm diam., decumbent, creeping to trailing, internodes *c.* 1–3 cm long, with sylleptic renewal growth; leaves 1–6 per module; petiole *c.* 15 cm long, *c.* 3 mm diam., the margins minutely alate and sometimes crisped, slightly asperous, minutely hairy/spinulous (hand lens required), pale green to purplish, sheathing for (50–)65–75% of its length; wings of sheath, at least in upper half, degrading, becoming dark brown and flaking shortly after the emergence of the enclosed leaf, *c.* 5 mm wide, ± straight, tapering, not ligulate; blade (thrice to) twice as long as broad, (elliptic to) ovate,

widest about the mid-point, the base obtuse to rather weakly cordate, the tip acute to weakly acuminate, pale to mid green, slightly glossy to dull, not variegated, usually tinged bronze when young, the margin smooth to weakly undulate; anterior lobe to *c.* 12 cm long; posterior lobes (0–) *c.* 8 mm; primary venation only faintly prominent above, prominent below, diverging from the midrib at 50–70°, *c.* 1 cm apart; interprimary veins present; secondary venation flush adaxially and abaxially, arising from the midrib and the bases of the primary veins; tertiary venation not or faintly visible adaxially, visible abaxially, forming a tesellate pattern. Inflorescences 1–5 together; peduncle to *c.* 5 cm, thin, 2.5 mm diam., erect at anthesis, then dangling; spathe 5.5–7.5 cm long; lower spathe narrow ovoid, to 3.5 cm long, 1.5 cm wide, green; limb persistent until well after anthesis, then deliquescing, lanceolate, acuminate tipped, opening only slightly, the distal portion remaining convolute, with only the ventral part of the male zone exposed; spadix 5–6 cm long; female zone 2–2.5 cm long, ± cylindrical, slightly curved towards dorsal side of spathe, obliquely inserted to adnate for *c.* 1/3 its length; interpistillar staminodes numerous, irregularly distributed, *c.* 1 mm high, larger than the pistils, globular, very shortly stalked, white; pistils c. 0.75 mm diam., globose-polyhedral, pale green, somewhat distant and sometimes patchily distributed; style nil; stigmas globose; interzonal staminodial region 1–1.3 cm long, cylindrical to slightly tapering. 5–8 mm thick, partly naked, consisting proximally of rather crowded structures resembling interpistillar staminodes, distally of scattered groups of much smaller staminodes resembling the stamens; male zone *c.* 1.5 cm long, 5 mm thick, cylindrical to slightly spindle-shaped, the lower part corresponding with the spathe constriction; male flowers not recognizable as such, the zone ostensibly a mass of stamens; filament rather slender, slightly shorter than the thecae; anther 1 mm wide, dehiscing through apical pores; pollen dusty, white; appendix very short, 3–5 mm long, conic; staminodes of appendix columnar, ivory white, *c.* 1 mm diam.; fruiting spathe declinate, urceolate.

DISTRIBUTION. Endemic to Peninsular Malaysia and so far only recorded from Perak in lowland hill forest to *c.* 1000 m alt., in damp places.

Other specimens seen:

PENINSULAR MALAYSIA. Penang, Waterfall. *Curtis s.n.* (SING), *Curtis* 1884 (SING); Pahang, Bentong-Raub boundary, *Furtado s.n.* (SING); Perak, Bukit Larut, *Hay et al.* 9072 (UPM & distr. ex cult. Hort. Reg. Bot. Sydney. Acc. No. 940168), 9075 (distr. ex cult. HBRS, 940171), 9104 (UPM & distr. ex cult. HBRS, 940198); Perak, foothills of Gunong Bubu, *Hay et al.* 9128a (distr. ex cult. HBRS, 942586); Kelantan, base of Bukit Batu Papan, *Henderson* 29562 (SING); Johor, Bukit Tunjok Laut, *Ngadiman* 36933a (SING), 36947 (K, SING), 37088 (SING); Pahang, Tahan R., *Ridley s.n.* (SING); Selangor, Petaling station, *Ridley s.n.* (SING); Perak, Temangoh, *Ridley* 14308 (K, SING); Gua Batu Puteh, *Wray* 1206 (CAL, SING).

The type of *S. brevipes*, which has only the female portion of the spadix and the

corresponding lower spathe, was considered by Ridley (1907) to represent a young plant of *S. scortechinii*. However, it is a clearly distinct and not closely related species. Engler & Krause's (1912) description (based on *Wray* 1206) of a white spathe appears to be incorrect.

S. minor represents a weak, creeping aspect of this species. Plants corresponding with this in cultivation maintain their slender habit and smaller dimensions of their reproductive parts. However, there are linking intermediates to more robust decumbent-stemmed forms in which the inflorescences are substantially larger and with larger ovaries and interpistillar staminodes. In the smaller forms, the lower part of the female zone is adnate to the spathe (to *c.* 1/3 in my observation, not the 1/2 noted by Hooker and repeated by Engler and Ridley), in more robust plants oblique insertion rather than adnation better describes the lower part of the female zone.

4. Schismatoglottis mutata Hook. *f.*, Fl. Brit. Ind. 6 (1894) 538; Ridl., Materials Fl. Mal. Pen. 3 (1907) 32, Fl. Mal. Pen. 5 (1925) 111; Engl., Pflanzenr. 55 (IV.23Da) (1912) 110; Henderson, J. Malayan Branch Roy. Asiat. Soc. 5 (1927) 275, J. Malayan Branch Roy. Asiat. Soc. 17 (1939) 84; Chin, Gard. Bull. Sing. 35 (1982) 182. Type: Malaysia, Perak, Bukit Larut, *King's Collector* 4443 (K! lecto, CAL! isolecto; selected here). (Fig. 2D)

Schismatoglottis ridleyana Engl., Pflanzenr. 55 (IV.23Da) (1912) 116. Type: Perak, Bukit Larut, *Curtis* 2076 (SING!, lecto; selected here).

Schismatoglottis linguiformis Engl., Pflanzenr. 55 (IV.23Da) (1912) 93; Ridl., Fl. Mal. Pen. 5 (1925) 112. Type: Malaysia, Perak, *Scortechini* 1197 (CAL!, holo).

Rather slender to moderately robust erect herbs *c.* 0.35–1.1 m tall; stem epigeal, pleonanthic, *c.* 2–4 cm thick, in the upper part often clothed with the remains of old leaf bases, the lower part naked as these rot; internodes *c.* 1–4 cm diam., often with conspicuous rather thick roots; leaves *c.* 5 per module, very variable in size; petiole *c.* 20–45 cm long, smooth to very faintly asperous to minutely velvety-hairy (hand lens), adaxially flattened to slightly channelled with the angles rounded to distally inconspicuously alate, pale green to bright dark red, sometimes somewhat glaucous (due to minute hairs, not wax), sheathing in the lower 1/3–3/5; wings of sheath membranous, deliquescent/marcescent ± immediately after emergence of leaf within; blade broadly to narrowly ovatosagittate, somewhat glossy bright mid-green to dull mid-green, usually bronze-tinged to pink when newly emerged; anterior lobe *c.* 12 × 7–40 × 30 cm, widest from at the base to about 1/3 along midrib, the tip acute to shortly acuminate; primary venation 9–15 per side, sometimes branched, diverging at *c.* 50–70°, impressed adaxially, prominent abaxially; interprimary veins rather conspicuous and raised abaxially, impressed adaxially; secondary venation flush with lamina and mostly inconspicuous; tertiary venation inconspicuous; posterior lobes prominent, always forming a rather deeply cordate blade base, *c.* 3–12 cm long, triangular to rounded and sometimes almost overlapping across the sinus; posterior costae sometimes

clearly differentiated for a few millimetres before dividing into primary venation of posterior lobes, occasionally naked in the sinus for 2–3 mm, more usually with lamina to the sinus and occasionally sub-peltate; inflorescences 2–several together on rather short slender peduncles which sometimes flop out of the subtending leaf sheath or cataphyll as these deliquesce/marcesce; spathe *c.* 7–15 cm long; lower spathe *c.* 1/3 the length of the whole, ovoid to subglobose at female anthesis, green to red to bright pink (correlated with petiole colour); spathe limb narrowly lanceolate, clasping the spadix, barely opening at anthesis, thence closing again and temporarily persistent, eventually marcescent or breaking away after senescing, yellowish ivory to pale orange to bright pink; spadix ± cylindrical-tapering, subequalling the spathe, sessile, obliquely inserted; female zone *c.* 1/3 the length of the spadix, cylindric, *c.* 8–10 mm diam. at base, slightly tapering distally; interpistillar staminodes very sparsely to irregularly densely distributed amongst the ovaries, but usually concentrated at the very base of female zone, stalked and clavate-headed, somewhat taller than and conspicuously larger than the pistils; immediately distal to female zone a somewhat complex 1–2 cm long sterile interstice composed of basal sessile interpistillar staminodes, then a concentration of smaller sessile staminodes, these becoming distant distally in small groups of commonly 2–4 surrounded by naked spadix tissue, these then usually concentrated again in an incomplete ring adjunct to the male zone; male zone ± cylindrical, *c.* 1.3–3.3 cm long; stamens not aggregated into "flowers", small, rectangular-dumbbell-shaped from above, 0.5 × 1 mm, with the thecae impressed, dehiscing by apical pores; pollen ivory, dusty; appendix exceeding to shorter than the male zone, *c.* 1.5–3 cm long, tapering and pointed to cylindric and round-tipped, basally the same diameter as the male zone, rarely narrowly ovoid, composed of columnar flat-topped staminodes; fruiting spathe declinate, narrowly ovoid.

DISTRIBUTION. Thailand and widespread in Peninsular Malaysia from the lowlands to *c.* 1500 m alt. Lowland rain forest to lower montane forest; sometimes on limestone in wet places.

Other specimens seen:

PENINSULAR MALAYSIA. Perak, Bukit Larut, *Boyce* 689 (K, KEP); Perak, Kuala Kangsar, *Boyce* 708 (K, KEP); Penang, Moniots Rd, *Burkill* 2678 (SING); Pahang, Bukit Fraser, *Burkill & Holttum* 8696 (SING); Selangor, Ulu Gombak, *Croat* 53310 (K); Penang, Moniots Rd, *Curtis s.n.* (SING); Perak, Sungei Batang Padang, Tapah Hill reserve, *Furtado* 33097 (K, SING); Selangor, Gombak Valley, *Hay et al.* 9042 (distr. ex cult. Hort. Reg. Bot. Sydney, acc. no. 940086); Perak, Bukit Larut, *Hay et al.* 9087, 9088 (distr. ex cult. HRBS 940181, 940182); Perak, foothills of Gunung Bubu, *Hay et al.* 9128, 9134 (distr. ex cult. HRBS 940124, 940130); Negeri Sembilan, Bukit Tangga, nr Jelebu, *Hay et al.* 9146, 9147 (distr. ex cult. HRBS 940142, 940143); Negeri Sembilan, Jaram Toi Recreation Area, *Hay et al.* 9155 (distr. ex cult. HRBS 940151); Terengganu, Ayer Terjun, Sekayu F.R., *Hay et al.* 9223, 9238, 9239 (distr. ex cult. HRBS 940291, 940306, 940307); Pahang, Bukit Fraser, *Hay et al.* 9273, 9275 (distr. ex cult. HRBS 940340, 940342); Perak, Batang Padang,

Henderson 10890 (K); Perak, Lubok Tamang, *Henderson* 10892 (SING); Pahang, Cameron Highlands, No. 4 Camp, *Henderson* 11079 (SING); Pahang, Bukit Fraser, *Henderson* 11270 (SING); Pahang, Bukit Fraser, *Henderson* 11464 (SING); Pahang, Cameron Highlands, Robinson Falls, *Henderson* 17979 (SING); Pahang, base of Kota Gelanggi, *Henderson* 22427 (K, SING); Pahang, Cameron's Highlands, *Henderson* 23353 (CAL); Negeri Sembilan, Ulu Brudok Forest Reserve, *Holttum* 9878 (SING); Terengganu, G. Padang, *Kiah & Moysey* 33942 (SING); Pahang, Bukit Fraser, *Mohd. Nur* 11283 (K); Perak, Bukit Larut (Maxwell's Hill), *Mohd. Nur* 12932 (SING); roadside Thaiping to Maxwell's Hill Station, *Nicolson* 1090 (SING); Kuala Lumpur-Bukit Fraser Highway, *Nicolson* 1162 (L, SING); 15th Mile, Pahang Rd, *Ridley* 8487 (CAL); Selangor, Gua Batu, *Ridley s.n.* (SING); Selangor, Genting Peras, *Ridley s.n.* (SING); Pahang, Telom, *Ridley s.n.* (SING); Selangor, Bukit Kutu, *Ridley s.n.* (SING); Perak, *Scortechini* 267 (K); Selangor, Ulu Gombak, *Symington* 20504 (KEP); Gua Panjang, Ulu Kelantan, *UNESCO Limestone Expedition (1962)* 528 (K, L).

As interpreted here, this is a highly variable species or a species complex which more intensive field study may resolve into further taxa. *S. ridleyana* represents a usually rather robust form with dull green broad leaves with rather prominent and close-spaced primary lateral veins and a fine dense velvety indumentum on the petioles and abaxial midrib. The new leaves are often a rather bright pink. It is common at mid-elevation on Bukit Larut. *S. linguiformis* is a less robust, narrow-leaved aspect. Forms occur with shiny pale green leaves (pale bronze when young) and more delicate forms with deep red stems and petioles (leaves bronze when young) and orange-yellow spathes. The indumentum on the leaves is commonly reduced (with intermediate states) to minute finely scattered excrescences on the petiole and midrib surface which may appear glabrous to the naked eye. The inflorescence is variable as to overall size, and in particular the relative length of the appendix and male zone. The unifying features are the narrow, shortly persistent, hardly opening spathe limb, the part-naked interval between the male and female zones, the rather to very robust more or less erect stem, deeply cordate leaves and deliquescent leaf sheath.

In Peninsular Malaysia, this species is closely allied to *S. brevipes* (*q.v.*) which differs in its much smaller size, creeping stem, usually not cordate leaf bases, green spathe limb and relatively much larger interpistillar staminodes. Further afield, it appears that *S. mutata* is closely allied to species such as *S. latifolia* Miq. (Java, Philippines, Sulawesi, *fide* Engler, 1912), *S. treubii* Engl. (Sumatra) and possibly others. It is possible that, on revision, these will merge as a widespread West and Central Malesian species, if the Peninsular Malaysia aspect cannot be fragmented.

5. Schismatoglottis scortechinii Hook. *f.*, Fl. Brit. Ind. 6 (1894) 537; Ridl., Materials Fl. Mal. Pen. 3 (1907) 32, Fl. Mal. Pen. 5 (1925) 113; Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 100. Type: Malaysia, Perak, *Scortechini* 148 (K!, holo; CAL!, iso). (Fig. 2E)

Schismatoglottis kingii Engl. in Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 97, fig. 62, J. Type: Malaysia, Johor, *King s.n.* (CAL!, holo).

Schismatoglottis marginata Ridl., J. Bot. 40 (1902) 36, Materials Fl. Mal. Pen. 3 (1907) 34; Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 89; *nom. illeg., non Schismatoglottis marginata* Engl., Bull. Soc. Tosc. Ortic. 4 (1879) 298 [i.e. *Piptospatha marginata* (Engl.) N.E. Br., Bot. Mag. 51 (1895) descr. ad t. 7410 (Borneo)]. Type: Malaysia, Pahang, Tahan woods, *Ridley s.n.* (SING!, holo).

Stem epigeal, pleonanthic, erect to decumbent or creeping, to *c.* 20 cm long, 1–2 cm thick, internodes 0.5–1 cm long, not freely rooting except when in contact with soil, renewal growth sylleptic but sometimes delayed by protracted inflorescence production; leaves 1–5 per module; petiole 10–30 cm long, 5–7 mm thick with the margins narrowly but distinctly alate and the wing crisped (rarely hardly alate), rough and longitudinally slightly ridged, dull mid-green, sheathing for about 1/3 its length; sheath persistent, membranous, the wing to *c.* 0.7 cm wide, spreading to slightly inrolled, the apex asymmetrically and bluntly ligulate for *c.* 0.7 cm, rarely the sheath tapering and fully attached throughout its length; blade c. 2–3 times as long as wide, elliptic to oblong to ovate, widest at around the mid-point, the base acute to obtuse to weakly cordate, the anterior lobe 15–30 cm long, grey-green to yellow-green to mid-green, not glossy, variegated spattered, bivittate or vittate in shades of grey-green or yellow-green; primary venation flush to more usually somewhat impressed adaxially, prominent adaxially, diverging at 45–90° with strongly acroscopic to flattened wide courses, 1–2 cm apart; interprimary veins present; secondary venation flush adaxially and abaxially, originating on the midrib and lower parts of the primary veins; tertiary venation inconspicuous; posterior lobes, if present, to *c.* 1.2 cm long. Inflorescences 1–8 together, with a strong sweet esteric odour at anthesis, turning dark brown in spirit; peduncle *c.* 5 cm long, *c.* 4 mm thick but thickening distally into the spathe base, erect at anthesis, then deflected; spathe 6–10 cm long; lower spathe narrowly ovoid to rhomboid in outline, 2–3.5 cm long, 1–1.5 cm wide, green; limb separated from lower spathe by an abrupt constriction, membranous, pale grey-green at first, broadly oblong with the tip mucronate, opening cowl-like, sometimes more so at the base than the apex, revealing the whole appendix and the distal part of the male zone, then deciduous, turning dirty dark grey and dying as it falls; spadix 5.5–9.9 cm long; female zone 1.5–2 cm long, ± conic, c. 1 cm thick, obliquely inserted; interpistillar staminodes (absent to) few to frequent, scattered, slightly taller than the pistils, the tops button-like, irregularly rounded-polygonal, white, *c.* 0.5 mm diam.; pistils *c.* 1.5 mm high, *c.* 1 mm diam., pale green, stigmas sessile, very flat and contiguous, somewhat impressed centrally; interzonal staminodial region torus-shaped, slightly thicker than both female and male zones, about 3–4 mm long, composed of two types of staminodes either of which may predominate or they are equally represented – proximally a crowd of structures more or less identical with the interpistillar staminodes, distally a crowd (or ring) of structures more or less identical with the staminodes of the appendix (see below); male zone 0.6–1 cm long, 4–6 mm thick, cylindric, ivory, narrower than the female zone and markedly narrower than the lower part of the appendix,

corresponding with the constriction of the spathe; male flowers (1–)2–3-staminate, the anthers trapezioid to triangular from above, terminal on slab-like filaments, opening by apical pores; pollen white, extruded in very fine filaments; appendix very large, 3–6 cm long, 0.8–1 cm thick, subcylindric, tapering, rather blunt-tipped; staminodes columnar, flat-topped, sometimes centrally impressed, in groups of 2–5, *c.* 1 mm diam., yellowish ivory to pale orange; fruiting spathe declinate, urceolate, dehiscing from the base; fruits greyish.

DISTRIBUTION. Endemic to Peninsular Malaysia, in lowland rain forest and lowland hill forest, mostly on the slopes of gulleys.

Other specimens seen:

PENINSULAR MALAYSIA. Selangor, Ulu Gombak Forest Reserve, *Boyce* 672 (K, KEP); Perak, Gopeng, base of G. Chanteh, *Furtado s.n.* (SING); Pahang, Bentong-Raub boundary, *Furtado* 33105a (K, L, SING); Pahang, Bentong, *Furtado* 33112 (K); Selangor, Gombak Valley, *Hay et al.* 9049 (distr. ex cult. Hort. Reg. Bot. Sydney, acc. no. 940093), 9052 (distr. ex cult. HRBS, 940096); Johor, Kota Tinggi- Mersing Road, *Hay et al.* 9205, 9206 (distr. ex cult, HRBS, 940273, 940274); Terengganu, Ayer Terjun, Sekayu F.R., *Hay et al.* 9220, 9224, 9230, 9231, 9232, 9235, 9236, 9237, 9254, 9257 (distr. ex cult. HRBS 940288, 940292, 940298, 940299, 940300, 940303, 940304, 940305, 940322, 940325); Johor, G. Beridong, *Holttum* 10969 (SING); Johor. Labis, Sg. Juasseh towards Sg. Ulu Kemidak, *Md. Shah* 2304 (SING); Selangor, Ulu Gombak, *Md. Nur* 34216 (SING); Selangor, Kanching forest, 3 mi SE of Rawang, *Melville* 4752 (K); Perak, Bujong Malacca, *Ridley s.n.* (SING); Selangor, Klang Gates, *Ridley s.n.* (SING); Selangor, Kuala Lumpur, Weld Hill, *Ridley s.n.* (K); Perak, Gua Batu Puteh, *Wray* 1201 (CAL, SING).

Spirit material of this species characteristically blackens.

S. kingii is based on a sterile plant which appears to match *S. scortechinii* well in leaf shape, petiole/blade ratio and in the channelled petiole with adaxial crisped wing. *S. marginata* Ridl. is a rather narrow-leaved aspect of *S. scortechinii* and does not appear to differ significantly in any other respect.

S. scortechinii is not closely related to other Peninsular Malaysian species, and not obviously close to any other species in the genus. Nevertheless there are similarities which suggest it is related to Bornean species including *S. asperata* Engl., *S. barbata* Engl. and *S. ferruginea* Merr. The petiolar epidermis is rough with protuberant epidermal cells which here and there agglomerate into minute multicellular pustules. Elaboration of the petiolar epidermis occurs also in *S. asperata* where there are very numerous minute recurved multicellular spinules and in *S. barbata* and *S. ferruginea* where the stem, petioles and sometimes the spathe base are covered with numerous lanceolate scale-like multicellular hairs. The leaves in this group tend to be oblong to obovate/oblanceolate and the stems are consistently epigeal.

This species is variable within and between populations. For example, the species' entire range of leaf shape, variegation and venation pattern is found in the population I collected from at Ayer Terjun, Sekayu Forest Reserve (Terengganu). Populations at Gombak and in Johor along the Kota Tingi-Mersing road have greyer leaves which are bright pink when young. The interzonal staminodial region varies from being comprised almost entirely of structures resembling interpistillar staminodes (recognized by their colour, diameter, height and reaction to alcohol) in the Gombak population, while in the Sekayu population the interzonal staminodial region is comprised either of structures resembling (by their different colour, lower height, greater diameter and darkening reaction to alcohol) staminodes of the appendix or a mixture of both kinds segregated longitudinally. While it is conventional to refer to interpistillar structures, interzonal structures and structures of the appendix as staminodes in this and other groups (e.g., Colocasieae), this would appear to be labelling as identical structures of somewhat differing homology.

6. Schismatoglottis brevicuspis Hook.*f.*, Fl. Brit. Ind. 6 (1894) 537; Ridl. Materials Fl. Mal. Pen. 3 (1907) 33, J. Straits Branch Roy. Asiat. Soc. 57 (1910) 113, Fl. Mal. Pen. 5 (1925) 113; Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 98, *pro parte excl. specim. cit.* Curtis (Penang, Waterfall), Ridley (Selangor, Petaling; Pahang, Tahan River), [i.e. *S. brevipes* Hook.*f.*, *q.v.*]. Type: Malaysia, Perak, *Scortechini* 612 (K!, holo; CAL!, SING!, iso). (Fig. 2F)

Stem epigeal, pleonanthic, decumbent, rooting in the internodes, dull dark green, *c.* 2 cm diam.; renewal growth sylleptic, leaves 3–4 per module; petiole 5–25 cm long, to 6 mm diam., with the margins sharp to minutely winged, minutely hairy and faintly rough, deep dull green; sheath 50–75% of the length of the petiole, the wings membranous, persistent, eventually marcescent, straight, completely attached to petiole, tapering; blade pale green when young, later slightly glossy dark green adaxially, paler abaxially, not known to be variegated, somewhat chartaceous, broadly ovate to oblong ovate, to *c.* 20 cm long, base obtuse to auriculate, tip acute, rather abruptly acuminate for *c.* 1–2 cm, margin irregularly wavy; primary lateral veins numerous, slightly prominent adaxially near the midrib, the rest flush, prominent abaxially, *c.* 1 cm apart, diverging at 60–80°; secondary venation flush abaxially and adaxially, emerging from the midrib and the basal parts of the primary veins; tertiary venation forming a distinct tessellate pattern abaxially. Inflorescences 1–3 together, often smaller ones produced on somewhat reduced lateral leafy, occasionally only cataphyll-bearing, shoots following flowering of the main axis; peduncle *c.* 4 cm long, 3 mm diam., erect at and after anthesis; spathe 5–12 cm long, conspicuously mucronate for to 2 cm, shiny mid-green throughout, with a resinous odour from the bruised spathe tissue; lower spathe narrowly ovoid to ovoid, 2–4 cm long, 1–2 cm wide; limb narrowly lanceolate, separated from the lower spathe by a rather weak constriction, gaping slightly in the upper part, the lower part (like the lower spathe) convolute, rather leathery, persistent shortly after anthesis but eventually yellowing and deliquescent; spadix 4.5–9 cm long; female zone 1.5–3 cm long, slightly tapering distally, *c.* 8 mm thick, obliquely inserted to adnate for

about half its length; interpistillar staminodes absent or a very few except for a single ring around the spadix immediately below the female zone, stalked, ± flat-topped and irregularly polygonal, about twice the height of the pistils, white; pistils 0.5 mm diam., subglobose with 3–4 conspicuous longitudinal bulges, green; stigma sessile, faintly 3–4-lobed, minutely papillate; interzonal staminodial region 0.5–1 cm long, ± cylindrical, 4–8 mm thick; interzonal staminodes mushroom-shaped, *c.* twice height of pistils, *c.* 1 mm diam., white, resembling the interpistillar staminodes; male zone 1.2–2 cm long, slightly thickening distally (the base corresponding with spathe constriction), 4–8 mm thick, pale yellow, ostensibly a mass of stamens not organised into "flowers", pale yellow; stamens *c.* 1 mm tall, filament slab-like, anther terminal, flat-topped, dehiscing through 2 apical pores; pollen dusty, ivory-white; appendix 1.4–3 cm long, tapering to a point, deeper yellow than the male zone; appendical staminodes columnar, flat-topped, circular to reniform in outline, *c.* 1 mm diam., slightly taller than stamens so that appendix slightly but abruptly thicker than male zone; fruiting spathe erect, rather narrowly urceolate, dehiscing from the base; fruits grey-green.

DISTRIBUTION. Endemic to Peninsular Malaysia, in wet gulleys and among rocks by streams in lowland rain forest and lowland hill forest.

Other specimens seen:

PENINSULAR MALAYSIA. Kedah, G. Bongsu, nr. Terap, *Bogner* 1692 (K); Pahang, Pulau Tioman, Jason Bay, *Burkill* 1042 (K, SING); Pahang, Kemaman, Ulu Ayam, Bukit Kajang, *Corner* 30249e (SING); Selangor, Ulu Gombak, *Croat* 53276 (K); Negeri Sembilan, Beremban Forest Reserve, foot of G. Angsi, *Furtado s.n.* (SING); Perak, Sungei Batang Padang, Tapah, *Furtado* 33096 (SING); Pahang, Raub-Bentong boundary, *Furtado* 33097a (SING); Selangor, Gombak valley, *Hay et al.* 9040 (distr. ex cult. HRBS, 940084); Perak, foothills of Gunong Bubu, *Hay et al.* 9130 (distr. ex cult. HRBS, 940126); Johor, Gunong Ledang (Mt Ophir), *Hay et al.* 9172 (distr. ex cult. HRBS, 940240); Johor, Bukit Tunjok Laut, *Ngadiman* 37088 (SING); Selangor, nr. Klang Gates Reservoir, *Nicolson* 1140; Melaka, Base of G. Mering, *Ridley s.n.* (SING); Selangor, Genting Peras, *Ridley s.n.* (SING); Pahang, Temango, *Ridley* 14308 (CAL).

This species is very distinctive and easily recognisable with its epigeal stem, deep green rather thinly coriaceous ovate leaves with obtuse bases and the tertiary venation forming an easily visible tessellate pattern on the abaxial side of the lamina. The spathe is more or less uniformly green, held down amongst the leaf bases and hardly opening. Not apparently closely related to other species in Peninsular Malaysia; however, several related species occur in Borneo.

In cultivation it was noted (in *Hay et al.* 9172) that stigmas bore pollination drops at the same time as pollen was being shed. However, no fruit was set.

7. Schismatoglottis longifolia Ridl., J. Bot. 40 (1902) 37, Materials Fl. Mal. Pen. 3 (1907) 34, J. Straits Branch Roy. Asiat. Soc. 57 (1910) 113, Fl. Mal. Pen. 5 (1925) 114; Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 89, fig. 58. Type: Malaysia, Perak, Bukit Larut, *King's Collector* 1967 (K!; lecto, selected here). (Fig. 2G)

[*Schismatoglottis rhynchopyle* Prain, ms.].

Clump-forming herbs; stem hypogeal, hapaxanthic, to *c.* 2 cm diam.; leaves *c.* 5 per module; petiole *c.* 25–40 cm long, smooth, somewhat flattened adaxially, with the angles rounded to acute, sheathing in the lower *c.* 1/2; wings of sheath membranous, peristent, to *c.* 1 cm wide, straight to slightly inrolled, fully attached except for *c.* 1–2 mm distal ligulate portion; blades dull to slightly glossy rich mid-green, not variegated, *c.* 25–40 cm long, 5–8 cm wide at widest point, oblanceolate, the base attenuate, the apex shortly acuminate and mucronate for *c.* 1.5–2 cm, the mucro solid; primary venation *c.* 6–8 per side, diverging at an angle of *c.* 35–45°, flush adaxially, barely prominent abaxially, interprimary veins irregularly present, secondary and tertiary venation inconspicuous and flush with the lamina; inflorescences several to *c.* 12 together, on very slender, wiry, suberect peduncles *c.* 12–25 cm long (elongating in fruit), nodding from the apex of the peduncle; spathe to *c.* 6 cm long including the *c.* 1 cm long mucro; lower spathe *c.* 2 cm long, narrowly ovoid, *c.* 0.8 cm diam. at anthesis, mid-green, separated from spathe limb by a rather weak constriction; limb narrowly lanceolate, clasping and slightly gaping at anthesis, then deliquescent-deciduous, pale yellowish green; spadix equalling laminar portion of spathe in length; female zone 1/3–1/2 the length of the spadix, adnate for *c.* 2/3 its length to the spathe, *c.* 5 mm thick; interpistillar staminodes few amongst the ovaries, mainly concentrated into a somewhat interrupted single ring at each of the base and apex of the female zone, slender-stalked, apically narrowly clavate, a little higher than the pistils; pistils globose, rather distant, *c.* 1 mm diam.; stigma punctate, sessile; male zone cylindric, *c.* 1 cm long, 5 mm thick; stamens close-packed, some with filaments partially united forming dimerous to trimerous male "flowers", others solitary; anthers ± dumbbell-shaped from above with the connective forming a slight dome between the thecae; thecae opening through apical slit-like pores; pollen dusty; appendix *c.* 1.5 cm long tapering-cylindric to very narrowly ovoid, *c.* 5mm thick at base, composed of very close-packed columnar flat-topped staminodes *c.* 0.7 mm diam.; fruiting spathe narrowly campanulate, nodding; fruit green.

DISTRIBUTION. Endemic to Peninsular Malaysia and known only from Perak, in lowland rain forest and lowland hill forest, and regrowth, sometimes near streams.

Other specimens seen:

PENINSULAR MALAYSIA. Perak, Tanjong Pondok, *Burkill & Hanif* 13246 (K, SING); Perak, Bukit Larut, *Hay et al.* 9063 (UPM & distr. ex cult. HRBS, 940159); Perak, foothills

of G. Bubu, *Hay et al.* 9125 (distr. ex cult. HRBS, 940121); Perak, Taiping Hill, *Henderson* 10253 (SING); Perak, Taiping, along rd to Maxwell's Hill, *Nicolson* 1069 (SING); Perak, Kuala Temangoh, *Ridley* 14307 (SING); Perak, G. Hijau, *Ridley s.n.* (SING); "Perak Hills", *Ridley s.n.* (K); Perak, Maxwell's Hill, *Ridley s.n.* (SING); Perak, Relau Tujor, *Wray* 1784 (CAL), 2193 (CAL, SING).

A very distinctive and morphologically uniform species easily recognized by the rather numerous nodding inflorescences on (for this genus) very long slender peduncles. Although it does sometimes grow along streams, it is by no means confined to that habitat and in spite of its rather narrowly lanceolate blades is not really a stenophyllous rheophyte. Although not ostensibly restricted to a specialized habitat, this species has proved extremely difficult to keep alive in cultivation.

According to Prain's note attached to the lectotype, material of this species was somehow overlooked when the aroids were being sent to Hooker for the Flora of British India account (Hooker, 1894). Prain proposed the name *S. rhynchopyle* owing to the resemblance (in the nodding inflorescence and narrow leaves) to species of what is now known as *Piptospatha* (syn. *Rhynchopyle*), but it was never published.

Inadequately known species

8. Schismatoglottis penangensis Engl. in Engl. & Krause, Pflanzenr. 55 (IV.23Da) (1912) 88. Type: Malaysia, Penang, 'Balch Poula' [?= Balik Pulau], *Deschamps s.n.* (CAL, holo, not found).

Translated from the Latin, Engler's description reads: "Stem hypogeal; petiole equalling to exceeding half the length of the blade, 8–12 cm long, channelled adaxially, sheathing for 2–3 cm; blade oblong-lanceolate, subequally narrowed on each side, the base running cuneate into the petiole, the apex acuminate; primary veins 4 on each side diverging at *c.* 30° and curving distally, distinctly prominent abaxially; peduncle of infructescence shorter than petiole, 10 cm long; fruiting spathe 2 cm long, 1.5 cm wide, cup-shaped."

Known only from the type.

From the protologue, it is evident that this species is imperfectly known; I have looked for the type at CAL where it was said by Engler (*loc. cit.*) to be, but was unable to find it in either the Type or the General Herbarium. The hypogeal stem and oblong lanceolate blade with cuneate base suggest *S. wallichii* but it differs from that in the rather short cup-shaped fruiting spathe.

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A new Bornean species of *Colocasia* Schott (*Araceae : Colocasieae*), with a synopsis of the genus in Malesia and Australia

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Summary. A synopsis, with key and illustrations, is given of the three species of *Colocasia* (*keladi*, taro) in Malesia and Australia. One, *C. oresbia* A. Hay (Borneo), is new to science. Infraspecific taxa in the Common Taro, *C. esculenta* (L.) Schott, are no longer recognized for either cultivated or wild forms. Krause's confused interpretation of *C. indica* (Lour.) Kunth, in which the current concepts of *Alocasia macrorrhizos* (L.) G. Don and *C. gigantea* (Bl.) Hook.*f.* were partly combined, is clarified. Eighteen binomials and trinomials in *Colocasia* are excluded from the genus. Features are given distinguishing *Colocasia* from *Alocasia* with which it is often confused.

Colocasia is a small, mainly Asian genus of herbs considered to be allied to other Old World, predominantly Asian, genera including *Protarum* Engl. (Seychelle Islands), *Steudnera* K. Koch (Himalaya and Indochina), *Remusatia* Schott (incl. *Gonatanthus* Klotszch (Li & Hay 1992); centred on eastern Himalaya/South East Asia/southern China but distributed to tropical Africa and tropical Australia) and *Alocasia* (Schott) G. Don (Indomalesia to East Asia and warm temperate Australia), all in the tribe Colocasieae (*sensu* Grayum 1990, Hay & Mabberley 1991: Colocasieae *sensu* Bogner & Nicolson (1991) includes only *Alocasia* and *Colocasia*, other above-mentioned genera being placed in allied tribes).

Colocasia is generally thought to be most closely related to, and in Malesia is most often confused with, *Alocasia*. They may be distinguished by the inflorescences arising in a centrifugal sequence radial to the stem in *Colocasia*, while the inflorescences in *Alocasia* are generally paired with each pair orientated more or less tangential to the stem (this arrangement is sometimes somewhat obscured in cases where many inflorescence pairs are produced sequentially without interruption by foliage leaves, e.g., in *A. portei* (Schott)

Becc. & Engl. and *A. scabriuscula* N.E. Br., but a linear radial sequence is not observed). The two genera may be separated on the occurrence of large numbers of ovules on parietal placentas in the ovaries of *Colocasia*, smaller numbers on basal placentas in *Alocasia* and large numbers of very small seeds in *Colocasia* and smaller numbers of much larger seeds in *Alocasia*. Scattered interpistillar staminodes are often found in *Colocasia*, but are not yet recorded in *Alocasia*. *Colocasia* always has peltate leaves which are usually waxy-glaucous while *Alocasia* species usually have non-peltate leaves (though the seedlings are almost always peltate-leaved). Peltate leaves in *Alocasia* display a variety of metallic, rugose, hairy or bullate surfaces, but they are never waxy-glaucous except in *Alocasia robusta* M. Hotta (Sarawak to Sabah) where only the abaxial side is glaucous.

While there is an extreme dearth of information on dispersal biology of Malesian aroids generally, it is notable that Hambali (1979) records the fruits of *C. esculenta* having a distinct smell which "varies from the fragrant smell of *Pandanus amaryllifolius* Roxb. leaves to the sourish smell of acetic acid or to the smell of an overripe pineapple", the latter odour also recorded for *C. gigantea*. The seeds of both species are dispersed by Common Palm Civets in Java, though other dispersers must also be involved, at least on the Marsupial (east) side of Wallace's Line. The fruits of *Alocasia* are always brightly coloured and, as far as I am aware, odourless, suggesting a different dispersal syndrome involving birds. Indeed, it would appear that odoriferous ripe fruits are rare in herbaceous aroids generally, though fairly frequent amongst climbers, where bat-dispersal may be occurring.

COLOCASIA Schott in Schott & Endlicher, Melet. Bot. (1832) 18, [*nom. cons.*; see Dandy in Taxon 18 (1969) 464; *non Colocasia* Link, Diss. Bot. (1795) 55, *nom. rej.*, § *Zantedeschia* Spreng.]. Type species: *C. antiquorum* Schott (*Arum colocasia* L.) [= *C. esculenta* (L.) Schott], *typ. cons.*

About 8 species of mostly East and South East Asian perennial herbs. *Colocasia* includes the now pantropical (and pansubtropical) starch crop taro or *keladi*, *C. esculenta* (L.) Schott (for reviews see, e.g., Chandra 1984, Wang 1983). The range of the wild-type of this species is not known for certain, though recent evidence suggests this may include at least Indochina, Malesia and sporadically in much of tropical Australia.

KEY TO SPECIES OF *COLOCASIA* IN MALESIA AND AUSTRALIA

1. Spathe limb yellow to golden, slightly recurved; fruiting peduncle down-curved; plants in the wild colony-forming, stoloniferous ..... 1. *C. esculenta*
   Spathe limb greenish white to pale creamy yellow, erect; fruiting peduncle straight; plants in the wild solitary to clump-forming, not stoloniferous 2

2. Plants very robust, *c.* 1.5–2 m tall; leaves very glaucous; inflorescences usually several together; appendix vestigial; interpistillar staminodes absent; lowland plants (the Malay Peninsula to Java) ..... 2. *C. gigantea*
Plants less robust, to *c.* 1 m tall; leaves not glaucous (except juveniles); inflorescences usually in pairs; appendix present, interpistillar staminodes present; montane plants (Borneo) ..... 3. *C. oresbia*

Note: Many cultivars of *C. esculenta* are not stoloniferous; these are distinguished from both the other two species by the declinate fruiting peduncle (Shaw 1975: Plate I), from *C. gigantea* by the smaller size and interpistillar staminodes and from *C. oresbia* by the waxy leaf, among other characters.

1. Colocasia esculenta (L.) Schott in Schott & Endlicher, Melet. Bot. (1832) 18. Type: *Arum minus, nymphaeae foliis, esculentum* Sloane, Voy. Jamaica Nat. Hist. (1725) 2: t. 106, f.1 (see Nicolson, 1979: 456). (Fig. 1)

Arum esculentum L., Sp. Pl. (1753) 965.

Caladium esculentum (L.) Vent., Jard. Cels. (1800) t. 30.

Colocasia antiquorum var. *esculenta* Schott *ex* Seem., Fl. Vit. (1868) 284.

Colocasia antiquorum subsp. *esculenta* (L.) Haudricourt, Rev. Bot. Appl. Agr. Trop. 21 (1941) 62.

Arum colocasia L., Sp. Pl. (1753) 965. Type: 1079.4 (LINN) (see Nicolson, 1979: 457).

Colocasia antiquorum Schott in Schott & Endlicher, Melet. Bot. (1832) 18.

Caladium colocasia (L.) W.Wight *ex* Safford, Contr. U.S. Nat. Herb. 9 (1905) 206 [*nom. illeg., non Caladium colocasia* Schott *ex* Wight, Icones 3 (1844) t. 787; i.e. *Alocasia cucullata* (Lour.) G. Don].

Colocasia antiquorum var. *typica* K. Krause, Pflanzenr. 71 (IV.23E) (1920) 66 [*nom. inadmiss.*; Art. 24.3].

Colocasia esculenta var. *antiquorum* (Schott) Hubb. & Rehder, Bot. Mus. Leafl. 1 (1932) 5.

Colocasia antiquorum subsp. *antiquorum* Haudricourt, Rev. Bot. Appl. Agr. Trop. 21 (1941) 62.

Fig. 1. *Colocasia esculenta* (L.) Schott. A wild-type plant, *c.* 1 m tall, at Tambun, near Ipoh, Perak, Peninsular Malaysia (no specimen preserved).

Caladium acre R.Br., Prodr. Fl. Nov. Holl. (1810) 336. Type: R. Brown (BM: not found).

Colocasia acris (R.Br.) Schott in Schott & Endlicher, Melet. Bot. (1832) 18.

Colocasia esculenta var. *acris* (R.Br.) Schott, Syn. Aroid. (1856) 41.

Calla gaby Blanco, Fl. Filip. (1837) 659. Type: based on Blanco's description, with no material preserved; see Merrill (1918:92) where is cited an illustrative specimen (Merrill: Species Blancoanae No. 21; *n.v.*) which may serve as epitype.

Colocasia vera Hassk., Flora 25 (2), Beibl. 1 (1842) 8. Type: *Caladium sativum* Rumph., Herb. Amboin. 5 (1747) t. 109. [Plus (*loc. cit.*) vars. *pallida, minor, atroviridis, rubrinervis, scripta, atrosanguinea* and *lurida*, and in Cat. hort. bot. bog. alt. (1844) 55, vars. *polyrrhiza, viridis, intermedia, monorrhiza* and *variegata*æall *nomina subnuda* and with types not located. An early attempt at enumerating the cultivars of taro in Java.].

Colocasia esculenta var. *aquatilis* Hassk., Pl. Jav. Rar. (1848) 150. Type: *Caladium aquatile* Rumph., Herb. Amboin. 5 (1747) t.110, fig. 1.

Colocasia antiquorum var. *aquatilis* (Hassk.) Krause, Pflanzenr. 71 (IV.23E) (1920) 68.

Colocasia gracilis Engl., Bot. Jahrb. Syst. 1 (1881) 185. Type: Sumatra, Padang Province, Singalan, Beccari P.S. *s.n.* (B!, holo; FI!, iso).

DISTRIBUTION. Pantropical and pansubtropical (in areas with adequate water) through cultivationæthe common taro or *keladi*. The range prior to human distribution is unknown, but may have been widespread from Indochina to southern Japan, through Malesia and northern Australia, corresponding to the present range of "var. *aquatilis*" (see further discussion below).

HABITAT. Wild forms occur as colonies on river banks, in open swampy places, on seepage slopes and on rocks and banks in the splash-zone of waterfalls from the lowlands to *c.* 1700m altitude in the tropics.

Some authors continue to recognise varieties—or subspecies (Haudricourt 1941)—of this species, in particular var. *esculenta* and var. *antiquorum* amongst cultivated forms (not cormelliferous and cormelliferous, respectively), while Nicolson (1979, 1987) considered it hopeless to maintain taxa in such a polymorphic, plastic species. Hasskarl's varietal name "*aquatilis*" has been used (e.g., recently, Matthews 1991, 1995; Matthews *et al.* 1992) to refer to stoloniferous semi-aquatic wild type *C. esculenta*, which had much earlier been described as a separate species in Australia as *Caladium acre* R. Br. (1810). Brown's slips (BM) record that he considered this species to be the wild form of the edible taro. *Caladium acre* was later combined by Schott (1832) into *Colocasia acris* and then reduced to varietal

rank in *C. esculenta* (Schott 1856); however, Hasskarl's name has priority at varietal rank. This wild-type, which is characteristically highly acrid [see Tanimoto *et al.* (1982)—but not there with this varietal name], is quite distinctive and is found from southern Japan south to throughout Malesia and sporadically in tropical Australia. A range of recent evidence including ribosomal DNA analysis (see Matthews 1990, Matthews & Terauchi 1994) suggests that the wild types in New Guinea and Australia, which have often been assumed to be escapes from cultivation following introduction from tropical Asia, may well be indigenous [see also Carson & Okada (1980)—endemic *C. esculenta*-specific flies in New Guinea; Coates *et al.* (1988); Spriggs (1982)]. Since these appear to form a naturally occurring morphological and ecological "entity", it might seem desirable to recognise the wild-type formally as an infraspecific taxon. However, the occurrence of wild-type phenotypes of taro in Polynesia (e.g., *C. esculenta* "Nokanoka"; see Wilder 1931:27) where there is universal agreement that the species is introduced by humans (see Matthews 1995), suggests that the wild-type can eventuate by "reversion to type" on escape from cultivation. The wild-type as a taxon would therefore be derived polyphyletically both from its wild-type ancestor and from cultivated forms. Since recognising the wild-type as a taxon would require the cultivated forms to be recognised as at least one other taxon at the same rank, and since the cultivated forms are very probably derived from the wild-type several times (cf. Coates *et al.* 1988, Hotta 1983), there would be erected a classification in which two (or perhaps more) taxa were polyphyletically interderived and mutually paraphyletic. It is logical formally to recognise only a single taxon, *C. esculenta*, in which cultivars and informal "wild-type(s)" are recognized (cf. Mabberley 1984; see also Burtt 1970). Enumerating the cultivars of *C. esculenta* is an enormous and specialised task beyond the scope of this paper (see, e.g., Whitney *et al.* 1939).

Colocasia gracilis Engl. appears to be no more than a depauperate form of wild-type *C. esculenta*. For shoots to flower before achieving adult size is a common occurrence in herbaceous aroids.

2. Colocasia gigantea (Blume) Hook.*f.*, Fl. Brit. Ind. 6 (1893) 524. Type: Indonesia, Java, *Blume s.n.* (L!, holo). (Fig. 2)

Caladium giganteum Blume, Catalogus (1823) 103.

Leucocasia gigantea (Blume) Schott, Oesterr. Bot. Wochenbl. 7 (1857) 34.

[*Colocasia indica auct. non* (Lour.) Kunth: Krause, Pflanzenr. 71 (IV.23E) (1920) 69, *pro parte quoad Caladium giganteum* Blume, *Leucocasia gigantea* (Blume) Schott & *Colocasia gigantea* (Blume) Hook.*f. in synon. & quoad* fig. 11, *excl.* fig. 11A, *habitus* (i.e., *Alocasia odora* (Roxb.) K. Koch, see below)].

Fig. 2. *Colocasia gigantea* (Blume) Hook.*f.* An immature plant, *c.* 1.5 m tall, at Bogor, Indonesia (no specimen preserved).

?*Colocasia indica* var. *pallida* Hassk., Flora 25 (2), Beibl. 1 (1842) 8. Type: none designated; this variety was based on Rumphius' very short description of a third "species" of *Arum indicum sativum* Rumph., Herb. Amb. 5 (1747) 308. This is effectively a *nomen subnudum* which Furtado (1941) thought may have referred to *C. gigantea*. It is either this or a form of *Alocasia macrorrhizos* (L.) G. Don. The matter can be settled by the designation of an epitype.

DISTRIBUTION. Native from southern China and Indo-China to the Malay Peninsula, Sumatra and Java. Matthews (1991) noted records from southern Japan, and has indicated (pers. comm.) that it is widely cultivated in temperate and subtropical Japan as a summer crop, but that it is nowhere wild there. Sastrapradja & Rijanti (1972) referred to a Sumatran cultivar. Sastrapradja & Hambali (1979) note the occurrence of this species in Kalimantan, but I have not seen any material from there myself, nor from Malaysian Borneo nor Brunei.

HABITAT. In the Malay Peninsula, mainly (but not exclusively) on limestone. Chin (1982) noted that it tolerates extreme exposure and has been observed as a pioneer after fire. I have observed it growing as a lithophyte in Perlis. In Java it is a common weed in disturbed places in the lowlands and up to *c.* 1000 m. Backer & Bakhuizen (1968:121) note its occurrence in mixed and teak forests, swamps, *Imperata* fields and in cultivation.

Okada & Hambali (1989) noted that this species hybridizes with *C. esculenta*, but that the progeny are weak and sterile.

The confusion by Krause (*loc. cit.*) appears to be based on the erroneous notion that *Arum indicum* Lour. (1790) was different from *Arum indicum* Roxb. (1832). This can be traced to Schott (1857, 1860) who considered *Arum indicum* Lour. a synonym of *Leucocasia gigantea* (Blume) Schott, while *Arum indicum* Roxb. was, in his view, the basionym of *Alocasia indica* Schott. Kunth (correct taxonomically) cited both as synonyms of *"Colocasia" indica* and consequently Krause was of the opinion that *C. indica* Kunth was a mixtum, citing it as a partial synonym of *Alocasia indica*, but retaining it inasmuch as it was based on Loureiro's *Arum indicum* as (wrongly) a *Colocasia*. In fact, Roxburgh's use of the binomial was based on and virtually identical in sense to that of Loureiro. *Arum indicum* Lour., while no herbarium material has yet been located, included *Arum indicum sativum* Rumph., of which Rumphius' plate was selected as lectotype (Nicolson, 1979: 455; reproduced in Hay & Wise, 1991). This element is unequivocally *Alocasia macrorrhizos* (L.) G. Don (syn. *Alocasia indica* (Lour.) Spach; *Colocasia indica* (Lour.) Kunth).

Krause's illustration, cited above, includes analytical drawings uncontestably of *C. gigantea*. However, the plate's habit drawing shows an erect stem typical of some species of *Alocasia*, but which *C. gigantea* does not develop, combined with an arrangement of inflorescences typical of *Alocasia*. Although in the drawing the leaves are peltate as in *C. gigantea*, the petioles are relatively too long and the blades too small for this species and very closely resemble those of *A. odora*. Indeed, if the drawing was made from an actual

plant, it can only be *A. odora*, combining as it does the erect stem, peltate leaves and rather distinctive inflated cucullate spathe limb seen also in *C. gigantea*. Alternatively it may be a muddled reconstruction of the habit, incorporating *C. gigantea* together with *A. macrorrhizos*. The latter also develops an erect stem and was involved in Krause's misinterpretation of *"C. indica"* as discussed above.

3. Colocasia oresbia A. Hay **sp. nov.** *In aspectu C. gigantea affinis, sed statura valde minora, folio haud glauco, lobo antico folii geoscopico, appendice producto, lamina spathae lanceolata differt. A C. esculenta habitu estolonifero, folio haud glauco, inflorescentia femina majore, infructescentia valde grandiore, pedunculo fructifero crasso recto, fructu brunneo-viride, spathae lamina breviora pallidiora erecta differt. Typus: Hay 10046, Malaysia, Sabah, Taman Kinabalu, near Silau Silau trail to Liwagu River, 30 March 1995 (holotypus SNP [= Sabah Parks herbarium]; photo BO, K, KEP, L, NSW, SAN, SAR, UPM).* (Figs. 3 & 4)

Robust solitary or clump-forming herb; stem condensed, creeping to decumbent, clothed in marcescent leaf bases, lacking stolons, to *c.* 40 cm long, *c.* 12 cm diam., cut tissues rapidly turning rusty orange on exposure to air. Leaves several together; blades very broadly ovate-saggitate, to *c.* 60 × 50 cm, deeply peltate, somewhat glossy greyish green adaxially, paler abaxially, not waxy-glaucous (except in very young plants), wettable (not water-shedding); anterior lobe *c.* 2/3 the length of the blade, widest at the base; primary lateral veins slightly raised adaxially and abaxially, 5–6 on each side of the anterior costa, diverging at 45–90°, the divergence angle diminishing distally along the anterior costa; secondary venation flush, not forming intercostal collective veins; posterior lobes to 15 cm long, with the margins rather crisped in the sinus, peltate for over half their length, the posterior costae diverging at *c.* 50°; petiole to 80 cm long, sheathing in the lower *c.* 1/3–1/2, wings of sheath *c.* 1.5 cm wide, persistent, ± straight (i.e., not recurved or inrolled). Inflorescences produced in both juvenile and adult plants, solitary or paired; peduncles almost completely enclosed in sheath of subtending leaf, when paired the sequence perpendicular to the circumference of the stem with the younger one further out, to 25 cm long, glaucous in the upper part, the second subtended by a bicarinate lanceolate prophyll extending to half way up the spathe tube at anthesis; spathe 12–15 cm long, tube narrowly ovoid, pale glaucous green, 3.5–4 cm long, limb erect, lanceolate, 8.5–*c.* 11 cm long, pale creamy yellow, open only at base, the rest convolute. Spadix sessile, *c.* 10 cm long; female zone *c.* 3.5 × 1 cm, slightly tapering distally; pistils very numerous (*c.* 150–400), interspersed irregularly in the lower half of and at the apex of the female zone with *c.* 2.5 mm long upturned ivory staminodes containing 1–2 vestigial thecae; ovaries incompletely 3–5-locular (briefly septate at apex only) with parietal placentas and numerous sub-orthotropous ovules; style distinct but very short (less than 0.5 mm long); stigma whitish, minutely lobed, *c.* 0.5 mm diam.; sterile interstice *c.* 2 cm long, basally of staminodes distally merging with a constricted zone of much reduced elongate ivory synandrodes; male zone *c.* 2 cm long × 0.5 cm, synandria ivory, irregularly

Fig. 3. *Colocasia oresbia* A. Hay. Habit, *c.* 90 cm tall (*Hay* 10046).

Fig. 4. *Colocasia oresbia* A. Hay. Inflorescence with part of spathe removed and the spathe limb browning as it senesces. Spadix *c.* 10 cm long (*Hay* 10046).

rhombo-hexagonal *c.* 1 mm diam (after dehiscence), 2–4-staminate; appendix constricted at base, *c.* 3 cm long × 0.4 cm, tapering to a point, surface slightly and irregularly rugose. Fruiting peduncle elongating *c.* 1.5 times, straight, erect to horizontal depending on condition of subtending leaf but not actively down-curved; fruiting spadix aligned with peduncle, *c.* 10 × 4 cm, enclosed within the expanded spathe tube which dehisces from the base; fruits numbering hundreds per infructescence, green tinged brown when ripe, irregularly subglobose, containing many ovoid, longitudinally ridged, orthotropous, ivory seeds *c.* 0.75 mm long in clear thin mucilage.

DISTRIBUTION. Borneo, Sabah; known only from Gunung Kinabalu and G. Alab.

HABITAT. Disturbed, mostly rather open sites on banks and road cuttings at *c.* 1500 m alt.

OTHER SPECIMENS EXAMINED—BORNEO, SABAH: Tenompok, Kinabalu, *Clemens & Clemens 29141* (K!); Kinabalu, headwaters of Columbon R., margin of Keebamban R., nr Lobang, *Clemens & Clemens 33884* (BM!); Penampang, along rd from Agr. Exp. Station to S of G. Alab, Alab Mts, *Kokawa & Hotta 1758* (KYO, L!); Penapis, G. Alab, *Kokawa & Hotta 1934* (KYO, L!).

This species is readily distinguished from wild-type *C. esculenta* by its non-waxy, wettable leaf blades, rather long stout stem thickly clothed in old leaf bases, lack of stolons, preference for non-saturated sites, much more robust infructescence, straight fruiting peduncle and its brown-tinged green (versus yellow-orange: Barrau 1959) fruits.

Although wild forms of *C. esculenta* occur at altitudes as high as 1700 m in Java (Hambali 1977), they are not of the heavily starch-storing type. *C. oresbia* however, is a thick-stemmed high altitude species which may have some potential importance in breeding high altitude tropical *keladi* cultivars.

The specific epithet means "mountain-dwelling".

Species et varietates excludendae

1. *Colocasia devansayana* L. Linden & Rodigas, Ill. Hort. 33 (1886) 97 = *Alocasia devansayana* (L. Linden & Rodigas) Engl., Nova Guinea 8 (1912) 808. Type: Ill. Hort. *loc. cit.* t. 601.

While clearly an *Alocasia*, the type is not able to be identified with certainty. Additional material cited by Engler (*loc. cit.*) is distinctly different (see Hay & Wise 1991).

2. *Colocasia? heterophylla* (Presl) Kunth, Enum. Pl. 3 (1841) 40 = *Alocasia heterophylla*

(Presl) Merr., Philipp. J. Sci. Bot. 3 (1908) 220. (*Caladium heterophyllum* Presl, Reliq. Haenk. 2 (1835) 148). Type: Haenke *s.n.* (PR).

3. *Colocasia? humilis* Hassk., Flora 25 (2), Beibl. 1 (1842) 10. *Nom. superfl. pro Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi, Syst. Verz. (1846) 83.

Hasskarl (*loc. cit.*) included *Arisarum esculentum* Rumphius, Herb. Amboin. 5 (1747) t.111, fig. 1—the type of *Calla calyptrata* Roxb., Fl. Ind. 3 (1832) 514—in the synonymy of *Colocasia humilis*.

4. *Colocasia humilis* var. *minor* Hassk., *loc. cit.* = ? *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi. Type: ?Hasskarl (?BO; not located).

Although *C. humilis* Hassk. (see above) is a synonym of *Schismatoglottis calyptrata*, it is not completely clear if var. *minor* is actually *Schismatoglottis* too. No element was cited that could serve as type, the description is very sparse and it is not indicated from where the plant is supposed to have originated. No herbarium material bearing this name has been located at L.

However, Hasskarl (1842a,b), in discussing the varieties, was clear about the specific character of the clavate appendix which does not accord with *Colocasia* in the current sense at all. It does however, accord with *Schismatoglottis calyptrata*, though also with other *Schismatoglottis* species. Hasskarl (1842a) also mentions capitate interpistillar staminodes as a character of *C. humilis* var. *minor*—another characteristic in accord with *S. calyptrata*, particularly when combined with the additional specific character of being stoloniferous (cf. Hay 1996).

5. *Colocasia humilis* var. *major* Hassk., Tijdschr. Nat. Gesch. & Physiol. 9 (1842) 160. *Nom. superfl. pro var. typ.* = *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi. Type: ?Hasskarl (?BO; not located).

Hasskarl's publications in Flora (1842a) and Tijdschr. Nat. Gesch. & Physiol. (1842b), cited above, appear to have been published in reverse order to that in which they seem to have been written. *C. humilis* var. *major*, designated variety α, appears in Hasskarl (1842 b; Aug./Sept.), but not in Hasskarl (1842a; July), where only var. *minor* appears, designated variety β. It is evident that Hasskarl considered var. *major* the "type" form from which var. *minor* was segregated, and not another variety in addition to an implicit var. *humilis*.

6. *Colocasia humilis* Hassk. var. *picta* Hassk., Cat. Hort. Bot. Bog. alt. (1844) 56 = ? *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi.

A *nomen nudum* in Hasskarl (1844), but "Exp. bant. 94" is cited. This may refer to published work on plants of Bantam, West Java, in Tijdschr. Neerl. Ind. 4(2) (1842)

126–131; 221–256 (*n.v.*; see van Steenis-Kruseman 1950: 221). This matter, together with other neo- or epitypifications in *C. humilis* if necessary, will be clarified in the context of revision of Javan *Schismatoglottis*.

7. *Colocasia indica* (Lour.) Kunth, Enum. Pl. 3 (1841) 39 = *Alocasia macrorrhizos* (L.) G. Don, Hort. Brit. ed. 3 (1839) 631. (*Arum indicum* Lour., Fl. Cochinch. (1790) 536.) Type: *Arum indicum sativum* Rumph., Herb. Amboin. 5 (1747) t. 106.

8. *Colocasia indica* var. *atroviridis* Hassk., Flora 25 (2), Beibl. 1 (1842) 8 = *Alocasia macrorrhizos* (L.) G. Don. Type: None designated; based on Rumphius' very brief description of a second "species" of *Arum indicum sativum* Rumph., Herb. Amb. 5 (1747) 308.

9. *Colocasia indica* var. *rubra* (Hassk.) Hassk., Pl. Jav. Rar. (1848) 145. = *Alocasia macrorrhizos* (L.) G. Don.

10. *Colocasia macrorrhizos* ('-rrhiza') (L.) Schott in Schott & Endlicher, Melet. Bot. (1832) 18 = *Alocasia macrorhhizos* (L.) G. Don, *loc. cit.* (*Arum macrorrhizon* L., Sp. Pl. (1753) 965.) Type: *Arum maximum macrorrhizon zeylanicum* Hermann, Parad. Bat. (1698) t. 73.

[*Colocasia macrorrhizos* ('-rrhiza') *sensu auctt.* Austral., non (L.) Schott, = *Alocasia brisbanensis* (F.M. Bailey) Domin (see Hay 1989, Hay & Wise 1991)].

11. *Colocasia? montana* (Roxb.) Kunth, Enum. Pl. 3 (1841) 40 = *Alocasia montana* (Roxb.) Schott, Oesterr. Bot. Wochenbl. 4 (1854) 410. (*Arum montanum* Roxb., Fl. Ind. 3 (1832) 497.) Type: Roxburgh drawing No. 248 (CAL, K; see Sanjappa *et al.*, 1991).

This name is probably misapplied to Malesian material (Hay *et al.* 1995).

12. *Colocasia neoguineensis* André, Ill. Hort. 27 (1880) 68, t. 380 = *Schismatoglottis neoguineensis* (André) N.E. Brown, Gard. Chron 24 (1885) 776. Type: Plate in Ill. Hort. (*loc. cit.*).

13. "*Colocasia odorata*" Hassk., Flora 25 (2), Beibl. 1 (1842) 9 = *Alocasia macrorrhizos* (L.) G. Don.

This may be interpreted as an orthographic variant of *Colocasia odora* (Roxb.) Brongn. (Nouv. Ann. Mus. Par. 3 (1834) 145, t.7; i.e. *Alocasia odora* (Roxb.) C. Koch), to be treated as if it were printed in its corrected form (Art. 61.4). Although "*odora*" and "*odorata*" are different words, Hasskarl used them interchangeably, ascribing the combination to Brongniart in either spelling. The name is misapplied to Malesian material.

14. *Colocasia odora* var. *viridis* Hassk., Flora 25 (2), Beibl. 1 (1842) 9. *Nom. superfl. pro var. typ.*; = *Alocasia macrorrhizos* (L.) G. Don.

15. *Colocasia odora* var. *rubra* Hassk. (*loc. cit.*). = *Alocasia macrorrhizos* (L.) G. Don.

16. *Colocasia pubera* Hassk., Cat. hort. bot. bog. alt. (1844) 302 = *Alocasia pubera* (Hassk.) Schott, Syn. Aroid. (1856) 47. Type: Java, ? Hasskarl *s.n.* (BO, not found).

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Temburongia, a new genus of bamboo (*Gramineae : Bambusoideae*) from Brunei

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Summary. A new genus of bamboo (Gramineae – Bambusoideae), *Temburongia*, is described from Brunei, with a single species *T. simplex*. The morphology of the vegetative parts and the inflorescence is discussed. The inflorescence is determinate, as buds do not occur at the base of spikelets, but the main axis is clearly segmented, and sheaths or bracts and prophylls are present in the inflorescence.

In 1988 a sterile scrambling bamboo was collected for the first time from Kuala Belalong, Temburong, Brunei Darussalam (*Wong s.n.*). At that time it was clear that the species was undescribed and it was also not possible to assign it to any genus. The culm nodes develop a circumaxial ridge, or patella. The leaf-blades have peculiar stiff, linear auricles (Fig. 1: F1 & F2). In 1989, during the first joint expedition under the Forestry Department, Brunei Darussalam and the Royal Botanic Gardens, Kew (U.K.) collaborative agreement, flowers of this bamboo were collected from the clump growing near the camp at Kuala Belalong on the Temburong River (this camp site is now the headquarters of the Ulu Temburong National Park). Subsequent research has shown that it belongs to a new undescribed genus, for which we propose the name *Temburongia*. Later, more flowering material was found in scattered populations along the river. Since then many more collections have been made. The inflorescences are up to 5 cm long, and are borne terminally on leafy branches. The main inflorescence axis is clearly segmented. Each branch of the main inflorescence axis bears 1–3 sessile spikelets, each having one fertile floret which easily falls off at maturity. The leafy branches bearing inflorescences are borne at nodes of the upper part of the scrambling culms or branches, often hanging over the river. This bamboo grows in primary

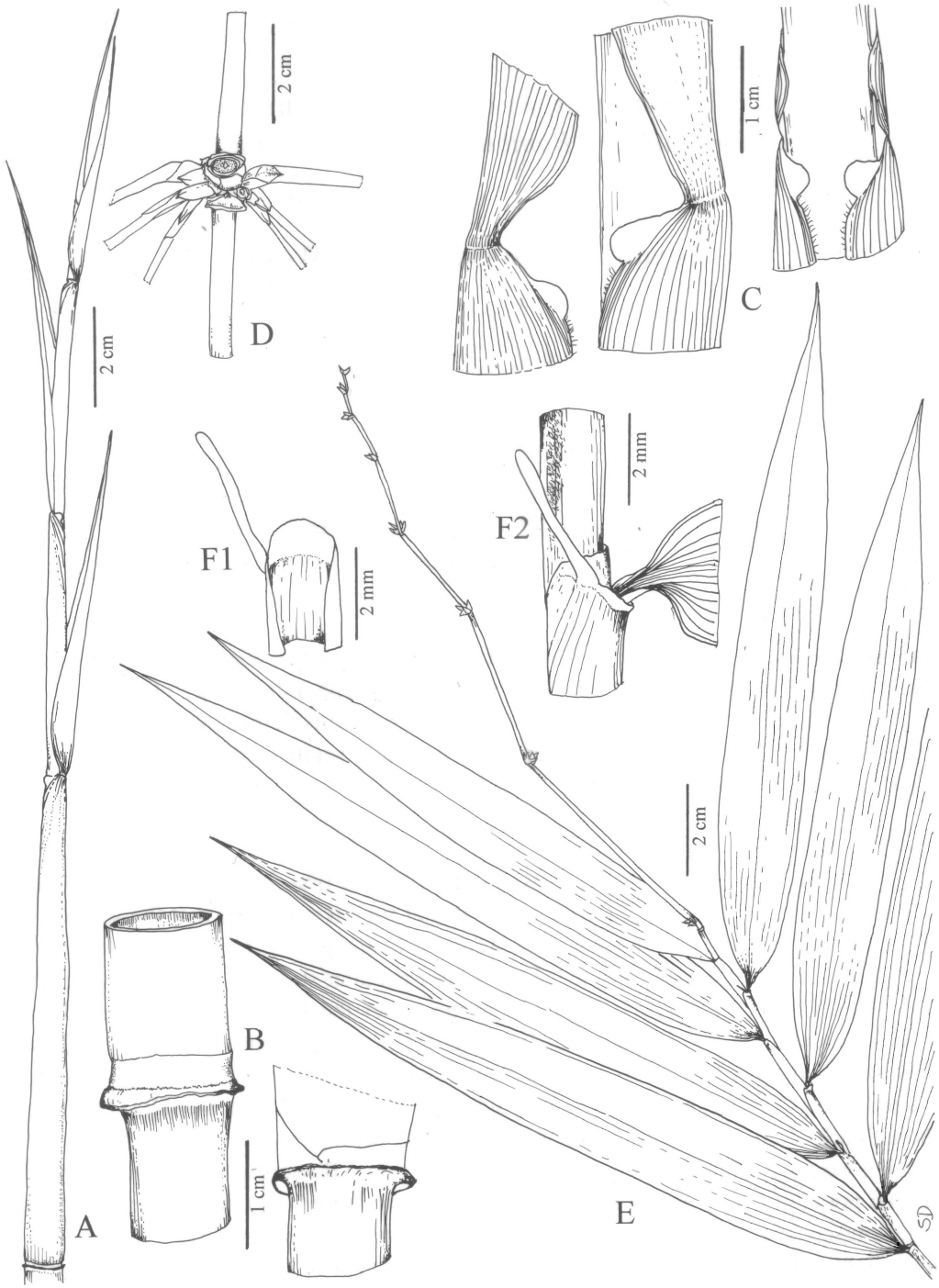

Fig. 1. *Temburongia simplex.* **A.** Young shoot. **B.** Portions of culm showing nodes with patella. **C.** Culm-sheath auricles. **D.** Structure of the branch complement. **E.** Leafy flowering branch, the spikelets fallen away. **F 1 & 2.** Leaf-blade auricles and ligule. **A & B** from *Wong s.n., 22 July 1988*, **C** from SD 1200, **D & E** from SD 1234, **F & G** from SD 1014. (Drawn by S. Dransfield.)

forest around Sungai (River) Belalong up to Bukit Belalong (i.e., Belalong Hill) along Sungai Temburong and near Selapon, also in Temburong District.

The inflorescence structure in *Temburongia*

Because the ultimate axes bearing the spikelets are short and such spikelet-bearing branchlets are, in effect, clustered together, superficially it looks as if the inflorescence is of an indeterminate nature, i.e., a cluster of such short spikelet-bearing branches at a node on the main inflorescence axis resembles a pseudospikelet cluster. Furthermore the spikelets are sessile, like those of *Bambusa* Schreb. or *Schizostachyum* Nees, which have indeterminate inflorescences. In mature spikelets the rachis internode below the fertile floret elongates considerably so as to expose this floret together with the extraordinarily long rachilla extension bearing a rudimentary floret, like that of the spikelet of *Schizostachyum*. After careful examination, it is found that the inflorescence in the new bamboo is determinate in its branching habit, with the presence of prophylls.

When McClure (1966) proposed the terms semelauctant (for an inflorescence of determinate nature) and iterauctant (for an inflorescence of indeterminate branching), he explained that the differences between them lay mainly in the structure of the basic unit of the inflorescence. In semelauctant inflorescences the basic unit is the spikelet; in interauctant inflorescences, it is termed pseudospikelet. He explained further that in the iterauctant inflorescence, all axes of the branches are clearly segmented and bear a sheathing organ at each node, each branch possessing a prophyll at the base. In semelauctant inflorescences, on the other hand, the branch portion below the spikelet is not or only weakly segmented, the sheathing organs are absent or only rudimentary, and prophylls are usually absent. However, McClure noted exceptions; for example, two genera, *Glaziophyton* Franch. and *Greslania* Balansa, have semelauctant inflorescences, for their basic unit is a spikelet, but all axes are segmented and bear a sheathing organ at each node. This type of semelauctant inflorescence is, in fact, not so common in bamboos, and is found in the genus *Hickelia* A. Camus from Madagascar and East Africa (Dransfield 1994), and *Nastus hooglandii* Holttum from New Guinea (Dransfield, unpubl.). The structure of the inflorescence in *Temburongia* is basically similar to that of the above genera. Here the main inflorescence axis is clearly segmented, and consists of 3–5 internodes. Each node of this main inflorescence axis bears a sheath (with or without reduced blade) subtending a branch that bears 1–3 sessile spikelets (Fig. 2 A, B & E). Each spikelet usually has two empty bracts or glumes, one sterile floret with reduced palea, one fertile floret and a rachilla extension bearing a reduced floret (Fig. 2 G, H & J).

Buds are not present in the axils of the bracts or glumes. This spikelet, when solitary at a node, bears a split prophyll at the base (Fig. 2 C & P). In the case of more than one spikelet (usually three) at a node, the branch bearing the terminal spikelet gives rise to a branch at each node below the lowermost glume; each such lateral branch, also terminated by a

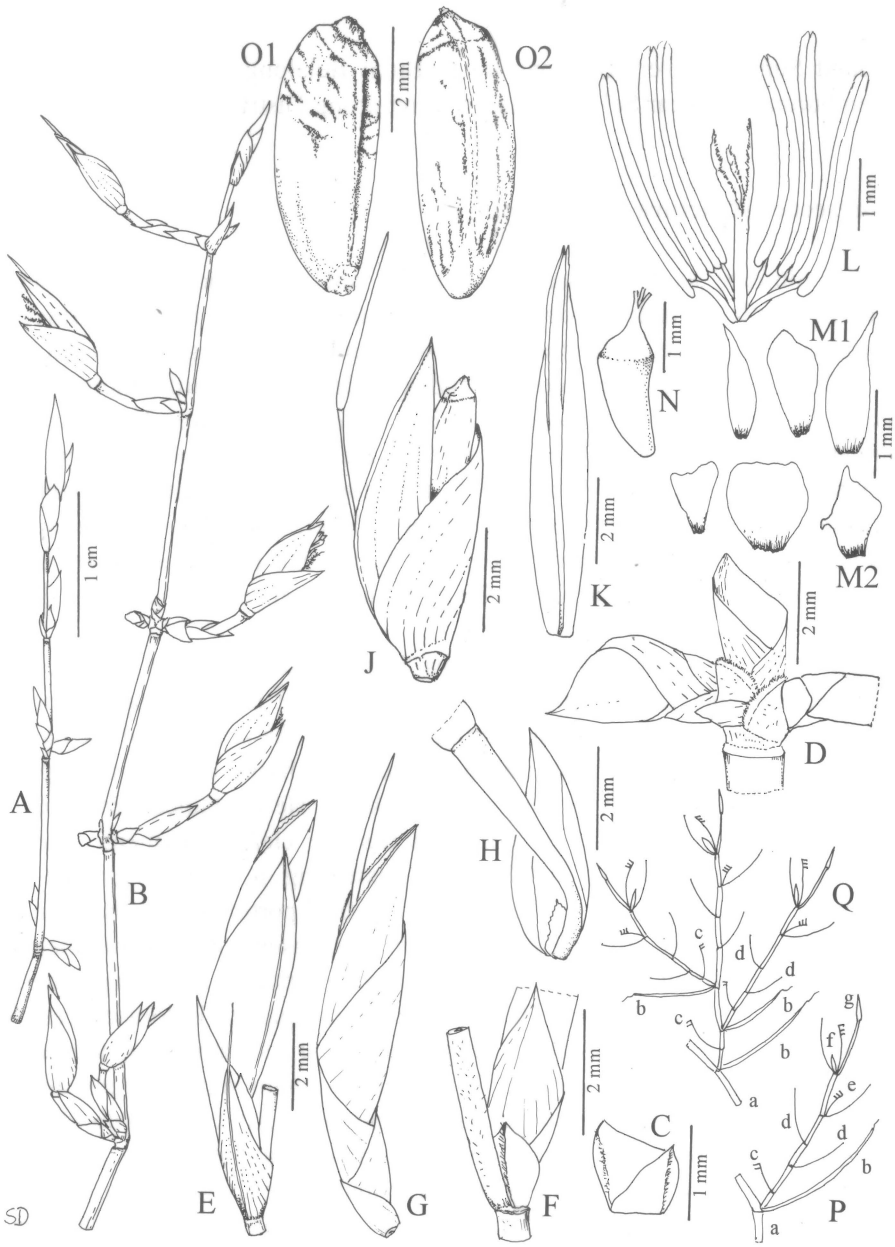

Fig. 2. *Temburongia simplex.* **A.** Young inflorescence. **B.** Older inflorescence, showing some mature spikelets and basal portions of some spikelets which have fallen away. **C.** Prophyll. **D.** Basal parts of a spikelet group of three. **E.** A node with a single spikelet, with a bract (or subtending sheath) still attached, and **F.** with bract removed. **G.** A young spikelet with two glumes (**d**). **H.** Sterile floret with elongated rachilla internode, showing lemma and reduced palea. **J.** Fertile floret with fruit and rachilla extension bearing rudimentary floret. **K.** Palea. **L.** Stamens and ovary. **M.** Lodicules of fertile floret, **M1** in young floret, **M2** in mature floret. **N.** Young fruit. **O.** Mature fruit. **P.** Diagram of **E**, a main axis node with one spikelet. **Q.** Diagram of **D**, a main axis node with three spikelets. (**a** = main axis, **b** = bract or subtending sheath, **c** = prophyll, **d** = glume, **e** = sterile (empty) floret, **f** = fertile floret, **g** = rachilla extension bearing rudimentary floret.) **A**–**N** from SD 1200, **O** from SD 1237. (Drawn by S. Dransfield.)

spikelet, is subtended by a sheath and has a split prophyll (Fig. 2 D & Q). Again, buds are not present at the base of these spikelets. The inflorescence, therefore, has a determinate nature, although the spikelets in the spikelet group may not necessarily mature simultaneously. In essence, the structure of each spikelet-bearing branch (or branch cluster) along the main inflorescence axis is homologous to that of a pseudospikelet (or pseudospikelet cluster) in an iterauctant inflorescence, except that buds are absent from the basal portion of the spikelets. This type of inflorescence has not been described before for any Malesian bamboo. The reason is that there has not been any comprehensive critical study of the structure of inflorescences in the bamboo genera occurring in the Old World, and in Malesia in particular. In the present situation it is almost impossible to relate this new genus to other Malesian bamboo genera. However, in inflorescence and spikelet structure *Temburongia* resembles *Greslania* from New Caledonia, which has semelauctant, or determinate, inflorescences with the presence of sheathing organs and prophylls. In *Greslania* the inflorescence is a panicle, and the spikelet consists of 3–5 transitional glumes, one perfect floret, and a rachilla extension bearing a rudimentary floret; the rachilla internode below the fertile floret does not elongate at maturity.

The new genus

Temburongia *S. Dransf. & K.M. Wong* **genus Graminearum–Bambusoidearum novum** *inflorescentia et structura spiculae distincta; inflorescentia determinata, ramum foliosum terminanti, segmentata, 3–5 internodiis, in quoque nodo bracteas et spiculas sessile ferenti; spicula base prophyllo minuto, flosculo imperfecto unico et flosculo hermaphrodito unico, internodio rachillae infra flosculum hermaphrodito elongato, extensione rachillae flosculum imperfectum ferenti; palea bicarinata, lemmatibus longior. Typus: T. simplex.*

Sympodial bamboo with erect and straight culms, and culm tips and branches scrambling or hanging over nearby vegetation or trees; culms of medium size, with relatively thin walls. Branch bud at each node, branches several with middle one dominant, elongating. Young shoots with glabrous culm leaves, sheath usually purplish green when young, blades erect. Leaf blades with very short petioles. Inflorescences terminating leafy branches, paniculate, determinate, main axis clearly segmented with 3–5 internodes, each node bearing a bract subtending a short unbranched axis with one sessile spikelet, or a short branched axis bearing three spikelets. Spikelets (other than those terminating the main axes) with very small prophylls at the base, prophyllated buds absent in the spikelets; two empty glumes, one imperfect floret, one hermaphrodite floret, and a rachilla extension bearing an imperfect floret; imperfect floret consisting of a lemma and a rudimentary palea; hermaphrodite floret consisting of lemma and palea, three lodicules, six stamens, glabrous ovary with long glabrous style and three hairy stigmas. Caryopsis oblong, with relatively thin pericarp not easily removed from the seed, seed with endosperm, and the embryo basal.

So far there is only one species known in the genus, found in the Temburong area, Brunei.

Fig. 3. Flowering branch of *Temburongia simplex.* (Photo by J. Dransfield.)

Temburongia simplex *S. Dransf. & K.M. Wong* **sp. nov.** *inflorescentia simplici, vaginis culmi auriculis rotundatis, vagina folii auricula rigida uno latere evoluta, 2–3 mm longa, inflorescentia 5 cm longa, 1–3 spicula in quoque nodo ferenti, spicula 2 glumas, minutas vacuas ferenti, flosculo hermaphrodito 3 lodiculis, fructu pericarpio tenuissimo distincta. Typus: Brunei, S. Dransfield SD 1200 (holotypus BRUN, isotypus K).* (Figs. 1–4)

Open tufted scrambling bamboo; culms about 10 m long, internodes 20–30 cm long, 0.7–3 cm in diameter, with walls 1 mm thick, with fine pale hairs becoming glabrous, pale green with white wax below nodes when young, nodes with patella; young shoots purplish green. Branch bud one at each node, branches several with middle branch dominant. Culm leaves with culm sheaths purplish green, glabrous, about 15.5 cm long, 4 cm wide in the middle, 1.5 cm wide at the top, the junction with the blade more or less horizontal; blades green, glabrous, erect, broadly lanceolate, up to 13 cm long, 1.8 cm near the base, 1.5 cm wide at the junction with the sheath, persistent; ligule very short, entire; auricles rounded, entire. Leafy branches 20–50 cm long, bearing 10–19 leaf-blades, blades 7–30 × 0.9–3.2 cm, with short petiole, base truncate, acuminate, finely short hairy below, glabrous above; sheaths glabrous; auricles undeveloped on one side, but in the form of a stiff lobe of 2–3 mm long on the other side. Inflorescence determinate, main axis clearly segmented, with sheaths and prophylls, up to 5 cm long, terminating leafy branches, with 3–5 internodes of 3–15 mm long (the length gradually decreasing toward the apex), each node bearing a lateral branch with one to three spikelets, each subtended by a sheath and possessing a split prophyll at the base. Spikelets glabrous, 7 mm long when young, about 17 mm at maturity, consisting of 2 (rarely 3) small empty glumes, one empty (reduced) floret, one fertile floret, and a rachilla extension bearing a reduced floret, rachilla internodes short, except that below fertile spikelet which elongates at maturity, up to 3 mm long; rachilla extension 8 mm long in mature spikelet, glabrous, slender; lemma glabrous, about 7 mm long, obtuse; palea glabrous, 8.5 mm long in mature floret, 2-keeled; lodicules 3, ovate with long narrow tips in young floret, with blunt tips in mature floret; stamens 6, filaments free, anthers with 2 short pointed tips; ovary slender, glabrous, with elongated style, stigmas 3. Caryopsis green when fresh, oblique, 4–5 mm long, with very thin pericarp not easily separated from the seed.

DISTRIBUTION. So far found only in Temburong (Temburong river and Belalong river up to Bukit Belalong), Brunei.

HABITAT. In primary forest on river banks or hill slopes, from 50 m to 900 m.

SPECIMENS EXAMINED—BORNEO. BRUNEI: Temburong River at Kuala Belalong, *Wong s.n.* 22 July 1988, sterile (BRUN, K); 20 June 1989, fl., *Wong* WKM 1152; 24 June 1989, fl., *Dransfield* SD 1014 (BRUN, K); 25 June 1989, fl., *Dransfield et al.* SD 1029 (BRUN, K); 10 February 1990, fl., *Wong* WKM 1641 (BRUN, K); 13 February 1992, fl., *Dransfield et al.* SD 1200 (BRUN, K); 15 February 1992, aerial roots, *Dransfield et al.* SD 1205 (K); Bukit Belalong, 22 February 1992, fl. & fr., *Dransfield et al.* SD 1234 (BRUN,

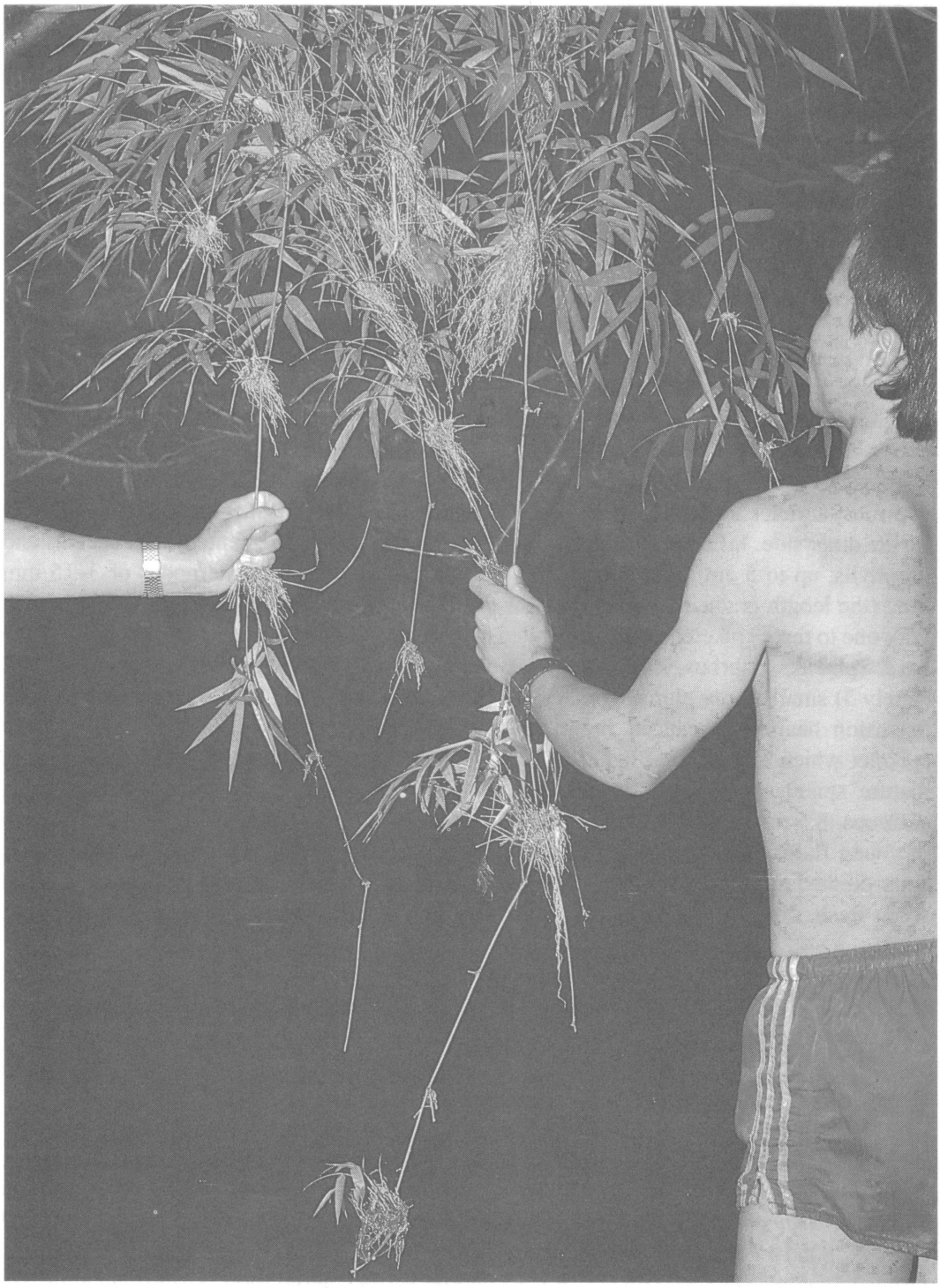

Fig. 4. Hanging apical portions of culms of *Temburongia simplex*, the nodes with branch complements that have developed abundant aerial roots at the branch bases. (Photo by K.M. Wong.)

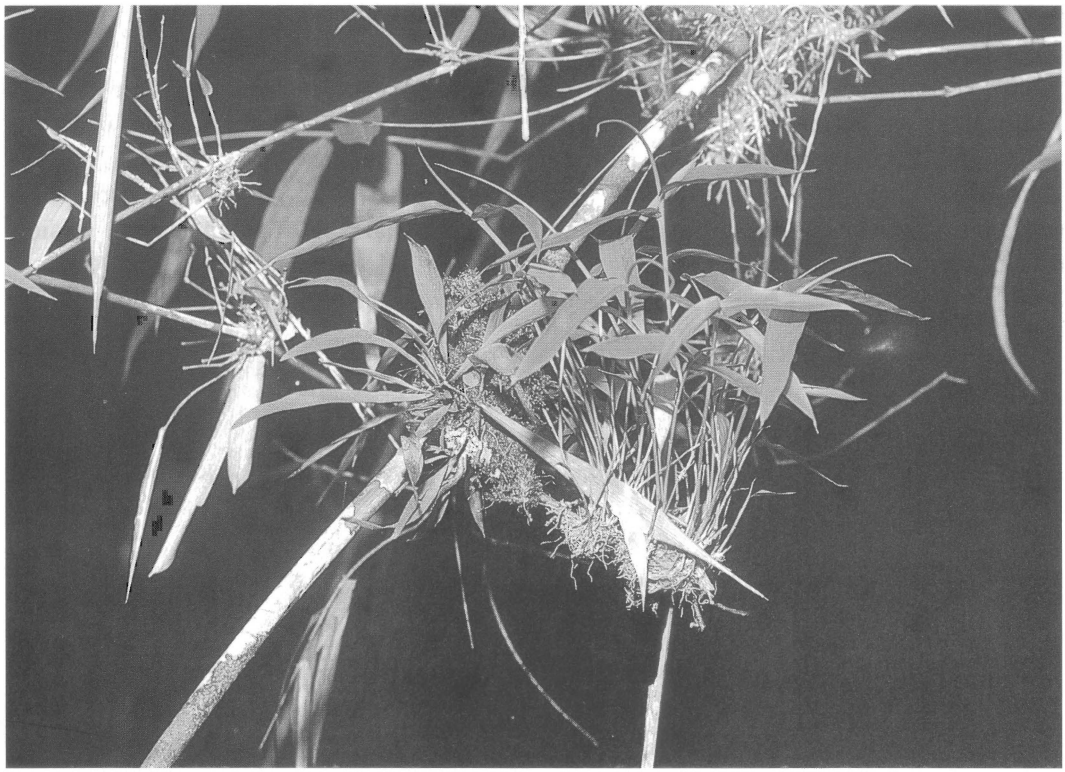

Fig. 5. Close-up view of root-bearing branch complements along an apical hanging portion of a culm of *Temburongia simplex.* (Photo by K.M. Wong.)

K); 25 February 1992, fl. & fr., *Dransfield et al.* SD 1255 (BRUN, K); Wong Nguan gorge, 10 April 1990, fl., *Wong* WKM 1740 (BRUN); Ulu Belalong, 17 January 1994, fl., *Dransfield et al.* JD 7348 (BRUN, K); Batu Apoi, Selapon, 30 January 1994, fl., *Dransfield et al.* JD 7490 (BRUN, K).

Like many other scrambling bamboos, in *Temburongia simplex* the upper (apical) parts of the main branches or main culms scramble over or lean on nearby vegetation or hang. However, in this species, it is interesting to note that the upper nodes of these branches and culm portions have branch complements that often produce many slender branched aerial roots, and that the tips of such branches and culms have been damaged (Fig. 4 & 5), possibly by the effect of floods. Such hanging branches or culm portions can be seen along the rocky banks of both the Sungai Temburong and the Sungai Belalong. During floods it is possible that these rooting nodes will be broken off, and carried down the river, and perhaps deposited on river banks. Such fragments might then grow and establish new clumps. This may be a way by which the bamboo is dispersed. So far, this situation has not been recorded in other bamboos. It has also been noticed that hanging branches without aerial roots also have undamaged tips. Limited observations also reveal that plants found growing away from the river (somewhat less common) do not behave in this way.

ACKNOWLEDGEMENTS

Fieldwork was supported by the Brunei Forestry Department, the Universiti Brunei Darussalam, the Royal Brunei Air Force and the Royal Botanic Gardens, Kew, U.K. We would like to thank the Forestry Department staff in Sungai Liang, Brunei, and Dr Kamariah Abu Salim of the university's Biology Department for valuable logistic help, especially in the field. Dr John Dransfield provided valuable comments on an early version of this manuscript. We are especially grateful to Haji Mohammad Yassin Bin Ampuan Salleh, Director of the Brunei Forestry Department, for his encouragement of such studies.

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SANDAKANIA 7 (1996): 59–61

Helicia mahmudii (*Proteaceae*), a new species of tree from Sarawak

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Summary. *Helicia mahmudii* (Proteaceae), from Sarawak's Lanjak-Entimau Wildlife Sanctuary, is described as a new species of tree.

In the course of botanical surveys conducted in the Lanjak-Entimau Wildlife Sanctuary of Sarawak, a species of *Helicia* (Proteaceae) new to science has been discovered. This is described below and is named in honour of Yang Amat Berhormat Datuk Patinggi Tan Sri Haji Abdul Taib Mahmud, the Honourable Chief Minister of Sarawak, Malaysia.

The new species is apparently very rare and is so far known only from the type collection.

Helicia mahmudii *P. Chai* **sp. nov.** *H. microcarpa Sleum. affinis sed nervis folii multo pluribus (26–30 paribus), infra glabris, perianthio breviore (7–8 mm longo) recedit. Typus: P. Chai S. 33791, Sarawak, Lanjak-Entimau Wildlife Sanctuary, March 1974 (holotypus SAR; isotypi K, KEP, L, MO, SAN).* (Fig. 1)

Small tree about 4 m tall, 2 cm girth. Bark surface dark brown, thin, finely vertically cracked. Young twigs rufous-tomentose, later glabrescent. Leaves entire, spiral; petiole 4.5–6 cm long, swollen at base. Leaves oblong-lanceolate, subcoriaceous, glabrous, 29–42 cm × 9–11.5 cm; drying light creamy brown below, dull olive green above; base cuneate, apex obtuse and shortly pointed; lateral veins ascending, 26–30 pairs, reticulations fine, raised on both surfaces. Racemes borne on the trunk (cauliflorous habit), about 30 cm above ground, pedicels not winged, single or in pairs; perianth rufous-tomentose, 7–8 mm long, attached to 4–6-mm-long pedicels, light greenish-cream; anthers whitish, attached to base of perianth lobes; ovary glabrous, green with whitish style and stigma, ovules two, close

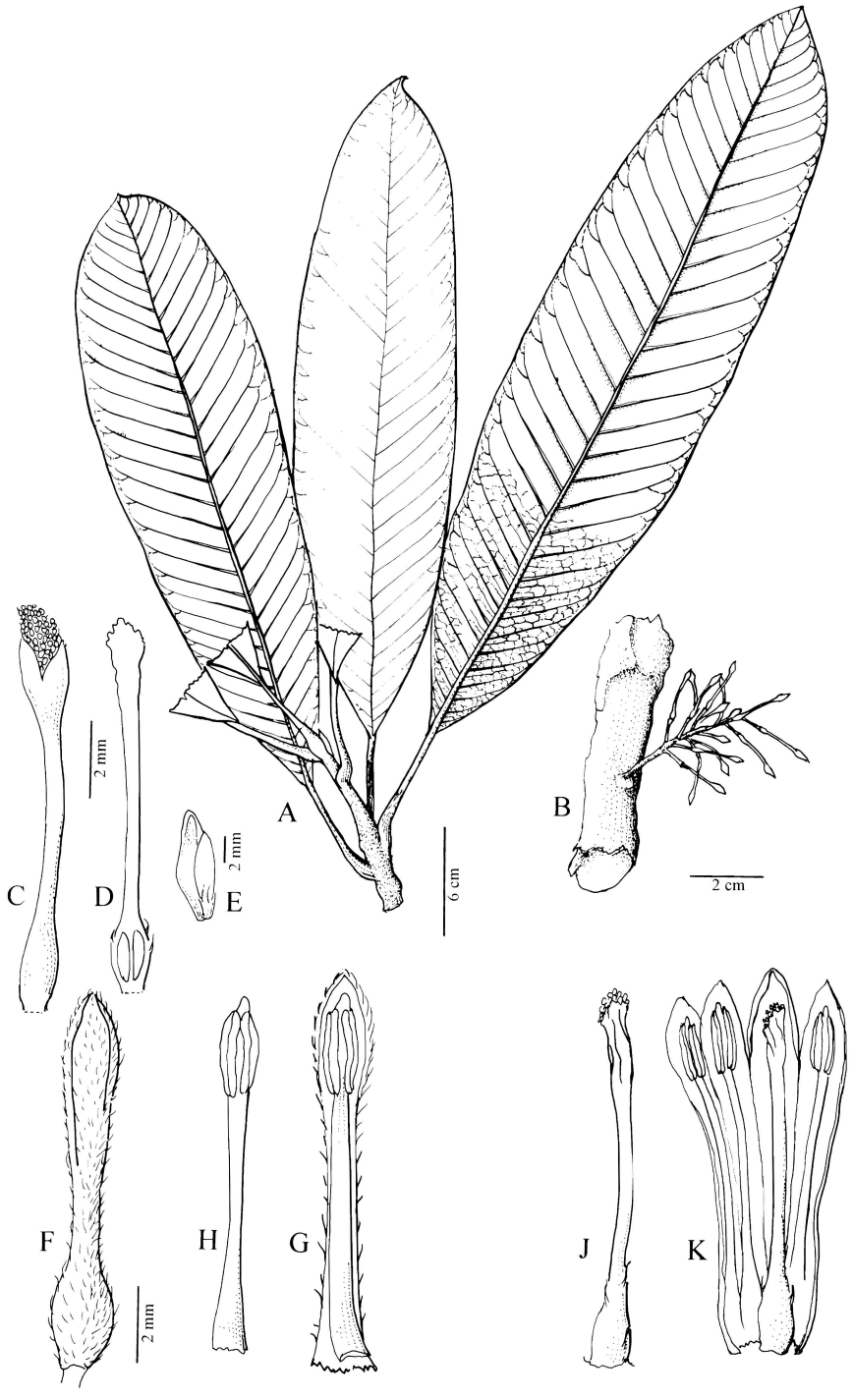

Fig. 1. *Helicia mahmudii.* **A.** Leafy twig. **B.** Young inflorescence. **C.** Partially open flower. **D.** Longitudinal section of gynoecium. **E.** Young flower bud. **F.** Flower just before opening. **G.** Stamen attached to perianth segment. **H.** Stamen torn away from the perianth but still attached to a basal portion of the perianth tube. **J.** Gynoecium. **K.** View of flower with perianth slit longitudinally.

together, ovule or seed anatropous and ascending, attached to the base of the ovary or fruit chamber, disk consisting of 4 thick glands.

Only very few species may be compared to the one here described and mostly have less than 18 pairs of leaf nerves (Sleumer 1955). *H. microcarpa* Sleum. also has densely rufous-tomentose perianths, but differs in having longer perianths (up to 18 mm) and fewer leaf nerves (about 6 pairs), and is an eastern New Guinea species. *H. hypoglauca* Diels and *H. albiflora* Sleum. have slightly less densely hairy perianths, but the hairs are appressed, not stiff and erect, and the perianths are longer than 10 mm. *H. commutata* Sleum. and *H. saurauioides* Sleum. have up to 16–20 pairs of leaf nerves, but *H. commutata* differs in its gradually attenuate leaf apex, shorter petioles (only about 1 cm long), axillary racemes, and glabrous perianths; *H. saurauioides* differs in having pubescent petioles and axillary racemes densely covered in short appressed hairs. Both are also New Guinea species.

ECOLOGY. In open places colonised by secondary pioneer vegetation following landslips at 610 m (2,000 feet) above sea level.

ACKNOWLEDGEMENTS

I would like to thank Datuk Leo Chai, Director of the Sarawak Forestry Department, for his support; the staff of the Forest Botany Unit for assistance in the field and herbarium; and Joseph Pao for preparing the drawing. My special thanks go to Dr Wong Khoon Meng of the Forest Research Centre in Sandakan, for valuable comments and suggestions regarding the manuscript, and Dr John Dransfield of the Royal Botanic Gardens, Kew, U.K., for his help with the Latin diagnosis used here.

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SANDAKANIA 7 (1996): 63–65

Symplocos leochaii (*Symplocaceae*), a new species from Sarawak

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Summary. *Symplocos leochaii* (Symplocaceae), from Sarawak, is described as new.

A new species of *Symplocos* (Symplocaceae) was discovered during field surveys in the Lanjak-Entimau Wildlife Sanctuary in Sarawak. This species is named in honour of Datuk Leo Chai Chia Liang, Director of the Forest Department, Sarawak.

Symplocos leochaii *P. Chai* **sp. nov.** *S. laeteviridis Stapf var. mjobergii (Merr.) Noot. affinis sed ramulis brevibus setosis, fructu apice glabro paniculis brevioribus (2.5–3 cm longis) differt. Typus: P. Chai S. 33926, Sarawak, Lanjak-Entimau Wildlife Sanctuary, March 1974 (holotypus SAR; isotypi K, L).* (Fig. 1)

Small tree about 2.5 m tall. Bark surface brown. Twigs slightly zigzag, young twigs ribbed; young twigs, terminal buds and lower leaf surfaces covered in brownish short bristly hairs that become stiff and rough on drying. Leaf arrangement distichous, petioles 1–1.2 cm long, leaves lanceolate, 27–32 cm × 7.8–9 cm, drying pale olive green above, base slightly cordate, apex acuminate; margins finely serrate, midribs raised below, sunken above, lateral veins 11 to 13 pairs, prominent, ascending, curving *c.* 7 mm from the margins to form wavy marginal veins; reticulations raised and distinct. Panicles up to 3 cm long, axillary, young fruits pale greenish-white, cylindric-ovoid, 6 × 2 mm, ripening blue, calyx persistent.

Symplocos laeteviridis Stapf var. *mjobergii* (Merr.) Noot. from Mount Murud in Sarawak and on Kinabalu in Sabah (Nooteboom 1977) has cordate leaf bases and nerves joining to form a marginal vein, but is distinct in its pilose twigs, hairy fruit apex, and a longer panicle (up to 4 cm long). *S. riangensis* Noot. from Bukit Raya in Kalimantan Tengah (Nooteboom

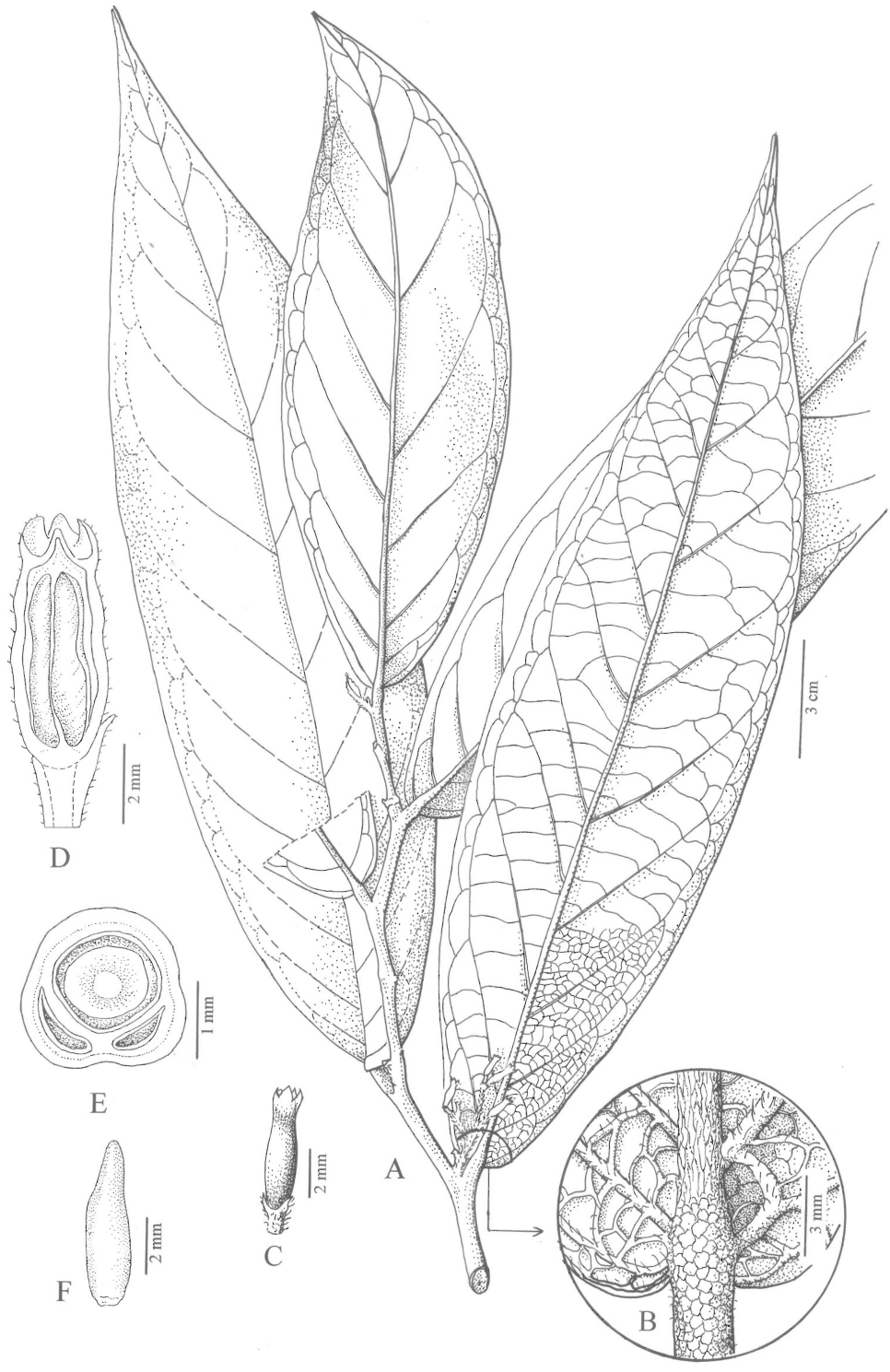

Fig. 1. *Symplocos leochaii.* **A.** Leafy twig. **B.** Detail of leaf base, lower side. **C.** Fruit. **D.** Longitudinal section of fruit. **E.** Cross-section of fruit. **F.** Seed.

1984) also has cordate leaf bases, but differs in its tomentose twigs, recurved leaf margins, and shorter inflorescences (only about 1 cm long) and longer bracts (1.5–2 mm long).

Although Nooteboom (1986) has probably examined several Sarawak specimens of *Symplocos* collected later than the type of *S. leochaii* (S. 32926, collected in March, 1974), this specimen was evidently not seen and studied by him and therefore not enumerated in the Flora Malesiana Identification Lists (Nooteboom 1976). Nooteboom (pers. comm. 1994) has confirmed this to be a new species.

ECOLOGY. Bukit Peninjau in the Lanjak-Entimau Wildlife Sanctuary, on a steep slope with yellow sandy clay soil at 850 m a.s.l.

ACKNOWLEDGEMENTS

I wish to thank the Forest Department, Sarawak, for assistance in both field and herbarium work. The drawing used here is the work of Mr Mohd. Akip of the Sarawak Herbarium. Dr Wong Khoon Meng of the Forest Research Centre in Sandakan kindly commented on a draft of this paper and Dr John Dransfield of the Royal Botanic Gardens, Kew, U.K., provided the Latin diagnosis of this species.

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Nooteboom H.P. (1984) *Symplocos* (Symplocaceae) from the Bukit Raya. Blumea 30: 75–76.

Nooteboom H.P. (1986) Additions to Bornean Symplocaceae. Blumea 31: 277–280.

SANDAKANIA 7 (1996): 67–80

Taxonomic notes on *Erythroxylum* (*Erythroxylaceae*) in Malesia

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Summary. Six species of *Erythroxylum* are recognized in Malesia, including *E. sarawakanum*, newly described here, and *E. iwahigense* and *E. latifolium* which are reinstated as species distinct from *E. cuneatum*. *E. iwahigense* forma *calcicola* is newly described from the Mulu limestone in Sarawak. Variation in leaf form within *E. cuneatum* is discussed. A key to the species of *Erythroxylum* in the Malesian region is also provided.

The genus *Erythroxylum* P. Browne was established in 1756 and typified by *E. areolatum* L. from South America (Plowman 1976). It is a pantropical genus of approximately 250 species (Schulz 1907). For the Malesian region, Payens (1958) recognized only two indigenous species (*E. cuneatum* (Miq.) Kurz and *E. ecarinatum* Burck), and Ng (1976) described a new species, *E. kochummenii*, endemic to Peninsular Malaysia. The genus has also been briefly treated for Sabah by Meijer (1968) and Cockburn (1976), for Peninsular Malaysia by Cockburn (1972), and for Sarawak by Ashton (1988).

A persisting taxonomic problem concerning species of *Erythroxylum* in Malesia has been the great variation in vegetative characters within *E. cuneatum sensu lato* as delimited by Payens (1958), whose bread concepts were followed by Meijer (1968) and Cockburn (1972, 1976). Ashton (1988), however, pointed out that in Sarawak two very different forms occurred, one confined to *kerangas* forest and the other found in peatswamp as well as lowland mixed dipterocarp forest.

In revising the family for the Tree Flora of Sabah and Sarawak, collections from Peninsular Malaysia, Borneo and the surrounding territories were studied. Our conclusions were that *E. iwahigense* Elmer and *E. latifolium* Burck should be recognized as species distinct from *E. cuneatum*, and that two distinct forms of *E. cuneatum* (forma *cuneatum* and forma *sumatranum*) can be recognized in Borneo. In addition, a new species, *E. sarawakanum*, from the Bako National Park, and a new form of *E. iwahigense* from the Mulu limestone in Sarawak, are described.

KEY TO *ERYTHROXYLUM* SPECIES AND FORMS IN MALESIA

1a. Flowers solitary.

2a. Leaves papery, apex acuminate with rounded tip; petioles (6–)7–10(–11) mm long. Pedicels 5–10 mm long. Fruit broadly obovoid, 20–22 × 15–20 mm, length:width ratio 1–1.4, more or less rounded in cross section, all locules in a single row ..... *E. kochummenii*

2b.Leaves leathery, apex acute with rounded or emarginate tip; petioles (2–)3–5(–6) mm long. Pedicels 15–25 mm long. Fruit ellipsoid, 8–12 × 3–5 mm, length:width ratio 1.8–2.9, rounded-triangular in cross section, locules arranged in a triangle.

3a. Leaves thick-leathery; spacing between lateral veins (measured along the midrib) 1–2(–2.5) mm ..... *E. iwahigense* forma *calcicola*

3b. Leaves thin-leathery; spacing between lateral veins (measured along the midrib) (3–)4–8(–10) mm ..... *E. iwahigense* forma *iwahigense*

1b. Flowers in clusters of 2–20, only sometimes solitary and then never exclusively so.

4a.Stamen tube shorter than or at most as long as calyx lobes.

5a. Leaves narrowly elliptic-lanceolate, length:width ratio 3–4.7; midrib raised above. Fruit obovoid, 1-locular, lens-shaped in cross-section ..... *E. ecarinatum*

5b. Leaves elliptic or obovate, length:width ratio 1.3–3; midrib sunken above. Fruit ellipsoid, 3-locular, rounded-triangular in cross-section.

6a. Leaves thick-leathery, apex obtuse with emarginate tip. Calyx lobes 1.4–1.8 mm long. Fruit ellipsoid, up to 4 mm wide, length:width ratio 2.3 ..... *E. sarawakanum*

6b. Leaves thin-leathery or papery, apex acute with rounded or pointed tip, cuspidate or rarely obtuse with rounded or emarginate tip. Calyx lobes 1–1.2 mm long. Fruit broadly ellipsoid, 4.5–8 mm wide, length:width ratio 1.4–2.1 ..... *E. latifolium*

4b. Stamen tube longer than calyx lobes.

7a. Leaf apex obtuse ..... *E. cuneatum* forma *cuneatum*

7b. Leaf apex acute ..... *E. cuneatum* forma *sumatranum*

1a. Erythroxylum cuneatum (Miq.) Kurz, forma **cuneatum**

J. As. Soc. Beng. 43, 2 (1847) 135. Type: *Wallich Catalogue* no. 4534, "India Orientalis" (holotype K).

Ficus cuneata Wall., Cat. (1828), *nom. nud.*

Urostigma ?cuneatum Miq., Hook. Lond. J. Bot. 6 (1847) 585.

E. burmanicum Griff., Posth. Papers, Not. Pl. As. 4 (1854) 468, *t.* 581, fig. 3. Type: *Griffith s.n.*, Burma, Mergui (K).

E. retusum Bauer ex Teijsm. & Binn., Cat. Hort. Bog. (1866) 214, *nom.* Type: *Cult. Hort. Bot. Bogor* 14430, Java, Bantam (BO).

E. longistipulatum Burck, Ann. Jard. Bot. Btzg. 11 (1893) 193. Type: *Cult. Hort. Bot. Bogor sub III.K.10* (BO).

E. bancanum Burck, Ann. Jard. Bot. Btzg. 11 (1893) 192, *t.* 16. Type: *Cult. Hort. Bot. Bogor sub III.K.32*, Banka, Tg. Pinang (BO).

E. cuneatum var. *bancanum* (Burck) O.E. Schulz., Pfl. R. Heft 29 (1907) 148.

E. platyphyllum Merr., Philip. J. Sc. 3 (1908) Bot. 232. Type: *Whitford & Hutchinson* FB 9285, Philippines, Mindanao, Zamboanga, Port Banga (BO).

Tree to 30 m tall, 50 cm diameter. Twigs dark brown to brown, flattened towards the ends, with prominent stipular scars. Stipules lanceolate, *c.* (2.5–)4–6(–7.5) mm long, distinctly bicarinate. Leaves obovate or elliptic or elliptic-lanceolate, (1.9–)3.5–9.5(–12) × (0.9–)1.9–4.5(–5.8) cm, length:width ratio (1.4–)1.8–2.6(–3.1); base cuneate, apex obtuse with emarginate or rounded tip, papery or thin-leathery; midrib sunken above, prominent below; lateral veins 8–12 pairs, areolation distinct, slightly prominent on both sides, spacing between lateral veins (2–)3–9(–13) mm; petiole (2–)3–7(–9) mm long, 0.5–1 mm thick, glabrous. Flowers in clusters of 2–6, only sometimes solitary and then never exclusively so; pedicels 3–9 mm long, 0.2–0.7 mm thick, glabrous, slightly thickened under the calyx, subtended by 2 bracteoles; calyx-lobes 0.5–1(–1.2) mm high, triangular; petals 5; stamens 10, stamen-tube longer than the calyx-lobe. Fruits ellipsoid, 8–10 × 2.5–4.5 mm, length:width ratio 2.3–3.2, curved, glabrous, tip pointed, rounded-triangular in cross-section, locules arranged in a triangle, with the fertile locule nearly of the same size as 2 sterile locules. Seeds 1 in fertile locule, flattened, with endosperm, *c.* 6–8 × 1.5–3.0 mm.

DISTRIBUTION. Burma, Thailand, Indo-China, Banka and Riouw Islands, Peninsular

Malaysia, Singapore, Anambas and Natuna Islands, Java (Western part, Kangean), Borneo, Philippines, Lesser Sunda Islands (Sumbawa) and Moluccas.

ECOLOGY. Seasonal monsoon forest, lowland mixed dipterocarp forests, beaches; also (rarely) on mountain peaks and limestone.

SPECIMENS EXAMINED—"India Orientalis", *Wallich Catalogue no. 4534* (K). **BURMA.** Mergui, *Griffith s.n.* (K). **THAILAND.** Phang-nga, Ko Yao Yai, *Hansen & Smitinand* 12404 (SING); Bang Sow, *Md. Haniff* SFN 4212 (SING). **PENINSULAR MALAYSIA.** Perlis, Bt. Bintang Forest Reserve, *Whitmore* FRI 484 (KEP, SING); Kaki Bukit, *Kiah* SFN 35259 (KEP, SING); Kedah, Bukit Kayu Hitam, *Symington* FMS 46959 (KEP), Gunong Jerai Forest Reserve, *Yusop* FMS 7716 (KEP), *Rahim* FMS 12362 (KEP, SING), Tangga Reserve, *Saaid FMS 20664* (KEP); Penang, *Griffith s.n.* (K), *Henderson* 189 (SING), Batu Ferringgi, *Stone* 6306 (SING); Perak, Pulau Pangkor, Sungei Pinang, *Hamid* FMS 2311 (KEP, SING), *Ridley* 7937 (SING), Gunong Sondok, *Sofian* SFN 36321 (SING); Selangor, Batu Caves, *Ng* FRI 1636 (KEP), Kuala Selangor, KEP 71150 (KEP); Negri Sembilan, Port Dickson, Teluk Kemang, Cape Rachado Forest Reserve, *Damanhuri* FRI 36006 (KEP), Tampin, *Burkill* 577 (SING), Tampin Forest Reserve, summit of Gunong Tampin, *Loh* FRI 17064 (KEP), *Wong* FRI 32320 (KEP); Malacca, *Griffith s.n.* (K), Bt. Bruang, *Hassan* 20 (SING), Sungei Udang *Ridley* 478 (SING); Kelantan, Lepan Bagan, FMS 32747 (KEP), Sik, *Kochummen* FRI 16786 (KEP), Tanah Merah, *Ahmad* KEP 93543 (KEP); Terengganu, Sungei Paka, *Symington* FMS 26817 (KEP), Ulu Brang, *Moysey & Kiah* SFN 33317 (KEP, SING), Pulau Kapas, *Hume* 72 (SING); Pahang, Kuantan Research Forest, *Soh* FMS 15058 (KEP, SING), Manchali, Sungei Rompin, *Bidin* FMS 15688 (KEP), Pulau Setindan, *Ng* FRI 5104 (KEP), Pulau Tioman, *Henderson* SFN 18482 (KEP, SING); Johore, Pulau Sibu, *Samsuri Ahmad* 15 (KEP), Jason Bay, Sungai Rhu, *Corner* SFN 28476 (KEP, SING), Segamat, Gunong Ledang Forest Reserve, *Saw* FRI 37723 (KEP), Penyabing via Endau, *Md. Shah* 4062 (SING). **SINGAPORE.** Changi, *Ridley* 1806 (SING), *Ridley 1934* (SING), *sine coll.* SFN 519 (SING), *Sinclair* SFN 37935 (SING), *Sidek Kiah & Ali Rahim s.n.* (SING); Pulau Angsa, *Burkill & Md. Shah* HMB 946 (SING); Pelehah, Pulau Sekijang, *Sinclair* SFN 39241 (SING); St. John Island, *Nura & Chin* NK 114 (SING). **BANKA ISLAND.** Tg. Pinang, *Cult. Hort. Bot. Bogor sub III.K.32* (BO). **RIOUW ISLAND.** Pulau Tujuh, *Bünnemeijer* 5869 (BO). **ANAMBAS AND NATUNA ISLANDS.** *Van Steenis* 1333 (BO, SING). **JAVA.** Peutjang Island, Udjung Kulon, *Kostermans, Kuswata, Soegeng & Soepadmo* KKSS 417 (KEP, SAN, SING); Kangean, *Backer* 29043 (SING). **SUMBAWA.** *Elbert* 4139 (BO, K, SING). **BORNEO. SABAH:** Sandakan District, Kuala Meruap, *Lee & Aban* SAN 107458 (KEP, SAN, SING); Northern part of Tambisan Island, *Lee* SAN 107522 (SAN); Pulau Libaran, *Chow* SAN 64569 (SAN); Tambisan, Ganduman Forest Reserve, *Aban & Saikeh* SAN 82275 (K, L, SAN, SAR, SING); Tanjong Peras, *Mail* BNB–FD 3645 (BO, K). **PHILIPPINES.** Mindanao, Zamboanga District, Port Banga, *Whitford & Hutchinson* FB 9285 (BO), *Foxworthy, Demesa & Villamil* FB 13908bis (L), *Stadtmiller, Ferraris & Almagro* FB 20102 (K),

Merrill Bur. Sci. 11637 (BO, K, L, SING). **MOLUCCAS.** Halmahera, *Beguin* 1795 (BO), *Teijsmann s.n.* (BO); Ternate, *Beguin* 1044 (BO), *Teijsmann s.n.* (BO), Ngade, near Laguna, *Alston* 16639 (SING).

The leaf size is very variable. The smallest leaves are found in specimens collected from rocky coasts, islands, mountains and limestones. This form is the predominant form found in Burma, Indo-China, Peninsular Malaysia, Singapore, Java and the Philippines. In Borneo, it is found mainly along beaches and on islands.

1b. Erythroxylum cuneatum (Miq.) Kurz, forma **sumatranum** (Miq.) R.C.K. Chung, **comb. nov.**

E. sumatranum Miq., Fl. Ned. Ind. Suppl. (1862) 200, 512. Type: *Teijsmann s.n.* (= Leiden no. 908. 125–2056), Sumatra, Palembang, Ogan Ulu (holotype L; isotype BO).

E. densinerve O.E. Schulz, Pfl. R. Heft 29 (1907) 142. Type: *Beccari* PB 3623, Sarawak (holotype K).

E. borneense Merr., Pl. Elm. Born. (1929) 112. Type: *Elmer* 21385, North Borneo, Tawau (holotype K; isotypes L, SING, U).

Tree to 25 m tall, 30 cm diameter. Twigs brown to grey-brown, flattened towards the ends, with prominent stipular scars. Stipules triangular, *c.* (2–)2.5–4(–5.0) mm long, distinctly bicarinate. Leaves elliptic to narrowly elliptic, lanceolate or rarely obovate, (2.8–)4.2–7.7(–10.2) × (0.9–)1.7–2.8(–3.2) cm, length:width ratio (1.7–)2.2–3.1(–3.8); base acute to obtuse, apex acute with rounded or emarginate or rarely pointed tip, papery or thin-leathery; midrib sunken above, prominent below; lateral veins 8–15 pairs, areolation distinct, slightly prominent below, faint above, spacing between lateral veins (2–)3–7(–9) mm; petiole (2–)3–5(–7) mm long, 0.5–1 mm thick, glabrous. Flowers in clusters of 2–6(–8); pedicels 3–10 mm long, 0.2–0.5 mm thick, glabrous, slightly thickened under the calyx, subtended by 2 bracteoles; calyx-lobes 0.5–1.2 mm high, triangular to lanceolate; petals 5; stamens 10, stamen-tube longer than the calyx-lobe. Fruits ellipsoid, 9–12 × 2.5–4 mm, length:width ratio 2.6–4, curved, glabrous, tip pointed, rounded-triangular in cross-section, locules arranged in a triangle, with the fertile locule nearly of the same size as 2 sterile locules. Seeds 1 in fertile locule, flattened, with endosperm, *c.* 8–10 × 1.5–2.5 mm.

DISTRIBUTION. Sumatra, Borneo and the Philippines.

ECOLOGY. In Borneo in mixed dipterocarp forests.

SPECIMENS EXAMINED—SUMATRA. Palembang, Ogan Ulu, *Teijsmann s.n.* (= Leiden no. 908.125–2056) (BO, L); Lampong District, Soekadana, Terbanggi Agoengbaroe,

Van Steenis bb. 31037 (SING). **BORNEO. SABAH:** *Goklin* BNB–FD 1568 (K); Kinabatangan District, Lamag, Karamuak, *Leopold Madani* SAN 81763 (AA, K, KEP, L, SAN, SAR, SING); Lahad Datu District, Bakapit Catchment Area, *Ahmad Talip* SAN 52748 (K, SAN), Kennedy Bay, Mile 4, *Wood* A 4261 (A, BRI, KEP, L, SING), Kretam, *Wood* A 4818 (K, KEP, SING), Sepagaya Suai-suaian Silam, Mile 9, *Muin Chai* SAN 29713 (KEP, SING), Silam, Mile 10, *Richard Benideh* SAN 58984 (SAN), Ulu Segama Forest Reserve, *Joseph, Lideh & Ahad* SAN 116853 (SAN), Ulu Sg. Danum, *Cockburn* SAN 85081 (K, KEP, KLU, L, SAN, SAR, SING), Jalan Taliwas, Km 12, *Joseph & Good* SAN 119332 (KEP, SAN); Sandakan District, Lungmanis, *Sabah Timber Company Staff* SAN 61686 (SAN), Sepilok, Mile 14, *Aban Gibot* SAN 82076 (SAN); Tawau District, Apas Road, Mile 15.5, *W. Pereira* SAN 44210 (K, L, SAN), *Elmer* 21385 (K, L, SING, U), Quoin Hill Road, Mile 17, *Aban Gibot* SAN 30377 (BO, K, KEP, L, SAN, SAR, SING), Ulu Sg. Apas, Quoin Hill Road, *Aban Gibot* SAN 32437 (K, L, SAN). **SARAWAK:** 1st Division, Kuching District, Semengoh Forest Reserve, *Haji Bujang* S. 12753 (B, K, L, SAN, SAR), Semengoh Forest Reserve, *Omar* S. 370 (K, SING); *Beccari* PB 3623 (K). **KALIMANTAN:** Tanah Boemboe, Kamp. Baroe, bb. 13295 (SING). **PHILIPPINES.** Dinagat Island, *Ramos & Pascasio* Bur. Sci. 35152 (SING).

The leaf size in this form, which is absent from Peninsular Malaysia, is less variable. Payens (1958) also noted that *E. cuneatum* occurred in Celebes and the Islands off W New Guinea. Material of this has not been studied for this account and it is uncertain whether one or both, or other forms occur in these places. Nevertheless, the nomenclature of the typical and variant forms discussed here does not depend on this and no validly published synonyms of *E. cuneatum* were based on these provenances.

2. Erythroxylum ecarinatum Burck

Ann. Jard. Bot. Btzg 11 (1893) 191. Type: Cult. Hort. Bot. Bogor, from Moluccas (BO).

E. salomonense White, J. Arn Arb. 31 (1950) 89. Type: *Walker & White* BSIP 156, Solomon Islands, New Georgia, Vanganu Island, near Kaukosi River (BO).

Tree to 30 m tall. Twigs glabrous, dark brown, flattened towards the ends, with prominent stipular scars. Stipules oblong-lanceolate, *c.* (4–)8–11(–20) mm long, rarely carinate. Leaves crowded at the ends of twigs, narrowly elliptic-lanceolate, (6–)7–12(–17) × (1.3–)1.9–3.8(–5) cm, length:width ratio 3–4.7; base cuneate, apex acuminate with rounded or pointed tip, papery; midrib raised above, prominent below; lateral veins 8–14 pairs, areolation distinct, slightly prominent on both sides, spacing between lateral veins (2–)4–9(–11) mm; petiole (3–)4–7(–9) mm long, 0.7–1 mm thick, glabrous. Flowers in clusters of (2–)4–8(–20); pedicels 5–9 mm long, *c.* 0.7–1 mm thick, glabrous, thickened under the calyx, subtended by 2 bracteoles; calyx-lobes 0.8–1.2 mm high, triangular; petals 5; stamens 10, stamen-tube shorter than or at most as long as the calyx-lobe. Fruits obovoid,

5–12(–17) × 3–6(–8) mm, length:width ratio 1.6–2.5, often curved, glabrous, sometimes slightly oblique with a rounded top, len-shaped in cross-section, 1-loculed. Seeds 1, without endosperm, *c.* 2.5–7 × 1.5–3 mm.

DISTRIBUTION. Celebes, Moluccas (Halmaheira, Sula, Buru, Ceram), New Guinea, Queensland, Melanesia (Solomon Islands: New Georgia).

ECOLOGY. Lowland to montane primary forest up to 2000 m. Often found on slopes and mountain ridges, on rocky and clayey soils.

SPECIMENS EXAMINED—CELEBES. Oesoe, Cel/II 396 (SING). **MOLUCCAS.** Ceram, Masohi, Wae Ruatan/Wae Ruwata catchment areas, *Burley, Tukirin & Ismail* 4303 (KEP); Ambon, *Robinson* 1854 (SING), Weda, Tiloppe, bb. 24872 (SING), bb. 24901 (SING). **NEW GUINEA.** Gulf, near Ihu, *Craven & Schodde* 705 (SING); New Britain, Talasea, South of Cape Ruge, *Frodin* NGF 26761 (SING), SW Mt. Talawe, *Frodin* NGF 26853 (SING); New Ireland, Namatanai, Danfu river, *Coode & Lelean* NGF 46088 (SING); Noemfoor, Jembeba, *Koster* BW 1041 (SING); *Carr* 13355 (SING); Kainantu, *Henty & Coode* NGF 29231 (SING); Koitaki, *Carr* 12881 (SING), *Carr* 12249 (SING), *Carr* 15652 (SING); Bensbanck, *Ridsdale & Galore* NGF 33477 (SING), *Ridsdale* NGF 33591 (SING); Boridi, *Carr* 13269 (SING); Sogeri, *Jackson* 4156 (SING), *Streimann* LAE 51593 (SING); Morehead, Sibidiri, Mai Kussa, *Henty & Katik* NGF 38772 (SING); Mayu Island, Milne Bay, Raba-raba, junction of Ugat & Mayu river, *Streimann & Katik* NGF 28660 (SING), *Leach & Katik* LAE 56053 (SING); Morobe, Yunzaing, *Clemens 3512* (SING). **QUEENSLAND.** Boonjie, Atherton Tableland, *Kajewski* 1162 (SING), *Kajewski* 1274 (SING). **SOLOMON ISLANDS.** *Whitmore* BSIP 1842 (SING); N Kolombangara, *Gafui* BSIP 8780 (SING); SE Kolombangara, *Mauriasi* BSIP 8549 (SING), *Mauriasi* BSIP 9578 (SING), *Mauriasi* BSIP 11418 (SING); NW Kolombangara, *Mauriasi* BSIP 8819 (SING); NE Kolombangara, *Mauriasi* BSIP 7616 (SING); Guadalcanal, Mt. Austen, *Whitmore* BSIP 1842 (SING); NW Guadalcanal, Mt. Mambulu, *Kere* 4903 (SING); SW Guadalcanal, Wanderer Bay, *Mauriasi* BSIP 12321 (SING); S Vella Lavella, Oula river, *Kotali* BSIP 11328 (SING); S San Cristobal, W Tetere Village, *Gafui* BSIP 12573 (SING); New Georgia, Vanganu Island, near Kaukosi river, *Walker & White* BSIP 156 (BO), Gizo Island, *Whitmore* BSIP 3026 (SING); NW New Georgia, Vaimbu river, *Cowmeadow* BSIP 3278 (SING); SE New Georgia, Viru Harbour, *Maenuu* BSIP 5199 (SING), Tita river, *Burn-Murdoch* BSIP 7196 (SING); San Cristobal, Wairaha river, *Whitmore* BSIP 4277 (SING); Samusodu, SW Station Ysabel, *Beer* BSIP 7282 (SING).

3a. Erythroxylum iwahigense Elmer, forma **iwahigense**

Leafl. Philip. Bot. 5 (1913) 1776. Type: *Elmer* 13227, Philippines, Palawan, Puerto Princesa, Mt. Pulgar (holotype L; isotypes BO, K).

E. cuneatum (*non* (Miq.) Kurz) *sensu* Payens, Fl. Males. 1, 5 (1958) 549, *pro parte, quoad syn. E. iwahigense.*

Small tree to 10 m tall, 5 cm diameter. Twigs dark brown, flattened towards the ends, with prominent stipular scars. Stipules triangular, (1.5–)2–2.5(–3) mm long, distinctly bicarinate. Leaves elliptic-lanceolate, (1.9–)4.1–8.3(–9.8) × (1.1–)1.9–3(–3.6) cm, length:width ratio (1.6–)1.9–2.8(–3); base cuneate to acute, apex acute with rounded or emarginate tip or rarely obtuse with emarginate tip, thin-leathery; midrib sunken above, prominent below; lateral veins (6–)9–12 pairs, areolation distinct, slightly prominent to faint on both sides, spacing between lateral veins (3–)4–8(–10) mm; petiole (2–)3–5(–6) mm long, 0.5–0.1 mm thick, glabrous. Flowers solitary; pedicels 15–25 mm long, 0.3–0.4 mm thick, glabrous, slightly thickened under the calyx, subtended by 2 bracteoles; calyx-lobes 1–1.2 mm high, triangular; petals 5; stamens 10, stamen-tube shorter than or at most as long as the calyx-lobe. Fruits ellipsoid, 8–11 × 3–5 mm, length:width ratio 1.8–2.9, curved, glabrous, with rounded tip, rounded-triangular in cross-section, locules arranged in a triangle, with fertile locule nearly of the same size as 2 sterile locules. Seeds 1 in fertile locule, flattened, with endosperm, *c.* 6–9 × 1.5–3 mm.

DISTRIBUTION. Philippines (Palawan island).

ECOLOGY. Montane forest.

SPECIMENS EXAMINED—PALAWAN. Puerto Princesa, Mt. Pulgar, *Elmer* 13227 (holotype L; isotypes BO, K); Narra, Victoria Peaks, Trident Mining Company concession area, below Mc. Gregor's tunnel, *Ridsdale* SMHI 1798 (KEP), Narra, Victoria Peaks, Trident Mining Company concession area, along access track, *Ridsdale* SMHI 1823 (KEP), Narra, Victoria Range, vicinity of Trident mine, *Soejarto & Madulid* 6173 (KEP).

3b. Erythroxylum iwahigense Elmer, forma **calcicola** R.C.K. Chung, **form. nov.** *A forma iwahigense in foliis ellipticis obovatisve crasse coriaceis nervorum lateralium interveniis 1–2(–2.5) mm latis differt. Typus: Paul Chai S. 39898, Sarawak, 4th Division, Gunong Mulu National Park, Gunong Buda (holotypus SAR; isotypi K, KEP, L, MO, SAN).* (Fig. 1)

Shrub or treelet to *c.* 1.5 m tall. Twigs glabrous, dark brown, flattened towards the ends with prominent stipular scars. Stipules triangular, 2–3 mm long, distinctly bicarinate. Leaves elliptic or obovate, (1.6–)2.4–4(–4.3) × (1.1–)1.3–1.8(–2) cm, length:width ratio (1.5–)1.7–2.3(–2.5); base cuneate, apex acute with rounded or emarginate tip, rarely obtuse with rounded tip; thick-leathery, drying dark brown to reddish brown on both sides, glabrous on both surfaces; midrib sunken on the upper surface, raised below; lateral veins (12–)14–20 pairs, fine, forming marginal loops and anastomosing irregularly with the intermediate, intercostal and intramarginal veins to form a distintive reticulate venation,

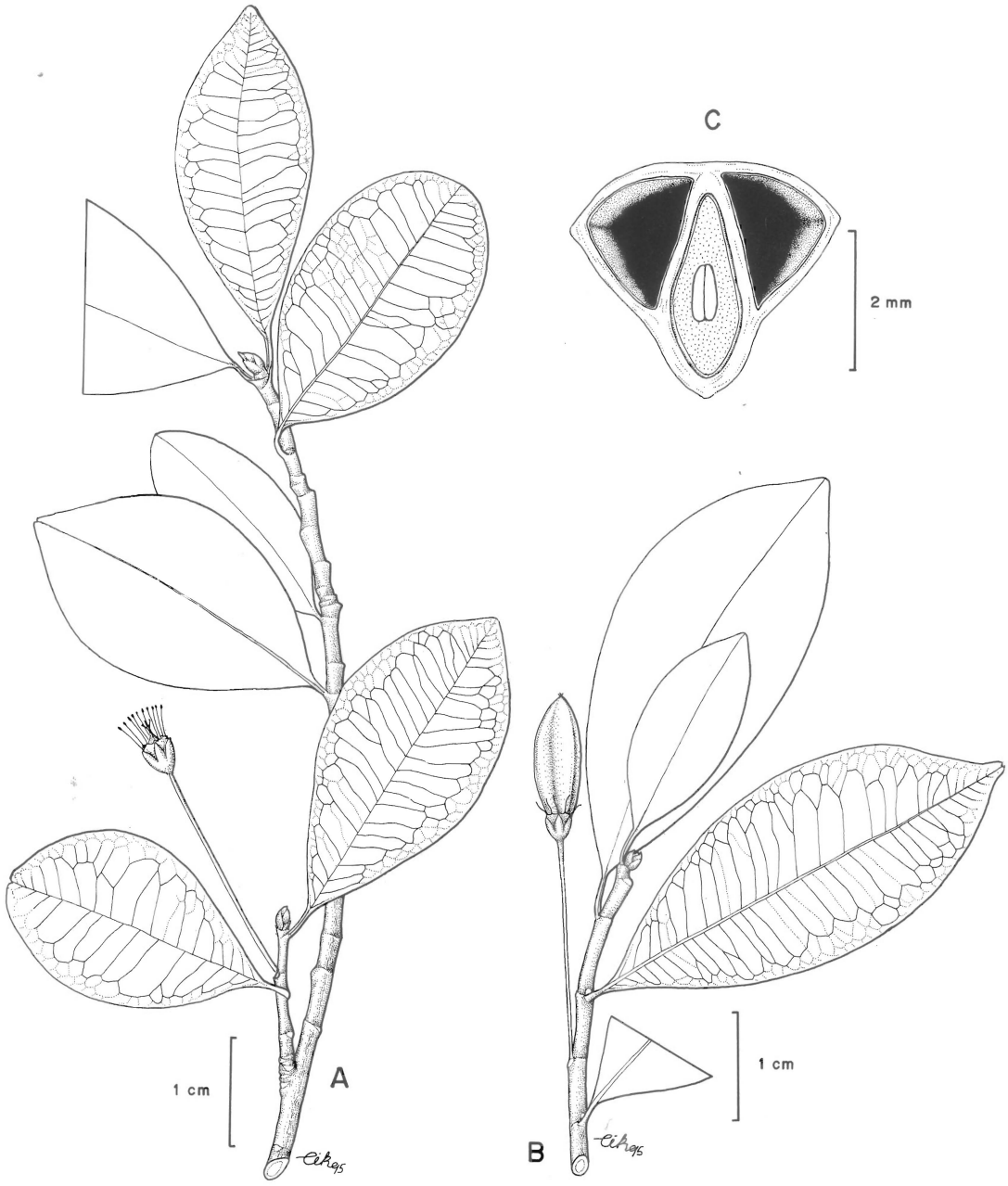

Fig. 1. *Erythroxylum iwahigense* forma *calcicola*. **A.** Flowering leafy twig. **B.** Fruiting leafy twig. **C.** Fruit in cross section. All from S. 39898.

prominent to faint on both sides, spacing between lateral veins 1–2(–2.5) mm; petioles (2–) 3–4 mm long, 0.5–0.8 mm thick, glabrous. Flowers solitary; pedicels 16–19 mm long, *c.* 0.5 mm thick, glabrous, thickened under the calyx, subtended by 2 bracteoles; calyx-lobes 1.1–1.5 mm high, triangular; petals 5; stamen-tube shorter than or at most as long as the calyx-lobe. Fruits ellipsoid, up to 12 × 4.5 mm, length:width ratio *c.* 2.6, glabrous, tip pointed, rounded-triangular in cross section, locules arranged in a triangle, with the 2 sterile ones as large as the fertile one, not curved. Seeds 1 in fertile locule, flattened, with endosperm, *c.* 10 × 2.5 mm.

DISTRIBUTION. Endemic to Borneo (Sarawak), known only from the type.

ECOLOGY. Limestone hills.

4. Erythroxylum kochummenii Ng

Gard. Bull. Sing. 28 (1976) 235. Type: *Kochummen* KEP 93146, Peninsular Malaysia, Selangor, Ulu Gombak Forest Reserve (holotype KEP; isotype SING).

Tree to 27 m tall, 50 cm diameter. Twigs dark brown to grey-brown, flattened towards the ends with prominent stipular scars. Stipules lanceolate, 3–4 mm long, distinctly bicarinate. Leaves broadly elliptic or elliptic, (3.5–)4.7–7.4(–7.6) × (1.6–)2–3.5(–3.8) cm, length:width ratio (1.7–)1.8–2.2(–2.3); base cuneate to acute, apex acuminate with rounded tip, papery; midrib sunken above, prominent below; lateral veins 10–14 pairs, areolation distinct, slightly prominent on both sides, spacing between lateral veins (3–)4–7(–9) mm; petiole (6–)7–10(–11) mm long, 0.5–0.8 mm thick, glabrous. Flowers solitary; pedicels 5–10 mm long, 0.2–0.4 mm thick, glabrous, slightly thickened under the calyx, subtended by 2 bracteoles; calyx-lobes 0.8–1 mm high, triangular; petals 5; stamens 10, stamen-tube shorter than or at most as long as the calyx-lobe. Fruits broadly obovoid, 20–22 × 15–20 mm, length:width ratio 1–1.4, not curved, glabrous, with a truncate top, more or less rounded in cross-section, locules arranged in a row, with the fertile locule much narrower than 2 sterile locules. Seeds 1 in fertile locule, flattened, with endosperm, *c.* 18–21 × 9–13 mm.

DISTRIBUTION. Endemic to Peninsular Malaysia (Selangor, Malacca and Kelantan only).

ECOLOGY. Hill forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Selangor, Ulu Gombak Forest Reserve, *Kochummen* KEP 93146 (holotype KEP; isotype SING), *Symington* KEP 51730 (KEP); Malacca, Merlimau, *Alvins* 1848 (SING); Kelantan, Ulu Lebir Forest Reserve, *Suppiah* FRI 17705 (KEP, SING).

5. Erythroxylum latifolium Burck.

Ann. Jard. Bot. Btzg 11 (1893) 192. Type: *Teijsmann s.n.*, Lingga (holotype BO).

E. latifolium var. *angustatum* O.E. Schulz, Pfl. R. Heft 29 (1907) 144. Type: *Teijsmann s.n.*, Billiton, Tanjong Pandang (BO, L).

E. latifolium var. *longipetiolatum* Boerlage & Koorders, Ic. Bog. 1 (1897) *t.* 6. Type: *Koorders s.n.*, Sumatra, Boewatan (BO, L).

E. cuneatum (*non* (Miq.) Kurz) *sensu* Payens, Fl. Males. 1, 5 (1958) 549, *pro parte, quoad syn. E. latifolium, incl.* var. *angustatum* O.E. Schulz & var. *longipetiolatum* Boerl. & Koord.

Shrub or small tree to 6 m tall. Twigs brown to grey-brown, flattened towards the ends, with prominent stipular scars. Stipules triangular, *c.* (2.5–)3.0–3.5(–4.0) mm long, distinctly bicarinate. Leaves elliptic or rarely obovate, (5.5–)6.2–13(–17) × (2.5–)2.8–5.7(–6.4) cm, length:width ratio (1.8–)1.9–2.8(–3); base cuneate to acute, apex acute with rounded or pointed tip, sometimes cuspidate or rarely obtuse with rounded or emarginate tip, papery or thin-leathery; midrib sunken above, prominent below; lateral veins 9–14 pairs, areolation distinct, slightly prominent below, faint above, spacing between lateral veins (3–)5–13(–16) mm; petiole (3–)4–8(–10) mm long, 0.8–1.5 mm thick, glabrous. Flowers in clusters of 2–4; pedicels 5–6 mm long, 0.8–1 mm thick, glabrous, slightly thickened under the calyx, subtended by 2 bracteoles; calyx-lobes 1–1.2 mm high, triangular; petals 5; stamens 10, stamen-tube shorter than or at most as long as the calyx-lobe. Fruits broadly obovoid, 9–12 × 4.5–8 mm, length:width ratio 1.4–2.1, not curved, glabrous, tip pointed, rounded-triangular in cross-section, locules arranged in a triangle, with the fertile locule nearly of the same size as 2 sterile locules. Seeds 1 in fertile locule, flattened, with endosperm, *c.* 7–9 × 3–5 mm.

DISTRIBUTION. Sumatra, Banka, Billiton, Lingga, Anambas and Natuna Islands, and Borneo.

ECOLOGY. Lowland mixed dipterocarp, *kerangas* and peatswamp forests.

SPECIMENS EXAMINED—SUMATRA. *Koorders* 22320β (BO). **BANKA ISLAND.** Soengei Liat, *Teijsmann s.n.* (BO); Djeboes, *Teijsmann s.n.* (BO). **BILLITON.** Tanjong Pandang, *Teijsmann s.n.*, (BO, L). **LINGGA ISLAND.** *Teijsmann s.n.* (holotype BO); *Hullett s.n.* (SING). **ANAMBAS AND NATUNA ISLANDS.** N Jemaja, Telok Padang, *Henderson* SFN 20428 (BO, K, SING). **BORNEO. SARAWAK:** 4th Division, Miri District, Baram, *Hose* 179 (K), Marudi Forest Reserve, *Chew* CWL 975 (SAR, SING), *Martin* S. 38236 (K, KEP, L, MO, SAN, SAR), Lambir Hills National Park, *Ilias & Yeo* S. 38335 (K, KEP, L, SAN, SAR), *Sibat ak Luang* S. 25076 (A, BO, K, L, SAN, SAR, SING), Sg. Dalam Forest Reserve, *Brunig* S. 987 (SAR); 6th Division, Sarikei District, Rejang

Delta, Lassa Protected Forest, *Hamdi* S. 27823 (SAR). **BRUNEI:** Belait District, Badas Forest Reserve, *Anderson* S. 5691A (SAR), *Smythies, Ashton & Wood* S. 5843 (KEP, SAR, SING), *Wong* WKM 9 (K, SAN, SING), *Van Niel* 4113 (L), Bt. Sawat, *Thomas* 218 (K), *Coode* 7346 (K), *Ashton* BRUN 980 (K), Kuala Badas, *Hotta* 13027 (L), Lumut Hills, *Fuchs* 21201 (SAR); Tutong District, Tutong, *Ashton* S. 1174 (SAR), *Van Niel* 4293 (L), *Jacobs* 5688 (B, BH, BRUN, CANB, G, K, L, US, S).

6. Erythroxylum sarawakanum R.C.K. Chung, **sp. nov.** *E. latifolio affinis sed foliis crasse coriaceis obovatis ellipticisve apice obtuso acumine emarginato, calycis lobis longioribus 1.4–1.8 mm longis, fructibus ellipsoideis ad 4 mm latis longitudinis/latitudinis ratione 2.3 differt. Typus: Ilias Paie S. 17894, Sarawak, Bako National Park (holotypus SAR; isotypi A, BO, K, L, SAN, SING).* (Fig. 2)

Shrub or treelet up to *c.* 5 m tall, 4 cm diameter. Twigs glabrous, grey-brown, flattened towards the ends, with prominent stipular scars. Stipules triangular, 2–2.5 mm long, distinctly bicarinate. Leaves obovate or elliptic, (4.3–)5.5–9(–10.5) × (2.2–)2.8–5(–5.5) cm, length:width ratio (1.3–)1.6–2.1(–2.4); base broadly cuneate to acute, apex obtuse with emarginate tip; thick-leathery, drying brown and glabrous above, pruinose below; midrib sunken above, raised below; lateral veins (6–)8–12 pairs, fine, joining and forming marginal loops and anastomosing irregularly with the intermediate, intercostal and intramarginal veins to form a distintive reticulate venation, prominent above, faint below, spacing between lateral veins (4–)7–12(–13) mm; petioles (6–)7–10(–12) mm long, 1–2 mm thick, glabrous. Flowers in clusters of 2–4; pedicels 4–5 mm long, *c.* 0.5 mm thick, glabrous, thickened under the calyx, subtended by 2 bracteoles; calyx-lobes 1.4–1.8 mm high, triangular; petals 5; stamens 10, stamen-tube shorter than or at most as long as the calyx-lobe. Fruits ellipsoid, 9 × 3.5–4 mm, length:width ratio *c.* 2.3, glabrous, with a rounded top, rounded-triangular in cross-section, locules arranged in a triangle, with 2 sterile ones as large as fertile one, seldom curved. Seeds 1 in fertile locule, flattened, with endosperm, *c.* 6–8 × 2.5–3 mm.

DISTRIBUTION. Endemic to Borneo (Sarawak only).

ECOLOGY. Lowland to hill forests, to *c.* 700 m alt.

SPECIMENS EXAMINED—BORNEO. SARAWAK: 1st Division, Kuching District, Bako National Park, *Ilias Paie* S. 17894 (holotype SAR; isotypes A, BO, K, L, SAN, SING), *Sinclair & Kadim* S. 10324 (A, B, E, FI, K, L, SAR, SING), *Jugah, Saupel & Mohd. Ismail* S. 73601 (K, KEP, KLU, L, MO, SAN, SAR); Mt. Matang, *J. & M.S. Clemens* 22354 (K); Gunong Santubong, *Martin* S. 37668 (K, KEP, L, SAR), *Jugah, Saupel &.Mohd. Ismail* S. 73603 (K, KEP, KLU, L, MO, SAN, SAR).

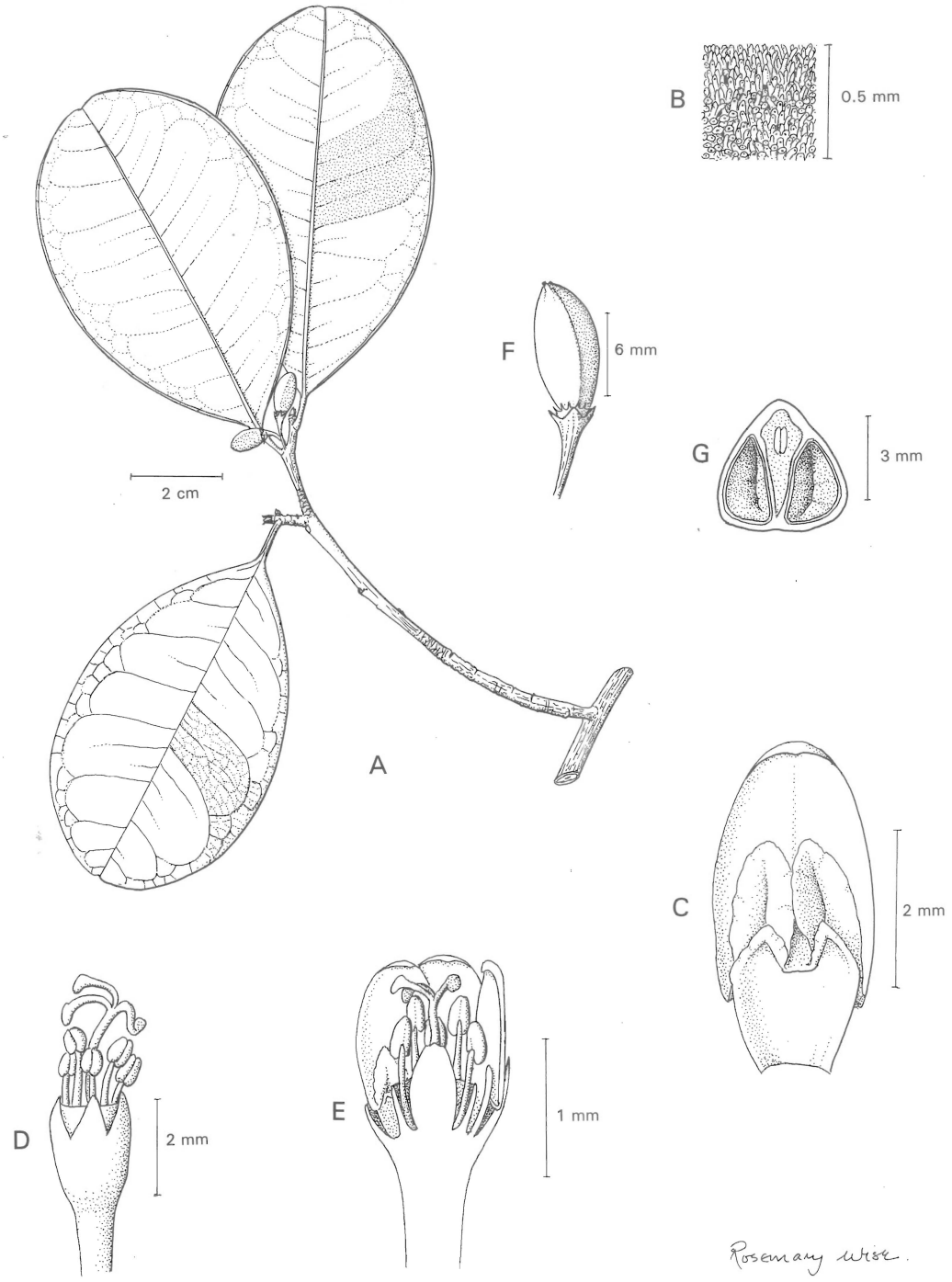

Fig. 2. *Erythroxylum sarawakanum*. **A.** Fruiting leafy twig. **B.** Detail of lower leaf surface. **C.** Posterior clawed petal with a 3-lobed ligule-like appendage. **D.** Mature flower bud with petals removed. **E.** Flower bud in longitudinal section. **F.** Fruit. **G.** Fruit in cross section. All from S. 17894 except **C, D** & **E**, from S. 73603.

E. sarawakanum differs from *E. latifolium* by its thick-leathery leaves, which are obovate or elliptic, and its obtuse leaf apex with an emarginate tip. The longer calyx lobes (1.4–1.8 mm long) and ellipsoid fruit (up to 4 mm wide, with a length:width ratio of 2.3) also distinguish it from the latter species.

ACKNOWLEDGEMENTS

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New species of *Anacardiaceae* and a new variety of *Parishia maingayi* from Sabah and Sarawak

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Summary. Nineteen new species in six genera of Anacardiaceae (*Drimycarpus, Mangifera, Melanochyla, Parishia, Semecarpus, Swintonia*) are described for Sabah and Sarawak. *Parishia minor* Ridley is raised from synonymy to varietal status under *P. maingayi* Hook. *f.*

In the course of studies conducted for the Tree Flora of Sabah and Sarawak, a number of new species were discovered in the Anacardiaceae. These are described below. *Parishia maingayi* var. *minor* (Ridl.) Kochummen is also proposed as a new combination.

Drimycarpus maximus Kochummen, **sp. nov**. *haec species a D. luridus in foliis crasse coriaceis magnis marginibus reflexis, petiolis longioribus crassioribus distincta. Typus: Othman et al. S. 43483, Sarawak, Ulu Sg. Belaga (holotypus KEP; isotypi K, L, MO, SAN, SAR).* (Fig. 1)

Medium-sized tree to 23 m tall, 33 cm diameter. Bark grey, smooth. Twigs brownish, angled, with sharp edges. Leaves thick-leathery, oblanceolate, 34–35.5 × 8.5–10 cm, base cuneate to tapered, margin thickened, reflexed, apex pointed with 1 cm tip; midrib raised above, strongly keeled below, lateral veins 22–25 pairs, raised below, almost invisible above, with short intermediate veins, intercostal veins reticulate, visible below, very faint to inconspicous above; petiole about 3–3.5 cm long, strongly wrinkled on drying. Flowers unknown. Infructescences axillary, 2–3 cm long. Drupe green when fresh, transversely oblong, 2 x 1.2 cm, with 0.7 cm long stalk.

DISTRIBUTION. Endemic to Borneo, so far known only from the type specimen from Ulu Belaga in Sarawak.

ECOLOGY. Mixed dipterocarp forest.

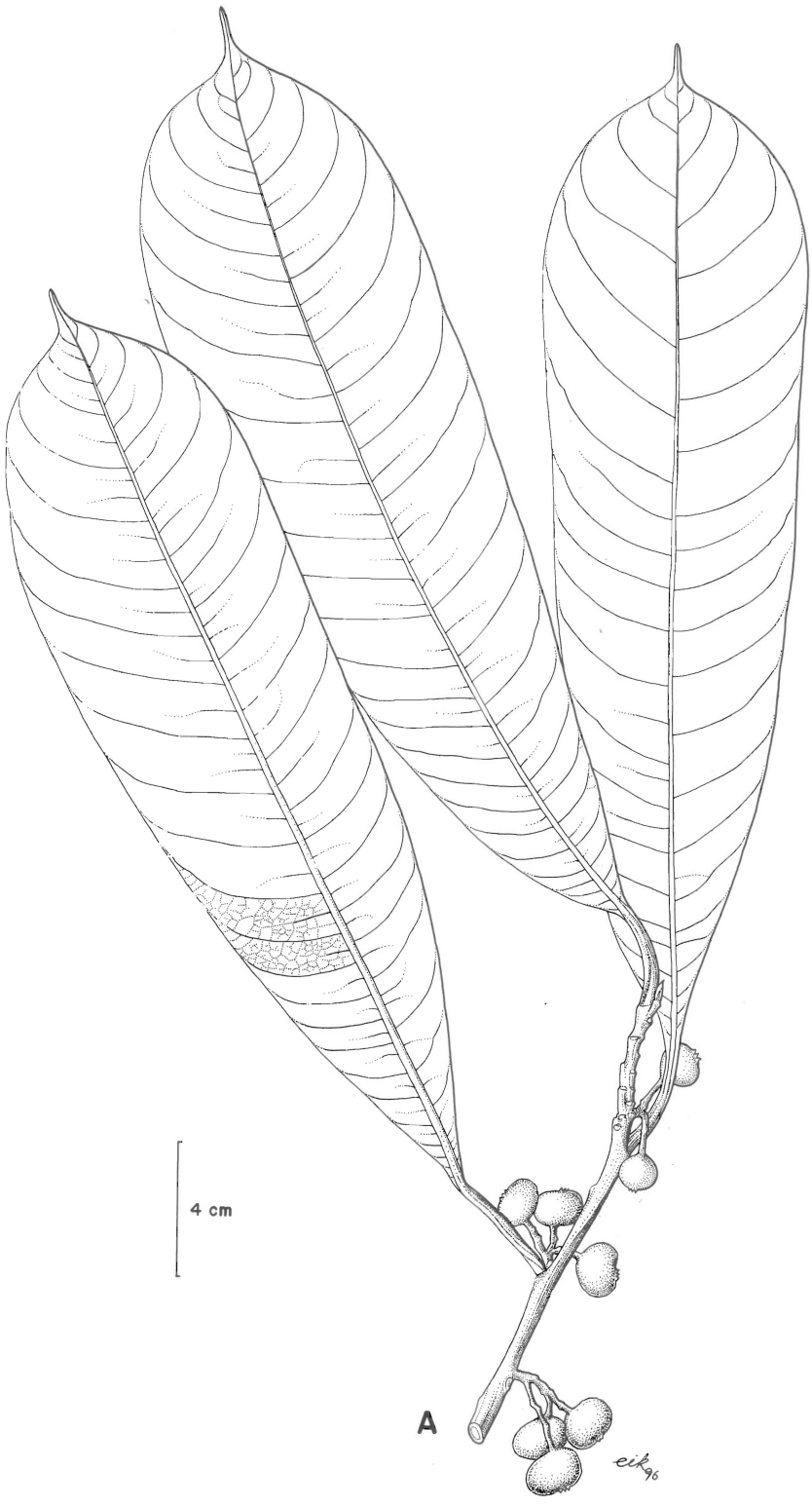

Fig. 1. *Drimycarpus maximus*. Fruiting leafy twig. (From S. 43483.)

Mangifera khoonmengiana Kochummen, **sp. nov**. *haec species ramulis nitidis, foliis marginibus incrassatis reflexis sine nervis intercostalibus venarum rete subtiliter areolatis, fructibus sessilibus oblongis basi apiceque rotundato notata. Typus: K.M. Wong WKM 682, Brunei, Belait, falls upstream from Batu Melintang (holotypus KEP; isotypi BRUN, K).* (Fig. 2)

Medium-sized tree to 30 m tall, 40 cm diameter. Bark brownish, smooth to slightly fissured; inner bark bright-yellow with cream latex which blackens on exposure. Sapwood pale yellow. Twigs brownish or yellowish brown, glossy, slightly angled. Leaves closely spirally arranged; blade leathery, elliptic or oblong, 15–20 × 6–9.5 cm, base cuneate, apex acute, margin thickened, curved inwards, lateral veins 13–15 pairs, almost at right angles to midrib, faintly raised on both surfaces, intercostal veins absent, reticulations fine, areolate, distinct on the lower surface, almost invisible above; petiole 3.5–5 cm long, lower 1.5 cm strongly swollen. Inflorescences in 30 cm long, terminal racemose-panicles, with few side branches, glabrous; bracteoles lanceolate. Flower pale green to cream, 4-merous; pedicel very short, up to 1 mm long; sepals 4, ovate, fleshy; petals membraneous, oblong with obtuse apex and base, with circular brown gland dots, ridges 4 with a number of branches; disc cup-shaped; fertile stamen one; ovary globose, style slightly excentric. Drupe green when fresh, dark brown on drying, oblong, 2.5–3.5 x 2 cm, with obtuse apex and base, sessile.

DISTRIBUTION. Endemic to Borneo; common in Brunei but apparently very rare in the rest of Borneo (one collection *S. 36600* from Miri, Sarawak).

ECOLOGY: Lowland forest. In Brunei this species is recorded as growing gregariously in swampy areas.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Miri, 21st mile Lambir-Subis road, *Tong* S. 36600 (K, KEP, L, MO, SAR). **BRUNEI:** Belait, falls upstream from Batu Melintang, *Wong* WKM 682 (BRUN, K, KEP).

Melanochyla condensata Kochummen, **sp. nov.** *haec species M. axillaris affinis inflorescentiis brevibus axillaribus, sed in foliis pubescentibus subtus non glaucis, nervis lateralibus 40–44 paribus differt. Typus: Ashton S. 18323, Sarawak, Similajau F.R., Ulu Sinrok (holotypus KEP; isotypi A, BO, FHO, K, L, MEL, P, SAN, SAR, SING).* (Fig. 3)

Small tree up to 12 m tall, 8 cm diameter. Bark grey brown, smooth; inner bark pinkish with abundant black sap. Twigs stout, 1–1.5 cm thick, yellowish brown adpressed hairy. Leaves coriaceous, softly hairy below, oblanceolate, 53–55 × 12–13 cm, papillae uniform below, base tapered, apex rounded or with very short point, midrib raised above, lateral veins 40–44 pairs, raised below, faintly sunken above, with short intermediate veins, intercostal veins scalariform-reticulate, raised below, faint to invisible above; petiole 2–7 cm long,

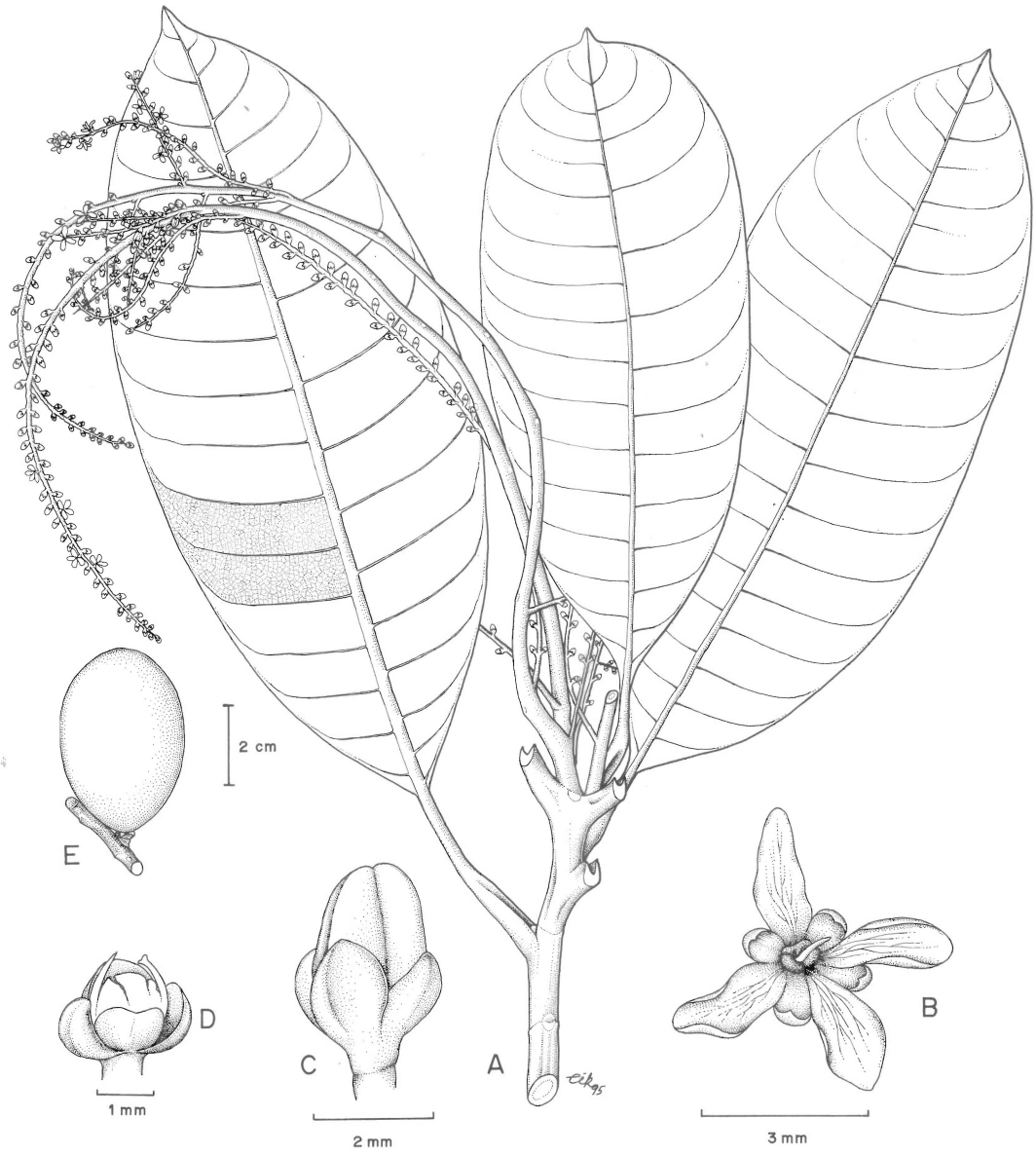

Fig. 2. *Mangifera khoonmengiana*. **A.** Flowering leafy twig. **B.** Flower viewed from above. **C.** Flower bud. **D.** Flower bud with petals removed. **E.** Fruit. (A–D from *Wong* WKM 682, E from S. 36600.)

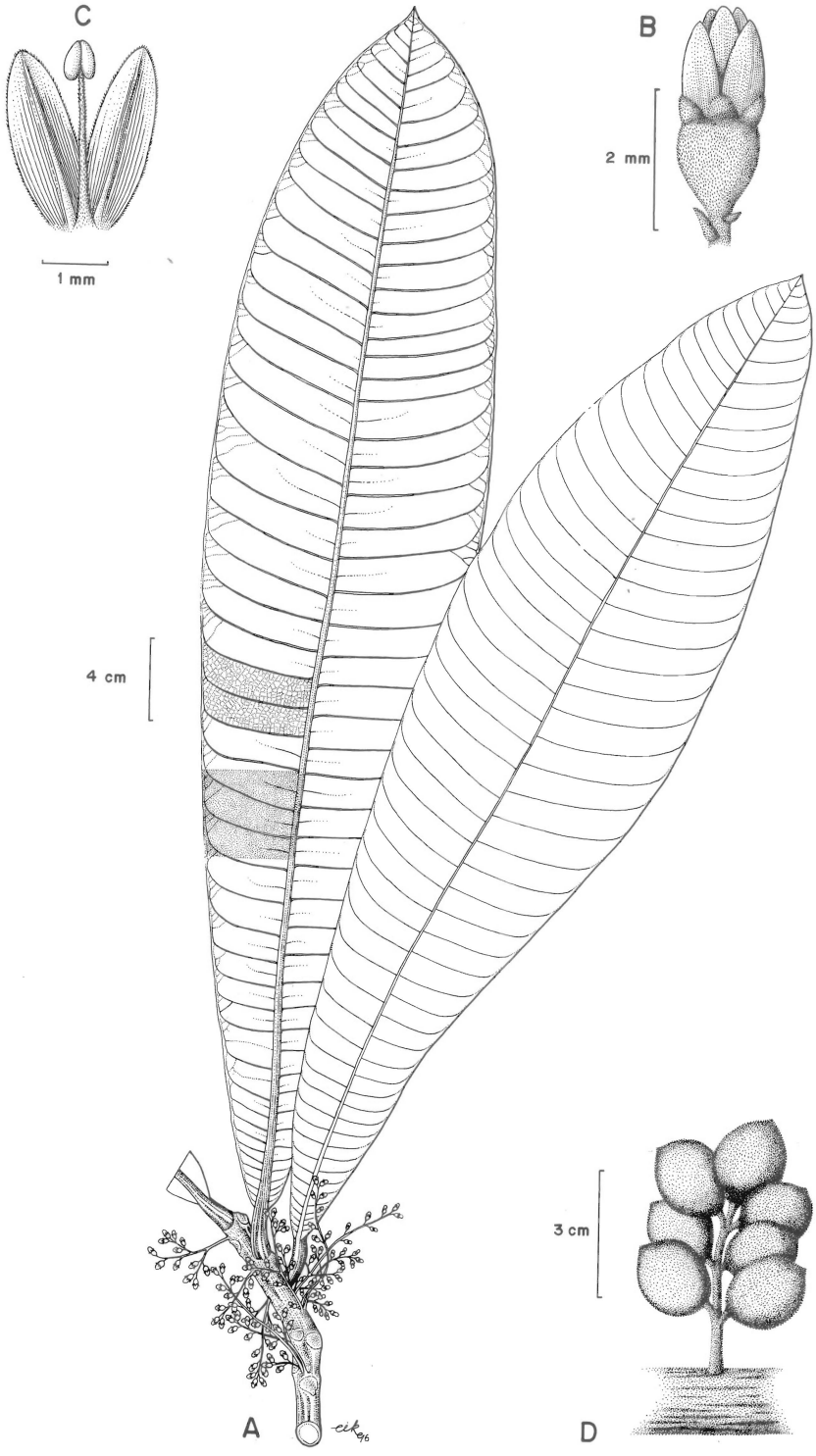

Fig. 3. *Melanochyla condensata*. **A.** Flowering leafy twig. **B.** Flower. **C.** Two petals and single stamen. **D.** Fruits. (A–C from *Wong* WKM 611, D from S. 18323.)

softly hairy, lower half swollen, wrinkled on drying. Inflorescences condensed, from leaf axils and leafless twigs, 6–7 cm long, hairy; bracts lanceolate, 2 mm long, hairy; bracteoles ovate, 1 mm long. Flowers (male) sessile, 7 mm long; calyx lobes triangular with pointed tip, 1mm long, hairy; petals oblong, 3 mm long, densely hairy inside; stamens free, filaments densely hairy; disc 5-lobed; rudimentery ovary absent. Infructescences 4.5–6 cm long. Drupe oblong, 1.8–2 × 1.2–1.5 cm, dark brown velvety hairy, apex pointed.

DISTRIBUTION. Endemic to Borneo. So far known only from the type collection from Sarawak and another from Brunei (*Wong WKM 611*) from which details of flowers were described.

ECOLOGY. Lowland forest.

The short axillary inflorescence is a distinct character which is present in *M. axillaris* too but that species has glabrous, glaucous leaves.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Similajau F.R., Ulu Sinrok, *Ashton* S. 18323 (A, BO, FHO, K, KEP, L, MEL, P, SAN, SAR, SING). **BRUNEI:** Belait, Sungei Ingei, *Wong* WKM 611 (BRUN, K, KEP).

Melanochyla montana Kochummen, **sp. nov.** *haec species congeneris ceteris in foliis crasse coreaceis glaucis apicibus rotundatis vel retusis, petiolis crassissimis 3–4 cm longis dimidio inferiore prominentiter tumidis differt. Typus: Mikil SAN 44330, Sabah, Tambunan (holotypus SAN; isotypus L).* (Fig. 4)

Very large tree reaching 45 m tall and 200 cm diameter. Bole with tall buttresses to 2.5 m high. Bark dark grey, smooth; inner bark reddish brown with black sap. Sapwood reddish brown. Bud scales stiff, lanceolate. Twigs stout, 1.2 cm thick. Leaves very thickly coriaceous, faintly glaucous below, oblong to lanceolate or obovate, 18–32 × 7–18 cm, papillae uniform below; base cuneate, apex rounded or notched; midrib prominently raised above, channelled below, lateral veins 17–22 pairs, raised on both surfaces, intercostal veins scalariform-reticulate, visible below, invisible above; petiole very stout, 3–4 cm long, lower half prominently swollen and wrinkled on drying. Flowers and fruits unknown.

DISTRIBUTION. Endemic to Borneo. Known only from a few collections in Sabah and Sarawak from montane forest, where it appears to be one of the tallest trees.

ECOLOGY. Montane forest at 1370–1800 m.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau, Kinabalu Park, Mesilau Trail, Pinosuk Plateau, *Tarmiji & Bongsu* SAN 75893 (SAN); Sipitang, SFI area, *Kulip* SAN 132820 (SAN).

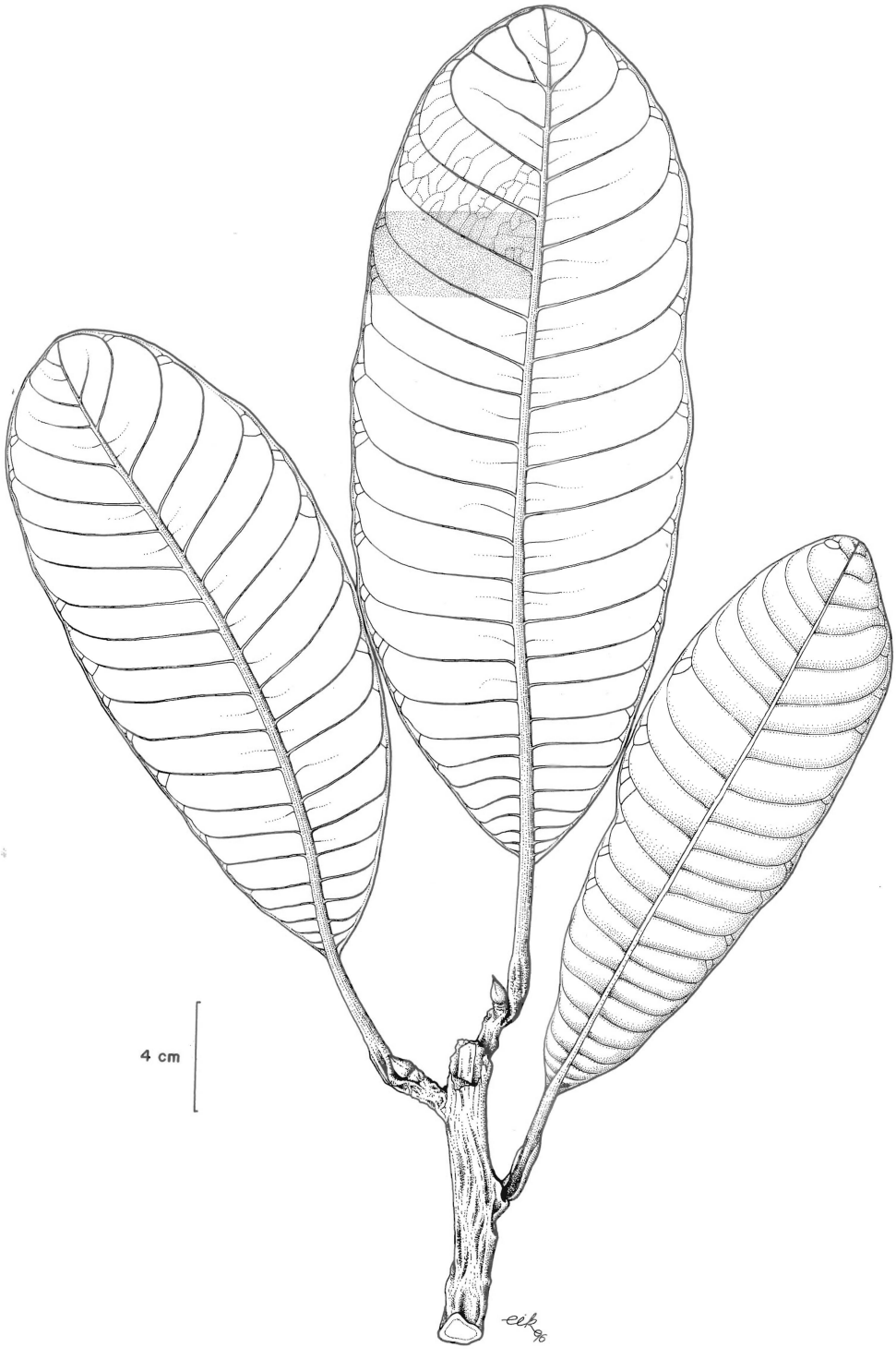

Fig. 4. *Melanochyla montana*. Leafy twig. (From SAN 44330.)

Melanochyla scalarinervis Kochummen, **sp. nov.** *Melanochyla bullata affinis, in foliis non-bullatis glabris venis secundariis intercostalibusque elevatis differt. Typus: Ilias S. 37722, Sarawak, Semenggoh Arboretum (holotypus SAN; isotypi L, MO, SAR).* (Fig. 5)

Medium-sized tree to 22 m tall, 15 cm diameter. Bark blackish, smooth; inner bark with black sap. Twig grey, 7 mm thick, with minute lenticels. Leaves coriaceous, oblong, 21–25 × 6.5–7 cm, glabrous on both surfaces, papillae uniform below; base cuneate, apex obtuse with short point; midrib raised above, lateral veins 30 pairs, prominent below, faintly raised above, intercostal veins scalariform, raised below, invisible above; petiole 1.5–2.5 cm long, whitish, wrinkled on drying. Inflorescences and flowers unknown. Infructescences terminal, 30 cm long, velvety hairy, with very short branches, each of which ends in a fruit. Drupe ellipsoid, 2–2.5 × 1.5–2 cm, densely velvety hairy, pointed, with shallow cup-like swelling at the bottom.

DISTRIBUTION. Endemic to Borneo. Extremely rare, known from only the type specimen from Sarawak.

ECOLOGY. Lowland forest.

This species is superficially similar to *M. bullata* Ding Hou, but that species has bullate hairy leaves with sunken lateral and intercostal veins.

Melanochyla woodiana Kochummen, **sp. nov.** *ab speciebus ceteris in folii basi obtusa, nervis lateralibus impressis, fructibus rugosis differt. Typus: Wood SAN 16969, Sabah, Beaufort (holotypus SAN; isotypi A, BO, K, KEP, L, SING).* (Fig. 6)

Medium-sized tree to 20 m tall. Twigs whitish powdery brown hairy. Leaves coriaceous, glabrous on both surface, elliptic or oblong, 17.5–19 × 9–10 cm, papillae uniform below; base broadly cuneate to obtuse, apex cuspidate with short point; midrib raised above, lateral veins 18 pairs, raised below, very faint to almost sunken above, intercostal veins scalariform-reticulate, raised below, invisible above; petiole 1.5–2.5 cm long, powdery hairy, lower half swollen, whitish and wrinkled on drying. Inflorescences and flowers unknown. Infructescences terminal, 30 cm long, finely brown powdery hairy, with a number of long side branches. Drupe ovoid or ellipsoid, 1.7–2 × 1–1.2 cm, with sharp point, surface rugose, powdery brown hairy.

DISTRIBUTION. Endemic to Borneo. Very rare, known only from the type specimen from Sabah.

ECOLOGY. Lowland forest.

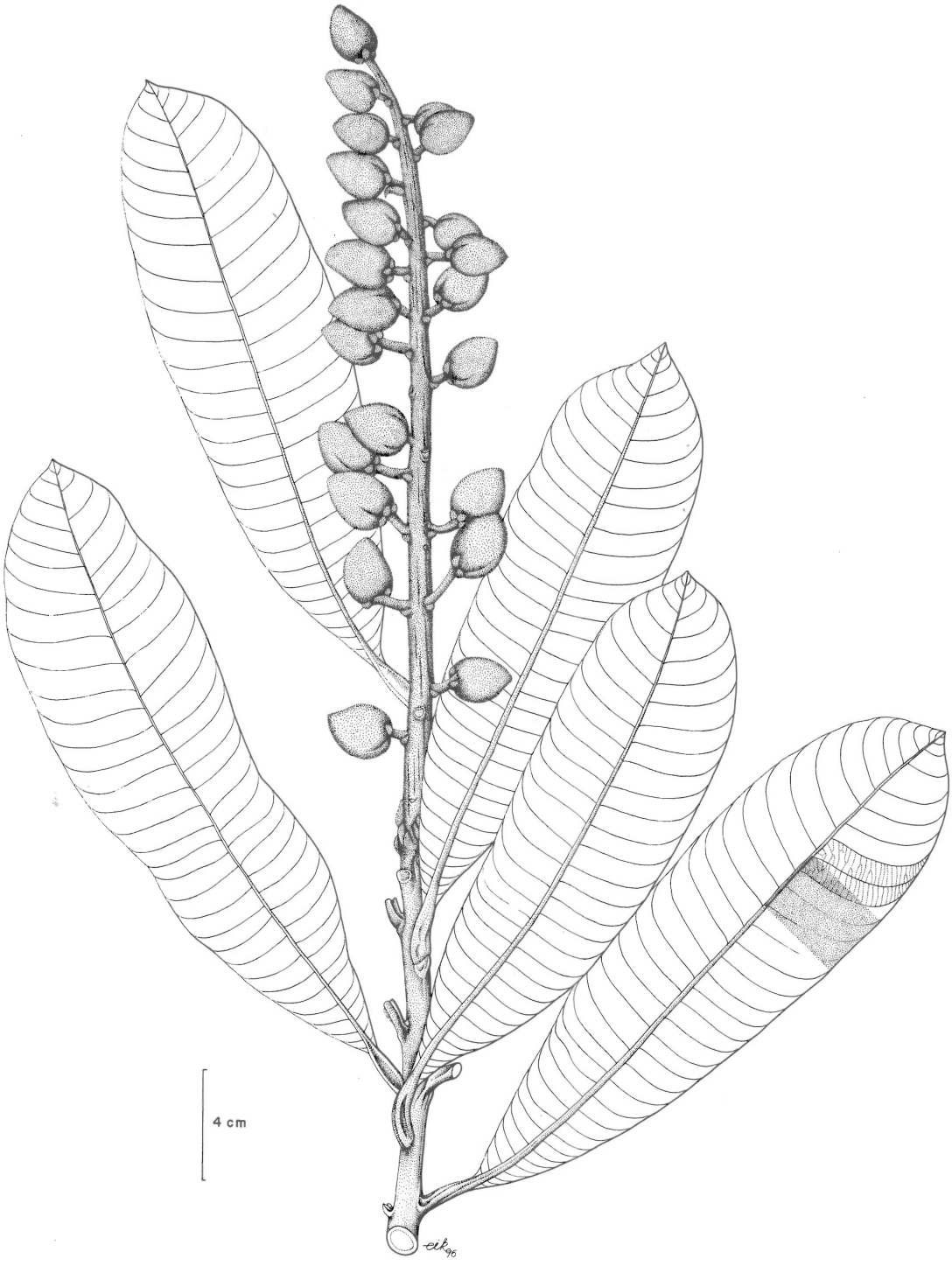

Fig. 5. *Melanochyla scalarinervis*. Fruiting leafy twig. (From S. 37722.)

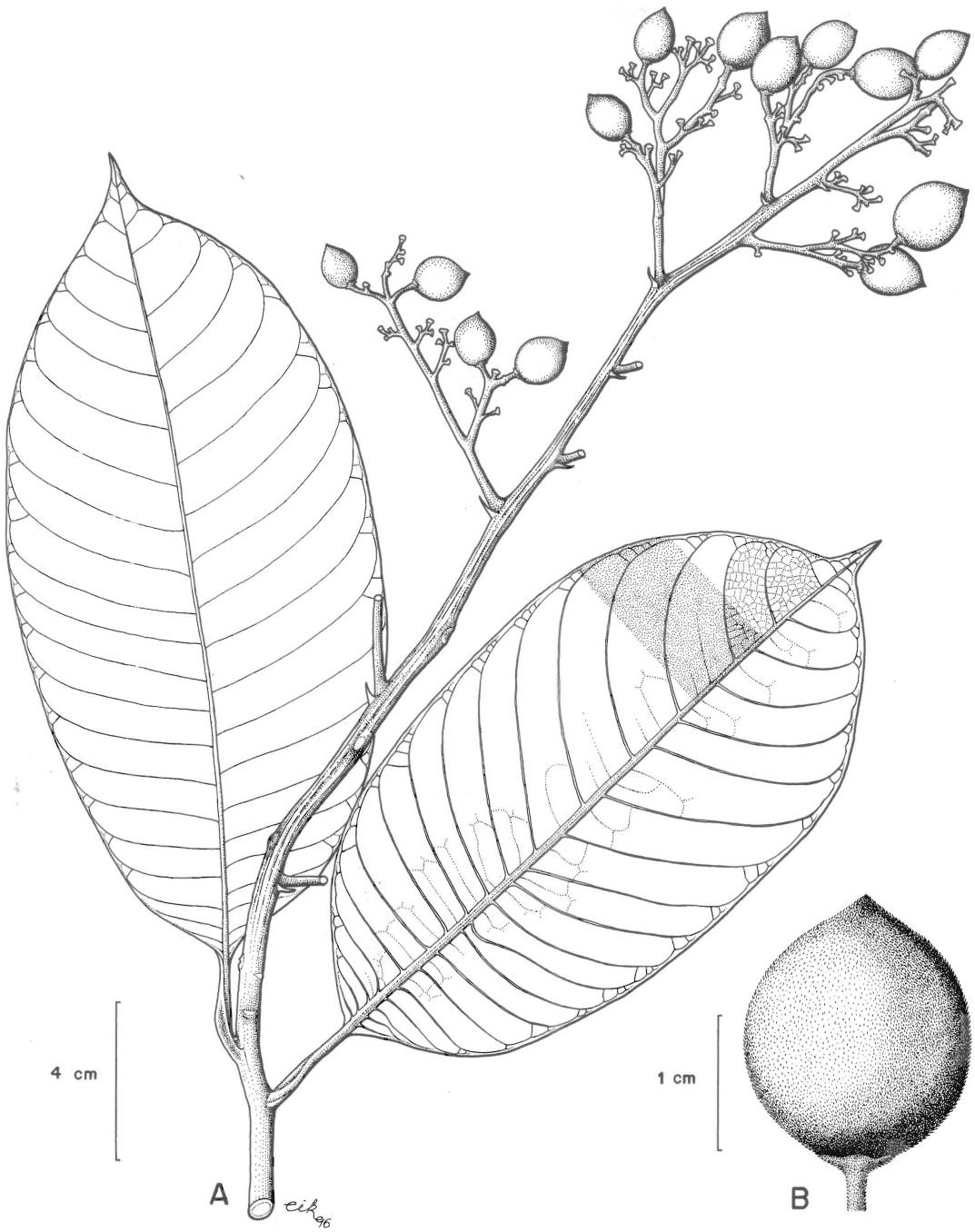

Fig. 6. *Melanochyla woodiana*. **A.** Fruiting leafy twig. **B.** Fruit. (From SAN 16969.)

Parishia dinghouiana Kochummen, **sp. nov.** *haec species foliolis concavis subtus porphyree pubescentibus, nervis lateralibus impressis, calycis alis accrescentibus tubo 2 cm longo 2.5 cm lato notatus. Typus: Jugah & Sibat S. 26300, Sarawak, 12th mile Penrissen road, Kuching (holotypus SAN; isotypi A, BO, K, L, SAR, SING).* (Fig. 7)

Small tree to 15 m tall, 30 cm diameter. Twigs stout, 1.5–2 cm thick, brown hairy. Leaves with rachis flattened above, hairy; leaflets slightly concave, oblong 10–18.5 × 6–7.5 cm, glabrous above, reddish brown hairy below; base broadly cuneate, apex pointed; midrib raised above, lateral veins 15–21 pairs, sunken above, raised below; with short intermediate veins, intercostal veins reticulate, faint below, invisible above; petiolules 3 mm long, densely hairy. Inflorescences and flowers unknown. Infructescences terminal, 68 cm long, densely hairy, axes 1–1.5 cm thick. Drupe (immature) ovoid, 7 × 5 mm, velvety hairy, enclosed by the enlarged hairy calyx-wings; calyx-tube 2 cm long, 2.5 cm wide, wing 5.5 × 1.5 cm, with distinct reticulate veins.

DISTRIBUTION. Endemic to Borneo. Very rare, known only from the type specimen from Sarawak.

ECOLOGY. Lowland forest, by stream.

Parishia trifoliolata Kochummen, **sp. nov**. *haec ab Parishiae speciebus aliis in foliis trifoliolatis, foliolis basi apiceque obtuso, costa impressa, venis intercostalibus valde reticulatis, calycis alis in fructu fusce velutinis differt. Typus: Yii S. 42974, Sarawak, Samumsan Wildlife Sanctuary (holotypus KEP, isotypi K, L, SAN, SAR).* (Fig. 8)

Small tree to 12 m tall, 10 cm diameter. Twigs brown, 8 mm thick. Leaves trifoliate; rachis glabrous; leaflets thick-leathery, drying to yellowish green, oblong, 17–21 × 10–15 cm, base rounded, apex rounded with a very short tip; midrib sunken above at least on the upper half, lateral veins 14–16 pairs, faintly visible on both surfaces, intercostal veins strongly reticulate, distinct below; petiolules 1–1.5. cm long, wrinkled on drying. Inflorescences and flowers unknown. Infructescences terminal, more than 40 cm long, with long side branches. Drupe (immature) 7 × 6 mm, velvety hairy, calyx-wing dark red when fresh, dark brown velvety hairy on both surfaces, calyx-tube 1 cm long, wing 3 cm long.

DISTRIBUTION. Endemic to Borneo. Very rare, known only from the type specimen from Sarawak.

ECOLOGY. Lowland *kerangas* forest.

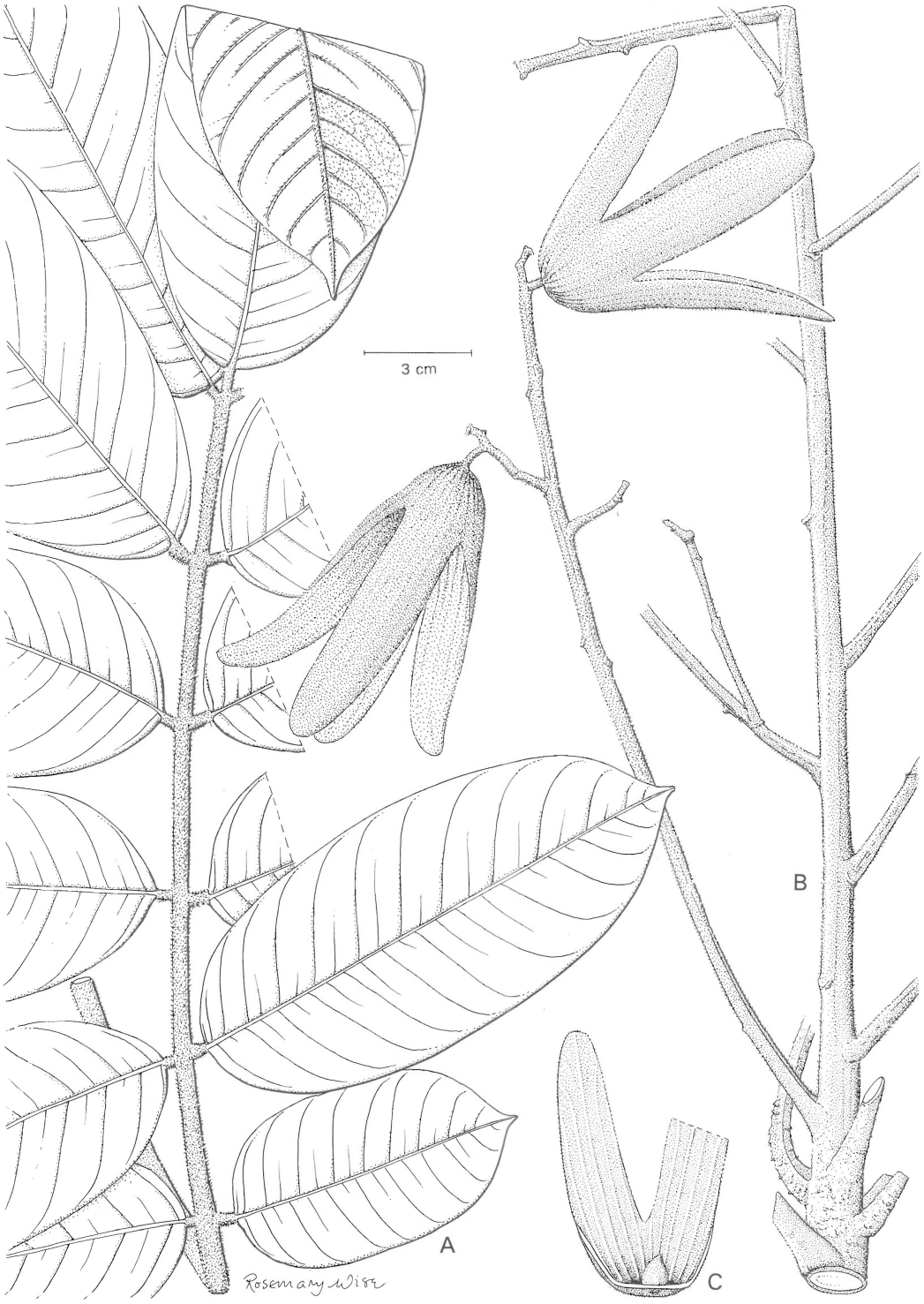

Fig. 7. *Parishia dinghouiana*. **A.** Leaf. **B.** Infructescence. **C.** Single fruit. (From S. 26300)

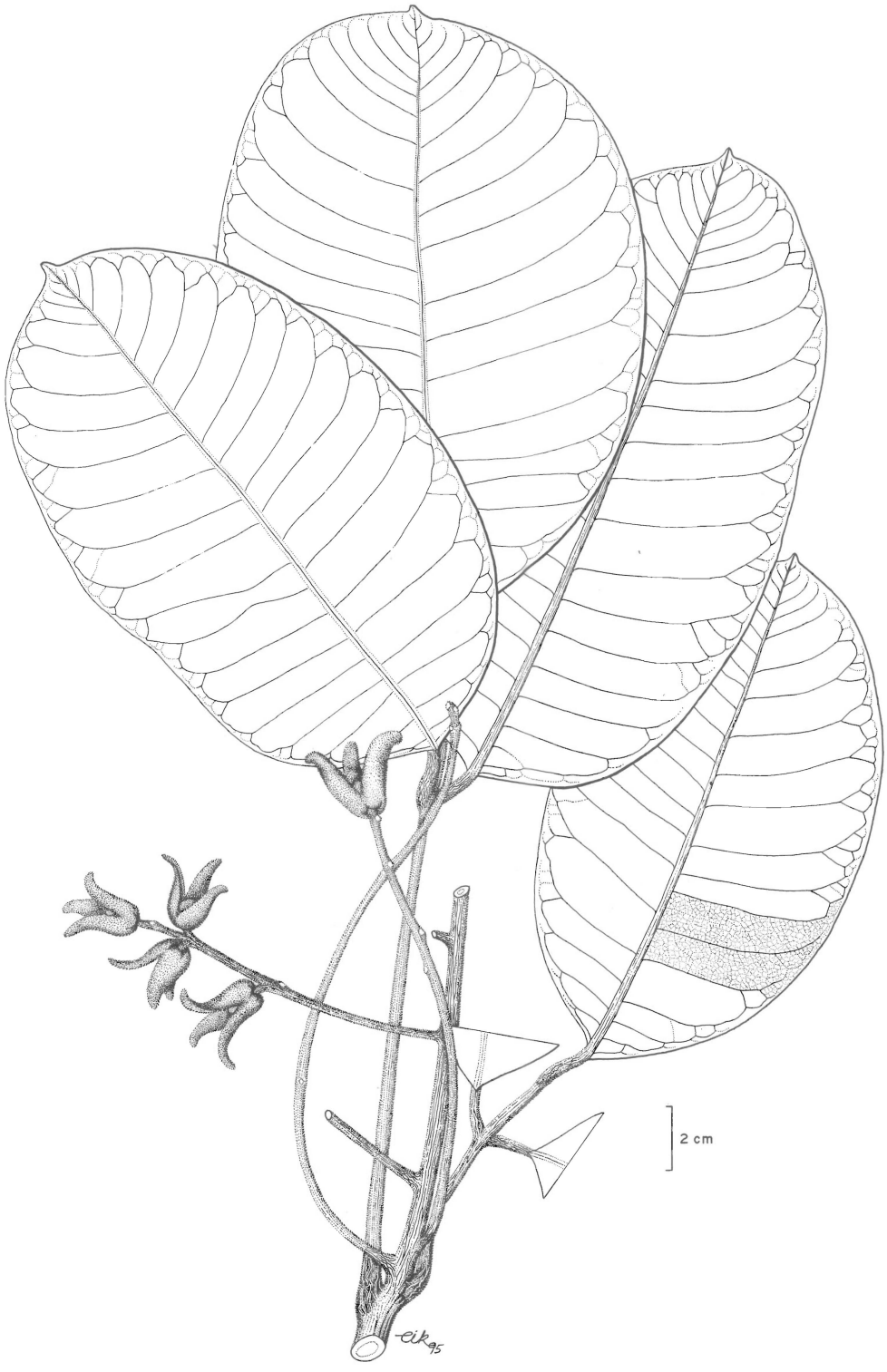

Fig. 8. *Parishia trifoliata*. Fruiting leafy twig. (From S. 42974.)

Parishia maingayi Hook. *f.* var. **minor** (Ridl.) Kochummen. **comb. nov**.

P. minor Ridl., Kew Bull. (1933) 201. Type: *Omar 368*, Sarawak, Kuching (holotype K).

Ding Hou, in his treatment of the Anacardiaceae for the Flora Malesiana, reduced *Parishia minor* Ridl. to *P. maingayi* Hook. *f.* I have raised it to varietal status because of the notched leaflet apices and the inconspicuous or slightly flattened midrib on the upper surface of leaflet, which distinguish this from typical *P. maingayi*.

Semecarpus angulatus Kochummen, **sp. nov**. *a speciebus ceteris in inflorescentiae axibus angulatis, foliis lanceolatis marginibus undulatis, ovario stylisque dense pubescentibus differt. Typus: Fedilis & Sumbing SAN 91435, Sabah, Kalabakan (holotypus SAN).* (Fig. 9)

Small tree to 6 m tall, 4 cm diameter. Twigs stout, 1.7 cm thick, grey brown, rugose. Leaves in close spirals; blade coriaceous, lanceolate, 28–31.5 × 10.5–12.5 cm, faintly glaucous and sparsely hairy below, papillae uniform below, dense; base cuneate, margin undulate, apex acute; midrib raised above, lateral veins 11–15 pairs, raised below, faint above, intercostal veins scalariform-reticulate, raised below, faint above; petiole 8–9 cm long, basal part swollen, concave above, wrinkled on drying. Inflorescences in terminal clusters, 15–19 cm long, with few short branches, finely hairy, axes angled. Flower (only female seen) sessile; bracteoles triangular, hairy, 1 mm long; calyx-lobes deltoid, 1 mm high, 2 mm broad, hairy outside; petals imbricate, elliptic, 5 × 2.5 mm, glabrous, with a number of black veins inside, apex obtuse; disc prominent, saucer-shaped, 0.5 mm high, margin entire, glabrous; abortive stamens very small; ovary broadly conical, 3 mm diameter, 2 mm high, densely hairy, styles 1 mm long, hairy; stigma peltate. Drupe unknown.

DISTRIBUTION. Endemic to Borneo. Extremely rare, known only from the type specimen from Sabah.

ECOLOGY. Lowland forest.

Semecarpus angustifolius Kochummen, **sp. nov**.

A speciebus ceteris in foliis longis angustis (52–64 cm longis, 3.8–4.4 cm latis), basi truncata, fructibus glabris ellipsoideis pedicellis 2 mm longis differt. Typus: Zainudin 5060, Sabah, Telupid, Bukit Tawai Forest Reserve (holotypus SAN). (Fig. 10)

Small tree to 3 m tall. Stem spiny. Twig 1 cm thick, brown, shallowly fissured, glabrous. Leaves in clusters; blade oblong, narrow, 52–64 × 3.8–4.4 cm, faintly glaucous below, papillae uniform below, distinct; base truncate, apex pointed; midrib raised above, lateral veins 32–36 pairs, curving and joining near margin, visible on both surfaces, intercostal

Fig. 9. *Semecarpus angulatus*. **A.** Flowering leafy twig. **B.** Flower buds. **C.** Female flower with 2 petals removed. (From SAN 91435.)

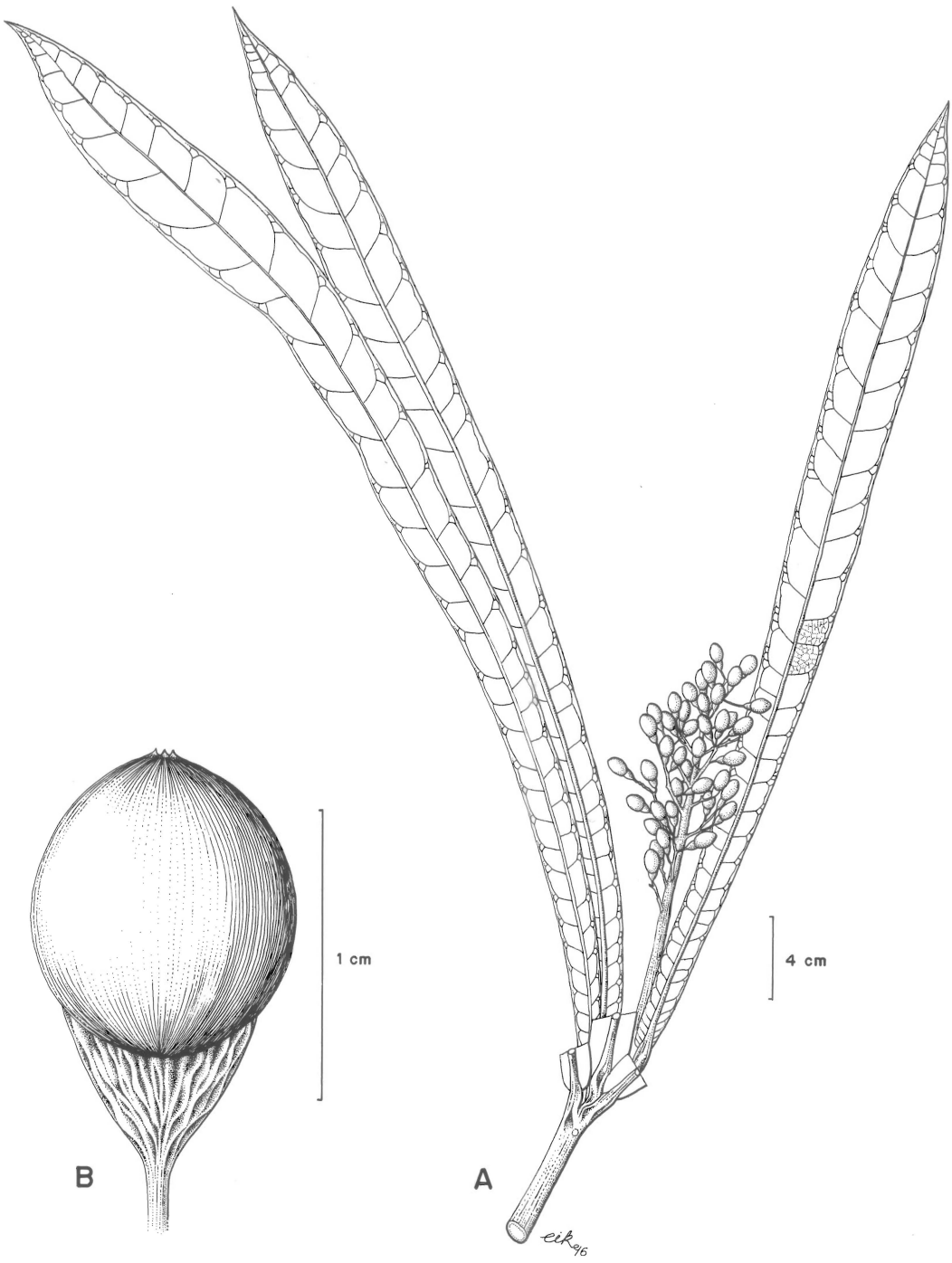

Fig. 10. *Semecarpus angustifolius*. **A.** Fruiting leafy twig. **B.** Fruit. (From *Zainuddin* 5060.)

veins reticulate, visible below, faint to invisible above; petiole 1 cm long, wrinkled. Inflorescenses and flowers unknown. Drupe ellipsoid, 1 x 0.5 cm, glabrous, apex obtuse, hypocarp glabrous or sparsely scaly, funnel-shaped, 3 mm long, stalk 2 mm long.

DISTRIBUTION. Endemic to Borneo. Very rare, known from the type specimen only from Sabah.

ECOLOGY. Lowland forest.

Semecarpus calcicolus Kochummen, **sp. nov**. *a speciebus ceteris in venis intercostalibus tenuissimis, infructescentiis extra-axillaribus, fructibus magnis oblongis (2.1–2.5 cm longis, 2–2.2 cm latis) glabris, habitatione calcarea differt. Typus: Dewol & Rahman SAN 90206, Sabah, Kota Belud, Mantanani Besar Island (holotypus SAN).* (Fig 11)

Small tree to 14 m tall, 20 cm diameter. Bark grey white; inner bark pale. Sapwood white. Twigs stout, 1.5 cm thick, lenticellate, hollow. Leaves in close spirals; blade oblanceolate, 26–34 × 7–8.5 cm, glabrous on both surfaces, papillae obscure below; base tapered, apex acuminate; midrib raised above, lateral veins 28–30 pairs, distinct below, faint above, intercostal veins finely reticulate, visible on both surfaces; petiole 1 cm long, drying black and wrinkled. Inflorescences and flowers unknown. Infructescences extra-axillary, *c.* 12 cm long. Drupe broadly oblong, 2.1–2.5 × 2–2.2 cm, glabrous, green when fresh, apex obtuse and slightly depressed in the middle, hypocarp obconic, 7 mm high.

DISTRIBUTION. Endemic to Borneo. Very rare, known only from the type specimen from Sabah.

ECOLOGY. Coastal limestone.

The occurrence of extra-axillary infructescences is unique.

Semecarpus cupularis Kochummen, **sp. nov.** *haec species character diagnostico optimo fructus hypocarpio cupulato tribus fructus guadrantibus includenti. Typus: Ilias S. 41671, Sarawak, Kapit (holotypus SAR; isotypi K, L, SAN).* (Fig. 12)

Small tree to 10 m tall, 10 cm diameter. Stem with scattered spines. Twigs stout, 1–2.2 cm thick, glabrous, yellowish grey, shallowly fissured. Leaves in clusters; blade glabrous, glaucous below, drying to greenish grey above, obovate, 28–52 × 8–19 cm, base tapered, apex pointed; midrib raised above, lateral veins *c.* 30 pairs, curving and joining near margin, raised on both surfaces, intercostal veins reticulate, visible on both surfaces; petiole 1.5 cm long, flattened above, yellowish on drying. Inflorescences and flowers unknown.

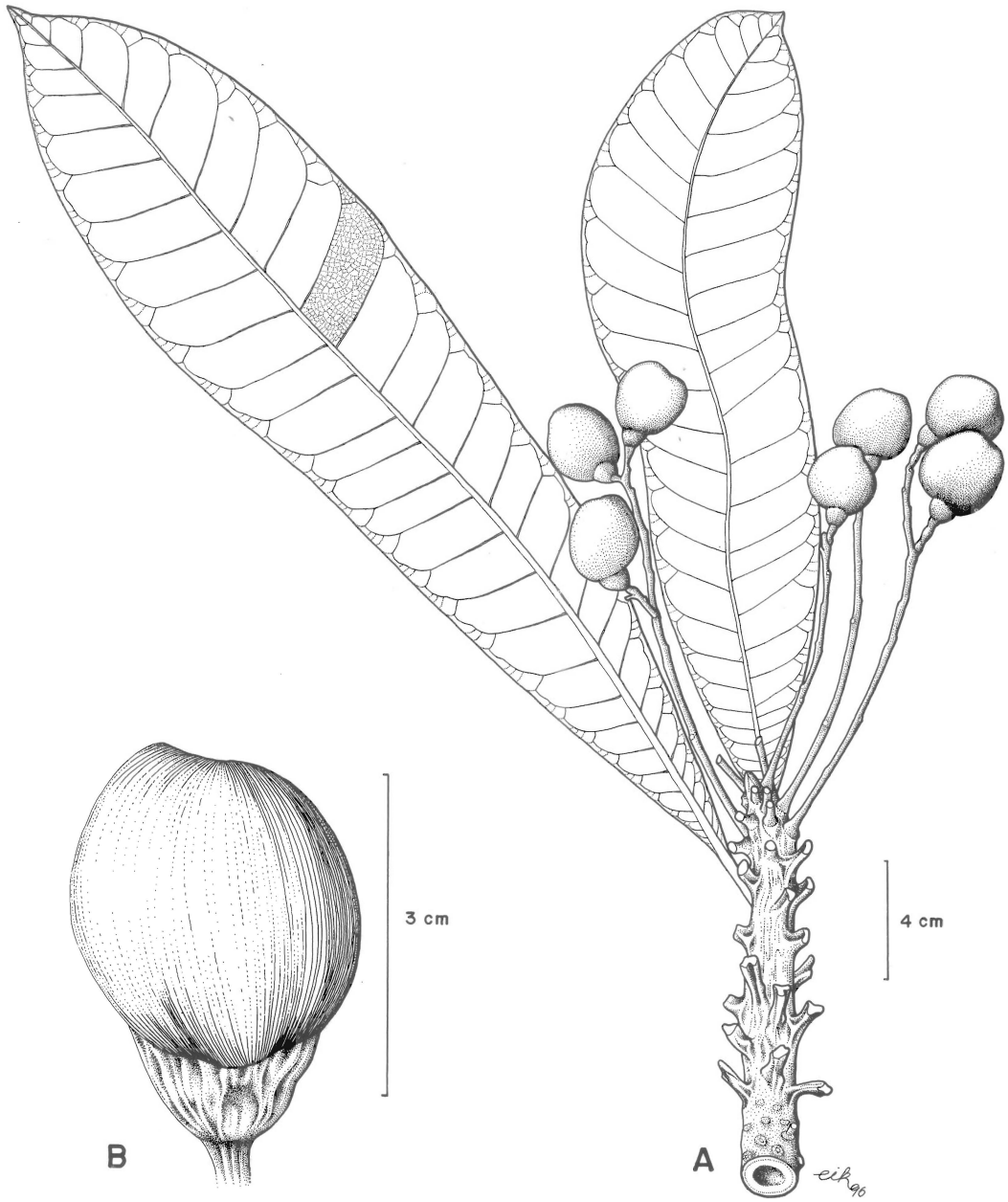

Fig. 11. *Semecarpus calcicolus*. **A.** Fruiting leafy twig. **B.** Fruit. (From SAN 90206.)

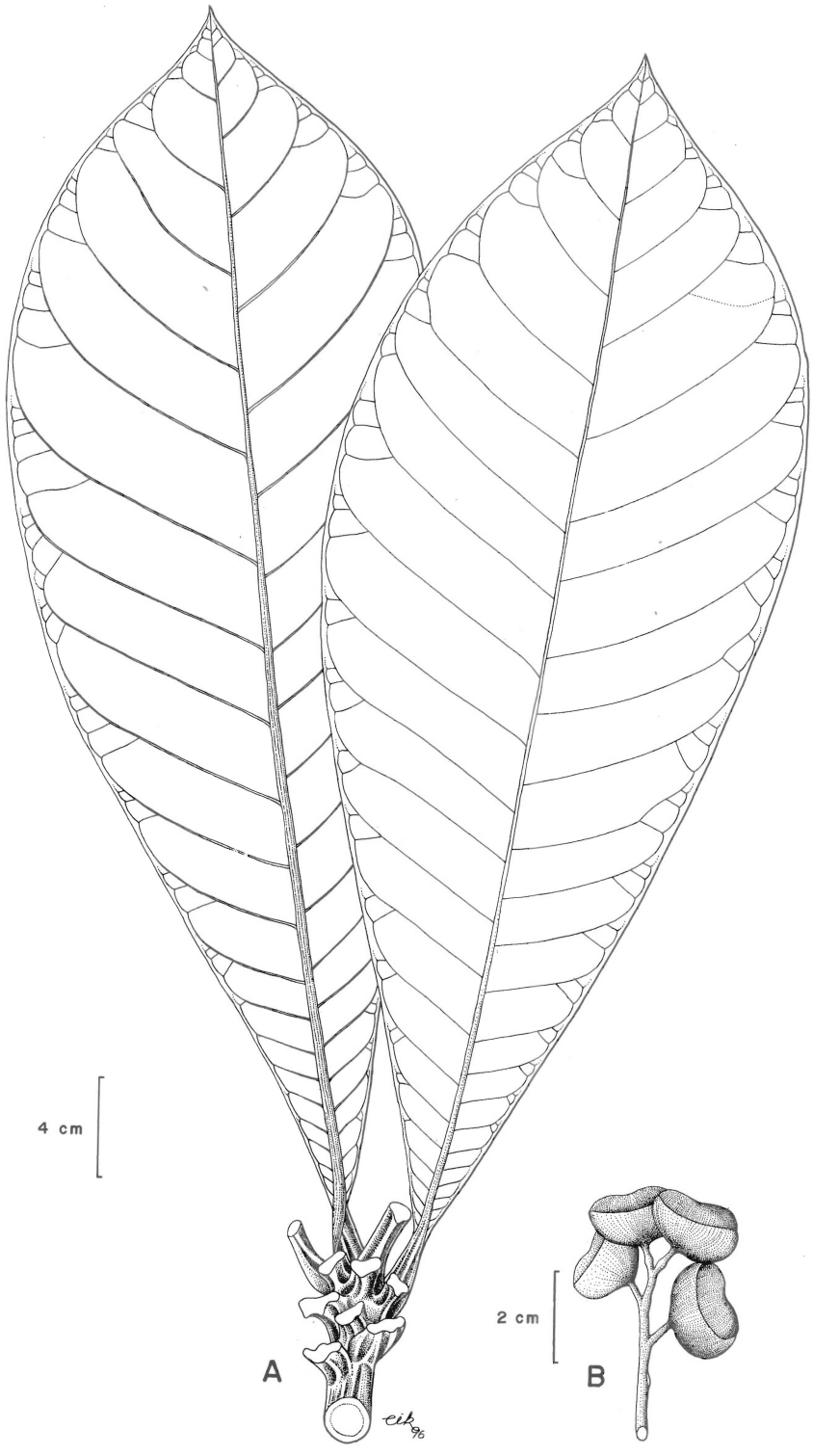

Fig. 12. *Semecarpus cupularis*. **A.** Leafy twig. **B.** Fruits. (From S. 41671.)

Infructescences terminal, more than 20 cm long on stout axes, glabrous. Drupe green ripening to orange, transversely oblong, 1.4–2 × 1.2–1.4 cm, glabrous, apex obtuse with shallow depression in middle, hypocarp cup-shaped enclosing more than 3/4 of fruit.

DISTRIBUTION. Endemic to Borneo. Very rare, known by 2 collections only including the type (*S. 41671*) and *S. 37203* from Kapit in Sarawak.

ECOLOGY. Lowland forest at 250 m altitude.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Kapit, Balleh, Ulu Sg. Melinau, near Ng. Sempurau, *Chai et al.* S. 37203 (K, KEP, L, MO, SAR), Kapit, *Ilias* S. 41671 (K, L, SAN, SAR).

Semecarpus euodiifolius Kochummen, **sp. nov.** *a speciebus ceteris in ramulis pallide albis glabris, costa impressa, fructu pubescenti dimidio parte inferiore hypocarpio cupulato includenti differt. Typus: Mikil SAN 28100, Sabah, Beaufort (holotypus KEP).* (Fig. 13)

Medium-sized tree to 23 m tall, 20 cm diameter. Bark brownish, smooth; inner bark pale yellow. Twigs pale whitish, glabrous, 2–3 mm thick. Leaves spirally arranged; blade thin-leathery, elliptic to oblong, 7.5–19.5 × 3.5–6.5 cm, glabrous, slightly glaucous below, papillae uniform on the under surface; base cuneate, apex acuminate; midrib sunken above, lateral veins 11–14 pairs, looping and joining near margin, faint on both surfaces, intercostal veins reticulate, visible on both surfaces; petiole 1.2–5 cm long, swollen near base. Inflorescences in terminal panicles or in clusters, 9–16 cm long, densely hairy, sometimes male and female flowers on the same inflorescence; bracts linear lanceolate, 1.5 mm long, receptacle funnel-shaped in male flowers, cup-shaped and larger in female flowers, densely hairy outside; calyx-lobes triangular, 0.5 mm long; petals oblong, glabrous, 2.5 × 1 mm, with 8–10 distinct black veins, apex pointed; stamens 1.5 mm long; abortive pistil in male flowers densely hairy; in female flowers ovary conical, densely hairy, rudimentary stamens present. Drupe hemispherical, 1.2–1.5 × 1.2–1.4 cm, densely hairy, apex slightly depressed, hypocarp cup-shaped, enclosing lower half of fruit.

DISTRIBUTION. Endemic to Borneo. Rare, recorded only from the Beaufort and Kuala Penyu area in Sabah.

ECOLOGY. Lowland forest.

SPECIMENS EXAMINED—BORNEO. SABAH: Beaufort, Beaufort Hill, *Mikil* SAN 28072 (SAN), SAN 28100 (SAN); Lumat from Beaufort, mile 4, *Pitty* SAN 58436 (SAN); Kuala Penyu, Bukit Limbayong Mansud, *Amin* SAN 102258 (SAN).

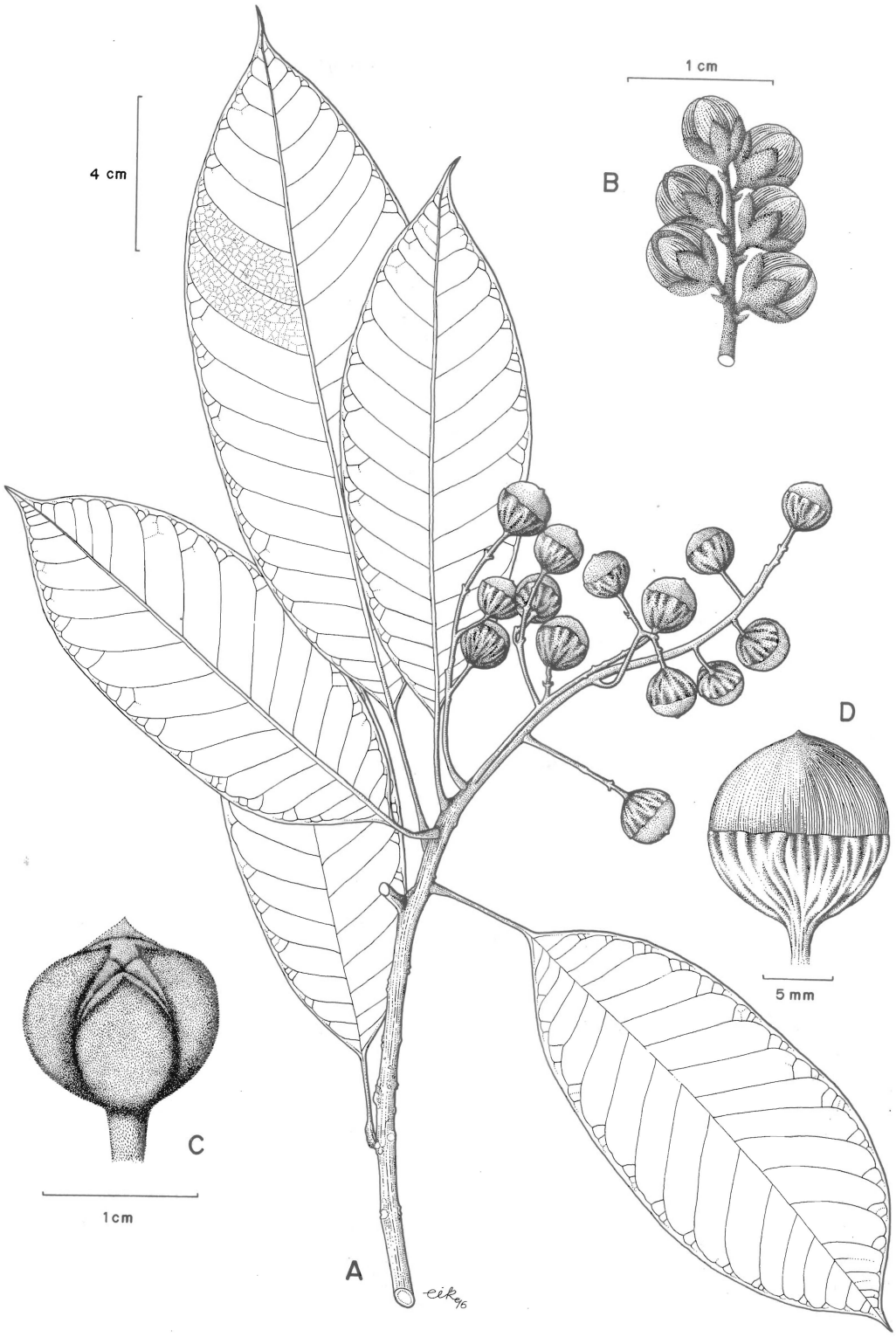

Fig. 13. *Semecarpus euodiifolius*. **A.** Fruiting leafy twig. **B.** Part of inflorescence. **C.** Flower bud. **D.** mature fruit. (A & D from SAN 102258, B–C from SAN 28100.)

Semecarpus impressicostatus Kochummen, **sp. nov.** *a speciebus ceteris in foliis maximis fasciculatis sessilibus pubescentibus, costa impressa, florum masculorum disco dense pubescenti differt.* Typus: *Kulip & Goh SAN 137045, Sabah, Tongod (holotypus SAN).* (Fig. 14)

Small unbranched tree to 20 m tall and 10 cm diameter. Twigs very stout, 2 cm thick. Leaves clustered, sessile or with 5 mm long petioles; blade coriaceous, oblanceolate, 43–85 × 11–22 cm, glabrous above, rough hairy below; base tapered, apex rounded, blunty pointed or notched, margin pale white on drying; midrib sunken above, prominent below, up to 8 mm broad, lateral veins 30–50 pairs, raised below, faint above, looping and joining near margin, intercostal veins reticulate, raised below, visible above. Inflorescences terminal, 75–92 cm long, with stout 7 mm thick axes, rusty brown hairy; bract lanceolate, 1.5 mm long; pedicel 1 mm long. Flower (only male seen) pale yellow in bud, densely hairy; calyx-lobes 0.5 mm long, triangular with blunt apex; petals oblong, 2 × 1 mm, glabrous on both surfaces, with distinct black veins inside; stamen filaments 2 mm long; disc densely hairy, abortive pistil absent. Drupe obliquely oblong, green when fresh, 1.7 × 1.5 cm, apex obtuse, sparsely hairy, hypocarp obconic, 5 mm long.

DISTRIBUTION. Endemic to Borneo. Rare, known from the Telupid-Tongod areas in Sabah, which are characterised by ultramafic soils.

ECOLOGY. Lowland forest.

SPECIMENS EXAMINED—BORNEO. SABAH: Tongod, Gunung Tingkar, *Kulip & Goh* SAN 137045 (SAN); mile 8, main road from Telupid to Ranau, *Aban & Saikeh* SAN 79352 (SAN); Beluran, Bidu Bidu F.R., *Kulip et al.* SAN 131008 (SAN).

Semecarpus kinabaluensis Kochummen, **sp. nov.** *plus minusve Semecarpum bunburyanum propinque, sed folia molliter pubescentia, fructus acutus hypocarpio cupulato hanc distinguent. Typus: Aban & Saikeh SAN 74108, Sabah, Kinabalu National Park (holotypus SAN; isotypi K, L).* (Fig. 15)

Small tree to 11 m tall. Stem spiny. Twigs 0.5–1 cm thick, grey brown, glabrous. Leaves in clusters; blade obovate, 22–37.5 × 8.5–15.5 cm, glabrous above, softly hairy below, papillae distinct covering lower surface; base tapered, apex acuminate, margin pale whitish; midrib raised above, lateral veins 18–28 pairs, raised below, visible above, intercostal veins reticulate, raised below, visible above; petiole 0.5–3.5 cm long, swollen at base, wrinkled on drying. Inflorescences in terminal panicles to 33 cm long, with many side branches, hairy; bracts broadly triangular, 1 x 1 mm, hairy; bracteoles lanceolate, 1.5 mm long, hairy. Flowers (only male seen) sessile; calyx-lobes triangular, 0.5 mm long; petals yellow when fresh, valvate, glabrous, outer surface rugose, oblong, 2 × 0.5 mm; stamens 2 mm long,

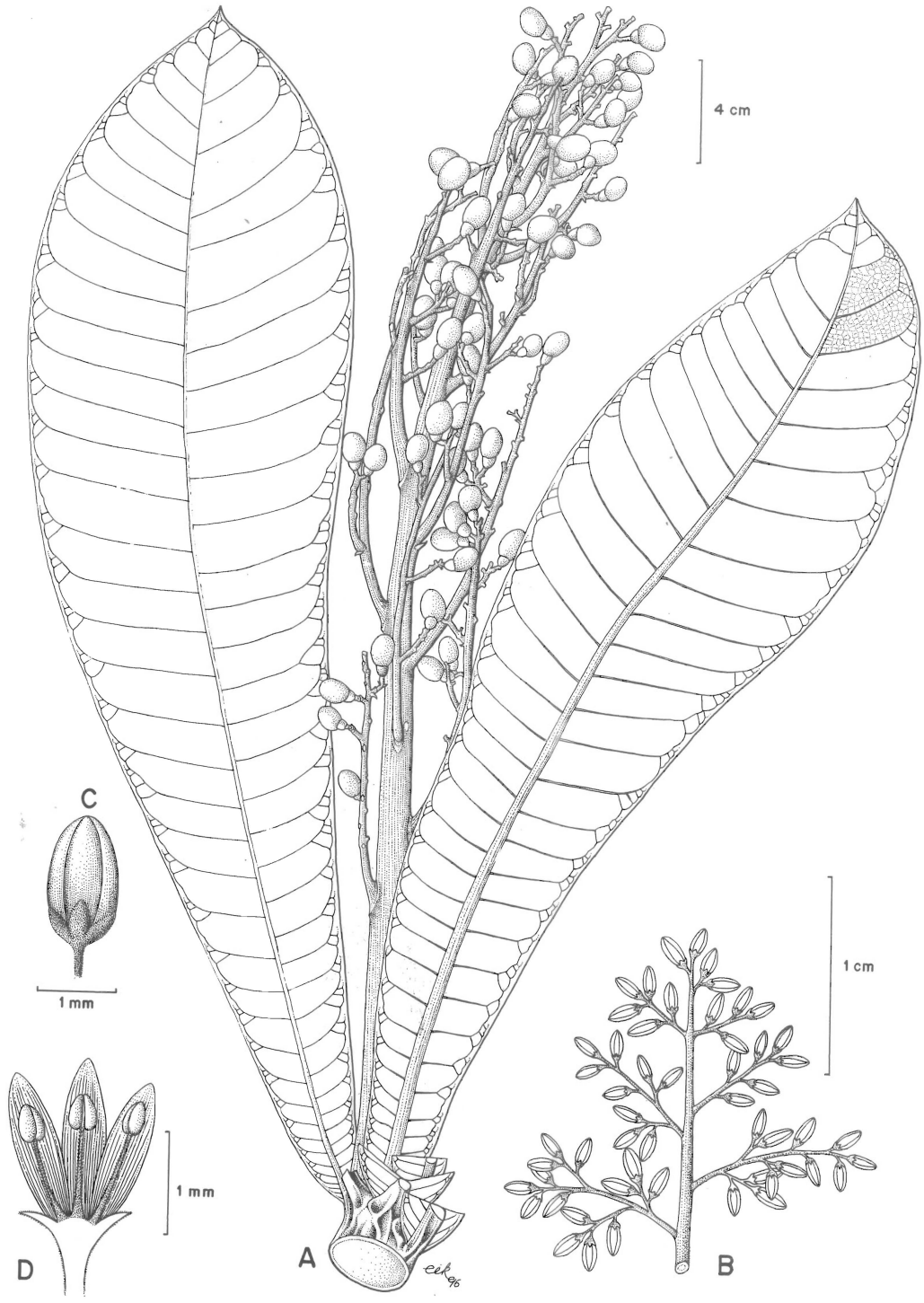

Fig. 14. *Semecarpus impressicostatus*. **A.** Fruiting leafy twig. **B.** Part of inflorescence. **C.** Flower bud. **D.** Longitudinal section of male flower. (A from SAN 79352, B–D from SAN 131008.)

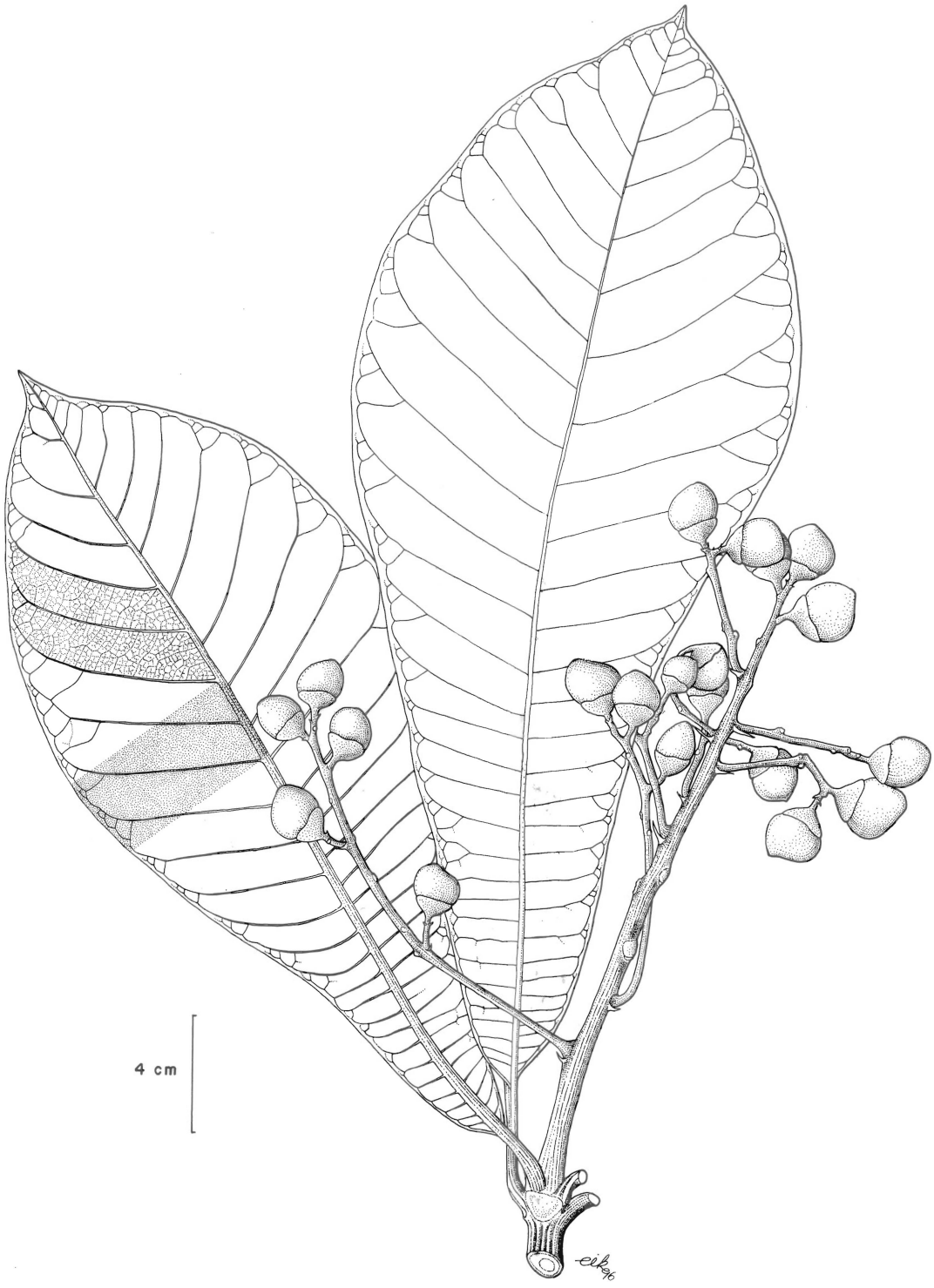

Fig. 15. *Semecarpus kinabaluensis*. Fruiting leafy twig. (From SAN 74108.)

anthers oblong, 1 mm long; disc 5-lobed, glabrous, abortive pistil absent. Drupe subglobose, 1.2 × 1.3 cm, glabrous, apex with short point, hypocarp cup-shaped 3–4 mm high.

DISTRIBUTION. Endemic to Borneo. So far known only from Kinabalu National Park in Sabah where it is common.

ECOLOGY. Montane forest at 1200–1800 m altitude.

SPECIMENS EXAMINED—BORNEO. SABAH: Ranau, Tenompok proposed forest reserve, *Mikil* SAN 56516 (SAN); Kinabalu Park, Mesilau trail, *Madani* SAN 76483 (SAN), Mesilau River, *Chew & Corner* RSNB 4167 (SAN), *Kokawa & Hotta* 4392 (SAN).

Semecarpus minutipetalus Kochummen, **sp. nov.** *a speciebus ceteris in petiolo costaque pallide lutea, foliorum marginibus pallidis reflexis, costa impressa, petalis calyce brevioribus differt. Typus: Ilias S. 39169, Sarawak, Miri (holotypus KEP; isotypi K, L, SAN, SAR).* (Fig. 16)

Small tree to 12 m tall, 12 cm diameter. Twigs pale whitish, glabrous. Leaves spirally arranged; blade narrowly obovate to oblong. 18.5–31.5 × 5.5–10 cm, glabrous, faintly glaucous below, distinctly papillose beneath; base cuneate, apex pointed, margin pale whitish, curled inwards; midrib sunken above, drying to pale yellowish below, lateral veins 20–25 pairs, looping and joining near margin, distinct below, faint to invisible above, intercostal veins reticulate, faintly visible on both surfaces; petiole 3.5–6 cm long, pale yellow on drying, swollen at base, narrowly grooved above. Inflorescences short panicles, arising from upper leaf axils, up to 8 cm long, densely hairy; bract linear lanceolate, 1.1 cm long, densely hairy; bracteoles to 2 mm long. Flowers (only immature male flowers seen), calyx-lobes 2 mm long, oblong, hairy outside with glabrous margins and with 3 black ridges inside; petals narrow oblong with blunt apices, very much smaller than calyx-lobes, 0.2 mm long, with a single ridge inside; stamens 5, rudimentary ovary absent.

DISTRIBUTION. Endemic to Borneo. Very rare, known only from the type specimen from Miri in Sarawak.

ECOLOGY. Lowland forest.

Semecarpus pulvinatus Kochummen, **sp. nov.** *a speciebus ceteris in foliis fasciculatis, petiolis longis basi manifeste tumida, fructu hemigloboso apice retuso, hypocarpio patelliformi differt. Typus: Dewol SAN 124556, Sabah, Kota Kinabatangan (holotypus SAN).* (Fig. 17)

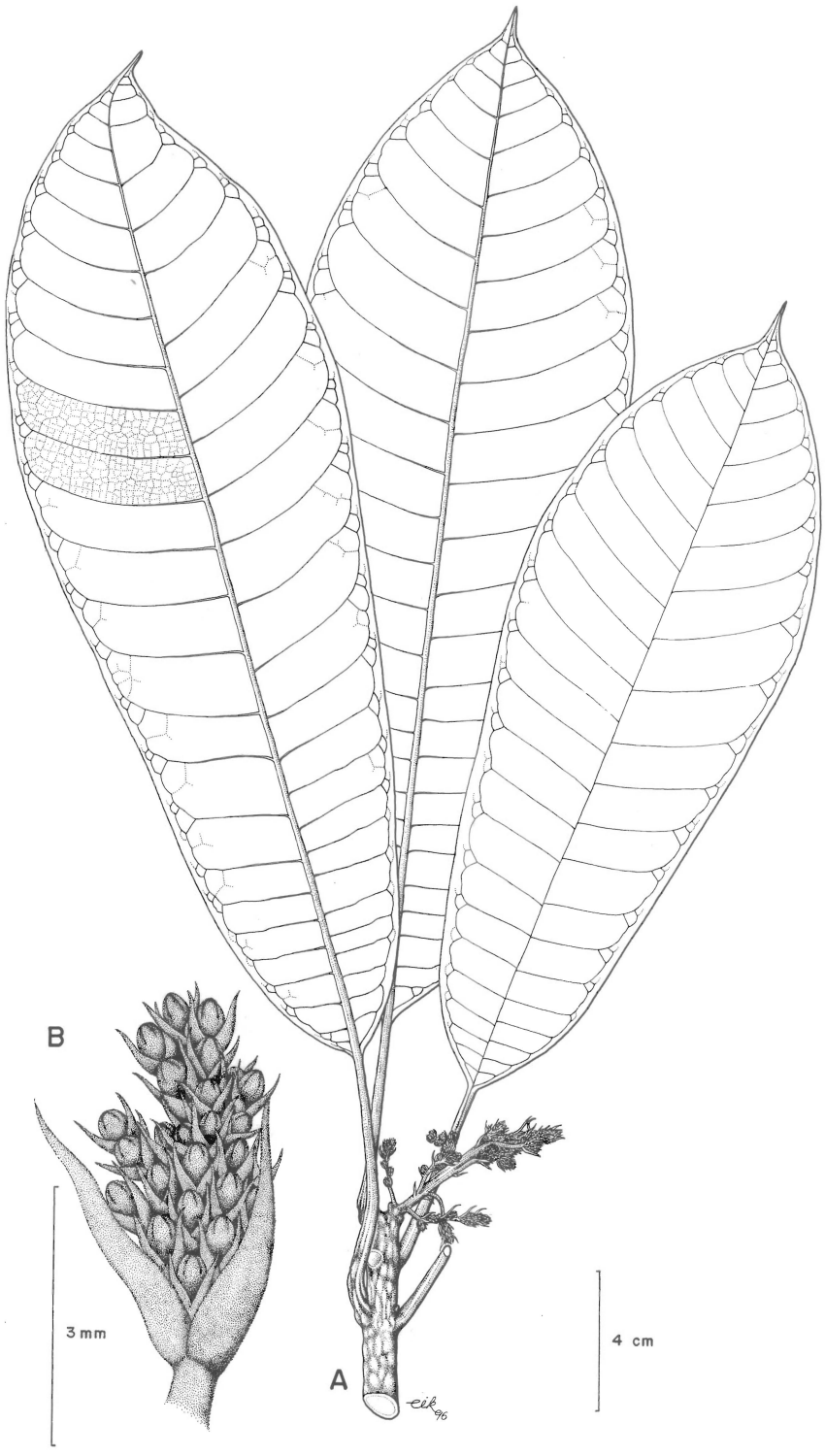

Fig. 16. *Semecarpus minutipetalus*. **A.** Flowering leafy twig. **B.** Young inflorescence (From S. 39169.)

Fig. 17. *Semecarpus pulvinatus*. **A.** Flowering leafy twig. **B.** Flower bud. **C.** Fruits. (A–B from SAN 124556, C from SAN 89703.)

Small tree to 8 m tall, 20 cm diameter. Bark grey, smooth. Twigs 7 mm thick, brownish. Leaves in close clusters; blade narrowly elliptic to oblanceolate, 20–30 × 3.5–6.5 cm, glabrous on both surfaces, faintly glaucous below. papillae obscure below; base tapered, apex acuminate; midrib raised above, lateral veins *c.* 35 pairs, looping and joining near margin, raised below, visible above, intercostal veins reticulate, faintly visible on both surfaces; petiole 4.5–6 cm long, lower 1–1.5 cm prominently swollen. Inflorescences terminal panicles, 45 cm long, with many side branches, sparsely hairy; bracts lanceolate, 0.5 mm long, hairy. Flowers sessile, calyx-lobes triangular, 0.5 mm long, hairy outside; petals valvate, glabrous on both surfaces, oblong, 3 × 1.5 mm, apex pointed, with 6–7 distinct veins; stamen filaments 2 mm long, anthers oblong, 1.5 mm long; disc cushion-like, glabrous; abortive pistil absent. Drupe hemispherical, 1.5–2 × 1–1.2 cm, glabrous, apex notched, hypocarp saucer-shaped.

DISTRIBUTION. Endemic to Borneo. Very rare, known from 2 collections only.

ECOLOGY. Lowland forest.

SPECIMENS EXAMINED—BORNEO. SABAH: Tawau, Luasong, mile 26, *Fedilis & Sumbing* SAN 89703 (SAN); Kota Kinabatangan, *Dewol* SAN 124556 (SAN).

Semecarpus sandakanus Kochummen, **sp. nov**. *haec species foliis subtus papillis distinctis aggregatis, inflorescentiis gracilibus bracteis linearibus, petiolis basi non tumida notatus. Typus*: *Saikeh SAN 87801, Sabah, Sandakan (holotypus KEP; isotypus SAN).*
(Fig. 18)

Small tree to 4.5 m tall. Twigs slender grey, glabrous. Leaves closely spirally arranged; blade thin-leathery, elliptic, 26–30.5 × 8–10 cm, glabrous, glaucous below, papillae in groups, distinct below; base cuneate, apex acuminate with 2–2.5 cm tip; midrib raised above, lateral veins 20–25 pairs, looping near margin, distinct below, faintly raised above; petiole 2–3 cm long, channelled above, yellowish on drying, not swollen at base. Inflorescences slender, 10 cm long panicles, with few side branches, sparsely hairy; bracts linear, 4 mm long, hairy; bracteoles linear lanceolate, 1.5 mm long, hairy. Flower (only male seen) calyx-lobes triangular, petals inbricate, oblong, 2.5 × 1 mm, glabrous, with distinct veins; stamens 1 mm long; disc cushion-shaped, 1 mm in diameter; abortive pistil absent. Drupe unknown.

DISTRIBUTION. Endemic to Borneo. Very rare, known only from the type specimen from Sandakan in Sabah.

ECOLOGY. Lowland forest.

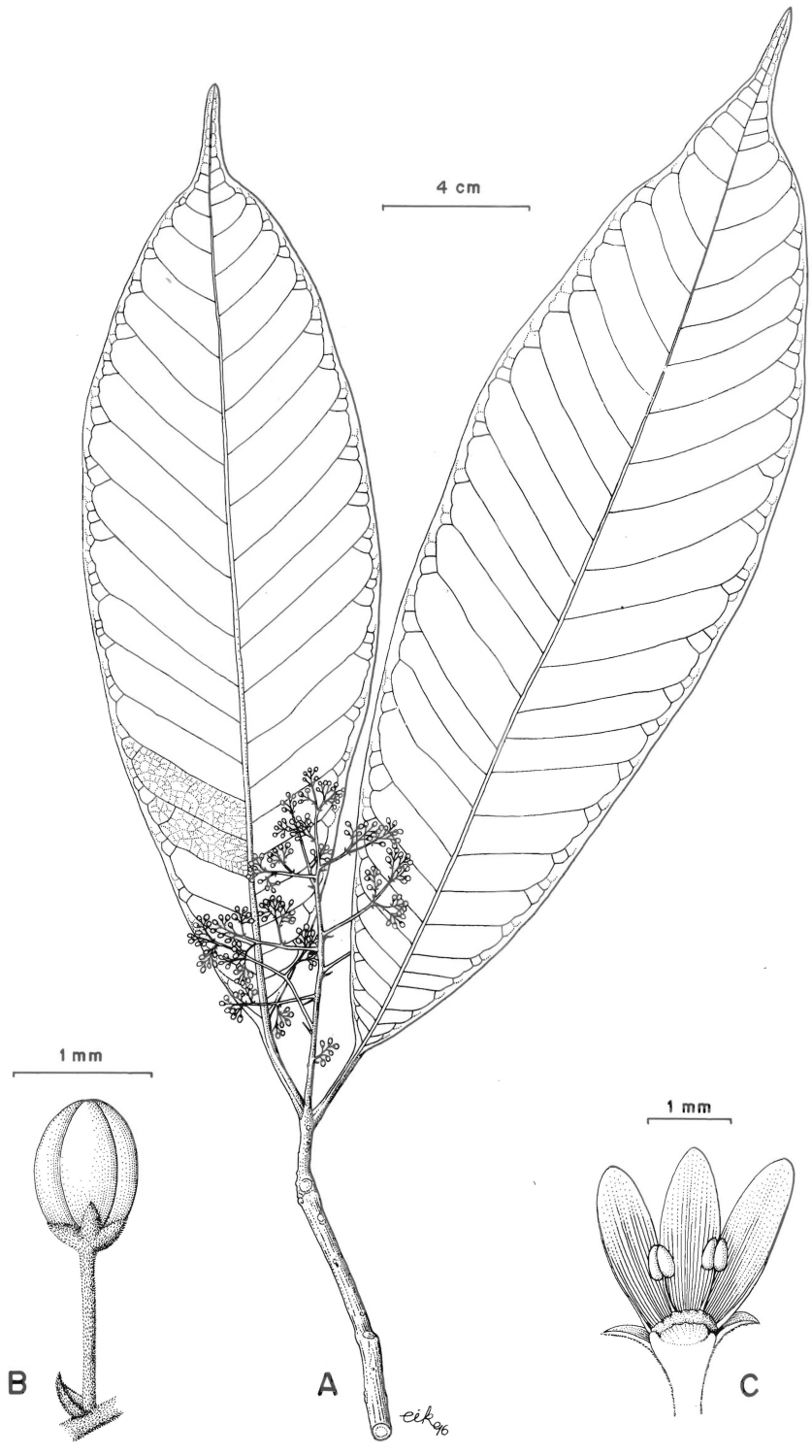

Fig. 18. *Semecarpus sandakanus*. **A.** Flowering leafy twig. **B.** Flower bud. **C.** Longitudinal section of flower. (From SAN 87801.)

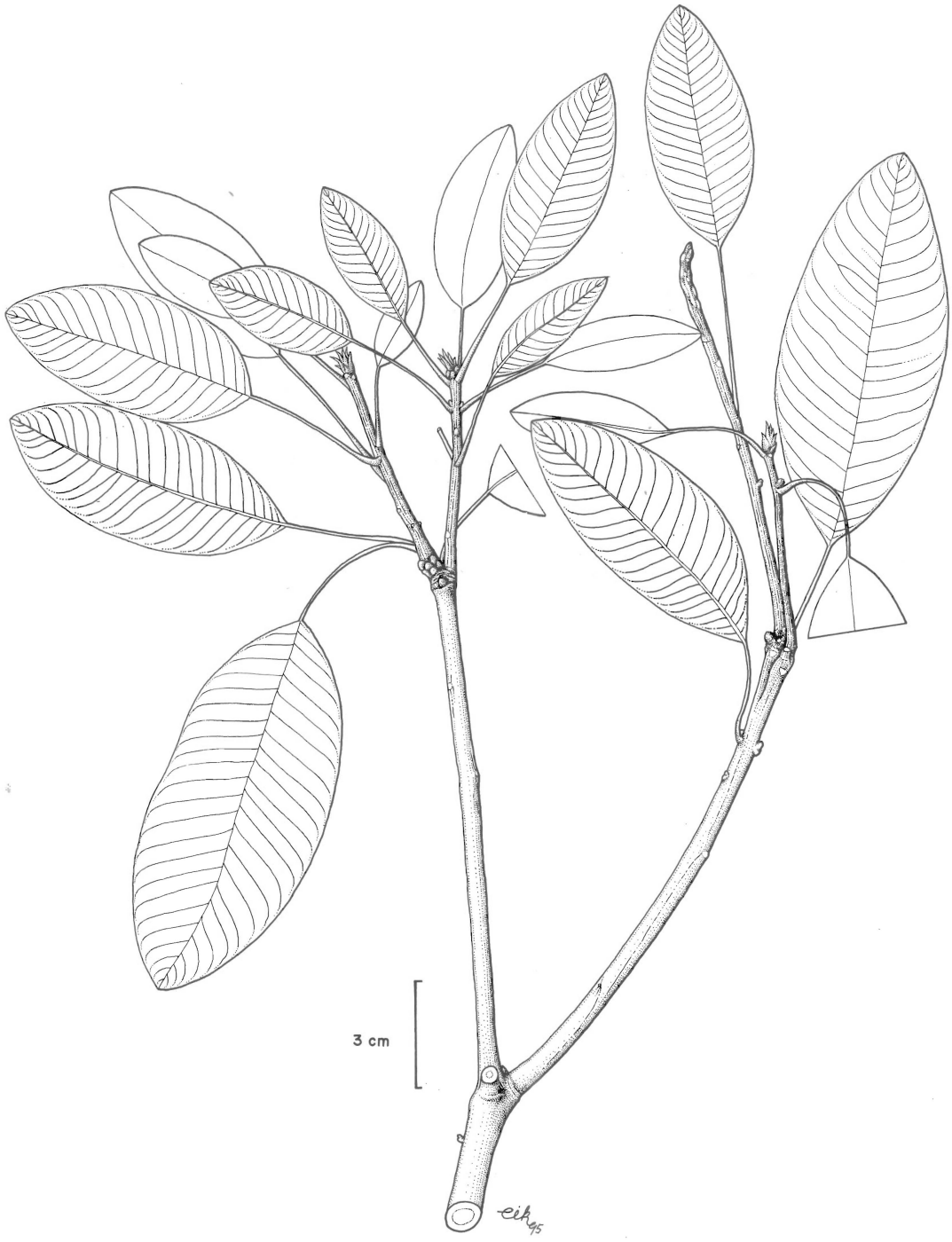

Fig. 19. *Swintonia sarawakana*. Leafy twig. (From S. 41497.)

Swintonia sarawakana Kochummen, **sp. nov.** *Swintonia schwenkii propinque, sed folia nervorum lateralium numero maiore subtus prominente elevatorum, costa impressa characteres quae S. sarawakanam distinguento. Typus: Othman S. 41497, Sarawak, Kapit, Balleh (holotypus SAN; isotypi K, KEP, L).* (Fig. 19)

Medium-sized tree to 30 m tall, 50 cm diameter. Bark reddish brown, smooth. Twigs brownish, 5 mm thick. Leaves in close spirals, appearing clustered; blade thin-leathery, faintly glaucous below, elliptic, 6.5–11.5 × 2.5–5 cm; base cuneate, apex acuminate; midrib sunken above, lateral veins 20–25 pairs, raised and distinct below, flat and seemingly sunken on the upper surface, intercostal veins reticulate, very faint below, sunken above; petiole 4–4.5 cm long, slender. Inflorescences terminal panicles, 23 cm long, with a number of long side branches, branching from base of axes, puberulous. Flowers (only male seen) pale green; floral bracts ovate, 1mm long; pedicel to 0.5 mm long; calyx almost glabrous, divided to more than half of its length; lobes triangular with pointed tip; petals obovate, 2.5 × 1 mm, densely hairy on both surfaces, base tapered, apex obtuse; disc-lobes confluent with base of filaments, filaments dilated at base; rudimentary ovary glabrous. Fruit unknown.

DISTRIBUTION. Endemic to Borneo. Very rare, known only from the type specimen from Kapit in Sarawak.

ECOLOGY. Hill forest at 1300 m altitude.

This species appears to be closely related to *S. schwenkii* in floral characters but the sunken midrib and veins, and the higher number of pairs of lateral veins that are prominently raised on the lower leaf surface, are good diagnostic characters.

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